ISC
MINIATURE BALL BEARINGS

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NSK Micro Precision Co., LTD.

ISC
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Miniature Ball Bearings

General Catalog

NSK Micro Precision Co., Ltd.

ISC MINIATURE BALL BEARINGS 是NSK Micro Precision 的品牌。

沿 革

1949年　4月　石井钢球株式会社成立（品牌名称为ISC: ISHII STEELBALL COMPANY LTD）
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1. 小型球轴承、微型轴承的类型和特征　Bearing types and features

包括仪器用精密球轴承在内的小型轴承、微型球轴承，基本上可以分为深沟型和角接触型。

最典型的深沟型轴承，包括外圈带止动挡边、宽内圈、薄壁及特殊形状的同步用轴承等。此外，根据有无密封圈，防尘盖，分为开放型、密封圈型及防尘盖型。各类轴承具体有如下特点。

另外，小型球轴承和微型球轴承的尺寸范围如**表1**所示。

Miniature and instrument ball bearings can be divided into two basic types, deep groove and angular contact. The first (deep groove) can be further divided into the following five classes depending on their design details:

- Standard type
- Flanged outer ring
- Extended inner ring
- Expanded type in which one ring has a radial thickness that is larger than normal compared with the bearing width.
- Thin section type in which both rings are extra thin in the radial direction.

Deep groove ball bearings can also be classified as "Open", "Shielded", or "Sealed" depending on the existence and type of seal or shield. The size ranges of extra small and miniature ball bearings are shown in **Table 1**.

表1 小型球轴承、微型球轴承的尺寸范围　Table 1　Size ranges of bearings

单位：mm　Units：mm

区分 Design	小型球轴承 Extra small ball bearings	微型球轴承 Miniature ball bearings
米制系列 Metric	轴承公称外径　D≧9 Outside diameter　D≧9 轴承公称内径　d<10 Bore diameter　d<10	轴承公称外径　D<9 Outside diameter　D<9 轴承公称内径　－ Bore diameter　－
英制系列 Inch	轴承公称外径　D≧9.525 Outside diameter　D≧9.525 轴承公称内径d<10 Bore diameter　d<10	轴承公称外径　D<9.525 Outside diameter　D<9.525 轴承公称内径　－ Bore diameter　－

（1）单列深沟球轴承 Single-row deep groove ball bearings

位于内、外圈上的沟道，其截面半径略大于球半径呈圆弧形的向心球轴承。

除承受径向载荷外，还可承受双向的轴向载荷。摩擦力矩小，最适合要求高转速，低噪音，低振动的用途。

Deep groove ball bearings have two inherent advantages; they can sustain some axial load in either direction as well as radial loads, and the two raceway cross-sections are simple circular arcs which can be very precisely finished so that the bearings have low friction and very little noise or vibration. Several different cage designs are available with different characteristics and the choice depends upon the individual application.

（2）带止动挡边深沟球轴承 Deep groove ball bearings with flanged outer rings

外圈一侧带挡边的深沟球轴承。使用这种轴承时，由于无需在轴承座内径上设计挡肩，利于加工高精度通孔。

这种轴承以轴承座端面为标准安装而成，所以需要精加工轴承座端面的垂直度。

Deep groove ball bearings with flanged outer rings correspond to ordinary ball bearings with snap rings. The flange extends around the entire circumference of the outer ring due to the size limitation and to improve its running accuracy. Since it is not necessary to provide a shoulder on the housing bore if this bearing is used, the bore can be a simple cylindrical shape which facilitates high precision machining and also reduces the machining time.

（3）宽内圈型深沟球轴承 Deep groove ball bearings with extended inner rings

内圈两侧宽度分别比外圈宽0.397mm（1/64 英寸）的深沟球轴承。使用这种轴承可以简化轴承外围结构设计且易于安装。

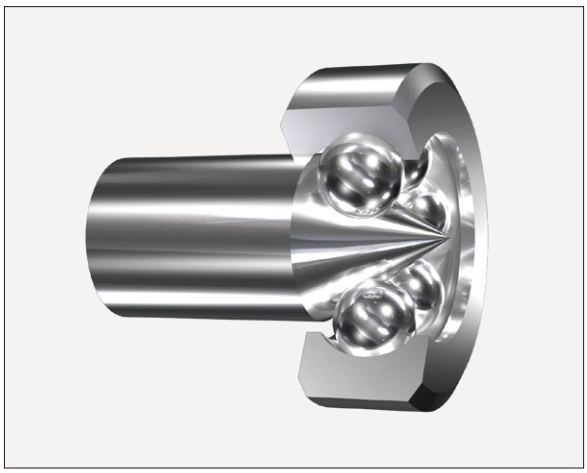
Deep groove ball bearings with extended inner rings are inch series bearings with their inner rings extended equally on both sides by 1/64 inch(0.0156inch,0.397mm) beyond the width of the outer ring. Since the inner ring is therefore wider by 1/32 inch than the outer ring, it is not necessary to provide a projection on parts installed in contact with the inner ring. This feature simplifies the design and fabrication of parts closely surrounding the bearing.

（4）薄壁型深沟球轴承　Extra-thin-section deep groove ball bearings

径向截面厚度小于标准的深沟球轴承。采用这种轴承可以实现设备的体小量轻。

Extra-thin-section deep groove ball bearings have a small radial cross-sectional thickness. ISC offers such bearings with bore diameters from 10 to 15mm. They are used when extreme compactness is important.

（5）枢轴球轴承　Pivot ball bearings



由外圈及数个滚珠所组成，用于支撑回转轴顶端圆锥部分(通常是60度的枢轴)的球轴承。由于滚珠间距较小及主轴枢轴部分额形状，可实现摩擦扭矩相对较小。

Pivot bearing consists of outer ring and several balls. This type supports a tapered tip (pivot of normally 60°) of spinning shaft. Small pitch circle diameter and pivot part of the shaft contribute for a performance of low frictional torque.

（6）推力球轴承　Thrust ball bearings without groove

由无轨道沟槽的平坦的轨道盘以及带滚珠的保持器所组成。用于低转速产品。只能承受一个方向的轴向载荷。由于轨道面为平面，摩擦扭距也较小。适用于低转速产品。

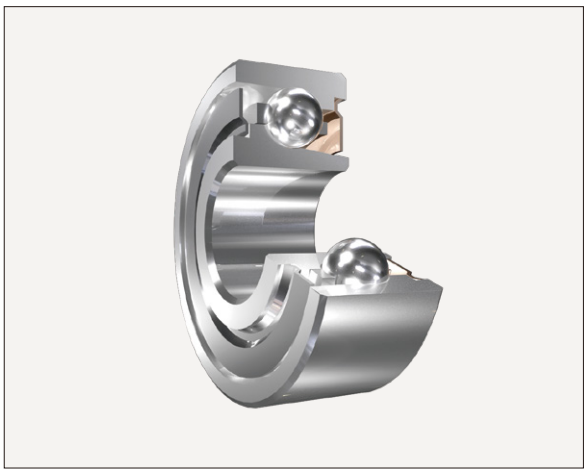
Thrust ball bearing consists of flat washer (without raceway groove) and ball-installed cage. This type can support an axial load only from one direction. Flat raceway contributes for a performance of low frictional torque. Thrust ball bearing is applied to the machinery with low speed rotation.

（7）带沟槽推力球轴承　Thrust ball bearings with groove

上下轨道盘均有轨道沟槽，可确保承受更大的额定载荷。此外，由于付有轨道沟槽，可抑制转动时滚珠及保持器的移动，由此可减少与主轴或外座的接触。

This type has a raceway groove on both washers and holds a higher load rating. The grooved washer restrains a tilt of ball & retainer and reduces a risk of touching a shaft or a housing while rotating.

（8）微型推力角接触球轴承（CROXY）　Miniature Thrust Angular Contact Bearing



能够承受径向载荷和一个方向的轴向载荷的微型球轴承。轴向负载能力高，承重侧的内环和外环的沟槽较深。接触角为45°，轴向刚度高。两侧具有钢材防尘盖，内部填充润滑脂。通常将两个轴承相向设置使用，内部游隙可调整。

适用于支撑滚珠螺杆。

This miniature ball bearing can support radial load and also axial load from one direction. Deeper grooves on load supporting inner ring and outer ring facilitate the higher supporting capability for axial load. Higher axial rigidity is achieved by the 45° contact angle.
This type is sealed on both sides by steel seal and fined grease is packed in.
Normally this type is used in a pair. Two of this bearing are matched to face each other and optimum internal clearance is given to a pair.
This type is the best choice for supporting part of ball screw.

2. 轴承代号 Formulation of bearing numbers

滚动轴承的代号，是标识轴承结构，主要尺寸，尺寸精度，旋转精度，内部游隙，规格的名称。由基本代号和补充代号所构成。

一般采用的轴承主要尺寸，多是以ISO规定的主要尺寸为准，这些标准轴承的代号，在JIS B 1513（滚动轴承的代号方法）中有相应规定。

因为需要详细区分轴承规格，ISC同时也采用了JIS以外的补充代号。

基本代号、补充代号的排列及内容示于**表2**。另外，有关接触角代号及补充代号，遵从代号从左到右的顺序排列。

Bearing numbers are alphanumeric combinations that indicate the bearing type, boundary dimensions, internal clearance, dimensional and running accuracies, and other related specifications. They consist of basic numbers and supplementary symbols. The boundary dimensions of commonly used bearings mostly conform to the organizational concept of ISO, and the bearing numbers of these standard bearings are specified by JIS B 1513 (Designation for rolling bearings). Due to a need for more detailed classification, ISC uses auxiliary symbols other than those specified by JIS.

Basic numbers, supplementary symbols, and the meanings of common numbers and symbols are listed in **Table 2** (Pages 8 and 9). The contact angle symbols and other supplementary designations are shown in successive columns from left to right in **Table 2**. For reference, five examples of bearing numbers are shown on Page 9.

表2 轴承代号的内容和排列 Table 2 Formulation of bearing numbers

基本代号 Basic numbers				補助記号 Supplementary symbols					
轴承系列代号 Bearing series symbols		内径或通用代号 Bore number of size number		材料記号 Materials symbol		保持器記号 Cage symbol		密封圈、防尘盖代号 Seals・shields symbol	
代号 Number	内容 Meaning	代号 Number	内容 Meaning	代号 Number	内容 Meaning	代号 Number	内容 Meaning	代号 Number	内容 Meaning
68 **69** **60** **62** **63** **F68** **F69** **F60** **F62** **F63**	单列深沟球轴承 Single-row deep groove ball bearings 带止动挡边深沟球轴承 Deep groove ball bearings with flanged outer rings	**1** **2** **3** ⋮ **1X** **2X** ⋮	轴承内径 1mm Bearing bore 1mm 轴承内径 2mm Bearing bore 2mm 轴承内径 3mm Bearing bore 3mm 轴承内径 1.2mm 或 1.5mm Bearing bore 1.2mm or 1.5mm 轴承内径 2.5mm Bearing bore 2.5mm	省略 Omitted **-H-**	SUJ2 （高碳铬轴承钢） High carbon chromium bearing steel SUJ2 Equivalent to ASTM A295 52100 套圈、滚动体是不锈钢 Stainless steel SUS440C Equivalent to SAE J405 51440C	**J** （省略） (Omitted) **W** （省略） (Omitted) **T12** **T1X**	钢板冲压浪型保持器 Pressed steel ribbon cage 钢板冲压冠形保持架 Pressed steel snap cage 塑料保持架 Plastic snap cage	**Z** **Z1**	一侧钢板防尘盖 Shield on one side only
								ZZ **ZZ1**	两侧钢板防尘盖 Shield on both sides
								D	一侧接触 橡胶密封圈 Contact rubber seal on one side only
								DD	两侧接触 橡胶密封圈 Contact rubber seals on both sides
	特定尺寸轴承 米制系列 Special metric design	**84**	轴承内径 8mm 轴承内径 4mm Brg O.D. 8mm Brg bore 4mm	**S**	特殊尺寸轴承的套圈、滚动体是不锈钢，排列时加在轴承系列代号的前面。 Stainless steel for special metric and inch designs "S" is prefix to series symbol			**V**	一侧非接触 橡胶密封圈 Non-contact rubber seal on one side only
MR	单列深沟球轴承 Single-row deep groove ball bearings	**148** ⋮	轴承外径 14mm 轴承外径 8mm Brg O.D. 14mm Brg bore 8mm					**VV**	两侧非接触 橡胶密封圈 Non-contact rubber seals on both sides
MF	带止动挡边深沟球轴承 Deep groove ball bearings with flanged outer rings								
MT	薄壁型深沟球轴承 Thin-section deep groove ball bearings								
R	英制系列 单列深沟球轴承 Inch design single-row deep groove ball bearings	**133**	轴承外径 4.762mm (3/16 英寸) 轴承内径 2.380mm (3/32 英寸) Brg O.D. 4.762mm (3/16inch) Brg bore 2.380mm (3/32inch)						
RW	宽内圈型 深沟球轴承 Deep groove ball bearings with extended inner rings	**155**	轴承外径 7.938mm (5/16 英寸) 轴承内径 3.967mm (5/32 英寸) Brg O.D. 7.938mm (5/16inch) Brg bore 3.967mm (5/32inch)						
FRW	带止动挡边宽内圈型 深沟球轴承 Deep groove ball bearings with extended inner rings, flanged	**2** ⋮	轴承外径 9.525mm (3/8 英寸) 轴承内径 3.175mm (1/8 英寸) Brg O.D. 9.525mm (3/8inch) Brg bore 3.175mm (1/8inch)						

(例) Examples of bearing numbers

(1)		681X		T12	ZZ	MC3	ER	P4	AF2	Q	→ 681XT12ZZMC3ERP4AF2Q
(2)		624	-H-		ZZ	MC2		P5	NS7	L	→ 624-H-ZZMC2P5NS7L
(3)		MR84		J	ZZ	MC3		P5	PS2	S	→ MR84JZZMC3P5PS2S
(4)	S	MF148		T12	DD	MC4		P5	NS7	L	→ SMF148T12DDMC4P5NS7L
(5)	S	R2		J	ZZ	MC3	E	7P	LG2	K	→ SR2JZZMC3E7PLG2K

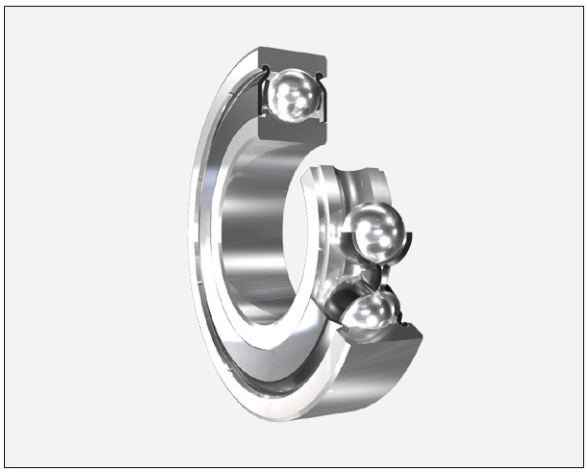
补充代号 Supplementary symbols

游隙代号 Internal clearance symbol		噪音代号 Noise level symbol		精度代号 Accuracy class symbol		潤滑記号 Lubricant symbol		潤滑量記号 Lubricant quantity symbol	
代号 Number	内容 Meaning	代号 Number	内容 Meaning	代号 Number	内容 Meaning	代号 Number	内容 Meaning	代号 Number	内容 Meaning
MC1	小于MC2游隙 Clearance less than MC2	省略 Omitted	标准 Standard	省略 Omitted	JIS 0 级 Normal	**AF2**	润滑油 Oil	**Q**	润滑油浸渍 Oil soaking
MC2	小于MC3游隙 Clearance less than MC3	**E**	低于标准级噪音 Quieter than standard	**P5**	JIS 5 级 CLASS 5	**NS7**	适用于广范温度范围的润滑脂 Wide temperature range grease	**K**	润滑脂填充量少于L Grease packed less than L
MC3	标准游隙 Upgrade normal clearance	**ER**	低于E级噪音 Quieter than E	**P4**	JIS 4 级 CLASS 4	**PS2**	适用于低温、低转速的润滑脂 Low temperature, Low torque grease	**L**	润滑脂填充量少于S Grease packed less than S
MC4	大于MC3游隙 Clearance greater than MC3			省略 Omitted	ANSI/ABMA ABEC1	**MLS**	适用于高温、高转速的润滑脂 High temperature, High speed grease	**S**	标准润滑脂填充量 Standard grease packing quantity
MC5	大于MC4游隙 Clearance greater than MC4			**5P**	ANSI/ABMA 仪器用精密球轴承 Instrument ball bearings inch design CLASS 5P	**ECE**	具有导电性的润滑脂 Conductive grease	**H**	润滑脂填充量大于S Grease packed more than S
MC6	大于MC5游隙 Clearance greater than MC5			**7P**	ANSI/ABMA 仪器用精密球轴承 Instrument ball bearings inch design CLASS 7P	**LG2**	具有抗粉尘性的润滑脂 Low refuse grease	**M**	润滑脂填充量大于H Grease packed more than H
				9P	ANSI/ABMA 仪器用精密球轴承 Instrument ball bearings inch design CLASS 9P				

选定型号时欢迎咨询ISC。
When selecting these specifications, please consult ISC.

3. 密封圈、防尘盖 Shielded and sealed

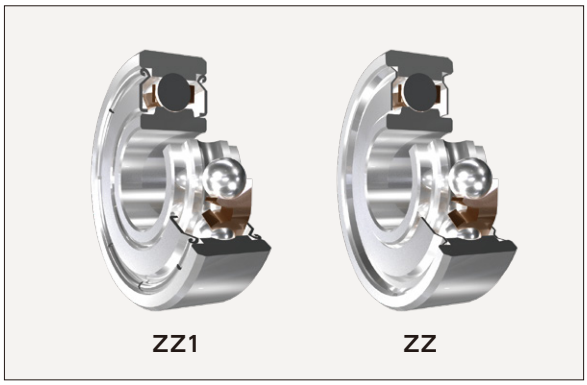
密封圈轴承、防尘盖轴承 Shielded and sealed bearings



为防止润滑脂泄漏及异物侵入，加有密封圈或防尘盖的深沟球轴承。这种轴承的一侧或两侧带密封圈或防尘盖。两侧带密封圈或两侧带防尘盖的轴承预先填充了优质润滑脂。

使用这种轴承可以简化轴承外围结构设计且易于安装。

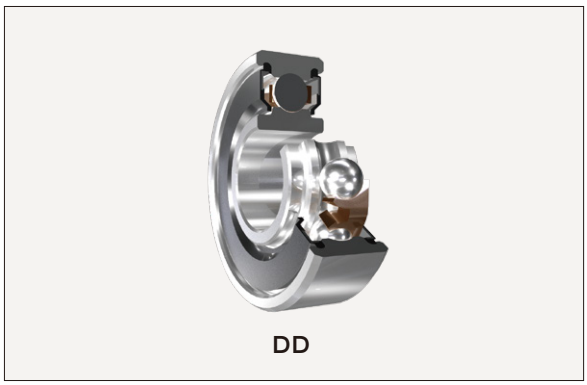
Deep groove ball bearings often have shields or seals installed on both sides and are factory-packed with a lubricant. The use of such bearings simplifies the structure around them and also their installation. It also eliminates the need for relubrication and, therefore, reduces maintenance costs. There are three types of such bearings: shielded bearings, contact sealed bearings, and non-contact sealed bearings.



(a) 防尘盖轴承ZZ1 (Z1)、ZZ (Z)
Shielded bearings ZZ1(Z1), ZZ(Z)

装配冲压钢板防尘盖的轴承。防尘盖一般采用不锈钢钢板或低碳钢板。

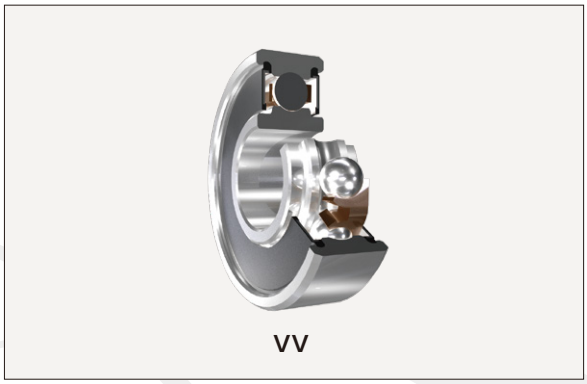
Shielded bearings are protected by a shield plate of pressed steel. They are classified into two types, ZZ1 and ZZ, depending on the manner in which the shield plate is fitted to the outer ring. The ZZ1 type, which is used for the larger bearing sizes, has its outer edge pressed into a shield groove in the outer ring. The ZZ type is used for the smaller bearing sizes. The shields can be made of either low carbon steel or stainless steel.



(b) 接触式密封圈轴承DD (D)
Contact sealed bearings DD(D)

采用橡胶密封圈的深沟球轴承，使密封圈内径侧唇部在内圈外径阶梯部位滑动的结构。因此，具有优异的 脂密封性及防尘性。

Sealed bearings have superior sealing effectiveness compared to shielded bearings, particularly, the contact type sealed bearings which prevent the intrusion of dust from outside because the seal plate lip slides on a seal groove in the inner ring. The torque is, however, high due to the friction of the seal lip.



(c) 非接触式密封圈轴承VV (V)
Non-contact sealed bearings VV(V)

在钢制的芯板上采用以合成橡胶包覆形成的密封圈的深沟球轴承。密封圈内径侧唇部与内圈外径阶梯部位之间形成迷宫式密封圈结构。因此，具有良好的脂密封性和防尘性，而且摩擦力矩小。

With this VV type, a rubber seal with metal backing is held in the outer ring by the elasticity of the rubber. Effective sealing is achieved by a labyrinth formed between its bore and the seal groove in the inner ring. It has the advantage that the frictional torque is low because the seal lip does not contact the seal groove.

4. 保持架 Cage design

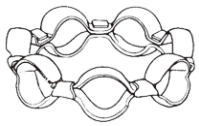
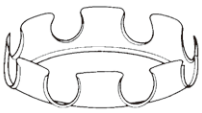
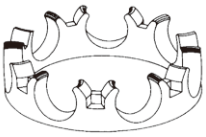
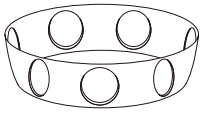
通常，小型、微型球轴承使用钢板波形冲压保持架或冠形冲压保持架。波形冲压保持架用于大型轴承，冠形冲压保持架用于小型轴承。

另外，近年来多采用更利于力矩、润滑脂寿命及噪音的合成树脂保持架。

保持架的类型、代号及名称如**表4**所示。

In general, the cages used in miniature bearings are either ribbon cages or snap cages, both made of pressed steel. Pressed steel ribbon cages are generally used in the larger bearings and pressed snap cages in the smaller ones. In recent years, plastic snap cages, which have the advantages of low torque, long grease life and low noise, have been used in many kinds of miniature ball bearings. **Table 4** shows the various types of cages and their symbols.

表4 保持架的类型与保持架代号 Table 4 Cage types and symbols

保持架 Type	代号 Symbol	名称 Name
	J	波形冲压保持架 Pressed steel ribbon cage
	W	冠形冲压保持架 Pressed steel snap cage
	T12 T1X	合成树脂保持架 Plastic snap cage
		冲孔保持架 Solid Cage

5. 外形尺寸精度及旋转精度 Bearing tolerances

小型球轴承、微型球轴承主要尺寸公差、公差值及据旋转精度依JIS B 1514(滚动轴承—轴承公差)和ANSI/ABMA Std.12.2(INSTRUMENT BALL BEARINGS·INCH DESIGN)标准。

表5.1、**表5.2**及**表5.3**适用于米制系列球轴承。**表5.4**及**表5.5**适用于英制系列球轴承。

轴承精度等级的选择取决于用途。普通情况下,0级精度通常可以充分满足要求,但高精度轴承的选择标准请参照**表5.6**所示。

The tolerances for the boundary dimensions and running accuracy of extra small and miniature ball bearings are specified by ISO 492/582 (Rolling bearings-radial bearings tolerances) and ANSI/ABMA Std. 12.2(Instrument ball bearings inch design). **Tables 5.1,5.2** and **5.3** apply to metric design extra small and miniature ball bearings. **Tables 5.4** and **5.5** apply to inch design extra small and miniature precision ball bearings for instruments.
Bearing accuracy should be chosen depending on the application. A rough guide for the selection of bearing accuracy is presented in **Table 5.6**.

表5.1 球轴承(米制系列)内圈的公差、公差值及外圈宽度的公差、公差值

Table 5.1 Tolerances and tolerance limits for inner rings and widths of outer rings (Metric design)

单位:μm Units:μm

轴承公称内径 Nominal bore diameter d (mm)		单一平面内平均内径偏差 Δ_{dmp}										单一内径偏差 Δ_{ds}			
		0级 Normal		6级 CLASS 6		5级 CLASS 5		4级 CLASS 4 直径系列 Diameter series		2级 CLASS 2 直径系列 Diameter series		4级 CLASS 4 直径系列 Diameter series		2级 CLASS 2 直径系列 Diameter series	
								7,8,9		7,8,9		0,1,2,3,4		0,1,2,3,4	
超过 over	到 incl	上 high	下 low	上 high	下 low	上 high	下 low	上 high	下 low	上 high	下 low	上 high	下 low	上 high	下 low
0.6(*1)	**2.5**	0	-8	0	-7	0	-5	0	-4	0	-2.5	0	-4	0	-2.5
2.5	**10**	0	-8	0	-7	0	-5	0	-4	0	-2.5	0	-4	0	-2.5
10	**18**	0	-8	0	-7	0	-5	0	-4	0	-2.5	0	-4	0	-2.5

轴承公称内径 Nominal bore diameter d (mm)		在单一径向平面内内径变化 V_{dsp}										平均内径变化 V_{dmp}				
		0级 Normal 直径系列 Diameter series			6级 CLASS 6 直径系列 Diameter series			5级 CLASS 5 直径系列 Diameter series		4级 CLASS 4 直径系列 Diameter series		2级 CLASS 2 直径系列 Diameter series	0级 Normal	6级 CLASS 6	5级 CLASS 5	4级 CLASS 4	2级 CLASS 2
		9	0,1	2,3,4	9	0,1	2,3,4	9	0,1,2,3,4	9	0,1,2,3,4	0,1,2,3,4					
超过 over	到 incl	最大 max			最大 max			最大 max		最大 max		最大 max	最大 max	最大 max	最大 max	最大 max	最大 max
0.6(*1)	**2.5**	10	8	6	9	7	5	5	4	4	3	2.5	6	5	3	2	1.5
2.5	**10**	10	8	6	9	7	5	5	4	4	3	2.5	6	5	3	2	1.5
10	**18**	10	8	6	9	7	5	5	4	4	3	2.5	6	5	3	2	1.5

轴承公称内径 Nominal bore diameter d (mm)		内圈(或外圈)单一宽度偏差 (*2) Δ_{Bs} (或Δ_{Cs}) Δ_{Bs} (or Δ_{Cs})								内圈(或外圈)宽度变动量 V_{Bs} (或V_{Cs}) V_{Bs} (or V_{Cs})				
		单体轴承 Single bearing				组合轴承(*3) Combined bearings				内圈(或外圈)(*2) Inner ring (or outer ring)		内圈 Inner ring		
		0级 Normal 6级 CLASS 6		5级 CLASS 5 4级 CLASS 4 2级 CLASS 2		0级 Normal 6级 CLASS 6		5级 CLASS 5 4级 CLASS 4 2级 CLASS 2		0级 Normal	6级 CLASS 6	5级 CLASS 5	4级 CLASS 4	2级 CLASS 2
超过 over	到 incl	上 high	下 low	上 high	下 low	上 high	下 low	上 high	下 low	最大 max	最大 max	最大 max	最大 max	最大 max
0.6(*1)	**2.5**	0	-40	0	-40	—	—	0	-250	12	12	5	2.5	1.5
2.5	**10**	0	-120	0	-40	0	-250	0	-250	15	15	5	2.5	1.5
10	**18**	0	-120	0	-80	0	-250	0	-250	20	20	5	2.5	1.5

轴承公称内径 Nominal bore diameter d (mm)		内圈的径向跳动 K_{ia}					内圈的轴向跳动 S_{ia}			内圈参考面(包含背面)向内的跳动 S_d		
		0级 Normal	6级 CLASS 6	5级 CLASS 5	4级 CLASS 4	2级 CLASS 2	5级 CLASS 5	4级 CLASS 4	2级 CLASS 2	5级 CLASS 5	4级 CLASS 4	2级 CLASS 2
超过 over	到 incl	最大 max	最大 max	最大 max	最大 max	最大 max	最大 max	最大 max	最大 max	最大 max	最大 max	最大 max
0.6(*1)	**2.5**	10	5	4	2.5	1.5	7	3	1.5	7	3	1.5
2.5	**10**	10	6	4	2.5	1.5	7	3	1.5	7	3	1.5
10	**18**	10	7	4	2.5	1.5	7	3	1.5	7	3	1.5

注 Notes
(*1) 0.6mm 包括在这个尺寸中。0.6mm is included in the group.
(*2) 外圈的宽度尺寸差及宽度不同,依据同样轴承的内圈值。5 级、4 级及2 级的外圈的宽度不同,依据表**表5.2**所示。
Tolerances for width deviation and width dimensional variation of the outer ring are based on the values for the inner ring of the same bearing. Tolerance for the width variation of the outer ring of CLASS 5, 4 and 2 are shown in **Table5.2**.
(*3) 适用于成对或成组安装时单个轴承的内、外圈。Applicable to individual rings manufactured for combined bearings.
备注 Remarks
1. 本表所规定的圆柱孔轴承内径的上偏差,不适用于套圈端面的倒角尺寸r(最大)1.2 倍距离以内的范围。
The cylindrical bore diameter "no-go side" tolerance limit (high) specified in this table does not necessarily apply within a distance of 1.2times the chamfer dimension r (max) from the ring face.
2. 根据ANSI/ABMA Std20-1996,ABEC1、ABEC3、ABEC5、ABEC7 及ABEC9 分别相当于0 级、6 级、5 级、4 级及2 级。
ANSI/ABMA Std20-1996 was amended:ABEC1, ABEC3, ABEC5, ABEC7 and ABEC9 are equivalent to CLASS Normal, 6, 5, 4 and 2, respectively.

表5.2 球轴承(米制系列)外圈的公差、公差值

Table 5.2 Tolerances and tolerance limits for outer rings (Metric design)

单位：μm Units：μm

轴承公称外径 Nominal outside diameter D (mm)		单一平面内平均外径偏差 Δ_{Dmp}										单一外径偏差 Δ_{Ds}			
		0级 Normal		6级 CLASS 6		5级 CLASS 5		4级 CLASS 4 直径系列 Diameter series 7,8,9		2级 CLASS 2 直径系列 Diameter series 7,8,9		4级 CLASS 4 直径系列 Diameter series 0,1,2,3,4		2级 CLASS 2 直径系列 Diameter series 0,1,2,3,4	
超过 over	到 incl	上 high	下 low	上 high	下 low	上 high	下 low	上 high	下 low	上 high	下 low	上 high	下 low	上 high	下 low
2.5(*1)	**6**	0	-8	0	-7	0	-5	0	-4	0	-2.5	0	-4	0	-2.5
6	**18**	0	-8	0	-7	0	-5	0	-4	0	-2.5	0	-4	0	-2.5
18	**30**	0	-9	0	-8	0	-6	0	-5	0	-4	0	-5	0	-4

轴承公称外径 Nominal outside diameter D (mm)		在单一径向平面内外径变化 V_{Dsp}														平均外径变化 V_{Dmp}				
		0级 Normal				6级 CLASS 6				5级 CLASS 5		4级 CLASS 4		2级 CLASS 2		0级 Normal	6级 CLASS 6	5级 CLASS 5	4级 CLASS 4	2级 CLASS 2
		开放型轴承 Open type			带密封圈、防尘盖轴承 Shielded sealed	开放型轴承 Open type			带密封圈、防尘盖轴承 Shielded sealed	开放型轴承 Open type		开放型轴承 Open type		开放型轴承 Open type						
		直径系列 Diameter series				直径系列 Diameter series				直径系列 Diameter series		直径系列 Diameter series		直径系列 Diameter series						
		9	0,1	2,3,4	2,3,4	9	0,1	2,3,4	0,1,2,3,4	9	0,1,2,3,4	9	0,1,2,3,4	0,1,2,3,4						
超过 over	到 incl	最大 max				最大 max				最大 max		最大 max		最大 max		最大 max	最大 max	最大 max	最大 max	最大 max
2.5(*1)	**6**	10	8	6	10	9	7	5	9	5	4	4	3	2.5		6	5	3	2	1.5
6	**18**	10	8	6	10	9	7	5	9	5	4	4	3	2.5		6	5	3	2	1.5
18	**30**	12	9	7	12	10	8	6	10	6	5	5	4	4		7	6	3	2.5	2

轴承公称外径 Nominal outside diameter D (mm)		外圈的径向跳动 K_{ea}					外圈参考面(背面)的母线倾斜变化(*2) S_D (*4)			外圈的轴向跳动 (*2) S_{ea}			外圈宽度变化 (*3) V_{Cs}		
		0级 Normal	6级 CLASS 6	5级 CLASS 5	4级 CLASS 4	2级 CLASS 2	5级 CLASS 5	4级 CLASS 4	2级 CLASS 2	5级 CLASS 5	4级 CLASS 4	2级 CLASS 2	5级 CLASS 5	4级 CLASS 4	2级 CLASS 2
超过 over	以到 incl	最大 max	最大 max	最大 max	最大 max	最大 max	最大 max	最大 max	最大 max	最大 max	最大 max	最大 max	最大 max	最大 max	最大 max
2.5(*1)	**6**	15	8	5	3	1.5	8	4	1.5	8	5	1.5	5	2.5	1.5
6	**18**	15	8	5	3	1.5	8	4	1.5	8	5	1.5	5	2.5	1.5
18	**30**	15	9	6	4	2.5	8	4	1.5	8	5	2.5	5	2.5	1.5

注 Notes

(*1) 2.5mm 包括在这个尺寸中。2.5mm is included in this group.

(*2) 不适用于带止动挡边球轴承。Applicable to assembled-bearing flange back face runout with raceway.

(*3) 0级及6级的外圈的宽度变动量，依据**表5.1**。The tolerances for outer ring width variation of CLASS Normal and 6 are shown in **Table 5.1**.

(*4) 当以外圈侧面或外圈止动挡边背面的外圈外径中心线与基准面的垂直度为基准时，它应该是所述值的一半。

In case of making center line of outer diameter of outer-ring against datum plane based on side face of outer-ring or flange's back face of outer-ring be squarenese, the value shall be half of the mentioned one.

备注 Remarks

1. 本表所规定的轴承外径的下偏差，不适用于套圈端面的倒角尺寸r(最大)1.2倍距离以内的范围。

The outside diameter "no-go side" tolerance limit (low) specified in this table does not necessarily apply within a distance of 1.2times the chamfer dimension r (max) from the ring face.

2. 根据ANSI/ABMA Std20-1996，ABEC1、ABEC3、ABEC5、ABEC7及ABEC9分别相当于0级、6级 、5级、4级及2级。

ANSI/ABMA Std20-1996 was amended: ABEC1, ABEC3, ABEC5, ABEC7 and ABEC9 are equivalent to CLASS Normal, 6, 5, 4 and 2, respectively.

表5.3 带止动挡边球轴承的止动挡边公差及公差值

Table 5.3 Flange tolerances for metric flanged bearings

(1) 止动挡边的外径公差

Tolerances of outside diameter flange

单位：μm Units：μm

止动挡边外径公称尺寸 Nominal flange outside diameter D_1 (mm)		止动挡边外径内尺寸差 Deviation of outside diameter flange Δ_{D1s}	
超过 over	到 incl	上 high	下 low
	10	+220	-36
10	18	+270	-43
18	30	+330	-52

备注 Remarks
如需要上述以外的公差，请垂询ISC。
Please contact ISC when tolerance other than above is required.

(2) 止动挡边宽度尺寸及相关的旋转精度公差值

Flange width tolerances and running accuracies related to flange

单位：μm Units：μm

轴承公称外径 Nominal bore diameter D (mm)		止动挡边宽度尺寸差 Deviation of flange width Δ_{C1s}	止动挡边宽度变动量 Variation of flange width V_{C1s}				止动挡边外表面母线对基准端面倾斜度的变动量(*2)(*4) S_{D1}			止动挡边背面的轴向跳动 (*3) S_{ea1}		
		0 級 Normal 6 級 6CLASS 5 級 5CLASS 4 級 4CLASS 2 級 2CLASS	0 級 Normal 6 級 6CLASS	5 級 CLASS 5	4 級 CLASS 4	2 級 CLASS 2	5 級 CLASS 5	4 級 CLASS 4	2 級 CLASS 2	5 級 CLASS 5	4 級 CLASS 4	2 級 CLASS 2
超过 over	到 incl	上 high　下 low	最大 max				最大 max	最大 max	最大 max	最大 max	最大 max	最大 max
2.5 (*1)	6	参照同一等级，相同轴承的dΔ_{Bs}公差值。 Use the Δ_{Bs} tolerance for d of the same bearing of the same class.	参照同一等级，相同轴承的dV_{Bs}的公差值。 Use the V_{Bs} tolerance for d of the same bearing of the same class.	5	2.5	1.5	8	4	1.5	11	7	3
6	18			5	2.5	1.5	8	4	1.5	11	7	3
18	30			5	2.5	1.5	8	4	1.5	11	7	4

注 Notes
(*1) 2.5mm 包括在这个尺寸中。2.5mm is included in this group.
(*2) 止动挡边背面与轴承外径面的倾斜度 Variation of brg outside surface generatrix inclination with flange back face
(*3) 止动挡边背面轴向跳动 Flange back face runout with raceway
(*4) 当以外圈侧面或外圈止动挡边背面的外圈外径中心线与基准面的垂直度为基准时，它应该是所述值的一半。
In case of making center line of outer diameter of outer-ring against datum plane based on side face of outer-ring or flange's back face of outer-ring be squarenese, the value shall be half of the mentioned one.

表5.4 球轴承(英制系列)内圈的公差及公差值

Table 5.4 Tolerances and tolerance limits for inner rings and widths of outer rings (ANSI/ABMA Standard・Instrument ball bearings・inch design)

单位：μm Units：μm

轴承公称内径 Nominal bore diameter d (mm)		单一平面内平均内径偏差 Δ_{dmp}				单一内径偏差 Δ_{ds}				在单一径向平面内内径变化 V_{dsp}		平均内径变化 V_{dmp}		内圈(或外圈)宽度偏差 Δ_{Bs}(或Δ_{cs}) Δ_{Bs}(or Δ_{cs})			
		CLASS 5P CLASS 7P		CLASS 9P		CLASS 5P CLASS 7P		CLASS 9P		CLASS 5P CLASS 7P	CLASS 9P	CLASS 5P CLASS 7P	CLASS 9P	单体轴承 Single brg CLASS 5P CLASS 7P CLASS 9P		组合轴承(*1) Combined brgs CLASS 5P CLASS 7P CLASS 9P	
超过 over	到 incl	上 high	下 low	上 high	下 low	上 high	下 low	上 high	下 low	最大 max	最大 max	最大 max	最大 max	上 high	下 low	上 high	下 low
–	10	0	-5.1	0	-2.5	0	-5.1	0	-2.5	2.5	1.3	2.5	1.3	0	-25.4	0	-400
10	18	0	-5.1	0	-2.5	0	-5.1	0	-2.5	2.5	1.3	2.5	1.3	0	-25.4	0	-400
18	30	0	-5.1	0	-2.5	0	-5.1	0	-2.5	2.5	1.3	2.5	1.3	0	-25.4	0	-400

轴承公称内径 Nominal bore diameter d (mm)		单一内圈宽度偏差 V_{Bs}			内圈的径向跳动 K_{ia}			内圈的轴向跳动 S_{ia}			内圈的横向跳动 S_d		
		CLASS 5P	CLASS 7P	CLASS 9P	CLASS 5P	CLASS 7P	CLASS 9P	CLASS 5P	CLASS 7P	CLASS 9P	CLASS 5P	CLASS 7P	CLASS 9P
超过 over	到 incl	最大 max	最大 max	最大 max	最大 max	最大 max	最大 max	最大 max	最大 max	最大 max	最大 max	最大 max	最大 max
–	10	5.1	2.5	1.3	3.8	2.5	1.3	7.6	2.5	1.3	7.6	2.5	1.3
10	18	5.1	2.5	1.3	3.8	2.5	1.3	7.6	2.5	1.3	7.6	2.5	1.3
18	30	5.1	2.5	1.3	3.8	3.8	2.5	7.6	3.8	1.3	7.6	3.8	1.3

注 Notes
(*1) 适用于以2个组合来调整差幅的轴承。Applicable to bearings for which the axial clearance (preload) is to be adjusted by combining two selected bearings.
备注 Remarks
CLASS 5P, 7P及9P是英制轴承的精度等级。 CLASS 5P,7P and 9P are for precision bearings for instruments.

表5.5 球轴承(英制系列)外圈的公差及公差值

Table 5.5 Tolerances and tolerance limits for outer rings (ANSI/ABMA Standard • Instrument ball bearings • inch design)

单位：μm Units：μm

轴承公称外径 Nominal outside diameter D (mm)		单一平面内平均外径偏差 Δ_{Dmp}				单一外径偏差 Δ_{Ds}						在单一径向平面内外径变化 V_{Dsp}			平均外径变化 V_{Dmp}		
		CLASS 5P CLASS 7P		CLASS 9P		CLASS 5P CLASS 7P				CLASS 9P		CLASS 5P CLASS 7P		CLASS 9P	CLASS 5P CLASS 7P		CLASS 9P
						开放型轴承 Open type		密封圈、防尘盖轴承 Shielded sealed		开放型轴承 Open type		开放型轴承 Open type	密封圈、防尘盖轴承 Shielded sealed	开放型轴承 Open type	开放型轴承 Open type	密封圈、防尘盖轴承 Shielded sealed	开放型轴承 Open type
超过 over	到 incl	上 high	下 low	上 high	下 low	上 high	下 low	上 high	下 low	上 high	下 low	最大 max	最大 max	最大 max	最大 max	最大 max	最大 max
–	18	0	-5.1	0	-2.5	0	-5.1	+1	-6.1	0	-2.5	2.5	5.1	1.3	2.5	5.1	1.3
18	30	0	-5.1	0	-3.8	0	-5.1	+1	-6.1	0	-3.8	2.5	5.1	2.0	2.5	5.1	2.0
30	50	0	-5.1	0	-3.8	0	-5.1	+1	-6.1	0	-3.8	2.5	5.1	2.0	2.5	5.1	2.0

轴承公称外径 Nominal outside diameter D (mm)		外圈宽度变动量（*1） V_{Cs}			外圈外表面对端面的垂直度 S_D			外圈的径向跳动 K_{ea}			外圈的轴向跳动 S_{ea}		
		CLASS 5P	CLASS 7P	CLASS 9P	CLASS 5P	CLASS 7P	CLASS 9P	CLASS 5P	CLASS 7P	CLASS 9P	CLASS 5P	CLASS 7P	CLASS 9P
超过 over	到 incl	最大 max	最大 max	最大 max	最大 max	最大 max	最大 max	最大 max	最大 max	最大 max	最大 max	最大 max	最大 max
–	18	5.1	2.5	1.3	7.6	3.8	1.3	5.1	3.8	1.3	7.6	5.1	1.3
18	30	5.1	2.5	1.3	7.6	3.8	1.3	5.1	3.8	2.5	7.6	5.1	2.5
30	50	5.1	2.5	1.3	7.6	3.8	1.3	5.1	5.1	2.5	7.6	5.1	2.5

轴承公称外径 Nominal outside diameter D (mm)		止动挡边外径偏差 Δ_{D1s}		止动挡边宽度偏差 Δ_{C1s}		轴向跳动（*2） S_{ea1}
		带止动挡边轴承 Flanged outer ring				
		CLASS 5P CLASS 7P		CLASS 5P CLASS 7P		CLASS 5P CLASS 7P
超过 over	到 incl	上 high	下 low	上 high	下 low	最大 max
–	18	0	-25.4	0	-50.8	7.6
18	30	0	-25.4	0	-50.8	7.6
30	50	0	-25.4	0	-50.8	7.6

注 Notes
(*1) 也适用于带止动挡边轴承的止动挡边宽度变动量。 Applicable to flange width variation for flanged bearings, but excluding CLASS 9P.
(*2) 适用于止动挡边背面。Applicable to flange back face.

表5.6 精度选择的参考
Table 5.6 Guide for selection of bearing accuracy

使用场合 Application	轴承精度等级 Bearing tolerance classes	
	JIS (ISO)	ANSI / ABMA
微电机、步进电机、风扇电机、 Micro motors, Stepping motors, Fan motors, 夹送辊、复印机送纸辊 VCR pinch rollers, Copy machine-feed rollers	0 级 Normal　6 级 CLASS 6	ABEC 1 ABEC 3
精密电机、同步电机、齿科用主轴、 High precision motors, Synchro motors, Dental spindles, 伺服电机、编码器、VTR 滚筒主轴、 Servo motors, Encoders, VTR drum spindles, 多边形镜扫描仪电机 Polygonal mirror scanner motors	5 级 CLASS 5　4 级 CLASS 4	CLASS 5P　CLASS 7P
高频主轴、陀螺仪转子、陀螺仪万向架 High frequency spindles, Gyro rotors, Gyro gimbals	4 级 CLASS 4　2 级 CLASS 2	CLASS 7P　CLASS 9P

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如需要出口此微型滚珠轴承目录中列出的单个高精度(JIS 5级 或更高)轴承,请咨询ISC。

表5.7 主要尺寸和运行精度的符号
Table 5.7 Symbols for boundary dimensions and running accuracy

d	公称轴承内径 Brg bore dia., nominal
Δ_{ds}	单一内径的偏差 Deviation of a single bore dia.
Δ_{dmp}	单一平面内平均内径偏差 Single plane mean bore dia. deviation
V_{dsp}	在单一径向平面内内径变化 Bore dia. Variation in a single radial plane
V_{dmp}	平均内径变化 Mean bore dia. variation
D	公称轴承外径 Brg outside dia., nominal
Δ_{Ds}	单一外径的偏差 Deviation of a single outside dia.
Δ_{Dmp}	单一平面内平均外径偏差 Single plane mean outside dia. deviation
V_{Dsp}	在单一径向平面内外径变化 Outside dia. Variation in a single radial plane
V_{Dmp}	平均外径变化 Mean outside dia. variation
D_1	公称凸缘外圈外径 Outside dia. of the outer ring flange, nominal
Δ_{D1s}	凸缘外圈单一外径的尺寸偏差 Deviation of a single outside diameter of the outer ring flange
B	公称内圈宽度 Inner ring width, nominal
Δ_{Bs}	单一内圈宽度偏差 Deviation of a single inner ring width
V_{Bs}	内圈宽度变化 Inner ring width variation

C	公称外圈宽度 Outer ring width, nominal
Δ_{Cs}	单一外圈宽度偏差 Deviation of a single outer ring width
V_{Cs}	外圈宽度变化 Outer ring width variation
C_1	公称凸缘外圈宽度 Outer ring flange width, nominal
Δ_{C1s}	单一凸缘外圈宽度偏差 Deviation of a single outer ring flange width
V_{C1s}	凸缘外圈宽度变化 Outer ring flange width variation
K_{ia}	内圈的径向跳动 Radial runout of assembled brg. inner ring
K_{ea}	外圈的径向跳动 Radial runout of assembled brg. outer ring
S_d	内圈参考面(包含背面)向内的跳动 Inner ring reference face (back face, where applicable) runout with bore
S_{ia}	内圈的轴向跳动 Assembled brg. inner ring face (back face) runout with raceway
S_D	外圈参考面(背面)的母线倾斜变化 Variation of brg. outside surface generatrix inclination with outer ring reference face (back face)
S_{ea}	外圈的轴向跳动 Assembled brg. outer ring face (back face) runout with raceway
S_{ea1}	凸缘外圈的轴向跳动 Assembled brg. outer ring flange back face runout with raceway

6. 配合与游隙 Fits and internal clearances

6.1 配合

将轴承安装到机器上的配合条件，对充分发挥机器性能是极其重要的。

由于小型、微型球轴承一般由于轻载荷条件下，采用从微小过盈量到轻微间隙配合范围的配合。

另外，为了便于安装，防止安装时发生故障，避免因配合而导致接触角、预紧力的变化等，有时选择间隙配合。选择间隙配合时，可以用螺母等将内圈紧固在轴肩上便于防止发生蠕变。

利用弹簧对轴承施加预紧时，支撑预紧侧套圈的配合应为间隙配合，以确保轴向顺畅移动为宜。

为减轻设备重量采用有色金属轴承座时，外圈配合面的游隙将随温升而增大，并可能导致设备性能下降及轴承发生早期损伤，因此最好使用钢制轴衬。

一般情况的配合举例如**表6.1**和**表6.2**所示。用于特殊情况时，请垂询**ISC**。

另外，轴及轴承座孔的尺寸公差参照**表6.3**和**表6.4**。

表6.1 内圈与轴的配合 Table 6.1 Inner ring fit with shaft

使用条件 Condition			适用举例 Application	轴承精度等级 Bearing tolerance class	配合条件 Fit	轴的尺寸公差 Shaft finish (μm)	推荐平均配合 (*1) Suggested average fit (*1)
内圈旋转 Inner ring rotation	低速 Low speed	内圈轴向自由 Inner ring axially free	同步电机 Synchros 伺服电机 Servos 电位器 Potentiometers 解析器 Resolvers 陀螺方向架 Gyro gimbals	5 级 CLASS 5 4 级 CLASS 4 CLASS 5P CLASS 7P	轻微间隙配合 Slightly loose fit (slip fit)	ϕd -2 -7	2L
	低速～中速 Low and medium speeds		微电机 Small motors 风扇电机 Fans 通用伺服电机 Servos	0 级 Normal 6 级 CLASS 6 ABEC 1 ABEC 3	过度配合 Transition fit	ϕd h5	±0
	中速～高速 Medium and high speeds		磁盘主轴 Computer disk spindles	5 级 CLASS 5 4 级 CLASS 4 CLASS 5P CLASS 7P	轻微间隙配合 (*2) Slightly loose fit (*2)	ϕd -5 -8	4L
			VTR滚筒主轴 Video cassette recorder drum spindles		客户自主 Close-sliding fit	ϕd -1 -6	1L
			陀螺仪转子 Gyro rotors 齿科用主轴 Dental Spindles 高频主轴 High-frequency spindles	4 级 CLASS 4 CLASS 7P CLASS 9P	轻微过盈配合 Slight interference fit (Push fit)	ϕd ±2.5	2T
			吸尘器 Vacuum cleaners 电动工具 Electric tools	0 级 Normal ABEC 1	过盈配合 interference fit	ϕd js5	4T
			多边形镜扫描仪电机 Polygonal mirror scanner motors	5 级 CLASS 5 4 级 CLASS 4 CLASS 5P CLASS 7P	间隙配合 Close-sliding fit	ϕd -1 -6	1L
		内圈轴向固定 Inner ring axially fixed	陀螺仪转子 Gyro rotors		间隙配合 Loose fit	ϕd -5 -10	5L
外圈旋转 Outer ring rotation	低速～高速 Low to high speeds	内圈轴向自由 Inner ring axially free	离合器 Clutches 小型风扇电机 Small fans	0 级 Normal 6 级 CLASS 6 ABEC 1 ABEC 3	轻微间隙配合 Slightly loose fit	ϕd g5	3L
		内圈轴向固定 Inner ring axially fixed	导带辊 Tape guide rolls 夹送辊 Pinch rolls	5 级 CLASS 5 4 级 CLASS 4 CLASS 5P CLASS 7P	间隙配合 Loose fit	ϕd -5 -10	5L

注 Notes
(*1) L: 间隙配合、T: 过盈配合 L:Loose fit, T:Interference fit
(*2) 安装后通常为粘接。 After mounting, usually bonded

Shaft and housing fits

The fitting practice used for bearings is extremely important in achieving their expected performance. Since miniature bearings are usually used under light loads, the range between a push fit (light interference) and a slip fit (slightly loose) is generally used.

In the case of a rotating inner ring, ordinary ball bearings are fitted to the shaft with interference, however, a slip fit is generally used for miniature bearings and instrument ball bearings in order to simplify their mounting, prevent damage during mounting and avoid changing the contact angle or preload. This is because the occurrence of creep in miniature bearings is easily prevented by tightening the side face of the inner ring against a shoulder on the shaft with a nut.

When a spring is used to apply a preload to a bearing, the fitting of the bearing ring in contact with the spring should be loosely fitted so the ring slides smoothly. When housings are built of lightweight alloys, the fitting clearance of the outer ring will increase with increasing temperature and possibly impair the machine's operation and reduce the bearing life; therefore, the bearings should be mounted in a steel bushing. **Tables 6.1** and **6.2** show the recommended fittings for various design conditions and applications. **Tables 6.3** and **6.4** show the dimension tolerance for bearing and housing shaft hole.

表6.2 外圈与轴承座孔的配合 Table 6.2 Outer ring fit with housing

使用条件 Condition		适用举例 Application	轴承的精度等级 Bearing tolerance class	配合条件 Fit	轴承座的尺寸公差 Shaft finish (μm)	推荐平均配合（*1） Suggested average fit（*1）
内圈旋转 Inner ring rotation	低速 Low speed	同步电机 Synchros 伺服电机 Servos 电位器 Potentiometers 解析器 Resolvers 陀螺万向架 Gyro gimbals	5 级 CLASS 5 4 级 CLASS 4 CLASS 5P CLASS 7P	轻微 间隙配合 Slightly loose fit (slip fit)	ϕD +3 -2	2L
	中速～高速 Medium and high speeds	微电机 Small motors 电动工具 Electric tools 吸尘器 Vacuum cleaners 风扇电机 Fans	0 级 Normal ABEC 1	间隙配合 Loose fit	ϕD H6	9L
		磁盘主轴 Computer disk spindles	5 级 CLASS 5 4 级 CLASS 4 CLASS 5P CLASS 7P	间隙配合 (*2) Loose fit (*2)	ϕD +3 0	4L
		VTR 滚筒主轴 Video cassette recorder drum spindles		轻微 紧固配合 Slightly interference fit	ϕD -2 -5	2T
		陀螺仪转子 Gyro rotors 高频主轴 High-frequency spindles	5 级 CLASS 5 4 级 CLASS 4 CLASS 5P CLASS 7P	间隙配合 Loose fit	ϕD +5 0	5L
		多边形镜扫描仪电机 Polygonal mirror scanner motors		间隙配合 (*2) Loose fit (*2)	ϕD +3 0	4L
外輪回転 Outer ring rotation	低速～高速 Low to high speeds	导电辊 Tape guide rolls 夹送辊 Pinch rolls	5 级 CLASS 5 4 级 CLASS 4 CLASS 5P CLASS 7P	轻微 间隙配合 Slightly loose fit	ϕD +3 -2	2L
		凸轮从动件 Cam followers 张紧轮 Tension pulleys 惰性齿轮 Idler gears	0 级 Normal 6 级 CLASS 6 ABEC 1 ABEC 3	过盈配合 Interference fit	ϕD M5	5T

注 Notes
(*1) L: 间隙配合、T: 过盈配合 L:Loose fit, T:Interference fit
(*2) 安装后通常再行粘接。 After mounting, usually bonded

表6.3 轴径的尺寸公差

Table 6.3 Tolerances for shaft diameters

单位：μm Units：μm

轴径（mm）Shaft dia		公差范围等级 Tolerance class for shafts					
超过 over	到 incl	g4	g5	h4	h5	js4	js5
–	3	-2 ～ -5	-2 ～ -6	0 ～ -3	0 ～ -4	±1.5	±2.0
3	6	-4 ～ -8	-4 ～ -9	0 ～ -4	0 ～ -5	±2.0	±2.5
6	10	-5 ～ -9	-5 ～ -11	0 ～ -4	0 ～ -6	±2.0	±3.0
10	18	-6 ～ -11	-6 ～ -14	0 ～ -5	0 ～ -8	±2.5	±4.0

表6.4 轴承座孔的尺寸公差

Table 6.4 Tolerances for housing bores

单位：μm Units：μm

轴承座孔径（mm）Bore dia		公差范围等级 Tolerance class for shafts							
超过 over	到 incl	H5	H6	JS5	JS6	K5	K6	M5	M6
–	3	+4 ～ 0	+6 ～ 0	±2.0	±3.0	0 ～ -4	0 ～ -6	-2 ～ -6	-2 ～ -8
3	6	+5 ～ 0	+8 ～ 0	±2.5	±4.0	0 ～ -5	+2 ～ -6	-3 ～ -8	-1 ～ -9
6	10	+6 ～ 0	+9 ～ 0	±3.0	±4.5	+1 ～ -5	+2 ～ -7	-4 ～ -10	-3 ～ -12
10	18	+8 ～ 0	+11 ～ 0	±4.0	±5.5	+2 ～ -6	+2 ～ -9	-4 ～ -12	-4 ～ -15
18	30	+9 ～ 0	+13 ～ 0	±4.5	±6.5	+1 ～ -8	+2 ～ -11	-5 ～ -14	-4 ～ -17

轴、轴承座精度不好的情况下，轴承受其影响，不能发挥所需性能。比如，安装部位的精度不好，会产生内、外圈倾斜。在轴承载荷之外，发生端部载荷机种（边缘应力），会成为保持架破损等损伤产生的原因。

在一般情况下，配合面只要精车即可。但是，运转时对振动和音响要求严格时，必须采用磨削加工。

轴、轴承座孔的精度如**表6.5**所示。

If the accuracy of a shaft or housing does not meet the specification, the performance of the bearings will be affected and they will not perform to their full capability. For example, inaccuracy in the squareness of the shaft shoulder may cause misalignment of the bearing inner and outer rings, which may reduce the bearing fatigue life by adding an edge load in addition to the normal load. Cage fracture and seizure sometimes occur for this same reason.

For normal operating conditions, a turned finish or smooth bored finish is sufficient for the flitting surface; however, a ground finish is necessary for applications where vibration and noise must be low. The accuracy and surface finish of shafts and housings for normal operating conditions are listed in **Table 6.5**.

表6.5 轴、轴承座孔的精度与粗糙度

Table 6.5 Accuracy and roughness of shaft and housing

项目 Item	轴承等级 Class of bearings	轴 Shaft	轴承座孔 Housing bore
圆度公差 Tolerance for out-of-roundness	0 级，6 级 Normal, CLASS 6	$\frac{IT3}{2}$ ～ $\frac{IT4}{2}$	$\frac{IT4}{2}$ ～ $\frac{IT5}{2}$
	5 级，4 级 CLASS 5, CLASS 4	$\frac{IT2}{2}$ ～ $\frac{IT3}{2}$	$\frac{IT2}{2}$ ～ $\frac{IT3}{2}$
圆柱度公差 Tolerance for cylindricality	0 级，6 级 Normal, CLASS 6	$\frac{IT3}{2}$ ～ $\frac{IT4}{2}$	$\frac{IT4}{2}$ ～ $\frac{IT5}{2}$
	5 级，4 级 CLASS 5, CLASS 4	$\frac{IT2}{2}$ ～ $\frac{IT3}{2}$	$\frac{IT2}{2}$ ～ $\frac{IT3}{2}$
挡肩的跳动公差 Tolerance for shoulder runout	0 级，6 级 Normal, CLASS 6	IT3	IT3 ～ IT4
	5 级，4 级 CLASS 5, CLASS 4	IT3	IT3
配合面的粗糙度 Roughness of fitting surfaces Ra	———	0.8	1.6

备注 Remarks

此表属一般半径法推荐值，按照轴承精度，选择基本公差IT等级。

This table is for general recommendation using the radius measuring method. The basic tolerance (IT) class should be selected in accordance with the bearing precision class.

6.2 轴承内部游隙
Bearing internal clearances

轴承在运转中的内部游隙会影响疲劳寿命，震动，躁声，发热等轴承的性能。因此需考量轴承装配，负荷，转速以及轴承运转中的温度等条件来选定适合的游隙。

ISC制定了六个等级的内部游隙，其数值如**表6.6**。

另外所量测出的游隙值会因为负荷的弹性变形总量测定值比理论内部游隙直还要来得大，所以有修正游隙值的必要。
(参考**表6.6**备注2)

The internal clearance of ball bearings greatly influences their performance, including fatigue life, vibration, noise, heat generation, etc. Consequently, it is necessary to select the proper clearance considering the bearing fit, load, speed and operating temperature. ISC provides clearances in six steps as shown in **Table 6.6**. To obtain accurate measurements, the clearance is generally measured by applying a specified measuring load on the bearing. As a result, the measured clearance is always slightly larger than the theoretical internal clearance by the amount of elastic deformation caused by the measuring load. The theoretical internal clearance may thus be obtained by correcting the measured clearance by the amount of elastic deformation (refer to **Table 6.6** Remark #2)

表6.6 小型和微型轴承的径向内部游隙
Table 6.6 Radial internal clearances in extra small and miniature ball bearings.

单位：μm
Units：μm

游隙记号 Clearance symbol	MC1		MC2		MC3		MC4		MC5		MC6	
游隙 Clearance	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
	0	5	3	8	5	10	8	13	13	20	20	28

游隙记号 Clearance symbol	MC1	MC2	MC3	MC4	MC5	MC6
游隙修正量 Clearance correction	1	1	1	1	2	2

备注 Remarks
1. 标准内部游隙为 MC3。
The standard clearance is MC3.
2. 使用测定游隙量的情况，须再加上下表的修正量。
To obtain the measured value, add the correction amount in the table below.

微型轴承：2.5N｛0.25kgf｝
小型轴承：4.4N｛0.45kgf｝
The measuring loads are as follows:
For miniature ball bearings 2.5N {0.25kgf}
For extra small ball bearings 4.4N {0.45kgf}

表6.7为选定内部游隙的选定参考值。如要选定特殊内部游隙的话，请与ISC联系。

Table 6.7 shows the criteria for selecting the radial clearance for extra small and miniature ball bearings.
For reference purpose, selection criteria of radial clearance is shown in **Table 6.7**.
Please consult with ISC for special radial clearance.

表6.7 径向游隙选则标准范例
Table 6.7 Selection of radial clearances

用途 Typical application	对于轴承的要求 Requirement	游隙记号 Clearances symbol	备考 Remarks
精密齿轮轴，伺服电机系统 步进马达 低转速应用机器 Shafts for precision gear, servo-mechanisms, stepping motors, other low-speed applications	● 无预压并小游隙。 Small bearing clearance is required with no preload. ● 轴向负荷小。 Low axial load. ● 无须高轴向刚性。 High axial rigidity is not required.	MC1 MC2	● 避免过盈配合。 Avoid interference fits.
同步电动机，径向负荷的旋转式平衡机 录相机磁鼓轴，磁碟转轴 多边形镜扫描马达 中低转速的机器 Synchros, gyro gimbal radial bearings, Video cassette recorder drum spindles, computer disk spindles, polygonal mirror scanner motors, other low or medium-speed applications	● 需低摩擦扭矩。 Low frictional torque is required. ● 轴向负荷中等。 Axial load and rigidity are normal. ● 中等轴向刚性。 High axial rigidity could be normal.	MC3 MC4	● 原则上避免过盈配合。 Avoid interference fits in most applications.
陀螺转子 轴向负荷的旋转式平衡机 冷却风扇，吸尘器 使用于高速或是高温得机器 Gyro rotors, gyro gimbal thrust bearings, fan motors, vacuum cleaners, other high-speed and high-temperature applications	● 需极低摩擦扭矩。 Extremely low frictional torque is required. ● 轴向负荷高。 High endurance and high axial rigidity are required. ● 需要轴向刚性。 High axial rigidity is required.	MC5 MC6	● 调整轴向游隙或是用弹性来预压。 Either axial clearance is made adjustable or spring preload is used. ● 允许过盈装配。 Interference fit may be allowed.

7. 润滑 Lubrication

7.1 润滑的目的

轴承润滑的目的是为了减少轴承内部的摩擦和磨损，及防止轴承过早失效。润滑的功用如下。

(1)减少摩擦及磨损

在构成轴承的轴承套圈，转动体，保持架间所相互接触的部分，来防止金属接触，减少摩擦和磨损。

(2)延长疲劳寿命

轴承的滚动疲劳寿命，会因为转动中的接触面有被充分润滑的时候而延长。反之润滑剂黏度低，润滑膜厚度不足而疲劳寿命将会变短。

(3)摩擦热能的散热及冷却

循环润滑可以将摩擦所产生的热以及外部传入的热能藉由油脂来散热冷却，以防止轴承过热，并防止润滑剂本身的劣化。

(4)其他

防止异物入侵轴承内部，或是生锈以及腐蚀的发生等效果。

7.2润滑方法

(1)润滑脂润滑

于密封型(DD，VV)以及防尘盖型(ZZ1，ZZ)的轴承内，事先注入适量的优质润滑脂，并可直接使用。润滑脂的注入量多的话，根据使用条件，会有发热以及漏油的状况，需要注意。一般润滑脂的注入量为轴承内部空间的一半以下。

且根据润滑脂的品牌，会大大影响轴承性能，ISC推荐**表7**的润滑脂。

特别NS7润滑脂为小型及微型轴承的标准润滑脂，用于多种用途的轴承。这些会润滑脂以外，也有许多种类的润滑脂。可与ISC联系来选定合适的润滑脂。

(2)油润滑

油润滑用于润滑脂难以达到的使用条件，例如要求极低的力矩，或是高转速的应用。特别是摩擦力矩会大大影响性能的陀螺仪，同步电机中的轴承，都使用低黏度的油来润滑。

且高频轴等高转速的情况，因油的搅拌产生的热较少对于轴承冷却性良好的油雾或是油气润滑法较为适合。

AF2润滑油(MIL- L- 6085A)作为标准的润滑油来使用。

7.1 Purposes of lubrication

The main purpose of lubrication is to reduce friction and wear for inside of bearings that may cause premature failure. The effects of lubrication can be briefly explained as follows:

(1) Reduction of friction and wear

Direct metallic contact between the bearing rings, rolling elements and cage is prevented by a lubricant film.

(2) Extension of fatigue life

The rolling fatigue life of bearings depends greatly upon the viscosity and film thickness between the rolling contact surfaces. Sufficient film thickness prolongs the fatigue life while film thickness shortens it.

(3) Dissipation of frictional heat and cooling

Circulating lubrication may be used to carry away frictional heat or heat transferred from outside the bearing.

(4) Others

Adequate lubrication also helps to prevent foreign matter from entering bearings and guards against corrosion and rust.

7.2 Lubricating Method

(1) Grease lubrication

Sealed (DD, VV) or shielded (ZZ1,ZZ) bearings are generally factory-packed with the proper quantity of good quality grease and can be used as delivered. More than the normal amount of grease can cause heat generation or grease leakage. Generally ISC packs less than half of the free internal space inside bearings.
Since the brand of grease affects bearing performance, ISC usually recommends those shown in **Tables 7**. Among them, NS7 grease is often used as the standard grease for many applications. Besides those listed in the Table, many other brands are available. For assistance when selecting grease, please consult ISC.

(2) Oil lubrication

Oil lubrication is used under conditions where satisfactory performance is difficult to achieve using grease, for example, when extremely low torque is required or for high-speed operations. Particularly in the case of gyro-gimbal and synchros which are largely affected by frictional torque, a low viscosity oil is used. Oil mist or oil air lubrication provides low heating due to agitation and also superior cooling of the bearing. AF2 oil (MIL-L-6085A) is used as the standard oil of ISC.

表7 润滑脂
Table 7 Grease

润滑脂代号 Grease	增稠剂 Thickener	基础油 Base oil	混合稠度 Consistency	基油动黏度 40℃ (cst) Base oil viscosity at 40℃(cst)	使用温度范围(℃) Working Temperature Range (℃)	特征 Characteristics	主要用途 Main applications
NS7	锂皂基 Lithium soap	多元醇酯+二酯 Polyol ester + Diester	250	24.1	-40 ～ +130	广泛温度范围 Wide temperature range	
NSC		烷基二苯醚+多元醇酯 Alkyl diphenyl ether + Polyol ester	235	53	-30 ～ +140	广泛温度范围 Wide temperature range	空调散热风扇马达 Fan motor for air conditioner
PS2		烯烃+二酯 Poly-alpha-olefin + Diester	275	15.9	-50 ～ +110	低温·低力矩 Low temperature Low torque	
LG2		矿物油+烯烃 Mineral oil + Poly-alpha-olefin	199	32	-20 ～ +70	低粉尘 Low refuse	
ECE		烯烃 Poly-alpha-olefin	235	30.5	-40 ～ +150	导电性 Conductive	事务机 Office appliances
AHQ	尿素 Urea	四羧酸酯油 Tetraester oil	250	100	-40 ～ +180	高温高转速 High temperature High speed	冷却风扇马达 Cooling fan motor
EA2		烯烃 Poly-alpha-olefin	243	47.3	-40 ～ +150	高温高转速 High temperature High speed	
EA7		烯烃 Poly-alpha-olefin	243	46	-40 ～ +150	高温高转速 High temperature High speed	
EK3		合成油 Synthetic oil	220	47.6	-40 ～ +150	耐化学腐蚀 Anti-chemical attack	
LGU		烯烃 Poly-alpha-olefin	201	95.8	-40 ～ +120	低粉尘·高温用 Low refuse High temperature	
MLS		烯烃 Poly-alpha-olefin	232	68	-40 ～ +150	高温高转速 High temperature High speed	冷却风扇马达 Cooling fan motor
KPM	PTFE PTFE	全氟聚醚 Perfluoropolyether	280	420	-20 ～ +200	高温用 High temperature	事务机加热滚筒 Heat roll for office appliances
RLS	铝复合基 Aluminum complex soap	烯烃 Poly-alpha-olefin	280	150	0 ～ +120	食品级润滑脂 Food grease	食品机器 Food processing machinery

8. 轴承的寿命 Bearing Life

8.1 轴承的寿命

即使正确地使用滚珠轴承，经过一段时间后会增加噪音·震动，因磨损导致降低精度，润滑脂劣化，滚动面的疲劳剥离等导致不堪使用。像这样到不再能使用的这段时间广义称为轴承寿命。也分其个别称为噪音寿命，磨损寿命，润滑脂寿命，疲劳寿命。

轴承的疲劳寿命，也会因材料而本质上有所差异，疲劳寿命的差异将其视为统计现象，并其使用定义为下述的基本额定寿命。

基本额定寿命为以在同一条件个别运转下的相同规格的轴承其90%的轴承不会因转动疲劳产生剥落(剥离)而持续运转的总转速。在一定的转速运行下，通常基本额定寿命表示总运转时间。

8.1 Bearing Life

The various functions required of rolling bearings vary according to the bearing application. These functions must be performed for a prolonged period. Even if bearings are properly mounted and correctly operated, they will eventually fail to perform satisfactorily due to an increase in noise and vibration, loss of running accuracy, deterioration of grease, or fatigue flaking of the rolling surfaces.

Bearing life, in the broad sense of the term, is the period during which bearings continue to operate and satisfy their required functions. This bearing life may be defined as noise life, abrasion life, grease life, or rolling fatigue life, depending on which one causes loss of bearing service.

Rolling fatigue life is represented by the total number of rotations at which time the bearing surface will start flaking due to stress. This is called fatigue life. Even for seemingly identical bearings, which are of the same type, size, and material and receive the same heat treatment and other processing, the rolling fatigue life varies greatly even under identical operating conditions. This is because the flaking of materials due to fatigue is subject to many other variables.

Consequently, "rating fatigue life", in which rolling fatigue life is treated as a statistical phenomenon, is used in preference to actual rolling fatigue life.

Suppose a number of bearings of the same type are operated individually under the same conditions. After a certain period of time, 10% of them fail as a result of flaking caused by rolling fatigue. The total number of rotations at this point is defined as the rating fatigue life or, if the speed is constant, the rating fatigue life is often expressed by the total number of operating hours completed when 10% of the bearings become inoperable due to flaking.

8.2 基本动定荷重及疲劳寿命

表示轴承负荷能力的基本动定荷重是指在外圈静止内圈转动的条件下，基本额定寿命可达100万转且不会有方向以及大小变动的负荷。

基本动定荷重C在轴承尺寸表上向心轴承表示为Cr，推力轴承表示为Ca。轴承的基本动定荷重，于轴承荷重及基本额定寿命间，有如下述的关系。

$$L = \left(\frac{C}{P}\right)^3$$

当 L=基本额定寿命(100万转单位)
P=轴承荷重(当量动荷重)(N)，{kgf}
C=基本动定荷重(N)，{kgf}

轴承使用在一定的转速下，以时间来表示轴承的疲劳寿命较为方便。当转速以n(min-1)的情况下，可得以下关系。

$$L = \frac{10^6}{60n}\left(\frac{C}{P}\right)^3$$

8.2 Basic Dynamic Load Rating and Fatigue Life

The basic load rating is defined as the constant load applied on bearings with stationary outer rings that the inner rings can endure for a rating life of one million revolutions. The basic load rating of radial bearings is defined as a central radial load of constant direction and magnitude.

The basic dynamic load ratings C are listed under Cr for radial bearings and Ca for thrust bearings in the bearing tables. The following relation exists between bearing load and rating fatigue life:

$$L = \left(\frac{C}{P}\right)^3$$

Where L=Rating fatigue life (10^6 rev.)
P=Bearing load (equivalent load) (N), {kgf}
C=Basic load rating (N), {kgf}

In the case of bearings that run at a constant speed, it is convenient to express the fatigue life in terms of hours. By designating bearing speed as n(min^{-1}), the relation is obtained as follows.

$$L = \frac{10^6}{60n}\left(\frac{C}{P}\right)^3$$

可由以下的公式来算出向心轴承的当量动荷重P。

$$P=XFr+YFa$$

当 Fr：径向荷重(N)，{kgf}
Fa：轴向荷重(N)，{kgf}
X：径向荷重系数(表 8.1)
Y：轴向荷重系数(表 8.1)

The equivalent load P on radial bearings may be calculated using the following equation.

$$P=XFr+YFa$$

Where Fr:Radial load (N), {kgf}
Fa:Axial load (N), {kgf}
X:Radial load factor (Table 8.1)
Y:Axial load factor (Table 8.1)

表8.1 径向荷重系数及轴向荷重系数 Table 8.1 Radial and axial load factors

Cor/Fa	Fa/Fr≦e 的话		Fa/Fr>e 的话		e
	X	Y	X	Y	
5	1	0	0.56	1.26	0.35
10	1	0	0.56	1.49	0.29
15	1	0	0.56	1.64	0.27
20	1	0	0.56	1.76	0.25
25	1	0	0.56	1.85	0.24
30	1	0	0.56	1.92	0.23
50	1	0	0.56	2.13	0.20

※此表轴向荷重比Cor/Fa的算法与JIS和ISO规格不同。

8.3 基本静定荷重及当量静荷重

当过大的荷重以及冲击荷重作用在轴承上，在钢球以及轨道面间会产生局部的永久变形。

随着荷重增大，变形量也会增加，但如果超过限度后，会妨碍轴承的运转。

基本静定荷重是指受到最大应力的钢球及轨道的接触面中央，于深沟球轴承产生在计算4200MPa (428kgf/mm2)的接触应力的静荷重。

因此接触应力产生的钢球及轨道的总永久变形量，约为钢球直径的0.0001倍。基本静定荷重Co在轴承尺寸表上，向心轴承记载为Cor，推力轴承表示为Coa。

当量静荷重是指在实际荷重条件下所产生的接触应力和于受到最大荷重的钢球与轨道面的接触部中央产生相同的接触应力的径向静力载荷。径向轴承的当量静荷重可由以下两个公式所算出的数值中取较大的数值。

$$Po=XoFr+YoFa$$
$$Po=Fr$$

当 Po：当量静荷重(N)，{kgf}
Fr：径向荷重(N)，{kgf}
Fa：轴向荷重(N)，{kgf}
Xo：径向静力系数 0.6
Yo：静轴向系数 0.5

轴承所容许的当量静荷重会因为基本静定荷重与轴承所要求的条件以及轴承使用条件有所差异。

为选择对于基本静定荷重安全度的静容许荷重系数fs可由以下公式算出，一般所建议的fs值如表所示。

$$fs=Co/Po$$

当 Co：基本静定荷重(N)，{kgf}
Po：当量静荷重(N)，{kgf}

轴承使用条件 Running Condition	fs的下限 Lower limit of fs
特别需要安静地运转的情形下 Low noise applications	2
有震动及冲击的情形下 Vibration and shock loads	1.5
普通运转条件下 Standard running conditions	1

8.3 Basic static load rating and static equivalent loads

Since rolling bearing is a high precision part, its handling should be carried when subjected to an excessive load or strong shock load, rolling bearings may incur a local permanent deformation of rolling elements and raceway surface if the elastic limit is exceeded. The nonelastic deformation increases in area and depth as the load increases, and when the load exceeds a certain limit, the smooth running of the bearing is impeded.

The basic static load rating is defined as that static load which produces the contact stress of 4200MPa (428kgf/mm^2 – ball bearing) at the center of the contact area between the rolling element subjected to the maximum stress and the raceway surface. In this most heavily stressed contact area, the sum of the permanent deformation of the rolling element and that of the raceway is nearly 0.0001 times the rolling diameter. The basic static load rating Co is written Cor for radial bearings and Coa for thrust bearings in the bearing tables.

The static equivalent load is a magnitude of the static radial load which causing the contact stress, equivalent to the maximum contact stress occurring under actual load conditions, on a center of the contact between the rolling element and raceway under maximum load.

The static equivalent load of radial bearings is taken as the larger value of the two values obtained from the two equations below.

$$Po=XoFr+YoFa$$
$$Po=Fr$$

where Po: Static equivalent load (N), {kgf}
Fr: Radial load (N), {kgf}
Fa: Axial load (N), {kgf}
Xo: Static radial load factor 0.6
Yo: Static axial load factor 0.5

The static equivalent load allowed for bearings varies depending on the basic static load rating, requirements of the bearings and bearing operating conditions.

The allowable static load factor fs for review of the safety factor against the basic static load rating is determined by following equation. Generally recommended values of fs are shown in the chart.

$$fs=Co/Po$$

where Co: Basic static load rating (N), {kgf}
Po: Static equivalent load (N), {kgf}

9. 容许转速 Limiting speeds

轴承各有其转速的界限在。

轴承在运转下，会随着转速越快，轴承内部会因摩擦造成温度上升。转速的界限是一个不会造成烧结或是过热并让轴承可以持续运转的经验上容许值。因此，各轴承的容许转速会因轴承的形式及尺寸，保持架的形式及材料，轴承的载重，润滑方式，润滑脂，加上轴承周围的散热状况有所差异。接触橡胶密封圈型轴承(DD型)的容许转速取决于防尘盖前端的滑动速度。

在轴承尺寸表里有每个轴承的润滑脂润滑以及油润滑的容许转速(min^{-1})。

此数值是标准设计的轴承在普通的荷重条件(C／P≧12、Fa／Fr≦0.2左右)下运转时所容许的转速。

轴承的运转速度超过轴承尺寸表的容许转速70%的话，需选用适合于高速性能的润滑脂或是润滑油。

且轴承的运转在超过容许转速的使用条件下，需考量轴承的精度等级、内部游隙、保持架形式、材质、润滑方法等来选择轴承。有考量到高速条件的情况下，可以达到比轴承尺寸表上还高的容许转速。

请咨询ISC来选型高转速轴承。

The speed of rolling bearings is subject to certain limits. When bearings are operating, the higher the speed, the higher the bearing temperature due to friction. The limiting speed is the empirically obtained value for the maximum speed at which bearings can be continuously operated without failing from seizure or generation of excessive heat consequently, the limiting speed of bearings varies depending on such factors as bearing type and size, cage form and material, load, lubrication method, and heat dissipating method including the design of the bearing's surroundings. The maximum permissible speed for contact rubber sealed bearing (DD type) is determined mainly by the sliding surface speed of the inner circumference of the seal. Values for the limiting speed of bearings lubricated by grease and oil are listed in the bearing tables. The limiting speeds in the tables are applicable to bearings of standard design that are subjected to normal loads, i.e, C/P≧12 and Fa/Fr≦0.2 approximately. The limiting speeds for oil lubrication listed in the bearing tables are for conventional oil bath lubrication.
When speeds are more than 70 percent of the listed limiting speed, it is necessary to select an oil or grease which has good high-speed characteristics.
When the required speed exceeds the limiting speed of the desired bearing, then the accuracy grade, internal clearance, cage type and material, and lubrication, must be carefully studied in order to select a bearing capable of the required speed. If all these conditions are considered, the maximum permissible speed may be higher than the limiting speed listed in the bearing table. It is recommended to consult ISC regarding high-speed spplications.

10. 预压 Preload

10.1 预压

将两个可承受轴向荷重的轴承配对设置，事先给予轴向的荷重F的状态称为预压。

轴承的内部游隙可藉由给予预压，可消除内部游隙，使钢球及轨道轮弹性接触。此结果可消除轴承因内部游隙的松动，抑止转动时的震动以及噪声。并且提高刚性。

但是预压过大的话，会变成摩擦力矩增加，发热或是烧结等原因。配合用途来适当的选择预压量，以及预压方式是很重要的。

10.1 Preload

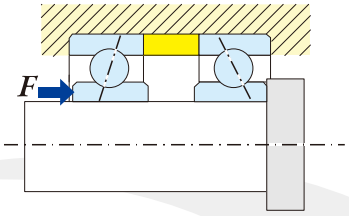
A pair of axially loadable bearing is to be loaded in advance in the axial direction F. This is called "Pre-loading". Bearing has an internal clearance. Pre-loading reduces this clearance and elastic contact of ball and raceway occurs. By the result, the bearing does not have a looseness due to the clearance, which leads to the reduction of vibration and noise when rotating. Moreover, this contributes to the higher rigidity of the bearing. However, excessive pre-loading causes the increase of friction moment, heat generation and seizure of the bearing. In order to avoid this, optimum selection of pre-loading level and method is highly recommended.

10.2 预压效果

1.正确地决定轴的径向以及轴向位置，来抑止轴心的偏差。
2.提高轴承的刚性。
3.防止因轴向的震动以及共振造成的噪声。
4.特别是高转速的情况下可以抑止钢球的公转及自转打滑。
5.可保持推力轴承的滚动体在正确的轨道轮位置上。

10.2 Effect of Pre-loading

1. Maintains the bearings in exact position both radially and axially and also maintains the running accuracy of the shaft
2. Increases the bearing rigidity
3. Minimizes noise due to axial vibration and resonance
4. Prevents sliding between the rolling elements and raceway due to gyroscopic moment for high speed application
5. Maintains the rolling elements in their proper position with the bearing rings



10.3 预压方法

预压方法有定位预压及定压预压。

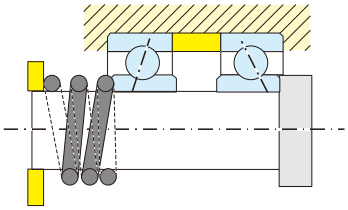
定压预压

图10.1所示使用螺形弹簧或碟形弹簧等来给予轴承适当的预压方法。

即使轴承在使用中有相对位置的变化，也可保持几乎一定的预压量。

例如难以受到因温度造成的尺寸变化等影响。但是需要使用弹簧并且要有使用弹簧的空间。相对于定位预压，定压预压的刚性较低。

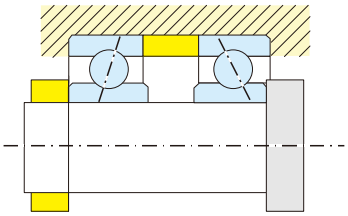
图10.1 定压预压的范例
Fig 10.1 Constant pressure preload



定位预压

如**图10.2**所示决定轴承间的面向位置来设定预压量的方式。例如从轴向荷重与轴向变位的关系，藉由轴承隔圈或轴承宽幅来设定相当于轴向负荷的变位，来固定轴承。刚性高但是会因温度造成的尺寸变化导致预压量产生变化。

图10.2 定位预压的范例
Fig 10.2 Position preload



10.4 预压的大小和方向

预压量取决于钢球及轨道轮的弹性接触状态，如果预压量设定过大的话，会导致异常发热，摩擦力矩增大，疲劳寿命下降。另一方面如果预压量过小的话，会导致钢性不足，因外部负荷导致预压损失而产生震动。在小型马达等有要求长时间耐久性的情况，建议的Cr约0.5%左右，机器零组件等有要求刚性的一般用途上，建议的Cr约1%左右。但除预压外，也须考量到外部荷重，物品本身重量等来决定。

预压方向如**图10.3**所示有背向组合(DB)以及**图10.4**的面向组合(DF)。背向组合因力矩负荷的作用而刚性高。但外壳的精度差且组装上有错位的话，内部荷重容易增大。面向组合对于力矩负荷的刚性相对较低，但外壳的精度以及轴心的偏离等受到的组装上的错位影响较小。

图10.3 背向组合(DB)的范例
Fig 10.3 Back-to-back matching (DB)

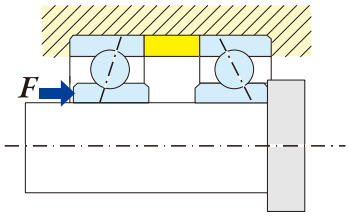
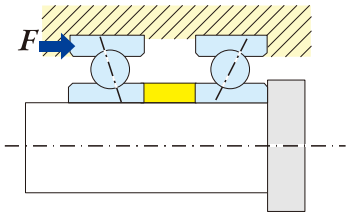


图10.4 面向组合(DF)的范例
Fig 10.4 Face-to-face matching (DF)



10.3 Pre-Loading Methods

Position pre-load and constant-pressure pre-load are available for pre-loading methods.

Constant-pressure preload

Constant pressure preload is achieved using a coil or leaf spring to impose a constant preload (refer to **Fig.10.1**).
Even if the relative position of the bearings changes during operation, the magnitude of the preload remains relatively constant. For example, this methods is effective for dimensional defect due to the temperature change. On the other hand, this method requires the additional parts and space for spring element. Rigidity is lower compared with the position preload.

Position Preload

A position preload is achieved by fixing two axially opposed bearing in a position to impose a preload and their relative position remains unchanged while in operation (refer to **Fig. 10.2**). For example, bearings are fixed in the certain displacement positions set by the spacer dimension or bearing width. This method offers higher rigidity. On the other hand, preload amount varies depending on the dimensional defect due to the temperature change.

10.4 Preload Amount and Direction

Since preload amount is a decisive factor for elastic contact status of rolling elements and raceway, excessive preloading leads the bearing to abnormal heat generation, increase of friction moment and decrease of fatigue life. On the contrary, insufficient preload causes rigidity loss, preload loss due to the outer load and vibration. ISC, from past experiences, recommends preload of 0.5% of Cr for the application of small motor which requires long lasting durability. Preload of 1.0% of Cr is recommended for the application for mechanical parts which requires higher rigidity. Other factors such as outer load and self weight are also important to decide the preload amount.

Preload direction has two types, back-to-back matching (**Fig. 10.3**) and face-to-face matching (**Fig. 10.4**). Back-to-back matching DB holds higher rigidity when moment load is in effect. However, in the case of misalignment due to poor accuracy of the housing, it tends to carry higher internal load. Face-to-face matching DF has relatively lower rigidity against moment load. However the effect of misalignment, due to the housing accuracy and shaft deflection, is relatively low for this type.

11. 材料　Bearing materials

轴承的套圈及滚动体是同时反覆受压力以及伴随滑动的接触。因此轴承套圈及滚动体的材料，主要要求有以下的特性。

- 滚动接触疲劳强度高
- 硬度高
- 耐磨损高
- 尺寸稳定性高
- 机械强度高
- 容易加工
- 依据用途还有耐热以及抗腐蚀

套圈以及滚动体使用高碳铬轴承钢(SUJ2)或是马氏体不锈钢(SUS440C)这些化学成分于**表11**。

高碳铬轴承钢因有足够的硬度，疲劳寿命长，以及在噪音及摩擦力矩的两面上发挥出良好的性能。不锈钢有耐腐蚀，不会因高温而硬度下降，所以用于会生锈的地方或是使用在高温条件上。

ISC在高碳铬轴承钢上进行真空除气处理，而不锈钢是使用电渣重溶制法，使用含氧量少纯净度高的材料，更改良制造技术，使轴承寿命大幅提升。

另也有生产提高音响特性的不锈钢轴承，详细请洽询**ISC**。

The bearing rings and rolling elements of rolling bearings are repeatedly subjected to high pressure with a small amount of sliding. The materials used for the rings and rolling elements must therefore have the following characteristics:

- High rolling contact fatigue strength
- High hardness
- High wear resistance
- High dimensional stability
- High mechanical strength

Other characteristics, such as ease of production, shock and heat resistance, and corrosion resistance, are required depending on individual applications.

The material used for the rings and balls in miniature ball bearings is either bearing steel or martensitic stainless steel. The chemical composition of each is shown in **Table 11**. Bearing steel provides a longer fatigue life because of its high hardness, and it is also superior with respect to running noise and torque. Stainless steel has good corrosion resistance and its hardness does not decrease at high temperature. Therefore, it is used in applications where corrosive elements exist or where operating temperatures are unusually high.

ISC uses vacuum degassed bearing steel designated by Japanese Industrial Standard (JIS) as SUJ2 (equivalent to ASTM A295 52100). Its stainless steel is JIS SUS440C (equivalent to SAE J405 51440C) produced by using the Electro Slag Remelting Method (ESR).

ISC selects bearing steels containing a minimum of oxygen, hydrogen, nitrogen, and hydrogen-compound impurities. The rolling fatigue life of bearings has been remarkably improved using these materials combined with the appropriate heat treatment.

Regarding stainless steel bearings with reduced noise, please consult ISC.

表11 高碳铬轴承钢及不锈钢的化学成分（主要成分）
Table 11 Chemical composition of high-carbon chromium bearing steel and stainless steel

型号 Standard	代號 Symbol	化学成分（%） Chemical composition (%)						
		C	Si	Mn	P	S	Cr	Mo
JIS 4805	SUJ 2	0.95～1.10	0.15～0.35	0.5 以下 max 0.5	0.025 以下 max 0.025	0.025 以下 max 0.025	1.30～1.60	0.08 以下 max 0.08
JIS 4303	SUS 440C	0.95～1.20	1.00 以下 max 1.00	1.00 以下 max 1.00	0.040 以下 max 0.040	0.030 以下 max 0.030	16.00～18.00	0.75 以下 max 0.75

12. 选择轴承 Choosing the bearing type

于选择轴承时，需先确定机器的用途，构造，尺寸，使用条件，要求的性能以及耐久性。

其次是确认使用轴承的空间以及尺寸来暂定轴承的形式。接着对于机器的寿命来比较轴承的耐久性，并选择可满足其寿命的轴承形式。

轴承的耐久性常容易仅考量疲劳寿命，也必须以各种角度来考量由润滑脂劣化所造成的烧结，磨耗以及噪声上升等。

且须根据用途来考量回转精度，轴承内部游隙，保持架形式，防尘盖形式，润滑脂种类等轴承内部样式。

一般轴承选型的顺序如下。须参考过去的实际经验，机器所要求最重要的性能，来选择是否可以满足这些要求的轴承形式与样式。

如适用于新设计的机器或是使用在特别环境及条件的话，请与ISC联系选择轴承。

For the right bearing selection, the following requirement needs to be clearly identified first: applications, mechanism, dimensions, term of use, features, and durability.
Then, the bearing type shall be determined based on the allowable space & dimensions.
As for durability, the fatigue life is normally taken into consideration but other various conditions also need to be considered from different points of view such as premature failure due to grease deterioration, wear, and noise.

Depending on the application, special considerations for bearing internal specifications may be required such as running accuracy, bearing internal clearance, cage types, seal/shield type, and grease type.
The general flow of bearing selection is shown below. In actual practices, bearing specifications & types are selected with the consideration of past results and most important mechanism for the application.
If you look for bearings to be used in newly designed devices or special environment/terms of use, it is recommended to consult ISC.

用途，使用条件，所要求的寿命及性能
Term of use, condition, durability & mechanism

↓

选择轴承形式·轴承尺寸
Bearing type/dimensions

↓

轴承经度等级，公差
Bearing accuracy class, tolerance

↓

选择性能
Functions

↓

选择润滑脂
Lubrications

↓

损伤案例及对策
Problem case & countermeasure

↓

使用方法
Handling

- 用途，允许使用轴承的空间
- 使用条件(荷重，温度，转速)
- 要求性能
- 市场性，经济效益

・Applications, allowable space
・Term of use (load, temp, running speed)
・Functional requirement
・Marketabilty, Economical

- 动定荷重及寿命 第24页
- 静定荷重 第25页
- 保持架 第11页
- 防尘盖 第10页
- 轴承材料 第28页

・Dynamic load & durability pg.24
・Static load pg.25
・Cage pg.11
・Seal/shield pg.10
・Raw material pg.28

- 尺寸精度，回转精度 第12页
- 过盈配合和游隙 第18页

・Dimensional accuracy, Running accuracy pg.12
・Fits and internal clearances pg.18

- 内部游隙 第21 页
- 预压 第26 页
- 容许转速 第26 页
- 轴心和外壳设计

・Internal clearance pg.21
・Preload pg.26
・Allowable speed pg.26
・Design of shaft & sleeve

- 润滑脂和油的种类 第22 页
- 润滑脂量和封入型态

・Grease/Oil type pg.22
・Grease amount, filling form

- 表13.1

・Table 13.1

- 安装及拆卸顺序 第34 页
- 治具
- 安装相关尺寸

・Procedure for mounting / dismounting pg.34
・Tooling
・Fitting size/dimension

表12 条件表

于决定轴承形式及样式时参考。

Table 12 Condition table

Use this as reference when deciding the bearing type and specifications.

项目 Item	细节 Details			
用途 Use				
尺寸 Size	轴心 Shaft	轴径 Shaft diameter	ϕ ϕ	mm mm	材质 Material
	外壳 Housing	内径 Bore diameter	ϕ ϕ	mm mm	材质 Material
	轴 Distance between shafts			mm mm	
使用条件 Operating conditions	荷重 Load	径向荷重 Radial load		N N	
		轴向负重 Axial load		N N	
	温度 Temperature	环境温度 Ambient temperature		℃ ℃	
	转速 Revolutions			min^{-1} (rpm) min^{-1} (rpm)	
		□内环转动 □Rotating inner ring		□外环转动 □Rotating outer ring	
性能·寿命要求 Required function, life span	耐久性 Durability	时间 hours			
	重要性能 Especially important function	□静音性 □Quietness	□低扭矩 □Low torque	□抗腐蚀，抗化学药品 □Corrosion and chemical resistance	
		□食品安全性 □Food safety	□耐冲击 □Impact resistance	□非磁性 □Non-magnetic	
预压 Preload					
	□内圈预压 □Inner ring preload	□外圈预压 □Outer ring preload			
规范物质 Controlled substance					
特别使用环境 Notable operating environment	使用环境及荷重条件等 Atmosphere, Loading condition etc	□冲击 □Impact		□高湿度，低湿度 □High humidity, Low humidity	
		□扭矩，组装错位 □Moment, Misalignment		□震动 □Vibration	
		□真空 □Vacuum		□水中，液体中 □Underwater, In liquid	
		□粉尘环境 □Dust environment		□其他 □Other	

MEMO

13. 轴承损伤案例及其对策 Examples of bearing damage and countermeasure

组装轴承的机器异常，或轴承损伤破损的情况，可其从症状和状态来探究原因。

处置异常可让轴承发挥并维持其性能。

且先将异常处置对策纳入轴承样式中，便可以预防异常发生。

以下为代表异常案例以及对策。

Causes of abnormal performance of product/device or damages of ball bearings can be identified by the observation of failure modes or conditions.
After taking the countermeasure on abnormality, ball bearing performs in the best condition constantly.
In addition, abnormal conditions/failures can be prevented by implementation of corrective actions.
Examples of failures and countermeasure are listed as follows.

表13 异常的症状及状态 Table 13 Symptoms or conditions of abnormality

症状·状态 Symptoms or conditions		主要推断原因 Main possible reason	对策 Example of corrective action
转速异常 Rotation	不转动 或是 转动阻力大 No rotation or high friction	润滑脂的影响(量及种类) Lubrication (grease): amount/type	重新选则润滑脂 Review the grease configuration
		与周围零件的接触 Interference with peripheral parts	重新设计，重新组装 Review the design/assembly method
		停止润滑(产生磨耗粉) Insufficient lubrication (generate abrasion powder)	重新选择润滑脂，增加润滑脂量 Review the grease configuration, increase the grease amount
		因金属疲劳而剥离 Flaking (due to metal fatigue)	确认荷重条件，回转条件 Check the condition of load & rotation 选择负荷能力高的轴承 Select bearings that is capable to withstand high load
噪声 Noise	规则的声音 Regulatory noise	组合零件共振 Resonance of components	重选组合零件的尺寸(厚度)及材料 Review dimensions (thickness) & material of components
		轨道面上布氏压痕 Brinell impression on the raceway	重新检视使用的轴承，组装作业 Review the handling of bearings, assembly methods 重新检视组装后机器移动的方式(有无加重冲击荷重) Review the process flow after bearing is installed (eg. Is the static load given?)
		轨道面因异物产生伤痕 Scar on the raceway due to foreign substances	重新检视安装轴承的周围环境，增加防尘性能 Review the environment condition where bearings are installed. Add dust-proof mechanism
	不规则的声音 Irregular noise	预压不足 Insufficient preload	从荷重及转速等条件来重新检视预压量 Review the preload amount based on the condition of load & rotation
		混入异物而卡住 Stuck foreign substances	重新检视安装轴承的周围环境，增加防尘性能 Review the environment condition where bearings are installed. Add dust-proof mechanism
		钢球产生伤痕 Scars on the ball	重新检视组装作业以及使用环境 (是否有异物入侵，有无加重过大的荷重) Review the assembly process and surrounding environment (eg. entrance of any foreign substance?, excess load is given?)
震动大 Vibration		内部游隙过大 Excessive ball clearance	减小内部游隙 Make the ball clearance smaller
		非适当预压 Not suitable preload amount	从荷重及转速等条件来重新检视预压量 Review the preload amount based on the condition of load & rotation
		组装错位 Misalignment	重新检视组合零件的尺寸公差及组装作业 Dimensional tolerances of components (fitting); review the assembly flow
		轨道面变形 Deformation of raceway	重新检视轴心或是外壳的加工精度 重新检视接着剂及接著作业，有压入的情况的话重新检视过盈公差 Review machining accuracy of shaft or sleeve (roundness), adhesive process, fitting tolerance (for press-fit)
温度上升 Rising temperature		润滑脂种类以及量不适当 Inappropriate grease type & amount	重新选择润滑脂 Review the grease configuration
		过大荷重 Overload	选择负荷能力高的轴承或是重新检视过盈 Select bearing that can be withstand the high load; review the fitting condition
漏油 Grease leakage		润滑脂种类以及量不适当 Inappropriate grease type & amount	重新选择润滑脂 Review the grease configuration

14. 行走痕迹 Running trace

轴承在运转时，内外圈的轨道面上会有与转动体接触的行走痕迹，但并非异常。可藉由行走痕迹来知道负荷条件，因此卸除轴承时须十分细心。

仔细观察行走痕迹可以推测出轴承本身承受何种荷重。

从观察行走痕迹来看是否轴承有受到预想之外的荷重或是安装的误差是否有无过大等，是追溯轴承损伤的原因。**表14**为深沟球轴承根据负荷条件等所产生的行走痕迹。

(a) 为内圈回转时只受轴向荷重的一般行走痕迹。

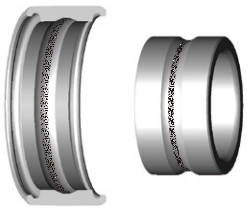
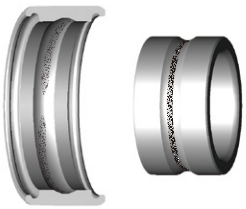
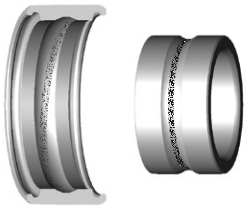
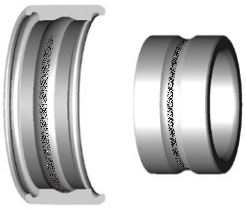
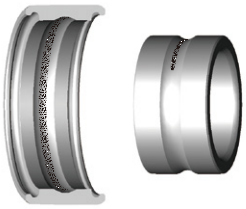
(e) ～ (h) 所示的行走痕迹为给轴承不良影响所造成寿命减少的例子。

When rolling bearing operates, raceways of inner & outer rings discolorates due to repeated cycle stress of rolling elements. However, it is normal.
The load condition can be estimated by observing the running traces. Therefore, if the bearing needs to be unmounted, it shall be unmounted with extra care.

By observation of running traces, it is possible to check if the excess load was given or the fit was loosen.
Therefore, it will be the clue to find causes of bearing damage. As for deep groove ball bearings, example of running traces generated due to excess load are illustrated in **Table 14**.

(a) Example of general running traces when the shaft rotates and axial load is applied to the bearing.
(e)～(h) These running marks can cause of short bearing life in most cases.

表14 Table 14

 a) 内圈回转或是外圈回转 单方向的轴向荷重 a) Inner Ring Rotation or Outer Ring Rotation One Direction Axial Load	b) 内圈回转 径向荷重 b) Inner Ring Rotation Radial Load	c) 内圈回转 径向荷重及 轴向荷重 c) Inner Ring Rotation Radial Load and Axial Load	 d) 内圈回转 力矩荷重(组装错位) d) Inner Ring Rotation Moment Load (misalignment)
 e) 内圈回转 轴向荷重击 组装错位 e) Inner Ring Rotation Axial Load and Misalignment	 f) 内圈回转 轴承内部无游隙 (运转游隙为负值) f) Inner Ring Rotation No Clearance in bearing inside (minus of operation clearance)	g) 内圈回转 外壳为椭圆形 g) Inner Ring Rotation Ellipse Housing	 h) 外圈回转 径向荷重 h) Outer Ring Rotation Radial Load

15. 轴承使用说明 Handling of ball bearing

15.1 使用上的注意点

轴承为精密的机器零件，在使用上须十分注意。
为发挥轴承本身的性能，在使用上须注意以下几点。

(1) 轴承以及其周围零组件须保持清洁(为防止灰尘等异物进入)
(2) 须小心使用轴承(避免给予强烈的冲击)
(3) 组装或卸除轴承时须使用是当的治具和工具(使用不适当的工具会给予轴承损伤)
(4) 须避免脏污等附着在轴承上(使用手套等来避免脏污或是手汗附着)须注意腐蚀性气体(可能因脏污或是手汗接触导致生锈)

15.1 Precautions for proper handling

Since rolling bearings are high precision machine parts, proper handling with precautions is required.
To achieve their expected performance, ball bearings must be handled accordingly.

(1) Keep bearings and surrounding area clean (prevent the entry of dust and dirt)
(2) Careful handling (Avoid heavy shocks)
(3) Use the proper equipment/tools when bearing is mounted/unmounted (general tools may damage bearings)
(4) Pay attention to prevent from dust/dirt (Prevent from perspiration on the hands and various contaminants by wearing gloves or finger cots)
Pay attention to corrosive gasses (Since perspiration on the hands and various other contaminants may cause corrosion)

15.2 轴承的组装

组装轴承的作业会影响轴承的精度等级，寿命及性能，因此组装时须将下列的内容纳入作业流程。

(1) 清洗及去除组装轴承的零件及周边组装零件上的油脂
(2) 确认相关零件的尺寸以及其状态
(3) 组装方法(勿给予冲击及过度用力组装)
依使用条件有所不同，但深沟球轴承的容许倾斜在一般在0.0006～0.003rad(2′～10′)和内外圈的过盈请参照第6页
(4) 组装轴承后的确认(轴承安定的回转并没有松动)

轴承的组装方法一般是轴心回转的情况较多，内圈和轴心是过盈配合，而外圈和外壳的装配是间隙配合。

15.2 Mounting

The method of mounting rolling bearings strongly affects their accuracy, life, and performance, so please follow the standard procedure with respect to the following items.

(1) Cleaning/removing the excess oil of the bearings and related parts
(2) Checking the dimensions and finish of related parts
(3) Mounting procedure (Make sure to be free from overload and heavy shocks when they are mounted)
The acceptable tilt of deep groove ball bearings is generally 0.0006 to 0.003rad (2′ to 10′), depending on the conditions of use.
Refer pg. 6 for the fit between inner/outer ring
(4) Inspection after mounting (ensure the smooth running & no wobbling)

As bearings are usually used on rotating shafts, the inner rings require a tight fit and outer rings to sleeve requires loose-fit.

15.3 运转检查

组装轴承后，为确认是否正常组装，须执行运转检查(回转检查)检查方法如**表15.1**。

在检查时有发现异常现象，需立即停止运转，检查轴承以及轴承周围。

其原因以及对策请参照**表15.2**。

15.3 Operation Inspection

After the mounting has been completed, operation inspection (running test) should be conducted to determine if the bearing has been mounted correctly.
Procedure of operation inspection is as stated in **Table 15.1**.
If any abnormality is found during the test operation, it must be stopped immediately and bearing and surrounding area should be inspected.
As for causes & countermeasures, refer to the **Table 15.2**.

表15.1 检查运转(回转检查)方法
Table 15.1 Operating inspection method (rotation check)

运转方法 Operation procedure	检查项目 Inspecting item
手动运转 手动来让轴心回转。 回转的部分无异常的话便改成用动力运转。 Manual operation Turn the shaft by hand. If there is no abnormality, powered operation may be started.	● 症结点(异物、伤痕、压痕所致) ● 回转扭矩不均(因组装不良所致) ● 力矩过大(因游隙过小或组装误差导致) ・Sticking (due to contaminants, scar, brinelling) ・Wobbling (due to mounting problem) ・Excess high friction (due to extremely tight clearance, mounting accuracy)
动力运转 先无负荷及低速开始转动,慢慢的上升至指定条件,并确认回转的状态。无异常的话以定格运转的条件下,确认其状态。 Powered operation Start slowly with no road and gradually increase the speed, load, etc to the normal levels and the operation should be observed. Then if there is no abnormality, continue to run the rated operation and observe the conditions.	确认有无异常声音 装置的温度(轴承的温度)的变化 确认有无震动 润滑脂漏油及变色 Check if there is abnormal noise Trend of Machine temp (Bearing temp) Check the vibration Leakage of lubricant, discoloration

表15.2 异常的运转状态及其原因对策
Table 15.2 Causes of and Countermeasures for Operating Irregularities

运转状态 Irregularities	推测原因 Possible causes	对策 Countermeasures
异常温度上升 Abnormal temperature rise	润滑脂过多 Excess amount of lubricant	减少润滑脂达适量化 Reduce amount of lubricant
	润滑脂不足不适量 Insufficient or improper lubricant	选择适当的润滑脂及润滑量 Correct the amount of lubricant, select another lubricant
	异常荷重 Abnormal load	修正过盈配合,检视轴承游隙,调整预压等 Improve the fit, internal clearance, preload, etc.
	组装不良 Incorrect mounting	改善轴心,外壳加工精度,改善组装经度,改善组装方法 Improve the machining accuracy and alignment of shaft and sleeve, accuracy of mounting method
	过盈面潜变 Creep on fitted surface	检视过盈精度,修正轴心及外壳 Review the fitting accuracy, correct the shaft and housing
震动大 Vibration	布氏压痕 Brinelling	更换轴承,注意轴承的使用 Replace the bearing and use care when handling bearings
轴心偏转 Shaft runout	剥离 Flaking	更换轴承 Replace the bearing
	组装不良 Incorrect mounting	修正轴心,外壳的轴承组装位置的直角度,圆度,圆柱度,同轴度及空间的直角度及平行度 Correct the perpendicularity, roundness, cylindricity, concentricity of shaft & housing, perpendicularity & parallelism of spacer
	异物入侵 Penetration of foreign particles	更换轴承,清洗各零件,改善密封装置等 Replace or clean the bearing, improve the seals
润滑脂漏油多 Leakage of lubricant	润滑脂过多,异物入侵 产生摩擦粉,入侵等 Too much lubricant penetration by foreign matter or abrasion chips	选定适当的润滑脂,检视更换轴承 Correct the amount of lubricant, replace the bearing

15.4 轴承的说明 Handling of ball bearing

图15.1 轴承安装时施加推力的方法
Fig 15.1 How to push in ball bearings

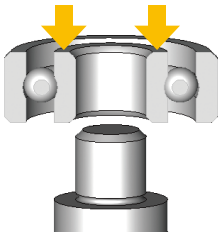
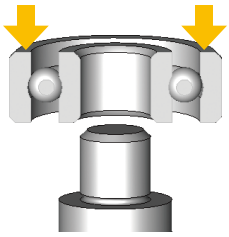
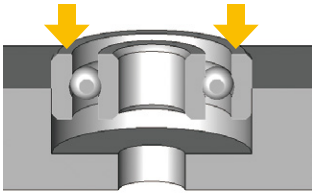
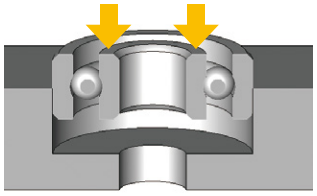
安装在轴上的例子 Example for assembling to shaft		安装在外壳上的示例 Example for assembling to housing	
正 Right	误 Wrong	正 Right	误 Wrong
			
在内圈上施加力。 Press to inner ring	在外圈上施加力。 Press to outer ring	在外圈上施加力。 Press to outer ring	在内圈上施加力。 Press to inner ring

图15.2 轴承使用时的注意事项
Fig 15.2 Point to be noted when handling of ball bearings

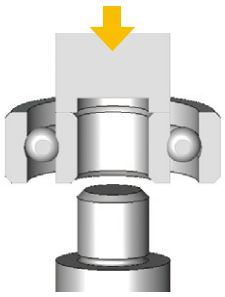
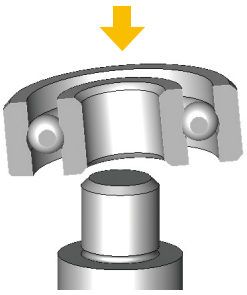
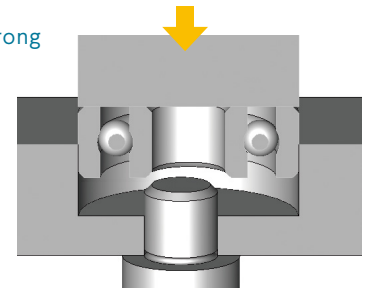
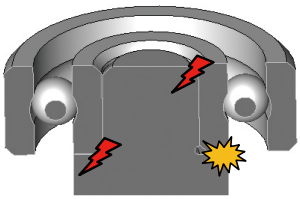
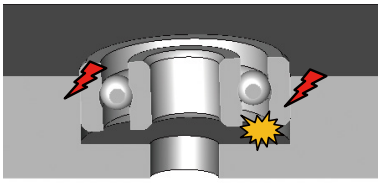
正 Right	误 Wrong	误 Wrong
		
轴与轴承平行，通过背板 轻轻的施加推力。 Place ball bearing and shaft in parallel, push in slowly with flat plate.	不要倾斜推进轴承。 Do not push in ball bearing with slanted position.	轴承与外壳同时安装时， 轴与外壳的中心对齐。 Align the center of shaft and Housing, when assembling Ball Bearing and Housing at the same time.

图15.1 异物、划痕引起的安装故障
Fig 15.3 Assembly error by contamination, scar





垃圾，金属粉末 等
particle, metal powder etc.

划痕、咬合
Scar, Stuck

如果轴及外壳存在异物、划痕，可能会导致轴承因咬合不良而倾斜
因此要除去安装表面的毛刺划痕并进行清洁。

Cleaning fixing surface and removing burrs and scar are required, ball bearing may slant or stuck if there are contamination or scar on shaft or housing.

16. 组合件产品 Unit Assembly

由微型滚珠轴承和精密加工零件组合而成的产品
Sub-assemblies of miniature ball bearings and precise components

- 所有产品都配备了内部制造的高精度滚珠轴承。
- 通过选择最佳轴承来最大限度地提高性能的结构设计。
- 实现高精度组装。
- 充分发挥在轴承制造中积累的优势，实现了高品质与低成本的并存。
- 除了原创产品以外，我们还可以根据您的需求提供轴承的周边产品。

・Both products are equipped with our own high-precision ball bearings.
・The design is for maximizing performance by selecting the optimal bearing.
・High-precision assembly is realized.
・Taking advantage of the strengths cultivated in bearing manufacturing, we have achieved both high quality and low cost.
・Besides our original products, we will give shape to your various requests related to the bearings.

减速器
Traction Drive

- 搭载微型滚珠轴承的小型轻量减速机。
- 搭载公司制造的微型滚珠轴承，能量损失低，即使在高速旋转时也能实现低噪音、低振动。
- 适用于不喜振动和噪音的设备以及小型机器人等。

・Equipped with miniature ball bearings, it is a small and lightweight reducer.
・Equipped with our own miniature ball bearing, energy loss is small and low noise and vibration are achieved even at high speeds.
・It can be used for equipment that dislikes vibration and noise and small robots, etc.

直线运动产品
Liner Motion Products

- 使用轴承的直线运动产品。
- 采用预压结构，滑块和滑轨之间的不良噪音为零。
- 由于轴承在轨道上滚动，因此静音性极佳。

・Use high precision ball bearings
・Achieves smooth, looseness-free motion by preloading
・Excellent quietness by the ball bearings are running on rail

微型支撑座组合件产品
Compact Support Unit

- 搭载公司制微型推力轴承。
- 业界首创，支持3-8mm微型球螺杆用支撑座组合件。
- 轻量，小型，为设备的小型化做出贡献。

・Use our own miniature thrust angular contact ball bearing
・Deliver industry's First 3~8mm miniature ball supported by screws
・Light wright & compact size contribute the down sizing

凸轮从动件导承
Miniature Guide Follower

- 采用预压结构，滚轮的不良噪音为零。
- 由于使用滚珠轴承，摩擦小。
- 适用于小型输送设备等。

・Looseness-free motion by preloading
・Low friction with ball bearings
・For Small Carrier devices

树脂缠绕轴承
Plastic Roller Bearing

- 采用JIS规格69系列轴承标准。
- 树脂使用的是聚缩醛树脂。
- 外径采用切割加工实现了高精度。
- 防潜变规格轴承，在轴承的内圈装有防潜变轮，使内圈内径与轴心间的耐潜变性能提升。

・JIS69 series bearing as standard
・Polyacetal resin
・Outer diameter of plastic resin is cutting finished and gives high precision
・Creep-free bearing: Creep-free ring is installed on inner ring to prevent from the occurrence of creep between inner ring and shaft

聚氨酯橡胶缠绕轴承
Urethane Bearing

- 橡胶通过烘烤直接粘合到轴承的外径上。
- 外径通过抛光处理实现高精度。
- 橡胶使用的是聚醚聚氨酯橡胶。(橡胶硬度HS90°±3°)
- 适用于需要低振动和低噪音的部件。

・Urethan Rubber is directly heat-sealed on bearing outside surface
・Grinding finished outer diameter gives high precision
・Polyether rubber (rubber hardness; HS90°±3°)
・Low vibration, Low noise

带轴轴承组合产品
Bearing with Shaft

- 可供应易安装于设备上的形状。
- 对压入后的轴承间隙进行设定，管理过盈量。
- 通过对各部分零件的管理，轴和轴承的拉拔力是恒定的。

・Delivers the products with ready-made from for quick mounting
・Controls interference by adjusting a clearance of press-fit bearing
・Stable Push-Out-Force between bearing & shaft by an adjustment of interference

16. 组合件产品 Unit Assembly

轴承尺寸表 Bearing Tables

深沟球轴承 Deep groove ball bearings

单列深沟求轴承 Single-row deep groove ball bearings

米制系列 单列深沟求轴承 Metric series 内径1～4mm Bore diameter 1～4mm ····· 40～41

内径5～9mm Bore diameter 5～9mm ····· 42～43

英制系列 单列深沟求轴承 Inch series 内径1.016～9.525mm Bore diameter 1.016～9.525mm ··· 44～45

带挡边外圈深沟球轴承 Deep groove ball bearings with flanged outer ring

米制系列 带挡边外圈深沟球轴承 Metric series 内径1～4mm Bore diameter 1～4mm ····· 46～47

内径5～9mm Bore diameter 5～9mm ····· 48～49

英制系列 带挡边外圈深沟球轴承 Inch series 内径1.191～9.525mm Bore diameter 1.191～9.525mm ··· 50～51

英制系列 宽内圈深沟球轴承 Deep groove ball bearings with extended inner ring Inch series

内径1.016～9.525mm Bore diameter 1.016～9.525mm ····· 52～53

英制系列 带挡边内圈宽幅形深沟球轴承 Deep groove ball bearings with extended inner ring, flanged Inch series

内径1.191～7.938mm Bore diameter 1.191～7.938mm ····· 54～55

米制系列 薄壁形深沟球轴承（SMT型） Extra-thin-section deep groove ball bearings Metric series

内径10～15mm Bore diameter 10～15mm ····· 56

枢轴用滚珠轴承 Pivot ball bearings

枢轴用滚珠轴承（BCF型） Pivot ball bearings BCF

内径 0.81～8.12mm Bore diameter 0.81～8.12mm ····· 56

推力球轴承 Thrust ball bearings

推力球轴承（F型） Thrust ball bearings F

内径 2～10mm Bore diameter 2～10mm ····· 57

带沟槽推力球轴承（F-M型） Thrust ball bearings with groove F-M

内径 3.2～10.2mm Bore diameter 3.2～10.2mm ····· 57

向心推力轴承（CROXY） Angular Contact Ball Bearings (CROXY)

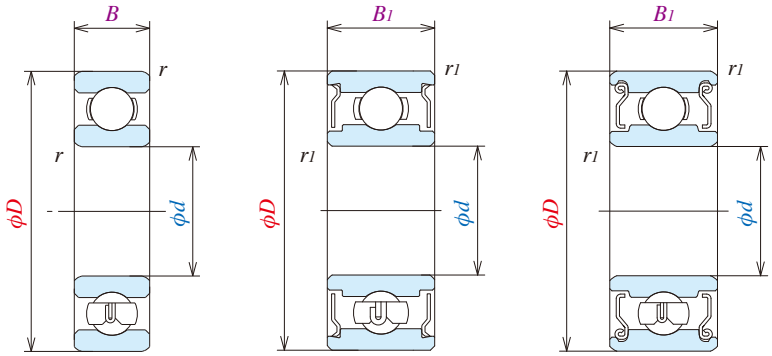
微型向心推力球轴承 Miniature Thrust Angular Contact Ball Bearings

内径 2～8mm Bore diameter 2～8mm ····· 58

米制系列 单列深沟求轴承 Single-row deep groove ball bearings (Metric series)

6○○形式、MR形式
6○○, MR

内径 1～4mm
Bore diameter 1～4mm



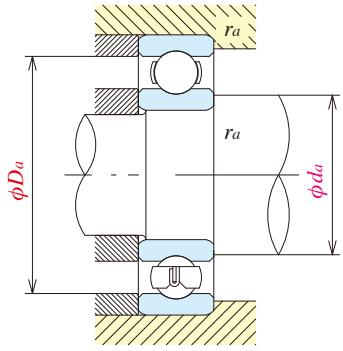
开放型
Open type

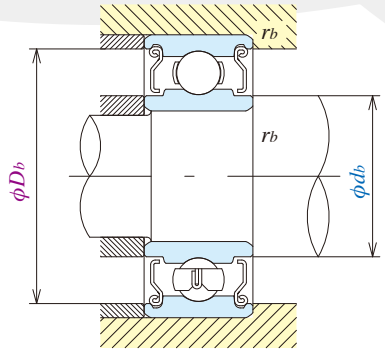
防尘盖型
Shielded type
ZZ

防尘盖型
Shielded type
ZZ1

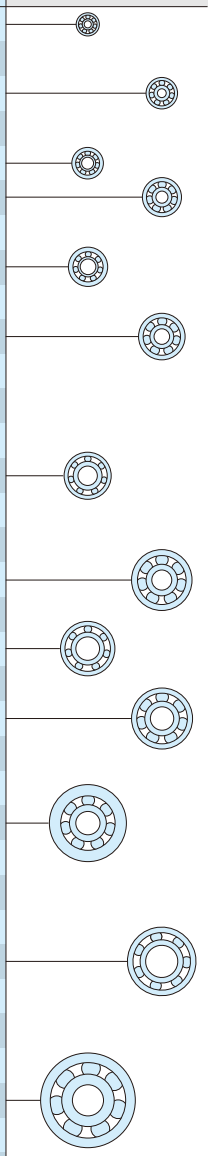
轴承型号 Bearing numbers				外形尺寸 (mm) Boundary dimensions						基本额定载荷 Basic load ratings			
开放型 Open	防尘盖型 Shielded	密封圈型 Sealed		*d*	*D*	*B*	*B1*	*r* (*1) 最小 min	*r1* (*1) 最小 min	(N) *Cr*	(N) *Cor*	{kgf} *Cr*	{kgf} *Cor*
681	**—**	**—**	**—**	**1**	3	1	—	0.05	—	80	23	8	2.5
MR31	**—**	**—**	**—**		3	1.5	—	0.05	—	80	23	8	2.5
691	**—**	**—**	**—**		4	1.6	—	0.1	—	138	35	14	3.5
MR41X	**MR41XZZ**	**—**	**—**	**1.2**	4	1.8	2.5	0.1	0.1	138	35	14	3.5
681X	**681XZZ**	**—**	**—**	**1.5**	4	1.2	2	0.05	0.05	112	33	11	3.5
691X	**691XZZ**	**—**	**—**		5	2	2.6	0.15	0.15	237	69	24	7
601X	**601XZZ**	**—**	**—**		6	2.5	3	0.15	0.15	330	98	34	10
682	**682ZZ**	**—**	**—**	**2**	5	1.5	2.3	0.08	0.08	169	50	17	5
MR52B	**MR52BZZ**	**—**	**—**		5	2	2.5	0.1	0.1	187	58	19	6
692	**692ZZ**	**—**	**—**		6	2.3	3	0.15	0.15	330	98	34	10
MR62	**MR62ZZ**	**—**	**—**		6	2.5	2.5	0.15	0.15	330	98	34	10
MR72	**MR72ZZ**	**—**	**—**		7	2.5	3	0.15	0.15	385	127	39	13
602	**602ZZ**	**—**	**—**		7	2.8	3.5	0.15	0.15	385	127	39	13
682X	**682XZZ**	**—**	**—**	**2.5**	6	1.8	2.6	0.08	0.08	208	74	21	7.5
692X	**692XZZ**	**—**	**—**		7	2.5	3.5	0.15	0.15	385	127	39	13
MR82X	**—**	**—**	**—**		8	2.5	—	0.2	—	560	179	57	18
602X	**602XZZ**	**—**	**—**		8	2.8	4	0.15	0.15	550	175	56	18
MR63	**MR63ZZ**	**—**	**—**	**3**	6	2	2.5	0.1	0.1	208	74	21	7.5
683A	**683AZZ**	**—**	**—**		7	2	3	0.1	0.1	390	130	40	13
MR83	**—**	**—**	**—**		8	2.5	—	0.15	—	560	179	57	18
693	**693ZZ**	**—**	**—**		8	3	4	0.15	0.15	560	179	57	18
MR93	**MR93ZZ**	**—**	**—**		9	2.5	4	0.2	0.15	570	187	58	19
603	**603ZZ**	**—**	**—**		9	3	5	0.15	0.15	570	187	58	19
623	**623ZZ**	**—**	**—**		10	4	4	0.15	0.15	630	218	64	22
633	**633ZZ1**	**—**	**—**		13	5	5	0.2	0.2	1300	485	133	49
MR74	**—**	**—**	**—**	**4**	7	2	—	0.1	—	310	115	32	12
—	**MR74ZZ**	**—**	**—**		7	—	2.5	—	0.1	255	107	26	11
MR84	**MR84ZZ**	**—**	**—**		8	2	3	0.15	0.1	395	139	40	14
684A	**684AZZ1**	**—**	**—**		9	2.5	4	(0.15)*1	(0.15)*1	640	225	65	23
MR104B	**MR104BZZ**	**—**	**—**		10	3	4	0.2	0.15	710	270	73	28
694	**694ZZ**	**—**	**—**		11	4	4	0.15	0.15	960	345	98	35
604	**604ZZ**	**—**	**—**		12	4	4	0.2	0.2	960	345	98	35
624	**624ZZ1**	**—**	**—**		13	5	5	0.2	0.2	1300	485	133	49
634	**634ZZ1**	**—**	**—**		16	5	5	0.3	0.3	1730	670	177	68

注 Notes
※ 不锈钢产品的基本额定动载荷乘以 0.85作为基本标准。The rough standard of basic dynamic load rating for stainless products would be 15% less than the value appeared in the list.
*1 (　　)内的值非 JIS B 1521标准。The values in parentheses are not based on ISO 15
*2 表示为内径,外径的实际尺寸。Actual dimensions of bore and outside diameter only.





极限转速 (min⁻¹) Limiting speeds (rpm) 脂润滑 Grease 开放性 Open Z・ZZ	油润滑 Oil 开放性 Open Z	安装尺寸 (mm) Abutment and fillet dimensions d_a 最小 min	d_b 最大 max	D_a 最大 max	D_b 最小 min	r_a 最大 max	r_b 最大 max	重量 (g) Mass (参考) (approx) 开放型 Open	防尘盖型 Shielded	轴承型号 Bearing numbers 开放型 Open	实际尺寸图 (*2) Actual size
130,000	150,000	1.4	—	2.6	—	0.05	—	0.03	—	**681**	
130,000	150,000	1.4	—	2.6	—	0.05	—	0.04	—	**MR31**	
100,000	120,000	1.8	—	3.2	—	0.10	—	0.09	—	**691**	
110,000	130,000	2.0	1.9	3.2	3.5	0.10	0.10	0.10	0.14	**MR41X**	
100,000	120,000	1.9	2.1	3.6	3.6	0.05	0.05	0.07	0.11	**681X**	
85,000	100,000	2.7	2.5	3.8	4.3	0.15	0.15	0.17	0.20	**691X**	
75,000	90,000	2.7	3.0	4.8	5.4	0.15	0.15	0.33	0.38	**601X**	
85,000	100,000	2.6	2.7	4.4	4.2	0.08	0.08	0.12	0.17	**682**	
85,000	100,000	2.8	2.7	4.2	4.4	0.10	0.10	0.16	0.23	**MR52B**	
75,000	90,000	3.2	3.0	4.8	5.4	0.15	0.15	0.28	0.38	**692**	
75,000	90,000	3.2	3.0	4.8	5.4	0.15	0.15	0.30	0.29	**MR62**	
63,000	75,000	3.2	3.8	5.8	6.2	0.15	0.15	0.45	0.49	**MR72**	
63,000	75,000	3.2	3.8	5.8	6.2	0.15	0.15	0.51	0.58	**602**	
71,000	80,000	3.1	3.7	5.4	5.4	0.08	0.08	0.23	0.29	**682X**	
63,000	75,000	3.7	3.8	5.8	6.2	0.15	0.15	0.41	0.55	**692X**	
60,000	67,000	4.1	—	6.4	—	0.20	—	0.56	—	**MR82X**	
60,000	71,000	3.7	4.1	6.8	7.0	0.15	0.15	0.63	0.83	**602X**	
71,000	80,000	3.8	3.7	5.2	5.4	0.10	0.10	0.20	0.27	**MR63**	
63,000	75,000	3.8	4.0	6.2	6.4	0.10	0.10	0.32	0.45	**683A**	
60,000	67,000	4.2	—	6.8	—	0.15	—	0.54	—	**MR83**	
60,000	67,000	4.2	4.3	6.8	7.3	0.15	0.15	0.61	0.83	**693**	
56,000	67,000	4.6	4.3	7.4	7.9	0.20	0.15	0.73	1.18	**MR93**	
56,000	67,000	4.2	4.3	7.8	7.9	0.15	0.15	0.87	1.45	**603**	
50,000	60,000	4.2	4.3	8.8	8.0	0.15	0.15	1.65	1.66	**623**	
40,000	48,000	4.6	6.0	11.4	11.3	0.20	0.20	3.38	3.33	**633**	
60,000	67,000	4.8	—	6.2	—	0.10	—	0.22	—	**MR74**	
60,000	71,000	—	4.8	—	6.3	—	0.10	—	0.29	**MR74**	
56,000	67,000	5.2	5.0	6.8	7.4	0.15	0.10	0.36	0.56	**MR84**	
53,000	63,000	4.8	5.2	8.2	8.1	0.10	0.10	0.63	1.01	**684A**	
50,000	60,000	5.6	5.9	8.4	8.8	0.20	0.15	1.04	1.42	**MR104B**	
48,000	56,000	5.2	5.6	9.8	9.9	0.15	0.15	1.70	1.75	**694**	
48,000	56,000	5.6	5.6	10.4	9.9	0.20	0.20	2.25	2.29	**604**	
40,000	48,000	5.6	6.0	11.4	11.3	0.20	0.20	3.03	3.04	**624**	
36,000	43,000	6.0	7.5	14.0	13.8	0.30	0.30	5.24	5.21	**634**	

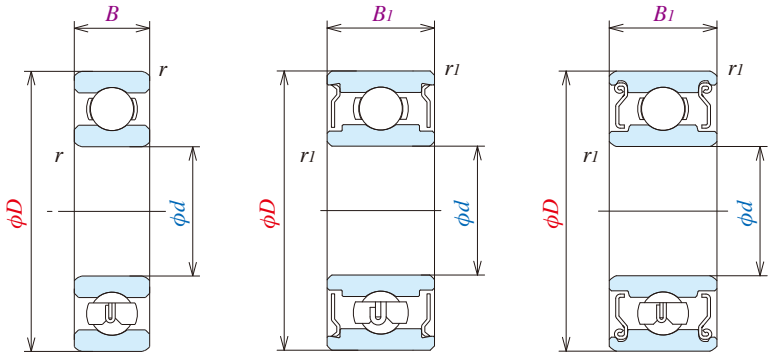


备注 Remarks
1. 防尘盖轴承使用外圈旋转时，请咨询ISC。 When using bearings with a rotating outer ring, please contact ISC if they are shielded.
2. 标记为两侧防尘盖型的轴承，也可生产单侧防尘盖轴承。 Bearings with double shields (ZZ, ZZ1) are also available with single shields (Z, Z1).

米制系列 单列深沟球轴承 Single-row deep groove ball bearings (Metric series)

6○○形式、MR形式
6○○, MR

内径 5～9mm
Bore diameter 5～9mm



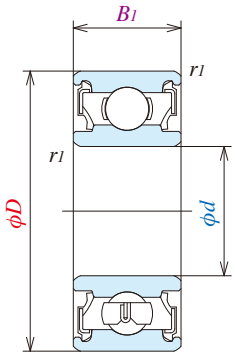
开放型
Open type

防尘盖型
Shielded type
ZZ

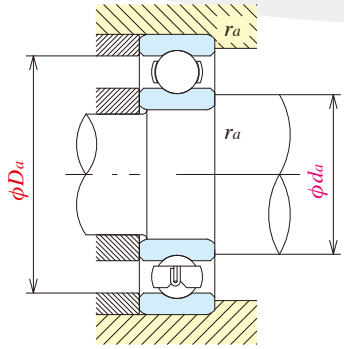
防尘盖型
Shielded type
ZZ1

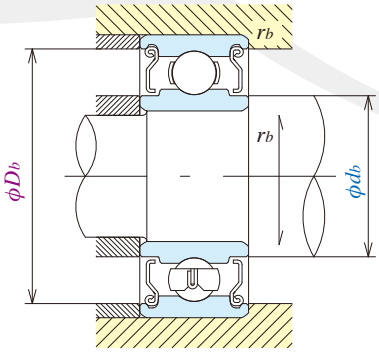
轴承型号 Bearing numbers				外形尺寸 (mm) Boundary dimensions						基本额定载荷 Basic load ratings			
开放型 Open	防尘盖型 Shielded	密封圈型 Sealed		*d*	*D*	*B*	*B1*	*r* (*1) 最小 min	*r1* (*1) 最小 min	(N) *Cr*	(N) *Cor*	{kgf} *Cr*	{kgf} *Cor*
MR85	**—**	**—**	**—**	**5**	8	2	—	0.10	—	310	120	31	12
—	**MR85ZZ**	**—**	**—**		8	—	2.5	—	0.10	278	131	28	13
MR95	**MR95ZZ1**	**—**	**—**		9	2.5	3	0.15	0.15	430	168	44	17
MR105	**MR105ZZ**	**—**	**—**		10	3	4	0.15	0.15	430	168	44	17
—	**MR115ZZ**	**VV**	**—**		11	—	4	—	0.15	715	282	73	28
685	**685ZZ**	**—**	**—**		11	3	5	0.15	0.15	715	281	73	29
695	**695ZZ1**	**VV**	**DD**		13	4	4	0.20	0.20	1080	430	110	44
605	**605ZZ**	**—**	**DD**		14	5	5	0.20	0.20	1330	505	135	52
625	**625ZZ1**	**VV**	**DD**		16	5	5	0.30	0.30	1730	670	177	68
635	**635ZZ1**	**VV**	**DD**		19	6	6	0.30	0.30	2340	885	238	90
MR106	**MR106ZZ1**	**—**	**—**	**6**	10	2.5	3	0.15	0.10	495	218	51	22
MR126	**MR126ZZ**	**—**	**DD**		12	3	4	0.20	0.15	715	292	73	30
686A	**686AZZ1**	**VV**	**DD**		13	3.5	5	0.15	0.15	1080	440	110	45
696	**696ZZ1**	**VV**	**DD**		15	5	5	0.20	0.20	1730	670	177	68
606	**606ZZ1**	**VV**	**DD**		17	6	6	0.30	0.30	2260	835	231	85
626	**626ZZ1**	**VV**	**DD**		19	6	6	0.30	0.30	2340	885	238	90
636	**636ZZ**	**VV**	**DD**		22	7	7	0.30	0.30	3300	1370	335	140
MR117	**MR117ZZ**	**—**	**—**	**7**	11	2.5	3	0.15	0.10	455	201	47	21
MR137	**MR137ZZ**	**—**	**—**		13	3	4	0.20	0.15	540	276	55	28
687	**687ZZ1**	**VV**	**DD**		14	3.5	5	0.15	0.15	1170	510	120	52
697	**697ZZ1**	**VV**	**DD**		17	5	5	0.30	0.30	1610	710	164	73
607B	**607BZZ1**	**VV**	**DD**		19	6	6	0.30	0.30	2340	885	238	90
627	**627ZZ**	**VV**	**DD**		22	7	7	0.30	0.30	3300	1370	335	140
637	**637ZZ1**	**VV**	**DD**		26	9	9	0.30	0.30	4550	1970	465	201
MR128	**MR128ZZ1**	**VV**	**DD**	**8**	12	2.5	3.5	0.15	0.10	545	274	56	28
MR148	**MR148ZZ**	**VV**	**DD**		14	3.5	4	0.20	0.15	820	385	83	39
688A	**688AZZ1**	**VV**	**DD**		16	4	5	0.20	0.20	1610	710	164	73
698	**698ZZ1**	**VV**	**DD**		19	6	6	0.30	0.30	2240	910	228	93
689	**689ZZ**	**VV**	**DD**	**9**	17	4	5	0.20	0.20	1330	665	136	68

注 Notes
※ 不锈钢产品的基本额定动载荷乘以 0.85作为基本标准。The rough standard of basic dynamic load rating for stainless products would be 15% less than the value appeared in the list.
*1 (　　)内的值非 JIS B 1521标准。The values in parentheses are not based on ISO 15
*2 表示为内径,外径的实际尺寸。Actual dimensions of bore and outside diameter only.

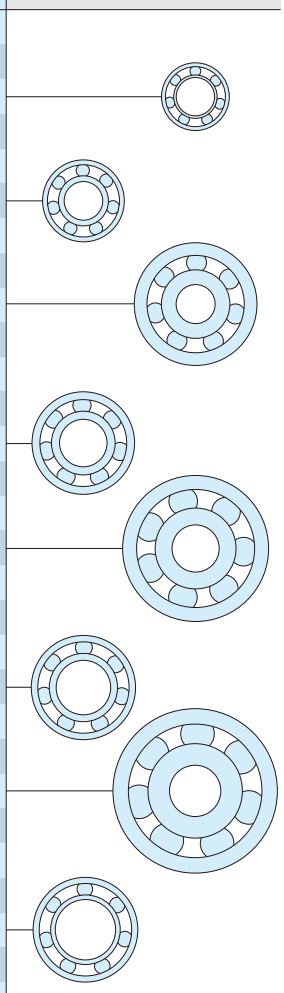


接触密封圈型
Contact sealed type
DD





极限转速 (min⁻¹) Limiting speeds (rpm) 脂润滑 Grease 开放型 Open Z·ZZ V·VV	D·DD	油润滑 Oil 开放型 Open Z	安装尺寸 (mm) Abutment and fillet dimensions d_a 最小 min	d_b 最大 max	D_a 最大 max	D_b 最小 min	r_a 最大 max	r_b 最大 max	重量 (g) Mass (参考) (approx) 开放型 Open	防尘盖型 Shielded	轴承型号 Bearing numbers 开放型 Open	实际尺寸图 (*2) Actual size
53,000	—	63,000	5.8	—	7.2	—	0.10	—	0.26	—	**MR85**	
53,000	—	63,000	—	5.8	—	7.4	—	0.10	—	0.34	**MR85**	
50,000	—	60,000	6.2	6.0	7.8	8.2	0.15	0.15	0.50	0.58	**MR95**	
50,000	—	60,000	6.2	6.0	8.8	8.4	0.15	0.15	0.95	1.29	**MR105**	
48,000	—	56,000	—	6.3	—	9.8	—	0.15	—	1.50	**MR115**	
45,000	—	53,000	6.2	6.2	9.8	9.9	0.15	0.15	1.20	1.96	**685**	
43,000	40,000	50,000	6.6	6.6	11.4	11.2	0.20	0.20	2.45	2.50	**695**	
40,000	38,000	50,000	6.6	6.9	12.4	12.2	0.20	0.20	3.54	3.48	**605**	
36,000	32,000	43,000	7.0	7.5	14.0	13.8	0.30	0.30	4.95	4.86	**625**	
32,000	30,000	40,000	7.0	8.5	17.0	16.5	0.30	0.30	8.56	8.34	**635**	
45,000	—	53,000	7.2	7.0	8.8	9.3	0.15	0.10	0.56	0.68	**MR106**	
43,000	40,000	50,000	7.6	7.2	10.4	10.9	0.20	0.15	1.27	1.74	**MR126**	
40,000	38,000	50,000	7.2	7.4	11.8	11.7	0.15	0.15	1.91	2.69	**686A**	
40,000	36,000	45,000	7.6	7.9	13.4	13.3	0.20	0.20	3.88	3.72	**696**	
38,000	34,000	45,000	8.0	8.2	15.0	14.8	0.30	0.30	5.97	6.08	**606**	
32,000	30,000	40,000	8.0	8.5	17.0	16.5	0.30	0.30	8.15	7.94	**626**	
30,000	28,000	36,000	8.0	10.5	20.0	19.0	0.30	0.30	14.00	14.00	**636**	
43,000	—	50,000	8.2	8.0	9.8	10.5	0.15	0.10	0.62	0.72	**MR117**	
40,000	—	48,000	8.6	9.0	11.4	11.6	0.20	0.15	1.58	2.02	**MR137**	
40,000	34,000	45,000	8.2	8.5	12.8	12.7	0.15	0.15	2.13	2.97	**687**	
36,000	28,000	43,000	9.0	10.2	15.0	14.8	0.30	0.30	5.26	5.12	**697**	
36,000	32,000	43,000	9.0	9.1	17.0	16.5	0.30	0.30	7.67	7.51	**607**	
30,000	28,000	36,000	9.0	10.5	20.0	19.0	0.30	0.30	12.70	12.90	**627**	
28,000	22,000	34,000	9.0	12.8	24.0	22.8	0.30	0.30	24.00	25.00	**637**	
40,000	—	48,000	9.2	9.0	10.8	11.3	0.15	0.10	0.71	0.97	**MR128**	
38,000	32,000	45,000	9.6	9.2	12.4	12.8	0.20	0.15	1.86	2.16	**MR148**	
36,000	28,000	43,000	9.6	10.2	14.4	14.2	0.20	0.20	3.12	4.02	**688A**	
36,000	28,000	43,000	10.0	10.0	17.0	16.5	0.30	0.30	7.23	7.18	**698**	
36,000	24,000	43,000	10.6	11.5	15.4	15.2	0.20	0.20	3.53	4.43	**689**	

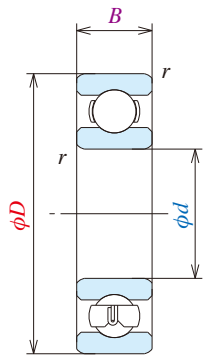


备注 Remarks
1. 防尘盖轴承使用外圈旋转时，请咨询ISC。When using bearings with a rotating outer ring, please contact ISC if they are shielded or sealed.
2. 标记为两侧防尘盖型的轴承，也可生产单侧防尘盖轴承。Bearings with double shields (ZZ, ZZ1) are also available with single shields (Z, Z1).
3. 带挡圈的轴承也生产，请咨询 ISC。Bearings with snap rings are also available, please contact ISC.

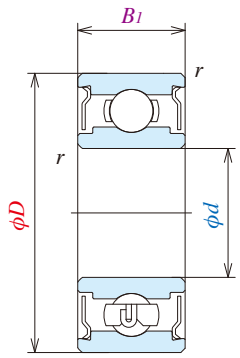
英制系列 单列深沟球轴承 Single-row deep groove ball bearings (Inch series)

R形式
R

内径 1.016～9.525mm
Bore diameter 1.016-9.525mm



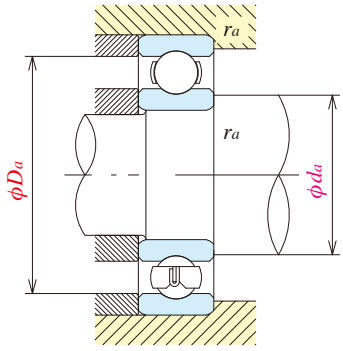
开放型
Open type

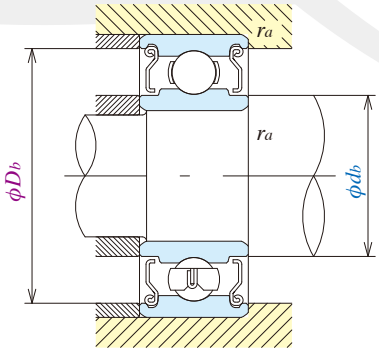


防尘盖型
Shielded type
ZZ

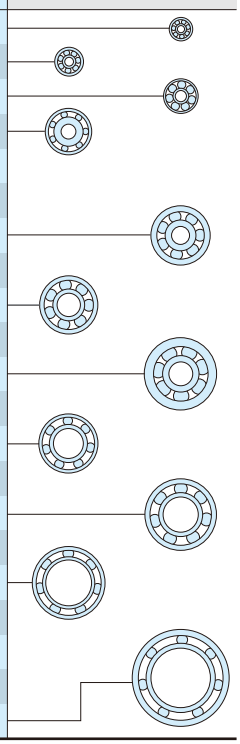
轴承型号 Bearing numbers				外形尺寸 (mm) Boundary dimensions					基本额定载荷 Basic load ratings			
开放型 Open	防尘盖型 Shielded	密封圈型 Sealed		*d*	*D*	*B*	*B1*	*r* 最小 min	(N) *Cr*	(N) *Cor*	{kgf} *Cr*	{kgf} *Cor*
R09	**—**	**—**	**—**	**1.016**	3.175	1.191	—	0.10	80	23	8	2.5
R0	**R0ZZ**	**—**	**—**	**1.191**	3.967	1.588	2.380	0.10	138	35	14	3.5
R1	**R1ZZ**	**—**	**—**	**1.397**	4.762	1.984	2.779	0.10	231	66	24	6.5
R1-4	**R1-4ZZ**	**—**	**—**	**1.984**	6.350	2.380	3.571	0.10	310	108	32	11
R133	**—**	**—**	**—**	**2.380**	4.762	1.588	—	0.10	188	60	19	6
—	**R133ZZS**	**—**	**—**		4.762	—	2.380	0.10	143	52	15	5.5
R1-5	**R1-5ZZ**	**—**	**—**		7.938	2.779	3.571	0.15	550	175	56	18
R144	**R144ZZ**	**—**	**—**	**3.175**	6.350	2.380	2.779	0.10	283	95	29	9.5
R2-5	**R2-5ZZ**	**—**	**—**		7.938	2.779	3.571	0.10	560	179	57	18
R2-6	**R2-6ZZ**	**—**	**—**		9.525	2.779	3.571	0.15	640	225	65	23
R2	**R2ZZ**	**—**	**—**		9.525	3.967	3.967	0.30	630	218	64	22
R2A	**R2AZZ**	**—**	**—**		12.700	4.366	4.366	0.30	640	225	65	23
R155	**R155ZZ**	**—**	**—**	**3.967**	7.938	2.779	3.175	0.10	360	149	37	15
R156	**R156ZZ**	**—**	**—**	**4.762**	7.938	2.779	3.175	0.10	360	149	37	15
R166	**R166ZZ**	**—**	**—**		9.525	3.175	3.175	0.10	710	270	73	28
R3	**R3ZZ**	**—**	**—**		12.700	3.967	4.978	0.30	1300	485	133	49
R168B	**R168BZZ**	**—**	**—**	**6.350**	9.525	3.175	3.175	0.10	420	204	43	21
R188	**R188ZZ**	**—**	**—**		12.700	3.175	4.762	0.15	1080	440	110	45
R4B	**R4BZZ**	**—**	**—**		15.875	4.978	4.978	0.30	1610	660	164	68
R4A	**R4AZZ1**	**—**	**—**		19.050	5.558	7.142	0.40	2620	1060	267	108
R1810	**R1810ZZ**	**—**	**—**	**7.938**	12.700	3.967	3.967	0.15	540	276	55	28

注 Notes
※ 不锈钢产品的基本额定动载荷乘以 0.85作为基本标准。The rough standard of basic dynamic load rating for stainless products would be 15% less than the value appeared in the list.
*1 表示为内径,外径的实际尺寸。 Actual dimensions of bore and outside diameter only.





极限转速（min^{-1}）Limiting speeds (rpm) 脂润滑 Grease 开放性 Open Z・ZZ	油润滑 Oil 开放性 Open Z	安装尺寸（mm）Abutment and fillet dimensions d_a 最小 min	d_b 最大 max	D_a 最大 max	D_b 最小 min	r_a 最大 max	重量（g）Mass（参考）(approx) 开放型 Open	防尘盖型 Shielded	轴承型号 Bearing numbers 开放型 Open	实际尺寸图（*1）Actual size
130,000	150,000	1.9	—	2.3	—	0.10	0.04	—	**R09**	
110,000	130,000	2.0	1.9	3.1	3.5	0.10	0.09	0.11	**R0**	
90,000	110,000	2.2	2.3	3.9	4.1	0.10	0.15	0.19	**R1**	
67,000	80,000	2.8	3.9	5.5	5.9	0.10	0.35	0.50	**R1-4**	
80,000	95,000	3.2	—	3.9	—	0.10	0.10	—	**R133**	
80,000	95,000	—	3.0	—	4.2	0.10	—	0.13	**R133**	
60,000	71,000	3.6	4.1	6.7	7.0	0.15	0.60	0.72	**R1-5**	
67,000	80,000	4.0	3.9	5.5	5.9	0.10	0.25	0.27	**R144**	
60,000	67,000	4.0	4.3	7.1	7.3	0.10	0.55	0.72	**R2-5**	
53,000	63,000	4.4	4.6	8.3	8.2	0.15	0.96	1.13	**R2-6**	
56,000	67,000	5.2	4.8	7.5	8.0	0.30	1.36	1.39	**R2**	
53,000	63,000	5.2	4.6	10.7	8.2	0.30	3.30	3.23	**R2A**	
53,000	63,000	4.8	5.5	7.1	7.3	0.10	0.51	0.56	**R155**	
53,000	63,000	5.6	5.5	7.1	7.3	0.10	0.39	0.42	**R156**	
50,000	60,000	5.6	5.9	8.7	8.8	0.10	0.81	0.85	**R166**	
43,000	53,000	6.8	6.5	10.7	11.2	0.30	2.21	2.79	**R3**	
48,000	56,000	7.2	7.0	8.7	8.9	0.10	0.58	0.62	**R168B**	
40,000	50,000	7.6	7.4	11.5	11.6	0.15	1.53	2.21	**R188**	
38,000	45,000	8.4	8.4	13.8	13.8	0.30	4.50	4.43	**R4B**	
36,000	43,000	9.4	9.0	16.0	16.6	0.40	7.48	9.17	**R4A**	
40,000	48,000	9.2	9.0	11.5	11.6	0.15	1.56	1.48	**R1810**	



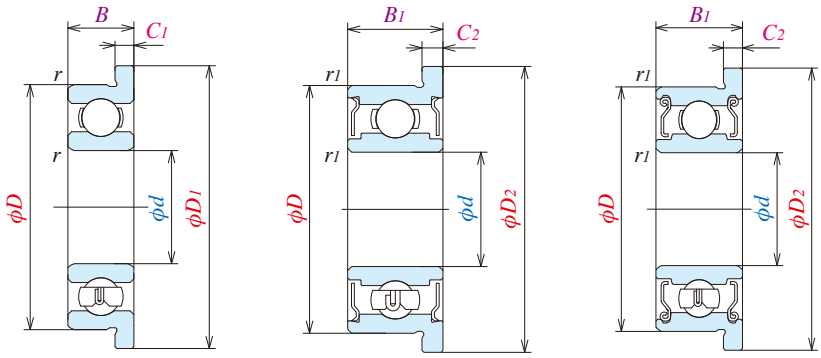
备注 Remarks
1. 防尘盖轴承使用外圈旋转时，请咨询ISC。When using bearings with a rotating outer ring, please contact ISC if they are shielded.
2. 标记为两侧防尘盖型的轴承，也可生产单侧防尘盖轴承。Bearings with double shields (ZZ, ZZ1) are also available with single shields (Z, Z1).

米制系列 带止动挡边单列深沟球轴承

Single-row deep groove ball bearings with flanged outer ring (Metric series)

F6○○形式、MF形式
F6○○, MF

内径 1～4mm
Bore diameter 1～4mm



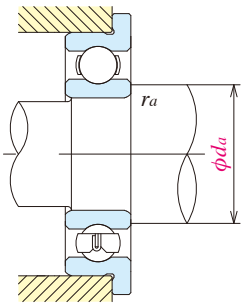
开放型
Open type

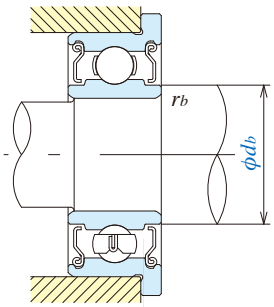
防尘盖型
Shielded type
ZZ

防尘盖型
Shielded type
ZZ1

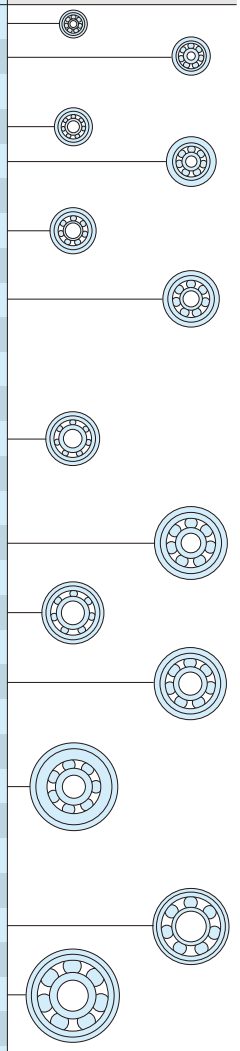
轴承型号 Bearing numbers				外形尺寸 (mm) Boundary dimensions										基本额定载荷 Basic load ratings			
开放型 Open	防尘盖型 Shielded	密封圈型 Sealed		*d*	*D*	*D1*	*D2*	*B*	*B1*	*C1*	*C2*	*r* (*1) 最小 min	*r1* (*1) 最小 min	(N) *Cr*	(N) *Cor*	{kgf} *Cr*	{kgf} *Cor*
F681	—	—	—	**1**	3	3.8	—	1	—	0.3	—	0.05	—	80	23	8	2.5
F691	—	—	—		4	5	—	1.6	—	0.5	—	0.1	—	138	35	14	3.5
MF41X	—	—	—	**1.2**	4	4.8	—	1.8	—	0.4	—	0.1	—	138	35	14	3.5
F681X	**F681XZZ**	—	—	**1.5**	4	5	5	1.2	2	0.4	0.6	0.05	0.05	112	33	11	3.5
F691X	**F691XZZ**	—	—		5	6.5	6.5	2	2.6	0.6	0.8	0.15	0.15	237	69	24	7
F601X	**F601XZZ**	—	—		6	7.5	7.5	2.5	3	0.6	0.8	0.15	0.15	330	98	34	10
F682	**F682ZZ**	—	—	**2**	5	6.1	6.1	1.5	2.3	0.5	0.6	0.08	0.08	169	50	17	5
MF52B	**MF52BZZ**	—	—		5	6.2	6.2	2	2.5	0.6	0.6	0.1	0.1	187	58	19	6
F692	**F692ZZ**	—	—		6	7.5	7.5	2.3	3	0.6	0.8	0.15	0.15	330	98	34	10
MF62	—	—	—		6	7.2	—	2.5	—	0.6	—	0.15	—	330	98	34	10
MF72	**MF72ZZ**	—	—		7	8.2	8.2	2.5	3	0.6	0.6	0.15	0.15	385	127	39	13
F602	**F602ZZ**	—	—		7	8.5	8.5	2.8	3.5	0.7	0.9	0.15	0.15	385	127	39	13
F682X	**F682XZZ**	—	—	**2.5**	6	7.1	7.1	1.8	2.6	0.5	0.8	0.08	0.08	208	74	21	7.5
F692X	**F692XZZ**	—	—		7	8.5	8.5	2.5	3.5	0.7	0.9	0.15	0.15	385	127	39	13
MF82X	—	—	—		8	9.2	—	2.5	—	0.6	—	0.2	—	560	179	57	18
F602X	**F602XZZ**	—	—		8	9.5	9.5	2.8	4	0.7	0.9	0.15	0.15	550	175	56	18
MF63	**MF63ZZ**	—	—	**3**	6	7.2	7.2	2	2.5	0.6	0.6	0.1	0.1	208	74	21	7.5
F683A	**F683AZZ**	—	—		7	8.1	8.1	2	3	0.5	0.8	0.1	0.1	390	130	40	13
MF83	—	—	—		8	9.2	—	2.5	—	0.6	—	0.15	—	560	179	57	18
F693	**F693ZZ**	—	—		8	9.5	9.5	3	4	0.7	0.9	0.15	0.15	560	179	57	18
MF93	**MF93ZZ**	—	—		9	10.2	10.6	2.5	4	0.6	0.8	0.2	0.15	570	187	58	19
F603	**F603ZZ**	—	—		9	10.5	10.5	3	5	0.7	1	0.15	0.15	570	187	58	19
F623	**F623ZZ**	—	—		10	11.5	11.5	4	4	1	1	0.15	0.15	630	218	64	22
MF74	—	—	—	**4**	7	8.2	—	2	—	0.6	—	0.1	—	310	115	32	12
—	**MF74ZZ**	—	—		7	—	8.2	—	2.5	—	0.6	—	0.1	255	107	26	11
MF84	**MF84ZZ**	—	—		8	9.2	9.2	2	3	0.6	0.6	0.15	0.1	395	139	40	14
F684	**F684ZZ**	—	—		9	10.3	10.3	2.5	4	0.6	1	(0.15) *1	(0.15) *1	640	225	65	23
MF104B	**MF104BZZ**	—	—		10	11.2	11.6	3	4	0.6	0.8	0.2	0.15	710	270	73	28
F694	**F694ZZ**	—	—		11	12.5	12.5	4	4	1	1	0.15	0.15	960	345	98	35
F604	**F604ZZ**	—	—		12	13.5	13.5	4	4	1	1	0.2	0.2	960	345	98	35
F624	**F624ZZ1**	—	—		13	15	15	5	5	1	1	0.2	0.2	1300	485	133	49
F634	**F634ZZ1**	—	—		16	18	18	5	5	1	1	0.3	0.3	1730	670	177	68

注 Notes
※ 不锈钢产品的基本额定动载荷乘以 0.85作为基本标准。The rough standard of basic dynamic load rating for stainless products would be 15% less than the value appeared in the list.
*1 ( )内的值非 JIS B 1521标准。The values in parentheses are not based on ISO 15
*2 表示为内径,外径的实际尺寸。Actual dimensions of bore and outside diameter only.





极限转速（min^{-1}）Limiting speeds (rpm)		安装尺寸 (mm) Abutment and fillet dimensions				重量（g）Mass（参考）(approx)		轴承型号 Bearing numbers	实际尺寸图（*2）Actual size
脂润滑 Grease 开放性 Open Z・ZZ	油润滑 Oil 开放性 Open Z	d_a 最小 min	d_b 最大 max	r_a 最大 max	r_b 最大 max	开放型 Open	防尘盖型 Shielded	开放型 Open	
130,000	150,000	1.4	—	0.05	—	0.04	—	**F681**	
100,000	120,000	1.8	—	0.10	—	0.14	—	**F691**	
110,000	130,000	2.0	—	0.10	—	0.12	—	**MF41X**	
100,000	120,000	1.9	2.1	0.05	0.05	0.09	0.14	**F681X**	
85,000	100,000	2.7	2.5	0.15	0.15	0.21	0.28	**F691X**	
75,000	90,000	2.7	3.0	0.15	0.15	0.42	0.52	**F601X**	
85,000	100,000	2.6	2.7	0.08	0.08	0.16	0.22	**F682**	
85,000	100,000	2.8	2.7	0.10	0.10	0.21	0.27	**MF52B**	
75,000	90,000	3.2	3.0	0.15	0.15	0.35	0.48	**F692**	
75,000	90,000	3.2	—	0.15	—	0.36	—	**MF62**	
63,000	75,000	3.2	3.8	0.15	0.15	0.52	0.56	**MF72**	
63,000	75,000	3.2	3.8	0.15	0.15	0.60	0.71	**F602**	
71,000	80,000	3.1	3.7	0.08	0.08	0.25	0.36	**F682X**	
63,000	67,000	3.7	3.8	0.15	0.15	0.51	0.68	**F692X**	
60,000	71,000	4.1	—	0.20	—	0.62	—	**MF82X**	
60,000	71,000	3.7	4.1	0.15	0.15	0.74	0.98	**F602X**	
71,000	80,000	3.8	3.7	0.10	0.10	0.27	0.33	**MF63**	
63,000	75,000	3.8	4.0	0.10	0.10	0.37	0.53	**F683A**	
60,000	67,000	4.2	—	0.15	—	0.56	—	**MF83**	
60,000	67,000	4.2	4.3	0.15	0.15	0.70	0.97	**F693**	
56,000	67,000	4.6	4.3	0.20	0.15	0.81	1.34	**MF93**	
56,000	67,000	4.2	4.3	0.15	0.15	1.00	1.63	**F603**	
50,000	60,000	4.2	4.3	0.15	0.15	1.85	1.86	**F623**	
60,000	67,000	4.8	—	0.10	—	0.29	—	**MF74**	
60,000	71,000	—	4.8	—	0.10	—	0.35	**MF74**	
56,000	67,000	5.2	5.0	0.15	0.10	0.44	0.63	**MF84**	
53,000	63,000	4.8	5.2	0.10	0.10	0.70	1.14	**F684**	
50,000	60,000	5.6	5.9	0.20	0.15	1.13	1.59	**MF104B**	
48,000	56,000	5.2	5.6	0.15	0.15	1.91	1.96	**F694**	
48,000	56,000	5.6	5.6	0.20	0.20	2.53	2.53	**F604**	
40,000	48,000	5.6	6.0	0.20	0.20	3.38	3.53	**F624**	
36,000	43,000	6.0	7.5	0.30	0.30	5.73	5.65	**F634**	



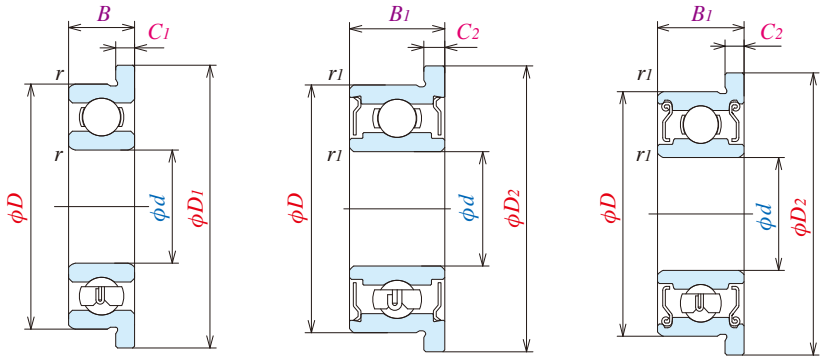
备注 Remarks
1. 防尘盖轴承使用外圈旋转时，请咨询ISC。 When using bearings with a rotating outer ring, please contact ISC if they are shielded.
2. 标记为两侧防尘盖型的轴承，也可生产单侧防尘盖轴承。 Bearings with double shields (ZZ, ZZ1) are also available with single shields (Z, Z1).

米制系列 带止动挡边单列深沟球轴承

Single-row deep groove ball bearings with flanged outer ring (Metric series)

F6○○形式、MF形式
F6○○, MF

内径 5～9mm
Bore diameter 5～9mm



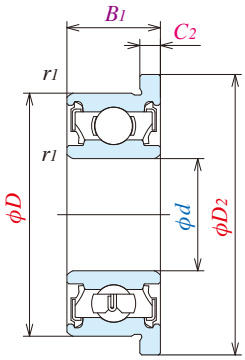
开放型
Open type

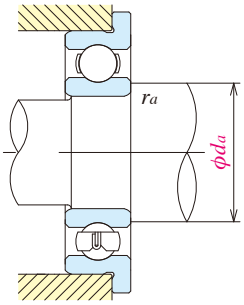
防尘盖型
Shielded type
ZZ

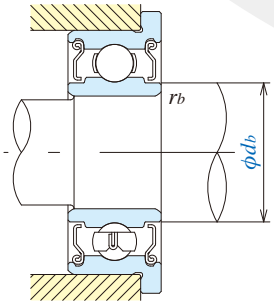
防尘盖型
Shielded type
ZZ1

轴承型号 Bearing numbers				外形尺寸 (mm) Boundary dimensions										基本额定载荷 Basic load ratings			
开放型 Open	防尘盖型 Shielded	密封圈型 Sealed		*d*	*D*	*D1*	*D2*	*B*	*B1*	*C1*	*C2*	*r* 最小 min	*r1* 最小 min	(N) *Cr*	(N) *Cor*	{kgf} *Cr*	{kgf} *Cor*
MF85	**—**	**—**	**—**	**5**	8	9.2	—	2	—	0.6	—	0.10	—	310	120	31	12
—	**MF85ZZ**	**—**	**—**		8	—	9.2	—	2.5	—	0.6	—	0.10	278	131	28	13
MF95	**MF95ZZ**	**—**	**—**		9	10.2	10.2	2.5	3	0.6	0.6	0.15	0.15	430	168	44	17
MF105	**MF105ZZ**	**—**	**—**		10	11.2	11.6	3	4	0.6	0.8	0.15	0.15	430	168	44	17
F685	**F685ZZ**	**—**	**—**		11	12.5	12.5	3	5	0.8	1	0.15	0.15	715	281	73	29
F695	**F695ZZ1**	**VV**	**DD**		13	15	15	4	4	1	1	0.20	0.20	1080	430	110	44
F605	**F605ZZ**	**—**	**DD**		14	16	16	5	5	1	1	0.20	0.20	1330	505	135	52
F625	**F625ZZ1**	**VV**	**DD**		16	18	18	5	5	1	1	0.30	0.30	1730	670	177	68
F635	**F635ZZ1**	**VV**	**DD**		19	22	22	6	6	1.5	1.5	0.30	0.30	2340	885	238	90
MF106	**MF106ZZ1**	**—**	**—**	**6**	10	11.2	11.2	2.5	3	0.6	0.6	0.15	0.10	495	218	51	22
MF126	**MF126ZZ**	**—**	**DD**		12	13.2	13.6	3	4	0.6	0.8	0.20	0.15	715	292	73	30
F686A	**F686AZZ1**	**VV**	**DD**		13	15	15	3.5	5	1	1.1	0.15	0.15	1080	440	110	45
F696	**F696ZZ1**	**VV**	**DD**		15	17	17	5	5	1.2	1.2	0.20	0.20	1730	670	177	68
F606	**F606ZZ**	**VV**	**DD**		17	19	19	6	6	1.2	1.2	0.30	0.30	2260	835	231	85
F626	**F626ZZ1**	**VV**	**DD**		19	22	22	6	6	1.5	1.5	0.30	0.30	2340	885	238	90
F636	**F636ZZ**	**VV**	**DD**		22	25	25	7	7	1.5	1.5	0.30	0.30	3300	1370	335	140
MF117	**MF117ZZ**	**—**	**—**	**7**	11	12.2	12.2	2.5	3	0.6	0.6	0.15	0.10	455	201	47	21
MF137	**MF137ZZ**	**—**	**—**		13	14.2	14.6	3	4	0.6	0.8	0.20	0.15	540	276	55	28
F687	**F687ZZ1**	**VV**	**DD**		14	16	16	3.5	5	1	1.1	0.15	0.15	1170	510	120	52
F697	**F697ZZ1**	**VV**	**DD**		17	19	19	5	5	1.2	1.2	0.30	0.30	1610	710	164	73
F607	**F607ZZ1**	**VV**	**DD**		19	22	22	6	6	1.5	1.5	0.30	0.30	2340	885	238	90
F627	**F627ZZ**	**VV**	**DD**		22	25	25	7	7	1.5	1.5	0.30	0.30	3300	1370	335	140
MF128	**MF128ZZ1**	**VV**	**DD**	**8**	12	13.2	13.6	2.5	3.5	0.6	0.8	0.15	0.10	545	274	56	28
MF148	**MF148ZZ**	**VV**	**DD**		14	15.6	15.6	3.5	4	0.8	0.8	0.20	0.15	820	385	83	39
F688A	**F688AZZ1**	**VV**	**DD**		16	18	18	4	5	1	1.1	0.20	0.20	1610	710	164	73
F698	**F698ZZ1**	**VV**	**DD**		19	22	22	6	6	1.5	1.5	0.30	0.30	2240	910	228	93
F689	**F689ZZ**	**VV**	**DD**	**9**	17	19	19	4	5	1	1.1	0.20	0.20	1330	665	136	68

注 Notes
※ 不锈钢产品的基本额定动载荷乘以 0.85作为基本标准。The rough standard of basic dynamic load rating for stainless products would be 15% less than the value appeared in the list.
*1 表示为内径，外径的实际尺寸。Actual dimensions of bore and outside diameter only.

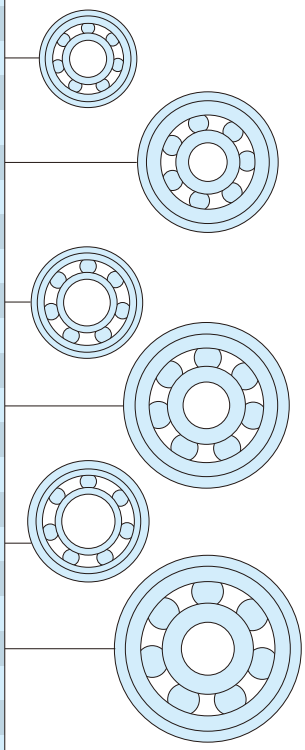






接触密封圈型
Contact sealed type
DD

极限转速（min^{-1}）Limiting speeds (rpm) 脂润滑 Grease 开放性 Open Z・ZZ	D·DD	油润滑 Oil 开放性 Open Z	安装尺寸（mm）Abutment and fillet dimensions d_a 最小 min	d_b 最大 max	r_a 最大 max	r_b 最大 max	重量（g）Mass（参考）(approx) 开放型 Open	防尘盖型 Shielded	轴承型号 Bearing numbers 开放型 Open	实际尺寸图（*1）Actual size
53,000	—	63,000	5.8	—	0.10	—	0.33	—	**MF85**	
53,000	—	63,000	—	5.8	—	0.10	—	0.41	**MF85**	
50,000	—	60,000	6.2	6.0	0.15	0.15	0.59	0.66	**MF95**	
50,000	—	60,000	6.2	6.0	0.15	0.15	1.05	1.46	**MF105**	
45,000	—	53,000	6.2	6.2	0.15	0.15	1.37	2.18	**F685**	
43,000	40,000	50,000	6.6	6.6	0.20	0.20	2.79	2.84	**F695**	
40,000	38,000	50,000	6.6	6.9	0.20	0.20	3.90	3.85	**F605**	
36,000	32,000	43,000	7.0	7.5	0.30	0.30	5.37	5.30	**F625**	
32,000	30,000	40,000	7.0	8.5	0.30	0.30	9.49	9.49	**F635**	
45,000	—	53,000	7.2	7.0	0.15	0.10	0.65	0.77	**MF106**	
43,000	40,000	50,000	7.6	7.2	0.20	0.15	1.38	1.94	**MF126**	
40,000	38,000	50,000	7.2	7.4	0.15	0.15	2.25	3.04	**F686A**	
40,000	36,000	45,000	7.6	7.9	0.20	0.20	4.34	4.26	**F696**	
38,000	34,000	45,000	8.0	8.2	0.30	0.30	6.58	6.61	**F606**	
32,000	30,000	40,000	8.0	8.5	0.30	0.30	9.09	9.09	**F626**	
30,000	28,000	36,000	8.0	10.5	0.30	0.30	14.60	14.70	**F636**	
43,000	—	50,000	8.2	8.0	0.15	0.10	0.72	0.82	**MF117**	
40,000	—	48,000	8.6	9.0	0.20	0.15	1.70	2.23	**MF137**	
40,000	34,000	45,000	8.2	8.5	0.15	0.15	2.48	3.37	**F687**	
36,000	28,000	43,000	9.0	10.2	0.30	0.30	5.65	5.65	**F697**	
36,000	32,000	43,000	9.0	9.1	0.30	0.30	8.66	8.66	**F607**	
30,000	28,000	36,000	9.0	10.5	0.30	0.30	14.20	14.20	**F627**	
40,000	—	48,000	9.2	9.0	0.15	0.10	0.82	1.15	**MF128**	
38,000	32,000	45,000	9.6	9.2	0.20	0.15	2.09	2.39	**MF148**	
36,000	30,000	43,000	9.6	10.2	0.20	0.20	3.54	4.47	**F688A**	
36,000	28,000	43,000	10.0	10.0	0.30	0.30	8.35	8.30	**F698**	
36,000	24,000	43,000	10.6	11.5	0.20	0.20	3.97	4.91	**F689**	



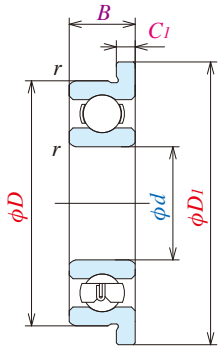
备注 Remarks
1. 密封防尘盖轴承使用外圈旋转时，请咨询ISC。When using bearings with a rotating outer ring, please contact ISC if they are shielded or sealed.
2. 标记为两侧防尘盖型的轴承，也可生产单侧防尘盖轴承。Bearings with double shields (ZZ, ZZ1) are also available with single shields (Z, Z1).

英制系列 带止动挡边单列深沟球轴承

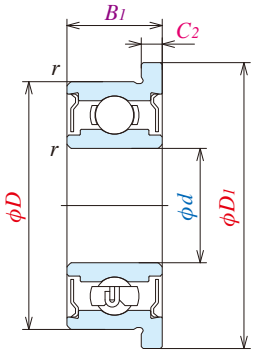
Single-row deep groove ball bearings with flanged outer ring (Inch series)

FR形式
FR

内径 1.191～9.525mm
Bore diameter 1.191～9.525mm



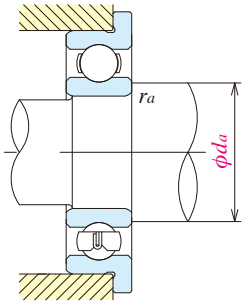
开放型
Open type

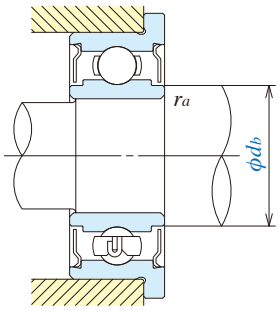


防尘盖型
Shielded type
ZZ

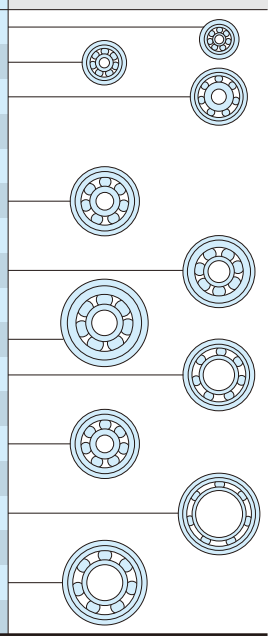
轴承型号 Bearing numbers		外形尺寸 (mm) Boundary dimensions								基本额定载荷 Basic load ratings			
开放型 Open	防尘盖型 Shielded	*d*	*D*	*D1*	*B*	*B1*	*C1*	*C2*	*r* 最小 min	(N) *Cr*	(N) *Cor*	{kgf} *Cr*	{kgf} *Cor*
FR0	**FR0ZZ**	**1.191**	3.967	5.156	1.588	2.380	0.330	0.790	0.10	138	35	14	3.5
FR1	**FR1ZZ**	**1.397**	4.762	5.944	1.984	2.779	0.580	0.790	0.10	231	66	24	6.5
FR1-4	**FR1-4ZZ**	**1.984**	6.350	7.518	2.380	3.571	0.580	0.790	0.10	310	108	32	11
FR133	**—**	**2.380**	4.762	5.944	1.588	—	0.460	—	0.10	188	60	19	6
—	**FR133ZZS**		4.762	5.944	—	2.380	—	0.790	0.10	143	52	15	5.5
FR1-5	**FR1-5ZZ**		7.938	9.119	2.779	3.571	0.580	0.790	0.15	550	175	56	18
FR144	**FR144ZZ**	**3.175**	6.350	7.518	2.380	2.779	0.580	0.790	0.10	283	95	29	9.5
FR2-5	**FR2-5ZZ**		7.938	9.119	2.779	3.571	0.580	0.790	0.10	560	179	57	18
FR2-6	**FR2-6ZZ**		9.525	10.719	2.779	3.571	0.580	0.790	0.15	640	225	65	23
FR2	**FR2ZZ**		9.525	11.176	3.967	3.967	0.760	0.760	0.30	630	218	64	22
FR155	**FR155ZZ**	**3.967**	7.938	9.119	2.779	3.175	0.580	0.910	0.10	360	149	37	15
FR156	**FR156ZZ**	**4.762**	7.938	9.119	2.779	3.175	0.580	0.910	0.10	360	149	37	15
FR166	**FR166ZZ**		9.525	10.719	3.175	3.175	0.580	0.790	0.10	710	270	73	28
FR3	**FR3ZZ**		12.700	14.351	4.978	4.978	1.070	1.070	0.30	1300	485	133	49
FR168B	**FR168BZZ**	**6.350**	9.525	10.719	3.175	3.175	0.580	0.910	0.10	420	204	43	21
FR188	**FR188ZZ**		12.700	13.894	3.175	4.762	0.580	1.140	0.15	1080	440	110	45
FR4B	**FR4BZZ**		15.875	17.526	4.978	4.978	1.070	1.070	0.30	1610	660	164	68
FR1810	**FR1810ZZ**	**7.938**	12.700	13.894	3.967	3.967	0.790	0.790	0.15	540	276	55	28

注 Notes
※ 不锈钢产品的基本额定动载荷乘以 0.85作为基本标准。The rough standard of basic dynamic load rating for stainless products would be 15% less than the value appeared in the list.
*1 表示为内径,外径的实际尺寸。Actual dimensions of bore and outside diameter only.





极限转速（min^{-1}）Limiting speeds (rpm) 脂润滑 Grease 开放性 Open Z・ZZ	油润滑 Oil 开放性 Open Z	安装尺寸 (mm) Abutment and fillet dimensions d_a 最小 min	d_b 最大 max	r_a 最大 max	重量（g）Mass（参考）(approx) 开放型 Open	防尘盖型 Shielded	轴承型号 Bearing numbers 开放型 Open	实际尺寸图（*1）Actual size
110,000	130,000	2.0	1.9	0.10	0.11	0.16	**FR0**	
90,000	110,000	2.2	2.3	0.10	0.20	0.25	**FR1**	
67,000	80,000	2.8	3.9	0.10	0.41	0.58	**FR1-4**	
80,000	95,000	3.2	—	0.10	0.13	—	**FR133**	
80,000	95,000	—	3.0	0.10	—	0.19	**FR133**	
60,000	71,000	3.6	4.1	0.15	0.68	0.82	**FR1-5**	
67,000	80,000	4.0	3.9	0.10	0.31	0.35	**FR144**	
60,000	67,000	4.0	4.3	0.10	0.62	0.81	**FR2-5**	
53,000	63,000	4.4	4.6	0.15	1.04	1.25	**FR2-6**	
56,000	67,000	5.2	4.8	0.30	1.51	1.55	**FR2**	
53,000	63,000	4.8	5.5	0.10	0.59	0.67	**FR155**	
53,000	63,000	5.6	5.5	0.10	0.47	0.53	**FR156**	
50,000	60,000	5.6	5.9	0.10	0.90	0.98	**FR166**	
43,000	53,000	6.8	6.5	0.30	2.97	3.09	**FR3**	
48,000	56,000	7.2	7.0	0.10	0.66	0.75	**FR168B**	
40,000	50,000	7.6	7.4	0.15	1.64	2.49	**FR188**	
38,000	45,000	8.4	8.4	0.30	4.78	4.78	**FR4B**	
40,000	48,000	9.2	9.0	0.15	1.71	1.63	**FR1810**	

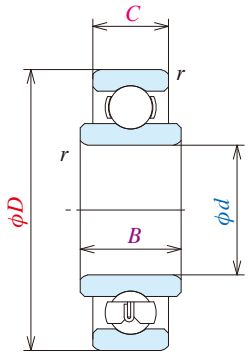


备注 Remarks
1. 防尘盖轴承使用外圈旋转时，请咨询ISC。 When using bearings with a rotating outer ring, please contact ISC if they are shielded.
2. 标记为两侧防尘盖型的轴承，也可生产单侧防尘盖轴承。 Bearings with double shields (ZZ, ZZ1) are also available with single shields (Z, Z1).

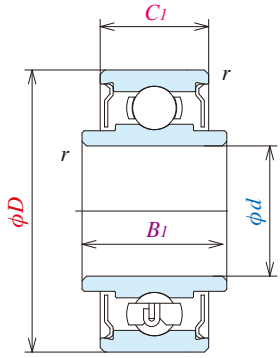
英制系列 宽内圈深沟球轴承
Deep groove ball bearings with extended inner ring (Inch series)

RW形式
RW

内径 1.016～9.525mm
Bore diameter 1.016 ～ 9.525mm



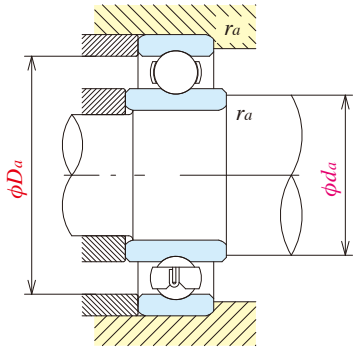
开放型
Open type

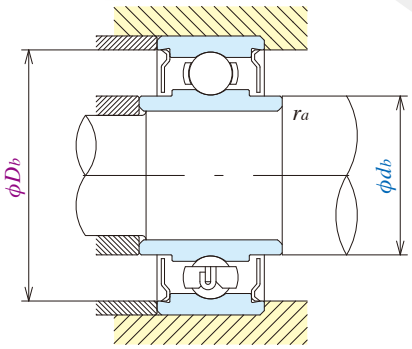


防尘盖型
Shielded type
ZZ

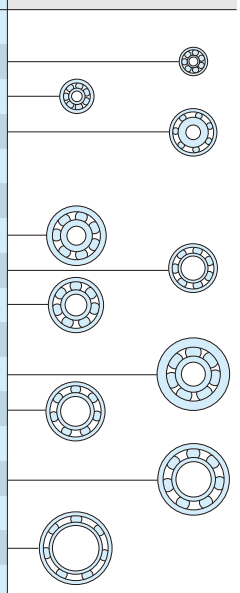
轴承型号 Bearing numbers		外形尺寸 (mm) Boundary dimensions							基本额定载荷 Basic load ratings			
									(N)		{kgf}	
开放型 Open	防尘盖型 Shielded	*d*	*D*	*B*	*B1*	*C*	*C1*	*r* 最小 min	*Cr*	*Cor*	*Cr*	*Cor*
RW09	**—**	**1.016**	3.175	1.984	—	1.191	—	0.10	80	23	8	2.5
RW0	**RW0ZZ**	**1.191**	3.967	2.380	3.175	1.588	2.380	0.10	138	35	14	3.5
RW1	**RW1ZZ**	**1.397**	4.762	2.779	3.571	1.984	2.779	0.10	231	66	24	6.5
RW1-4	**RW1-4ZZ**	**1.984**	6.350	3.175	4.366	2.380	3.571	0.10	310	108	32	11
RW133	**—**	**2.380**	4.762	2.380	—	1.588	—	0.10	188	60	19	6
—	**RW133ZZ**		4.762	—	3.175	—	2.380	0.10	143	52	15	5.5
RW1-5	**RW1-5ZZ**		7.938	3.571	4.366	2.779	3.571	0.15	550	175	56	18
RW144	**RW144ZZ**	**3.175**	6.350	3.175	3.571	2.380	2.779	0.10	283	95	29	9.5
RW2-5	**RW2-5ZZ**		7.938	3.571	4.366	2.779	3.571	0.10	560	179	57	18
RW2-6	**RW2-6ZZ**		9.525	3.571	4.366	2.779	3.571	0.15	640	225	65	23
RW2	**RW2ZZ**		9.525	4.762	4.762	3.967	3.967	0.30	630	218	64	22
RW155	**RW155ZZ**	**3.967**	7.938	3.571	3.967	2.779	3.175	0.10	360	149	37	15
RW156	**RW156ZZ**	**4.762**	7.938	3.571	3.967	2.779	3.175	0.10	360	149	37	15
RW166	**RW166ZZ**		9.525	3.967	3.967	3.175	3.175	0.10	710	270	73	28
RW3	**RW3ZZ**		12.700	4.762	5.771	3.967	4.978	0.30	1300	485	133	49
RW168B	**RW168BZZ**	**6.350**	9.525	3.967	3.967	3.175	3.175	0.10	420	204	43	21
RW188	**RW188ZZ**		12.700	3.967	5.558	3.175	4.762	0.15	1080	440	110	45
RW4B	**RW4BZZ**		15.875	5.771	5.771	4.978	4.978	0.30	1610	660	164	68
RW1810	**RW1810ZZ**	**7.938**	12.700	4.762	4.762	3.967	3.967	0.15	540	276	55	28

注 Notes
※ 不锈钢产品的基本额定动载荷乘以 0.85作为基本标准。The rough standard of basic dynamic load rating for stainless products would be 15% less than the value appeared in the list.
*1 表示为内径,外径的实际尺寸。Actual dimensions of bore and outside diameter only.





极限转速（min⁻¹）Limiting speeds (rpm) 脂润滑 Grease 开放性 Open Z・ZZ	油润滑 Oil 开放性 Open Z	安装尺寸 (mm) Abutment and fillet dimensions d_a 最小 min	d_b 最大 max	D_a 最大 max	D_b 最小 min	r_a 最大 max	重量（g）Mass（参考）(approx) 开放型 Open	防尘盖型 Shielded	轴承型号 Bearing numbers 开放型 Open	实际尺寸图（*1）Actual size
130,000	150,000	1.9	—	2.3	—	0.10	0.05	—	**RW09**	
110,000	130,000	2.0	1.9	3.1	3.5	0.10	0.11	0.16	**RW0**	
90,000	110,000	2.2	2.3	3.9	4.1	0.10	0.17	0.25	**RW1**	
67,000	80,000	2.8	3.9	5.5	5.9	0.10	0.46	0.46	**RW1-4**	
80,000	95,000	3.2	—	3.9	—	0.10	0.12	—	**RW133**	
80,000	95,000	—	3.0	—	4.2	0.10	—	0.17	**RW133**	
60,000	71,000	3.6	4.1	6.7	7.0	0.15	0.63	0.73	**RW1-5**	
67,000	80,000	4.0	3.9	5.5	5.9	0.10	0.30	0.33	**RW144**	
60,000	67,000	4.0	4.3	7.1	7.3	0.10	0.74	0.74	**RW2-5**	
53,000	63,000	4.4	4.6	8.3	8.2	0.15	1.00	1.10	**RW2-6**	
56,000	67,000	5.2	4.8	7.5	8.0	0.30	1.40	1.30	**RW2**	
53,000	63,000	4.8	5.5	7.1	7.3	0.10	0.56	0.62	**RW155**	
53,000	63,000	5.6	5.5	7.1	7.3	0.10	0.44	0.49	**RW156**	
50,000	60,000	5.6	5.9	8.7	8.8	0.10	0.82	0.87	**RW166**	
43,000	53,000	6.8	6.5	10.7	11.2	0.30	2.33	2.90	**RW3**	
48,000	56,000	7.2	7.0	8.7	8.9	0.10	0.62	0.66	**RW168B**	
40,000	50,000	7.6	7.4	11.5	11.6	0.15	1.70	2.10	**RW188**	
38,000	45,000	8.4	8.4	13.8	13.8	0.30	4.72	4.62	**RW4B**	
40,000	48,000	9.2	9.0	11.5	11.6	0.15	1.90	1.60	**RW1810**	



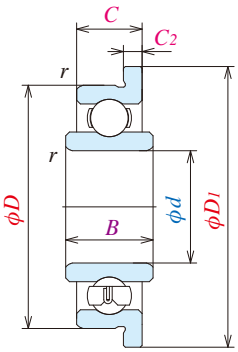
备注 Remarks
1. 防尘盖轴承使用外圈旋转时，请咨询ISC。When using bearings with a rotating outer ring, please contact ISC if they are shielded.
2. 标记为两侧防尘盖型的轴承，也可生产单侧防尘盖轴承。Bearings with double shields (ZZ, ZZ1) are also available with single shields (Z, Z1).

英制系列 带止动挡边宽内圈深沟球轴承

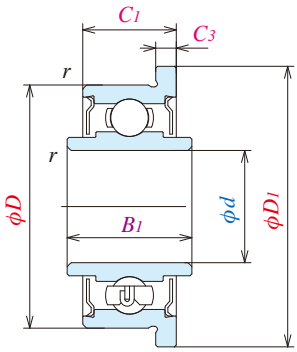
Deep groove ball bearings with extended inner ring, flanged (Inch series)

FRW形式
FRW

内径 1.191～7.938mm
Bore diameter 1.191 ～7.938mm



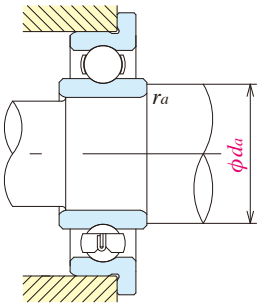
开放型
Open type

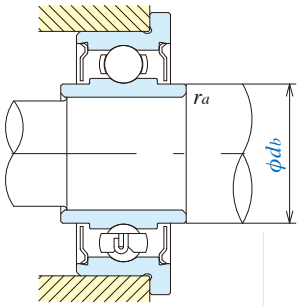


防尘盖型
Shielded type
ZZ

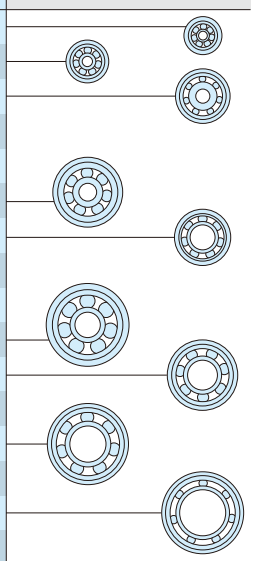
轴承型号 Bearing numbers		外形尺寸 (mm) Boundary dimensions										基本额定载荷 Basic load ratings			
开放型 Open	防尘盖型 Shielded	*d*	*D*	*D1*	*B*	*B1*	*C*	*C1*	*C2*	*C3*	*r* 最小 min	(N) *Cr*	(N) *Cor*	{kgf} *Cr*	{kgf} *Cor*
FRW0	**FRW0ZZ**	**1.191**	3.967	5.156	2.380	3.175	1.588	2.380	0.330	0.790	0.10	138	35	14	3.5
FRW1	**FRW1ZZ**	**1.397**	4.762	5.944	2.779	3.571	1.984	2.779	0.580	0.790	0.10	231	66	24	6.5
FRW1-4	**FRW1-4ZZ**	**1.984**	6.350	7.518	3.175	4.366	2.380	3.571	0.580	0.790	0.10	310	108	32	11
FRW133	**—**	**2.380**	4.762	5.944	2.380	—	1.588	—	0.460	—	0.10	188	60	19	6
—	**FRW133ZZ**		4.762	5.944	—	3.175	—	2.380	—	0.790	0.10	143	52	15	5.5
FRW1-5	**FRW1-5ZZ**		7.938	9.119	3.571	4.366	2.779	3.571	0.580	0.790	0.15	550	175	56	18
FRW144	**FRW144ZZ**	**3.175**	6.350	7.518	3.175	3.571	2.380	2.779	0.580	0.790	0.10	283	95	29	9.5
FRW2-5	**FRW2-5ZZ**		7.938	9.119	3.571	4.366	2.779	3.571	0.580	0.790	0.10	560	179	57	18
FRW2-6	**FRW2-6ZZ**		9.525	10.719	3.571	4.366	2.779	3.571	0.580	0.790	0.15	640	225	65	23
FRW2	**FRW2ZZ**		9.525	11.176	4.762	4.762	3.967	3.967	0.760	0.760	0.30	630	218	64	22
FRW155	**FRW155ZZ**	**3.967**	7.938	9.119	3.571	3.967	2.779	3.175	0.580	0.910	0.10	360	149	37	15
FRW156	**FRW156ZZ**	**4.762**	7.938	9.119	3.571	3.967	2.779	3.175	0.580	0.910	0.10	360	149	37	15
FRW166	**FRW166ZZ**		9.525	10.719	3.967	3.967	3.175	3.175	0.580	0.790	0.10	710	270	73	28
FRW3	**FRW3ZZ**		12.700	14.351	5.771	5.771	4.978	4.978	1.070	1.070	0.30	1300	485	133	49
FRW168B	**FRW168BZZ**	**6.350**	9.525	10.719	3.967	3.967	3.175	3.175	0.580	0.910	0.10	420	204	43	21
FRW188	**FRW188ZZ**		12.700	13.894	3.967	5.558	3.175	4.762	0.580	1.140	0.15	1080	440	110	45
FRW4B	**FRW4BZZ**		15.875	17.526	5.771	5.771	4.978	4.978	1.070	1.070	0.30	1610	660	164	68
FRW1810	**—**	**7.938**	12.700	13.894	4.762	4.762	3.967	3.967	0.790	0.790	0.15	540	276	55	28

注 Notes
※ 不锈钢产品的基本额定动载荷乘以 0.85作为基本标准。The rough standard of basic dynamic load rating for stainless products would be 15% less than the value appeared in the list.
*1 表示为内径,外径的实际尺寸。Actual dimensions of bore and outside diameter only.





极限转速 (min⁻¹) Limiting speeds (rpm) 脂润滑 Grease 开放性 Open Z・ZZ	油润滑 Oil 开放性 Open Z	安装尺寸 (mm) Abutment and fillet dimensions d_a 最小 min	d_b 最大 max	r_a 最大 max	重量 (g) Mass (参考) (approx) 开放型 Open	防尘盖型 Shielded	轴承型号 Bearing numbers 开放型 Open	实际尺寸图 (*1) Actual size
110,000	130,000	2.0	1.9	0.10	0.14	0.19	**FRW0**	
90,000	110,000	2.2	2.3	0.10	0.24	0.32	**FRW1**	
67,000	80,000	2.8	3.9	0.10	0.59	0.59	**FRW1-4**	
80,000	95,000	3.2	—	0.10	0.17	—	**FRW133**	
80,000	95,000	—	3.0	0.10	—	0.22	**FRW133**	
60,000	71,000	3.6	4.1	0.15	0.83	0.93	**FRW1-5**	
67,000	80,000	4.0	3.9	0.10	0.44	0.47	**FRW144**	
60,000	67,000	4.0	4.3	0.10	0.93	0.93	**FRW2-5**	
53,000	63,000	4.4	4.6	0.15	1.30	1.40	**FRW2-6**	
56,000	67,000	5.2	4.8	0.30	1.80	1.70	**FRW2**	
53,000	63,000	4.8	5.5	0.10	0.73	0.79	**FRW155**	
53,000	63,000	5.6	5.5	0.10	0.58	0.63	**FRW156**	
50,000	60,000	5.6	5.9	0.10	1.20	1.20	**FRW166**	
43,000	53,000	6.8	6.5	0.30	3.10	3.20	**FRW3**	
48,000	56,000	7.2	7.0	0.10	0.70	0.79	**FRW168B**	
40,000	50,000	7.6	7.4	0.15	2.10	2.50	**FRW188**	
38,000	45,000	8.4	8.4	0.30	5.08	4.98	**FRW4B**	
40,000	48,000	9.2	9.0	0.15	2.30	2.10	**FRW1810**	

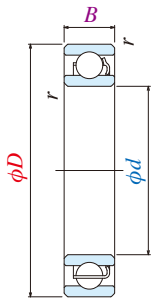


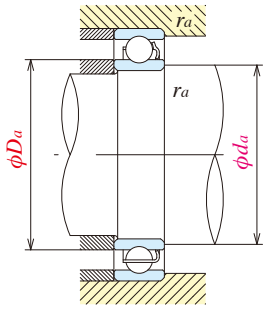
备注 Remarks
1. 防尘盖轴承使用外圈旋转时，请咨询ISC。 When using bearings with a rotating outer ring, please contact ISC if they are shielded.
2. 标记为两侧防尘盖型的轴承，也可生产单侧防尘盖轴承。 Bearings with double shields (ZZ, ZZ1) are also available with single shields (Z, Z1).

米制系列 薄壁形深沟球轴承
Extra-thin-section deep groove ball bearings (Metric series)

SMT 形
SMT

内径 10～15mm
Bore diameter 10～15mm





轴承型号 Bearing numbers	外形尺寸 (mm) Boundary dimensions				基本额定载荷 Basic load ratings (N)		{kgf}	
	d	D	B	r 最小 min	Cr	Cor	Cr	Cor
SMT1510	**10**	15	3	0.15	815	410	83	42
SMT2015	**15**	20	3.5	0.15	800	470	82	48

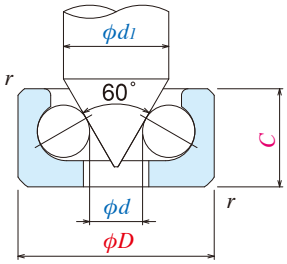
轴承型号 Bearing numbers	极限转速 (min⁻¹) Limiting speeds (rpm)		安装尺寸 (mm) Abutment and fillet dimensions			重量 (g) Mass (参考) (approx)
	脂润滑 Grease 开放型 Open	油润滑 Oil 开放型 Open	da 最小 min	Da 最大 max	ra 最大 max	
SMT1510	36,000	43,000	11.2	13.8	0.15	1.40
SMT2015	30,000	36,000	16.2	18.8	0.15	2.20

备注 Remarks
1. 薄壁形单列深沟球轴承的材料以不锈钢为标准。These bearings are made of stainless steel.
2. 适用的精度等级为 JIS 0级和 JIS 6级。The tolerance classes for this type of bearing are normal and class 6..
3. 径向间隙适用 于JIS。The radial internal clearance for this type of bearing is specified by ISO 5593 Rolling bearings-Radial internal clearance.

枢轴用球轴承
Pivot ball bearings

BCF 形
BCF

内径 0.81～8.12mm
Bore diameter 0.81～8.12mm



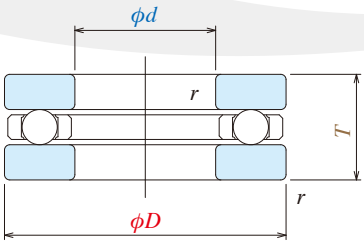
轴承型号 Bearing numbers	外形尺寸 (mm) Boundary dimensions				基本额定载荷 Basic load ratings (N)		{kgf}		最小轴径 Min. shaft dia.	重量 (g) Mass (参考) (approx)
	d	D	C	r 最小 min	Cr	Cor	Cr	Cor	d1	
BCF3	**0.81**	3	1.5	0.10	32	3.0	3	0.30	1.0	0.06
BCF4X	**1.31**	4	2.2	0.15	58	5.5	6	0.55	1.5	0.14
BCF5	**1.58**	5	2.4	0.15	80	8.0	8	0.80	1.8	0.24
BCF6	**1.60**	6	2.5	0.15	108	11.0	11	1.0	1.9	0.37
BCF7	**2.09**	7	3.0	0.20	119	12.0	12	1.0	2.3	0.61
BCF8	**2.40**	8	3.5	0.30	223	24.0	23	2.5	2.7	0.83
BCF9	**3.13**	9	3.5	0.20	274	31.0	28	3.0	3.5	1.05
BCF10	**3.13**	10	4.0	0.20	274	31.0	28	3.0	3.5	1.64
BCF12	**4.18**	12	4.5	0.20	460	56.0	47	5.5	4.6	2.42
BCF12X	**6.09**	12	3.5	0.20	435	60.0	45	6.0	6.8	1.57
BCF13	**5.16**	13	4.5	0.20	535	68.0	55	7.0	5.7	2.78
BCF14	**6.13**	14	4.5	0.30	610	81.0	62	8.5	6.8	3.04
BCF16	**8.12**	16	4.5	0.30	735	107	75	11.0	9.0	3.65

注 Notes
※ 不锈钢产品的基本额定动载荷乘以 0.85作为基本标准。The rough standard of basic dynamic load rating for stainless products would be 15% less than the value appeared in the list.

推力球轴承
Thrust ball bearings

F 形
F

内径 2～10mm
Bore diameter 2～10mm

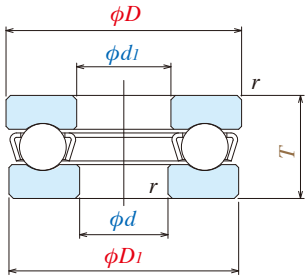


轴承型号 Bearing numbers	外形尺寸 (mm) Boundary dimensions				重量 (g) Mass (参考) (approx)	基本额定载荷 Basic load ratings (N)		{kgf}	
	d	*D*	*T*	*r* 最小 min		*Ca*	*Coa*	*Ca*	*Coa*
F2-6	**2**	6	3.0	0.1	0.49	151	44.0	15.0	4.5
F2X-7	**2.5**	7	3.5	0.1	0.81	211	64.0	21.0	6.5
F3-8	**3**	8	3.5	0.15	1.21	233	75.0	23.0	7.5
F4-9	**4**	9	4.0	0.15	1.37	232	85.0	24.0	8.5
F4-10	**4**	10	4.5	0.15	1.93	375	131	38.0	13.0
F5-11	**5**	11	4.5	0.15	2.22	360	131	37.0	13.0
F6-12	**6**	12	4.5	0.15	2.48	410	168	42.0	17.0
F7-15	**7**	15	5.0	0.2	4.22	835	335	85.0	34.0
F8-16	**8**	16	5.0	0.2	4.81	565	237	58.0	24.0
F9-17	**9**	17	5.0	0.2	4.99	860	380	88.0	38.0
F10-18	**10**	18	5.5	0.2	6.01	840	380	86.0	38.0

带沟槽推力球轴承
Thrust ball bearings with groove

F-M 形
F-M

内径 3.2～10.2mm
Bore diameter 3.2～10.2mm



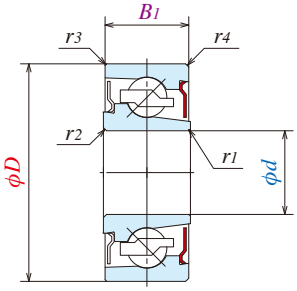
轴承型号 Bearing numbers	外形尺寸 (mm) Boundary dimensions						重量 (g) Mass (参考) (approx)	基本额定载荷 Basic load ratings (N)		{kgf}	
	d	*d1*	*D*	*D1*	*T*	*r* 最小 min		*Ca*	*Coa*	*Ca*	*Coa*
F3-7M	**3**	**3.2**	7	6.8	3	0.05	0.47	570	530	58.0	54.0
F3-8M	**3**	**3.2**	8	7.8	3.5	0.05	0.86	1000	930	102.0	95.0
F4-9M	**4**	**4.2**	9	8.8	4	0.05	1.12	955	930	97.0	95.0
F4-10M	**4**	**4.2**	10	9.8	4	0.1	1.47	930	930	95.0	95.0
F5-10M	**5**	**5.2**	10	9.8	4	0.1	1.33	1200	1400	122	142
F5-12M	**5**	**5.2**	12	11.8	4	0.1	2.05	1070	1240	109	127
F6-12M	**6**	**6.2**	12	11.8	4.5	0.15	2.16	1840	2220	187	226
F6-14M	**6**	**6.25**	14	13.8	5	0.15	3.53	2170	2440	222	249
F7-15M	**7**	**7.2**	15	14.8	5.5	0.15	4.10	4050	5000	415	510
F7-17M	**7**	**7.2**	17	16.8	6	0.15	6.41	3100	3800	315	390
F8-19M	**8**	**8.2**	19	18.8	7	0.2	9.27	3950	4950	405	505
F9-17M	**9**	**9.2**	17	16.8	5	0.2	4.05	3850	5000	395	510
F9-20M	**9**	**9.2**	20	19.8	7	0.2	9.92	3900	4950	395	505
F10-20M	**10**	**10.2**	20	19.8	6.5	0.15	8.45	5500	7550	560	770

注 Notes
※ 不锈钢产品的基本额定动载荷乘以 0.85作为基本标准。The rough standard of basic dynamic load rating for stainless products would be 15% less than the value appeared in the list.

微型向心推力球轴承 (CROXY)

Miniature Thrust Angular Contact Ball Bearings

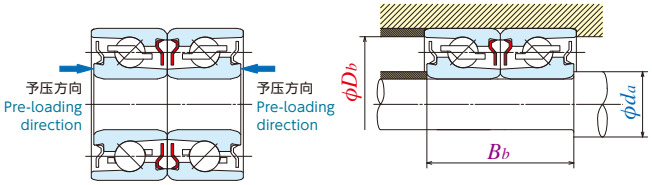
内径 2～8mm
Bore diameter 2～8mm



轴承型号 Bearing numbers	外形尺寸 (mm) Boundary dimensions							基本额定载荷 (N) Basic load ratings								极限轴向负载 (N) Permissible Axial Load	极限回转数 (min⁻¹) Limiting speeds (rpm)
								轴向 Axial				径向 Radial					
								额定动负载 Dynamic load rating Ca		额定静负载 Static load rating Coa		额定动负载 Dynamic load rating Cr		额定静负载 Static load rating Cor			
	d	D	B1 外轮宽幅 OD width	r1	r2 倒角（最小） Chamfer (min)	r3	r4	SUJ2	鋼材 Stainless	SUJ2	鋼材 Stainless	SUJ2	鋼材 Stainless	SUJ2	鋼材 Stainless		
MTA02-06	**2**	6	3	0.1	0.1	0.04	0.1	555	470	450	360	288	245	92	75	87	26,000
MTA03-08	**3**	8	4	0.1	0.1	0.03	0.1	960	820	840	670	480	410	172	138	164	22,000
MTA04-11	**4**	11	4.5	0.2	0.2	0.1	0.2	1470	1250	1410	1130	745	635	282	227	464	17,000
MTA05-13	**5**	13	5	0.2	0.2	0.1	0.2	2090	1777	2170	1740	1080	915	440	355	549	16,000
MTA06-15	**6**	15	5.5	0.2	0.2	0.2	0.2	2760	2350	2950	2360	1390	1180	580	465	854	14,000
MTA08-19	**8**	19	6.5	0.2	0.2	0.3	0.3	4000	3400	4350	3480	2030	1730	870	700	1520	13,000

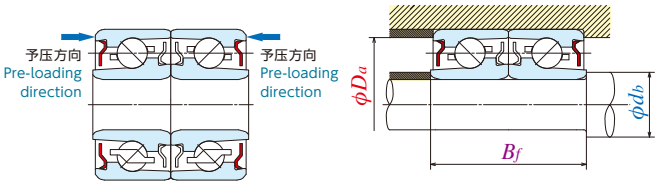
注 Notes
※ 极限轴向负载：使滚珠越过轨道的负载或者发生布氏硬度压痕的负载 Permissible Axial Load: Run-on load or maximum load where brinelling occurs

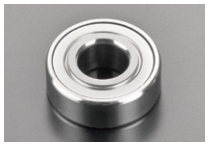
DB 组合 DB Matching



内圈予压（匹配青铜色）
Inner ring pre-loaded (Bronze color side matching)

DF 组合 DF Matching





外圈予压（匹配银色）
Outer ring pre-loaded (Silver color side matching)

轴承型号 Bearing numbers	组合 Matching									组装扭矩 (N・cm) Tightening Torque	
	DB 组合 (mm) DB matching			DF 组合 (mm) DF matching			轴向刚性 (N/μm) Axial Rigidity	一组质量（参考）(g) Mass (pair)	推荐予压 (N) Recommended pre-load	DB 组合 DB matching	DF 组合 DF matching
	安装部位 Mounting part 轴 最小 Shaft min φda	安装部位 Mounting part 外壳 最大 Housing max φDb	组合内輪幅 Matched IR width Bb	安装部位 Mounting part 轴 最小 Shaft min φdb	安装部位 Mounting part 外壳 最大 Housing max φDa	组合内輪幅 Matched IR width Bf					
MTA02-06	3.0	5.3	5.80	2.8	5.0	6.20	21	0.8	7	7	20
MTA03-08	4.4	7.2	7.72	3.9	6.7	8.28	28	1.7	12	7	50
MTA04-11	6.2	9.5	8.60	5.1	8.9	9.40	39	3.7	20	10	50
MTA05-13	7.2	11.3	9.60	6.1	10.8	10.40	52	5.5	34	25	50
MTA06-15	8.6	13.2	10.50	7.2	12.5	11.50	60	7.7	45	30	80
MTA08-19	11.4	16.8	12.36	9.4	15.8	13.64	76	14.0	70	60	80

MTA系列轴承型号构成
MTA Series
Bearing Number Formulation

MTA 04 – 11 -H-26 T21 Z2ZB CG75 P5 DB EA7L

- MTA：微型推力角 Miniature・Thrust・Angular
- 04：内径尺寸 Inner Diameter
- 11：外径尺寸 Outer Diameter
- -H-26：材料符号 Material Symbol
- T21：保持器符号 Cage Type
- Z2ZB：防尘盖符号 Seal Type
- CG75：径向间隙 Radial Clearance
- P5：精度符号 Accuracy Class
- DB：组合符号（DB・DF）Matching Type
- EA7L：润滑剂符号 Lubrication Symbol

附录 Appendices

附录1 国际单位制 (SI)的 换算 ····· 60～61
Appendix Table1 Conversion from SI (International Units) System

附录2 N-kgf 换算表 ····· 62
Appendix Table2 N-kgf Conversion Table

附录3 Inch-mm 换算表 ····· 63
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(11) 英制系列 带挡边内轮宽幅形深沟球轴承(开放型) ····· 75
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Deep groove ball bearings with extended inner ring, Flanged：shielded type (Inch series)

附录1 国际单位制(SI)换算
Appendix Table1 Conversion from SI (International Units) System

SI、CGS 制以及工程单位制对照表 Comparison of SI, CGS, and Engineering Units

单位制 Unit System \ 量 Units	长度 Length	重量 Mass	时间 Time	温度 Temp.	加速度 Acceleration	力 Force	应力 Stress	压力 Pressure	能量 Energy	作业率 Power
SI	m	kg	s	K	m/s^2	N	Pa	Pa	J	W
CGS制 CGS System	cm	g	s	℃	Gal	dyn	dyn/cm^2	dyn/cm^2	erg	erg/s
工程单位制 Engineering Unit System	m	$kgf\cdot s^2/m$	s	℃	m/s^2	kgf	kgf/m^2	kgf/m^2	kgf·m	kgf·m/s

SI单位的转换率 Conversion Factors from SI Units

量 Parameter	SI单位 SI Units		SI以外的单位 Units other than SI		SI单位的换算率 Conversion Factors from SI Units
	单位名称 Name of Units	记号 Symbols	单位名称 Name of Units	记号 Symbols	
角度 Angle	弧度 Radian	rad	度 Degree 分 Minute 秒 Second	° ' "	$180/\pi$ $10800/\pi$ ' $648000/\pi$ "
长度 Length	米 Meter	m	微米 Micron 埃 Angstrom	μ Å	10^6 10^{10}
面积 Area	平方米 Square meter	m^2	公亩 Are 公顷 Hectare	a ha	10^{-2} 10^{-4}
体积 Volume	立方米 Cubic meter	m^3	升 Liter 分升 Deciliter	l, L dl, dL	10^3 10^4
时间 Time	秒 Second	s	分 Minute 小时 Hour 天 Day	min h d	1/60 1/3600 1/86400
振动次数、频率 Frequency	赫兹 Hertz	Hz	周波 Cycle	s^{-1}	1
转速 Speed of Rotation	转/秒 Revolution per second	s^{-1}	转/分 Revolution per minute	min^{-1}	60
速度 Speed	米/秒 Meter per second	m/s	公里/小时 Kilometer per hour 海里 Knot	km/h kn	3600/1000 3600/1852
加速度 Acceleration	米/秒^2 Meter per second per second	m/s^2	伽 Gal g g	Gal G	10^2 1/9.80665
重量 Mass	千克 kilogram	kg	顿 Ton	t	10^{-3}
力量 Force	牛顿 Newton	N	公斤力 Kilogram 顿力 Ton-force 达因 Dyne	kgf tf dyn	1/9.80665 $1/(9.80665\times10^3)$ 10^5
扭矩及 力矩 Torque or Moment	牛顿米 Newton·meter	N·m	公斤力米 Kilogram-force meter	kgf·m	1/9.80665
应力 Stress	帕斯卡 Pascal 牛顿每平方米 Newton per square meter	Pa (N/m^2)	公斤力/平方厘米 Kilogram-force per square centimeter 公斤力/平方毫米 Kilogram-force per square millimeter	kgf/cm^2 kgf/mm^2	$1/(9.80665\times10^4)$ $1/(9.80665\times10^6)$

SI国际单位制词冠 Prefixes Used in SI System

乘以单位的倍数 Multiples	词冠名称 Prefix		记号 Symbols
10^{18}	兆兆兆	Exa	E
10^{15}	千兆兆	Peta	P
10^{12}	兆兆	Tera	T
10^{9}	千兆	Giga	G
10^{6}	兆	Mega	M
10^{3}	千	Kilo	k
10^{2}	百	Hecto	h
10^{1}	十	Deca	da

乘以单位的倍数 Multiples	词冠名称 Prefix		记号 Symbols
10^{-1}	分	Deci	d
10^{-2}	厘	Centi	c
10^{-3}	毫	Milli	m
10^{-6}	微	Micro	μ
10^{-9}	毫微	Nano	n
10^{-12}	微微	Pico	p
10^{-15}	毫微微	Femto	f
10^{-18}	微微微	Ato	a

SI单位的换算率(接续) Conversion Factors from SI Units (Continued)

量 Parameter	SI单位 SI Units		SI以外的单位 Units other than SI		SI单位的换算率 Conversion Factors from SI Units
	单位名称 Name of Units	记号 Symbols	单位名称 Name of Units	记号 Symbols	
压力 Pressure	帕斯卡 (牛顿/平方米) Pascal (Newton per square meter)	Pa (N/m^2)	公斤力/平方米 Kilogram-force per square meter	Kgf/m^2	1/9.80665
			水柱米 Water Column	mH_2O	$1/(9.80665\times10^3)$
			水银柱毫米 Mercury Column	mmHg	$760/(1.01325\times10^5)$
			托 Torr	Torr	$760/(1.01325\times10^5)$
			巴 Bar	bar	10^{-5}
			气压 Atmosphere	atm	$1/(1.01325\times10^5)$
能量 Energy	焦耳 (牛顿米) Joule (Newton-meter)	J (N·m)	尔格 Erg	erg	10^7
			卡(国际) Calorie (International)	Cal_{IT}	1/4.1868
			公斤力米 Kilogram-force meter	Kgf·m	1/9.80665
			千卡每小时 Kilowatt hour	kW·h	$1/(3.6\times10^6)$
			米制马力·时 French horse power hour	PS·h	$\approx 3.77672\times10^{-7}$
动力,功率 Work	瓦特(焦耳/秒) Watt (Joule per second)	W (J/s)	公斤力米/秒 Kilogram-force meter per second	kgf·m/s	1/9.80665
			千瓦/小时 Kilocalorie per hour	Kcal/h	1/1.163
			米制马力 French horse power	PS	≈ 1/735.4988
粘度,粘度指数 Viscosity, Viscosity Index	帕斯卡秒 Pascal second	Pa·s	泊 Poise	P	10
动粘度,动粘度指数 Kinematic Viscosity, Kinematic Viscosity Index	平方米/秒 Square meter per second	m^2/s	沲 Stokes	St	10^4
			寸沲 Centistokes	cSt	10^6
温度,温度差 Temperature	开尔文 摄氏度 Kelvin	K	摄氏温度,度 Degree, Celsius	℃	(*1)
电流,磁力势 Electric Current, Magnetomotive Force	安培 Ampere	A	安培 Ampere	A	1
电压,电动势 Voltage, Electromotive Force	伏 Volt	V	(瓦特每安培) (Watts per ampere)	(W/A)	1
磁感应强度 Magnetic Field Strength	安培米 Ampere per meter	A/m	奥斯特 Oersted	Oe	$4\pi/10^3$
磁场强度 Magnetic Flux Density	特斯拉 Tesla	T	高斯 Gauss	Gs	10^4
			伽马 Gamma	γ	10^9
电阻 Electrical Resistance	欧姆 Ohm	Ω	(伏特/安培) (Volts per ampere)	(V/A)	1

注 Notes
*1 由TK向θ℃的温度换算为θ=T-273.15,温度差换算为△T=△θ。但△T及△θ分别表示以开尔文及摄氏所测量的温度差。
The conversion from TK into θ℃ is θ=T-273.15 but for a temperature difference, it is △T=△θ. However, △T and △θ represent temperature differences. Measured using the Kelvin and Celsius scales respectively.
备注 Remarks
圆括号内所列单位的名称和符号代表其上方或左方所列单位的定义。The names and symbols in () are equivalent to those directly above them or on their left.
换算例1N=1/9.806 65kgf Example of conversion 1N=1/9.806 65kgf

附表2 N-kgf 换算表
Appendix Table2 N-kgf Conversion Table

[表格的读取方法]

例如，将 10N 转换为 kgf 时，请看第一块表格的中间栏右侧的kgf列，便可知 10N 为 1.0197 kgf。此外，将10kgf换算成N时，请看左边的N栏，便可知是98.067N。

[How to use this table]

For example, to convert 10N into kgf, read the figure in the right kgf column adjacent to the 10 in the center column in the 1st block. This means that 10N is 1.0197kgf. To convert 10kgf into N, read the figure in the left N column of the same row, which indicates that the answer is 98.067N.

1N = 0.1019716kgf
1kgf = 9.80665N

N		kgf	N		kgf	N		kgf
9.8067	**1**	0.1020	333.4261	**34**	3.4670	657.0456	**67**	6.8321
19.613	**2**	0.2039	343.233	**35**	3.5690	666.852	**68**	6.9341
29.420	**3**	0.3059	353.039	**36**	3.6710	676.659	**69**	7.0360
39.227	**4**	0.4079	362.846	**37**	3.7729	686.466	**70**	7.1380
49.033	**5**	0.5099	372.653	**38**	3.8749	696.272	**71**	7.2400
58.840	**6**	0.6118	382.459	**39**	3.9769	706.079	**72**	7.3420
68.647	**7**	0.7138	392.266	**40**	4.0789	715.885	**73**	7.4439
78.453	**8**	0.8158	402.073	**41**	4.1808	725.692	**74**	7.5459
88.260	**9**	0.9177	411.879	**42**	4.2828	735.499	**75**	7.6479
98.067	**10**	1.0197	421.686	**43**	4.3848	745.305	**76**	7.7498
107.87	**11**	1.1217	431.49	**44**	4.4868	755.11	**77**	7.8518
117.68	**12**	1.2237	441.30	**45**	4.5887	764.92	**78**	7.9538
127.49	**13**	1.3256	451.11	**46**	4.6907	774.73	**79**	8.0558
137.29	**14**	1.4276	460.91	**47**	4.7927	784.53	**80**	8.1577
147.10	**15**	1.5296	470.72	**48**	4.8946	794.34	**81**	8.2597
156.91	**16**	1.6315	480.53	**49**	4.9966	804.15	**82**	8.3617
166.71	**17**	1.7335	490.33	**50**	5.0986	813.95	**83**	8.4636
176.52	**18**	1.8355	500.14	**51**	5.2006	823.76	**84**	8.5656
186.33	**19**	1.9375	509.95	**52**	5.3025	833.57	**85**	8.6676
196.13	**20**	2.0394	519.75	**53**	5.4045	843.37	**86**	8.7696
205.94	**21**	2.1414	529.56	**54**	5.5065	853.18	**87**	8.8715
215.75	**22**	2.2434	539.37	**55**	5.6084	862.99	**88**	8.9735
225.55	**23**	2.3453	549.17	**56**	5.7104	872.79	**89**	9.0755
235.36	**24**	2.4473	558.98	**57**	5.8124	882.60	**90**	9.1774
245.17	**25**	2.5493	568.79	**58**	5.9144	892.41	**91**	9.2794
254.97	**26**	2.6513	578.59	**59**	6.0163	902.21	**92**	9.3814
264.78	**27**	2.7532	588.40	**60**	6.1183	912.02	**93**	9.4834
274.59	**28**	2.8552	598.21	**61**	6.2203	921.83	**94**	9.5853
284.39	**29**	2.9572	608.01	**62**	6.3222	931.63	**95**	9.6873
294.20	**30**	3.0591	617.82	**63**	6.4242	941.44	**96**	9.7893
304.01	**31**	3.1611	627.63	**64**	6.5262	951.25	**97**	9.8912
313.81	**32**	3.2631	637.43	**65**	6.6282	961.05	**98**	9.9932
323.62	**33**	3.3651	647.24	**66**	6.7301	970.86	**99**	10.0952

附表3 英寸-毫米 换算表

Appendix Table3 Inch-mm Conversion Table

1" = 25.4mm

inch		0	1	2	3	4	5	6	7	8	9	10
分数 Fraction	小数 Decimal	mm										
0	0.000000	0.000	25.400	50.800	76.200	101.600	127.000	152.400	177.800	203.200	228.600	254.000
1/64	0.015625	0.397	25.797	51.197	76.597	101.997	127.397	152.797	178.197	203.597	228.997	254.397
1/32	0.031250	0.794	26.194	51.594	76.994	102.394	127.794	153.194	178.594	203.994	229.394	254.794
3/64	0.046875	1.191	26.591	51.991	77.391	102.791	128.191	153.591	178.991	204.391	229.791	255.191
1/16	0.062500	1.588	26.988	52.388	77.788	103.188	128.588	153.988	179.388	204.788	230.188	255.588
5/64	0.078125	1.984	27.384	52.784	78.184	103.584	128.984	154.384	179.784	205.184	230.584	255.984
3/32	0.093750	2.381	27.781	53.181	78.581	103.981	129.381	154.781	180.181	205.581	230.981	256.381
7/64	0.109375	2.778	28.178	53.578	78.978	104.378	129.778	155.178	180.578	205.978	231.378	256.778
1/8	0.125000	3.175	28.575	53.975	79.375	104.775	130.175	155.575	180.975	206.375	231.775	257.175
9/64	0.140625	3.572	28.972	54.372	79.772	105.172	130.572	155.972	181.372	206.772	232.172	257.572
5/32	0.156250	3.969	29.369	54.769	80.169	105.569	130.969	156.369	181.769	207.169	232.569	257.969
11/64	0.171875	4.366	29.766	55.166	80.566	105.966	131.366	156.766	182.166	207.566	232.966	258.366
3/16	0.187500	4.763	30.163	55.563	80.963	106.363	131.763	157.163	182.563	207.963	233.363	258.763
13/64	0.203125	5.159	30.559	55.959	81.359	106.759	132.159	157.559	182.959	208.359	233.759	259.159
7/32	0.218750	5.556	30.956	56.356	81.756	107.156	132.556	157.956	183.356	208.756	234.156	259.556
15/64	0.234375	5.953	31.353	56.753	82.153	107.553	132.953	158.353	183.753	209.153	234.553	259.953
1/4	0.250000	6.350	31.750	57.150	82.550	107.950	133.350	158.750	184.150	209.550	234.950	260.350
17/64	0.265625	6.747	32.147	57.547	82.947	108.347	133.747	159.147	184.547	209.947	235.347	260.747
9/32	0.281250	7.144	32.544	57.944	83.344	108.744	134.144	159.544	184.944	210.344	235.744	261.144
19/64	0.296875	7.541	32.941	58.341	83.741	109.141	134.541	159.941	185.341	210.741	236.141	261.541
5/16	0.312500	7.938	33.338	58.738	84.138	109.538	134.938	160.338	185.738	211.138	236.538	261.938
21/64	0.328125	8.334	33.734	59.134	84.534	109.934	135.334	160.734	186.134	211.534	236.934	262.334
11/32	0.343750	8.731	34.131	59.531	84.931	110.331	135.731	161.131	186.531	211.931	237.331	262.731
23/64	0.359375	9.128	34.528	59.928	85.328	110.728	136.128	161.528	186.928	212.328	237.728	263.128
3/8	0.375000	9.525	34.925	60.325	85.725	111.125	136.525	161.925	187.325	212.725	238.125	263.525
25/64	0.390625	9.922	35.322	60.722	86.122	111.522	136.922	162.322	187.722	213.122	238.522	263.922
13/32	0.406250	10.319	35.719	61.119	86.519	111.919	137.319	162.719	188.119	213.519	238.919	264.319
27/64	0.421875	10.716	36.116	61.516	86.916	112.316	137.716	163.116	188.516	213.916	239.316	264.716
7/16	0.437500	11.113	36.513	61.913	87.313	112.713	138.113	163.513	188.913	214.313	239.713	265.113
29/64	0.453125	11.509	36.909	62.309	87.709	113.109	138.509	163.909	189.309	214.709	240.109	265.509
15/32	0.468750	11.906	37.306	62.706	88.106	113.506	138.906	164.306	189.706	215.106	240.506	265.906
31/64	0.484375	12.303	37.703	63.103	88.503	113.903	139.303	164.703	190.103	215.503	240.903	266.303
1/2	0.500000	12.700	38.100	63.500	88.900	114.300	139.700	165.100	190.500	215.900	241.300	266.700
33/64	0.515625	13.097	38.497	63.897	89.297	114.697	140.097	165.497	190.897	216.297	241.697	267.097
17/32	0.531250	13.494	38.894	64.294	89.694	115.094	140.494	165.894	191.294	216.694	242.094	267.494
35/64	0.546875	13.891	39.291	64.691	90.091	115.491	140.891	166.291	191.691	217.091	242.491	267.891
9/16	0.562500	14.288	39.688	65.088	90.488	115.888	141.288	166.688	192.088	217.488	242.888	268.288
37/64	0.578125	14.684	40.084	65.484	90.884	116.284	141.684	167.084	192.484	217.884	243.284	268.684
39/64	0.609375	15.478	40.878	66.278	91.678	117.078	142.478	167.878	193.278	218.678	244.078	269.478
5/8	0.625000	15.875	41.275	66.675	92.075	117.475	142.875	168.275	193.675	219.075	244.475	269.875
41/64	0.640625	16.272	41.672	67.072	92.472	117.872	143.272	168.672	194.072	219.472	244.872	270.272
21/32	0.656250	16.669	42.069	67.469	92.869	118.269	143.669	169.069	194.469	219.869	245.269	270.669
43/64	0.671875	17.066	42.466	67.866	93.266	118.666	144.066	169.466	194.866	220.266	245.666	271.066
11/16	0.687500	17.463	42.863	68.263	93.663	119.063	144.463	169.863	195.263	220.663	246.063	271.463
45/64	0.703125	17.859	43.259	68.659	94.059	119.459	144.859	170.259	195.659	221.059	246.459	271.859
23/32	0.718750	18.256	43.656	69.056	94.456	119.856	145.256	170.656	196.056	221.456	246.856	272.256
47/64	0.734375	18.653	44.053	69.453	94.853	120.253	145.653	171.053	196.453	221.853	247.253	272.653
3/4	0.750000	19.050	44.450	69.850	95.250	120.650	146.050	171.450	196.850	222.250	247.650	273.050
49/64	0.765625	19.447	44.847	70.247	95.647	121.047	146.447	171.847	197.247	222.647	248.047	273.447
25/32	0.781250	19.844	45.244	70.644	96.044	121.444	146.844	172.244	197.644	223.044	248.444	273.844
51/64	0.796875	20.241	45.641	71.041	96.441	121.841	147.241	172.641	198.041	223.441	248.841	274.241
13/16	0.812500	20.638	46.038	71.438	96.838	122.238	147.638	173.038	198.438	223.838	249.238	274.638
53/64	0.828125	21.034	46.434	71.834	97.234	122.634	148.034	173.434	198.834	224.234	249.634	275.034
27/32	0.843750	21.431	46.831	72.231	97.631	123.031	148.431	173.831	199.231	224.631	250.031	275.431
55/64	0.859375	21.828	47.228	72.628	98.028	123.428	148.828	174.228	199.628	225.028	250.428	275.828
7/8	0.875000	22.225	47.625	73.025	98.425	123.825	149.225	174.625	200.025	225.425	250.825	276.225
57/64	0.890625	22.622	48.022	73.422	98.822	124.222	149.622	175.022	200.422	225.822	251.222	276.622
29/32	0.906250	23.019	48.419	73.819	99.219	124.619	150.019	175.419	200.819	226.219	251.619	277.019
59/64	0.921875	23.416	48.816	74.216	99.616	125.016	150.416	175.816	201.216	226.616	252.016	277.416
15/16	0.937500	23.813	49.213	74.613	100.013	125.413	150.813	176.213	201.613	227.013	252.413	277.813
61/64	0.953125	24.209	49.609	75.009	100.409	125.809	151.209	176.609	202.009	227.409	252.809	278.209
31/32	0.968750	24.606	50.006	75.406	100.806	126.206	151.606	177.006	202.406	227.806	253.206	278.606
63/64	0.984375	25.003	50.403	75.803	101.203	126.603	152.003	177.403	202.803	228.203	253.603	279.003

附表4 硬度 换算表

Appendix Table4 Hardness Conversion Table (Reference)

洛氏 Fraction	维氏硬度 Vickers Hardness	布氏硬度 Brinell Hardness		洛氏硬度 Rockwell Hardness		肖氏硬度 Shore Hardness
C 标准硬度 C scale Hardness (1471N) {150kgf}		标准球 Standard Ball	碳化钨球 Tungsten Carbide Ball	A标准 A scale Load 588.4N brale 压头 brale indenter	B标准 B scale Load 980.7N 球径1.588mm 1.588mm Ball	
68	940	–	–	85.6	–	97
67	900	–	–	85.0	–	95
66	865	–	–	84.5	–	92
65	832	–	739	83.9	–	91
64	800	–	722	83.4	–	88
63	772	–	705	82.8	–	87
62	746	–	688	82.3	–	85
61	720	–	670	81.8	–	83
60	697	–	654	81.2	–	81
59	674	–	634	80.7	–	80
58	653	–	615	80.1	–	78
57	633	–	595	79.6	–	76
56	613	–	577	79.0	–	75
55	595	–	560	78.5	–	74
54	577	–	543	78.0	–	72
53	560	–	525	77.4	–	71
52	544	500	512	76.8	–	69
51	528	487	496	76.3	–	68
50	513	475	481	75.9	–	67
49	498	464	469	75.2	–	66
48	484	451	455	74.7	–	64
47	471	442	443	74.1	–	63
46	458	432	432	73.6	–	62
45	446	421	421	73.1	–	60
44	434	409	409	72.5	–	58
43	423	400	400	72.0	–	57
42	412	390	390	71.5	–	56
41	402	381	381	70.9	–	55
40	392	371	371	70.4	–	54
39	382	362	362	69.9	–	52
38	372	353	353	69.4	–	51
37	363	344	344	68.9	–	50
36	354	336	336	68.4	(109.0)	49
35	345	327	327	67.9	(108.5)	48
34	336	319	319	67.4	(108.0)	47
33	327	311	311	66.8	(107.5)	46
32	318	301	301	66.3	(107.0)	44
31	310	294	294	65.8	(106.0)	43
30	302	286	286	65.3	(105.5)	42
29	294	279	279	64.7	(104.5)	41
28	286	271	271	64.3	(104.0)	41
27	279	264	264	63.8	(103.0)	40
26	272	258	258	63.3	(102.5)	38
25	266	253	253	62.8	(101.5)	38
24	260	247	247	62.4	(101.0)	37
23	254	243	243	62.0	100.0	36
22	248	237	237	61.5	99.0	35
21	243	231	231	61.0	98.5	35
20	238	226	226	60.5	97.8	34
(18)	230	219	219	–	96.7	33
(16)	222	212	212	–	95.5	32
(14)	213	203	203	–	93.9	31
(12)	204	194	194	–	92.3	29
(10)	196	187	187	–	90.7	28
(8)	188	179	179	–	89.5	27
(6)	180	171	171	–	87.1	26
(4)	173	164	165	–	85.5	25
(2)	166	158	158	–	83.5	24
(0)	160	152	152	–	81.7	24

附表5 金属材料的物理机械性能

Appendix Table5 Physical and Mechanical Properties of Materials

材料 Materials	比重 Specific Gravity	线膨胀系数 (0℃~100℃) Coefficient of Linear Expansion (0℃ to 100℃)	硬度 (布氏) Hardness (Brinell)	纵向弹性系数 (MPa) {kgf/mm²} Modulus of Direct Elasticity (MPa) {kgf/mm²}	拉伸强度 (MPa) {kgf/mm²} Tensile Strength (MPa) {kgf/mm²}	屈服点 (MPa) {kgf/mm²} Yield Point (MPa) {kgf/mm²}	延申率 (%) Elongation (%)
轴承钢(淬火、回火) Bearing Steel (hardened)	7.83	12.5×10^{-6}	650~740	208000 {21200}	1570~1960 {160~200}	1370 {140}	0.5以下
马氏体不锈钢 SUS440C Martensitic Stainless Steel SUS 440C	7.68	10.1×10^{-6}	580	200000 {20400}	1960 {200}	1860 {190}	–
软钢(C=0.12~0.20%) Mild Steel (C=0.12 to 0.20%)	7.86	11.6×10^{-6}	100~130	206000 {21000}	373~471 {38~48}	216~294 {22~30}	24~36
硬刚(C=0.3~0.5%) Hard Steel (C=0.3 to 0.5%)	7.84	11.3×10^{-6}	160~200	206000 {21000}	539~686 {55~70}	333~451 {34~46}	14~26
奥氏体不锈钢 SUS304 Austenitic Stainless Steel SUS 304	8.03	16.3×10^{-6}	150	193000 {19700}	588 {60}	245 {25}	60
铸铁 Cast Iron 灰铸铁 FC 200 Gray Iron FC 200	7.3	10.4×10^{-6}	223以下 less than	98100 {10000}	200以上 {20以上} more than	–	–
铸铁 Cast Iron 球墨铸铁 FCD 400 Spheroidal graphite Iron FCD 400	7.0	11.7×10^{-6}	201以下 less than		400以上 {41以上} more than	–	12以上
铝 Aluminum	2.69	23.7×10^{-6}	15~26	70600 {7200}	78 {8}	34 {3.5}	35
锌 Zinc	7.14	31×10^{-6}	30~60	92200 {9400}	147 {15}	–	30~40
铜 Copper	8.93	16.2×10^{-6}	50	123000 {12500}	196 {20}	69 {7}	15~20
黄铜 Brass (退火) (Annealed)	8.5	19.1×10^{-6}	约45	103000 {10500}	294~343 {30~35}	–	65~75
黄铜 Brass (加工) (Machined)			85~130		363~539 {37~55}		15~50

备注 Remarks
经过淬火的轴承钢及马氏体不锈钢的硬度，一般以洛氏标准硬度加以表示，但为了做对比，将其换算成布氏硬度表示。
The hardness of hardened bearing steel and martensitic stainless steel is usually expressed using the Rockwell C Scale, but for comparison, it is converted into Brinell hardness.

附表6 基本公差 IT值

Appendix Table6 Values of Standard Tolerance Grades IT

基准尺寸的分类 (mm) Basic Size (mm)		公差 Standard Grades										
		IT1	IT2	IT3	IT4	IT5	IT6	IT7	IT8	IT9	IT10	IT11
超过 over	以下 inel	基本公差值（μm） Tolerances (μm)										
–	3	0.8	1.2	2	3	4	6	10	14	25	40	60
3	6	1	1.5	2.5	4	5	8	12	18	30	48	75
6	10	1	1.5	2.5	4	6	9	15	22	36	58	90
10	18	1.2	2	3	5	8	11	18	27	43	70	110
18	30	1.5	2.5	4	6	9	13	21	33	52	84	130
30	50	1.5	2.5	4	7	11	16	25	39	62	100	160
50	80	2	3	5	8	13	19	30	46	74	120	190
80	120	2.5	4	6	10	15	22	35	54	87	140	220
120	180	3.5	5	8	12	18	25	40	63	100	160	250
180	250	4.5	7	10	14	20	29	46	72	115	185	290
250	315	6	8	12	16	23	32	52	81	130	210	320
315	400	7	9	13	18	25	36	57	89	140	230	360
400	500	8	10	15	20	27	40	63	97	155	250	400
500	630	9	11	16	22	30	44	70	110	175	280	440
630	800	10	13	18	25	36	50	80	125	200	320	500
800	1000	11	15	21	29	40	56	90	140	230	360	560
1000	1250	13	18	24	33	47	66	105	165	260	420	660
1250	1600	15	21	29	39	55	78	125	195	310	500	780
1600	2000	18	25	35	46	65	92	150	230	370	600	920
2000	2500	22	30	41	55	78	110	175	280	440	700	1100
2500	3150	26	36	50	68	96	135	210	330	540	860	1350

备注 Remarks
1. 公差等级 it14 ～ it18不适用于基准尺寸1mm以下。Standard tolerance grades IT14 to IT18 shall not be used for basic sizes less than or equal to 1mm.
2. 超过500mm 的参考尺寸，公差等级 it1 ～ it5的公差值是供实验使用的临时值。
Values for standard tolerance grades IT1 to IT5 for basic sizes over 500mm are included for experimental use.

基准尺寸的分类 (mm) Basic Size (mm)		公差 Standard Grades						
		IT12	IT13	IT14	IT15	IT16	IT17	IT18
超过 over	以下 inel	基本公差值（mm） Tolerances (mm)						
–	3	0.10	0.14	0.25	0.40	0.60	1.00	1.40
3	6	0.12	0.18	0.30	0.48	0.75	1.20	1.80
6	10	0.15	0.22	0.36	0.58	0.90	1.50	2.20
10	18	0.18	0.27	0.43	0.70	1.10	1.80	2.70
18	30	0.21	0.33	0.52	0.84	1.30	2.10	3.30
30	50	0.25	0.39	0.62	1.00	1.60	2.50	3.90
50	80	0.30	0.46	0.74	1.20	1.90	3.00	4.60
80	120	0.35	0.54	0.87	1.40	2.20	3.50	5.40
120	180	0.40	0.63	1.00	1.60	2.50	4.00	6.30
180	250	0.46	0.72	1.15	1.85	2.90	4.60	7.20
250	315	0.52	0.81	1.30	2.10	3.20	5.20	8.10
315	400	0.57	0.89	1.40	2.30	3.60	5.70	8.90
400	500	0.63	0.97	1.55	2.50	4.00	6.30	9.70
500	630	0.70	1.10	1.75	2.80	4.40	7.00	11.00
630	800	0.80	1.25	2.00	3.20	5.00	8.00	12.50
800	1000	0.90	1.40	2.30	3.60	5.60	9.00	14.00
1000	1250	1.05	1.65	2.60	4.20	6.60	10.50	16.50
1250	1600	1.25	1.95	3.10	5.00	7.80	12.50	19.50
1600	2000	1.50	2.30	3.70	6.00	9.20	15.00	23.00
2000	2500	1.75	2.80	4.40	7.00	11.00	17.50	28.00
2500	3150	2.10	3.30	5.40	8.60	13.50	21.00	33.00

附表7 ISC/NSK 与其他公司产品的轴承型号对照表
Appendix Table7 Conversion

（1）米制系列 单列深沟求轴承（开放型）
Deep groove ball bearings：Open type (Metric series)

轴径 Bore diameter (mm)	(inch)	ISC/NSK	NMB	NTN
1	0.0394	681	L-310	681
		MR31	L-310W51	–
		691	R-410	691
1.2	0.0472	MR41X	R-412	BC1.2-4
1.5	0.0591	681X	L-415	68/1.5
		691X	R-515	69/1.5
		601X	R-615	60/1.5
2	0.0787	682	L-520	682
		MR52B	L-520W02	BC2-5
		692	R-620	692
		MR62	R-620W52	BC2-6
		MR72	R-720Y52	BC2-7A
		602	R-720	602
2.5	0.0984	682X	L-625	68/2.5
		692X	R-725	69/2.5
		MR82X	R-825Y52	BC2.5-8
		602X	R-825	60/2.5
3	0.1181	MR63	L-630	673
		683A	L-730	683
		MR83	R-830Y52	BC3-8
		693	R-830	693
		MR93	R-930Y52	BC3-9
		603	R-930	603
		623	R-1030	623
		633	–	633
4	0.1575	MR74	L-740	674A
		MR84	L-840	BC4-8
		684A	L-940	684AX50
		MR104B	L-1040X2	BC4-10
		694	R-1140	694
		604	R-1240	604
		624	R-1340	624
		634	R-1640	634
5	0.1969	MR85	L-850	675
		MR95	L-950	BC5-9
		MR105	L-1050	BC5-10
		685	L-1150	685
		695	R-1350	695A
		605	R-1450	605
		625	R-1650	625
		635	R-1950	635

轴径 Bore diameter (mm)	(inch)	ISC/NSK	NMB	NTN
6	0.2362	MR106	L-1060	676A
		MR126	L-1260	BC6-12
		684A	L-1360	686
		696	R-1560X2	696
		606	R-1760X2	606
		626	R-1960	626
		636	–	636
7	0.2756	MR117	L-1170	677
		MR137	L-1370	BC7-13
		687	L-1470	687A
		697	–	697
		607B	R-1970	607
		627	R-2270	627
		637	–	637
8	0.3150	MR128	L-1280	678A
		MR148	L-1480	BC8-14
		688A	L-1680	688A
		698	R-1980	698
9	0.3543	689	L-1790	689
如果是不锈钢 In case of stainless steel		JIS 型号在基本编号后带有"-H-" 694-H-	DD □	F-□
例 Example		特殊尺寸型号是基本编号的开头添加"S" SMR117	DDL-1170	F-677

（2）米制系列　单列深沟球轴承（两侧防尘盖型）
Deep groove ball bearings：Shielded type (Metric series)

轴径 Bore diameter (mm)	(inch)	ISC/NSK	NMB	NTN
1.5	0.0591	**681XZZ**	L-415X5ZZ	W68/1.5ZZA
		691XZZ	R-515ZZ	W69/1.5ZZA
		601	R-615ZZ	W60/1.5ZZA
2	0.0787	**682ZZ**	L-520ZZ	W682ZZA
		MR52BZZ	L-520ZZW52	WBC2-5ZZA
		692ZZ	R-620ZZ	W692ZZA
		MR62ZZ	R-620ZZY52	–
		MR72ZZ	R-720ZZY03	WBC2-7ZZA
		602ZZ	R-720ZZ	W602ZZA
2.5	0.0984	**682XZZ**	L-625ZZ	W68/2.5ZZA
		692XZZ	R-725ZZ	W69/2.5ZZA
		602XZZ	R-825ZZ	W60/2.5ZZA
3	0.1181	**MR63ZZ**	L-630ZZ	WA673ZZA
		683AZZ	L-730ZZ	W683ZZ
		693ZZ	R-830ZZ	W693ZZ
		MR93ZZ	R-930ZZY04	WBC3-9ZZA
		623ZZ	R-1030ZZ	623ZZ
		633ZZ	–	633ZZ
4	0.1575	**MR74ZZ**	L-740ZZ	WA674ZZA
		MR84ZZ	L-840ZZ	WBC4-8ZZ
		684AZZ	L-940ZZ	W684AX50ZZ
		MR104BZZ	L-1040X2ZZ	WBC4-10ZZ
		694ZZ	R-1140ZZ	694ZZ
		604ZZ	R-1240KK1	604ZZ
		624ZZ	R-1340HH	624ZZ
		634ZZ1	R-1640HH	634ZZ
5	0.1969	**MR85ZZ**	L-850ZZ	WA675ZZ
		MR95ZZ1	L-950ZZ	WBC5-9ZZ
		MR105ZZ	L-1050ZZ	WBC5-10ZZ
		685ZZ	L-1150ZZ	W685ZZ
		695ZZ	R-1350ZZ	695AZZ
		605ZZ	R-1450ZZ	605ZZ
		625ZZ1	R-1650HH	625ZZ
		635ZZ1	635ZZ	635ZZ

轴径 Bore diameter (mm)	(inch)	ISC/NSK	NMB	NTN
6	0.2362	**MR106ZZ1**	L-1060ZZ	WA676AZZ
		MR126ZZ	L-1260ZZ	WBC6-12ZZ
		686AZZ1	L-1360ZZ	W686ZZ
		696ZZ1	R-1560X13KK	696ZZ
		606ZZ	R-1760X2ZZ	606ZZ
		626ZZ1	R-1960ZZ	626ZZ
		636ZZ	–	636ZZ
7	0.2756	**MR117ZZ**	L-1170ZZ	WA677ZZ
		MR137ZZ	L-1370ZZ	WBC7-13ZZ
		687ZZ1	L-1470KK	W687AZZ
		697ZZ1	–	697ZZ
		607ZZ1	R-1970ZZ	607ZZ
		627ZZ	R-2270HH	627ZZ
		637ZZ	–	637ZZ
8	0.3150	**MR128ZZ1**	L-1280ZZ	W678AZZ
		MR148ZZ	L-1480ZZ	WBC8-14ZZ
		688AZZ1	L-1680ZZ	W688AZZ
		698ZZ	R-1980KK	698ZZ
		608ZZ	R-2280ZZ	608ZZ
9	0.3543	**689ZZ1**	L-1790ZZ	W689ZZ
如果是不锈钢 In case of stainless steel		JIS 型号在基本编号后带有“-H-” **694ZZ-H-**	DD□	F-□
例 Example		特殊尺寸型号是基本编号的开头添加“S” **SMR117ZZ**	DDL-1170ZZ	F-WA677ZZ

（3）米制系列　带挡边的深沟球轴承（开放型）

Deep groove ball bearings with flanged outer ring : Open type (Metric series)

轴径 Bore diameter (mm)	(inch)	ISC/NSK	NMB	NTN
1	0.0394	**F681**	LF-310	FL681
		F691	RF-410	FL691
1.2	0.0472	**MF41X**	RF-412	FLBC1.2-4
1.5	0.0591	**F681X**	LF-415	FL68/1.5
		F691X	RF-515	FL69/1.5A
		F601X	RF-615	FL60/1.5
2	0.0787	**F682**	LF-520	FL682
		MF52B	–	–
		F692	RF-620	FL692
		MF62	RF-620W52	FLBC2-6
		MF72	RF-720Y52	–
		F602	RF-720	FL602
2.5	0.0984	**F682X**	LF-625	FL68/2.5
		F692X	RF-725	FL69/2.5
		MF82X	RF-825Y52	FLBC2.5-8
		F602X	RF-825	FL60/2.5
3	0.1181	**MF63**	LF-630	FL673
		F683A	LF-730	FL683
		MF83	RF-830Y52	FLBC3-8
		F693	RF-830	FL693
		MF93	RF-930Y52	FLBC3-9
		F603	RF-930	FL603
		F623	RF-1030	FL623
4	0.1575	**MF74**	LF-740	FL674A
		MF84	LF-840	FLBC4-8
		F684A	LF-940	FL684AX50
		MF104B	LF-1040	FLBC4-10
		F694	RF-1140	FL694
		F604	RF-1240	FL604
		F624	RF-1340	FL624
		F634	RF-1640	–
5	0.1969	**MF85**	LF-850	FL675
		MF95	LF-950	FLBC5-9
		MF105	LF-1050	FLBC5-10
		F685	LF-1150	FL685
		F695	RF-1350	FL695A
		F605	RF-1450	FL605
		F625	RF-1650	FL625
		F635	RF-1950	–

轴径 Bore diameter (mm)	(inch)	ISC/NSK	NMB	NTN
6	0.2362	**MF106**	LF-1060	FL676A
		MF126	LF-1260	FLBC6-12
		F686A	LF-1360	FL686
		F696	RF-1560	FL696
		F606	RF-1760X2	FL606
		F626	RF-1960	FL626
		F636	–	–
7	0.2756	**MF117**	LF-1170	FL677
		MF137	LF-1370	FLBC7-13
		F687	LF-1470	FL687A
		F697	–	FL697
		F607	–	–
		F627	RF-2270	–
8	0.3150	**MF128**	LF-1280	FL678A
		MF148	LF-1480	FLBC8-14
		F688A	LF-1680	FL688A
		F698	RF-1980	FL698
9	0.3543	**F689**	LF-1790	FL689
如果是不锈钢 In case of stainless steel 例 Example		JIS 型号在基本编号后带有"-H-" **F694-H-** 特殊尺寸型号是基本编号的开头添加"S" **SMF117**	DD ☐ DDLF-1170	F- ☐ F-FL677

（4）米制系列 带挡边的深沟球轴承（两侧防尘盖型）

Deep groove ball bearings with flanged outer ring : Shielded type (Metric series)

轴径 Bore diameter (mm)	(inch)	ISC/NSK	NMB	NTN
1.5	0.0591	**F681XZZ**	LF-415ZZ	FLW68/1.5ZZA
		F691XZZ	RF-515ZZ	FLW69/1.5ZZA
		F601XZZ	RF-615ZZ	FLW60/1.5ZZA
2	0.0787	**F682ZZ**	LF-520ZZ	FLW682ZZA
		MF52BZZ	–	–
		F692ZZ	RF-620ZZ	FLW692ZZA
		MF72ZZ	RF-720ZZY03	FLWBC2-7ZZA
		F602ZZ	RF-720ZZ	FLW602ZZA
2.5	0.0984	**F682XZZ**	LF-625ZZ	FLW68/2.5ZZA
		F692XZZ	RF-725ZZ	FLW69/2.5ZZA
		F602XZZ	RF-825ZZ	FLW60/2.5ZZA
3	0.1181	**MF63ZZ**	LF-630ZZ	FLWA673ZZA
		F683AZZ	LF-730ZZ	FLW683ZZ
		F693ZZ	RF-830ZZ	FLW693ZZ
		MF93ZZ	RF-930ZZY04	FLAWBC3-9ZZA
		F603ZZ	RF-930ZZ	FLW603ZZ
		F623ZZ	RF-1030ZZ	FL623ZZ
4	0.1575	**MF74ZZ**	LF-740ZZ	FLWA674AZZA
		MF84ZZ	LF-840ZZ	FLWBC4-8ZZ
		F684AZZ	LF-940ZZ	FLW684AX50ZZ
		MF104BZZ	LF-1040ZZ	FLAWBC4-10ZZ
		F694ZZ	RF-1140ZZ	FL694ZZ
		F604ZZ	RF-1240ZZ	FL604ZZ
		F624ZZ	RF-1340ZZ	FL624ZZ
		F634ZZ1	RF-1640ZZ	FL634ZZ
5	0.1969	**MF85ZZ**	LF-850ZZ	FLWA675ZZ
		MF95ZZ	LF-950ZZ	FLWBC5-9ZZ
		MF105ZZ	LF-1050ZZ	FLAWBC5-10ZZ
		F685ZZ	LF-1150ZZ	FLW685ZZ
		F695ZZ1	RF-1350ZZ	FL695AZZ
		F605ZZ	RF-1450ZZ	FL605ZZ
		F625ZZ1	RF-1650HH	FL625ZZ
		F635ZZ1	RF-1950ZZ	FL635ZZ

轴径 Bore diameter (mm)	(inch)	ISC/NSK	NMB	NTN
6	0.2362	**MF106ZZ1**	LF-1060ZZ	FLWA676AZZA
		MF126ZZ	LF-1260ZZ	FLAWBC6-12ZZ
		F686AZZ1	LF-1360ZZ	FLW686ZZ
		F696ZZ1	RF-1560ZZ	FL696ZZ
		F606ZZ	RF-1760X2ZZ	FL606ZZ
		F626ZZ1	RF-1960ZZ	FL626ZZ
		F636ZZ	–	–
7	0.2756	**MF117ZZ**	LF-1170ZZ	FLWA677ZZA
		MF137ZZ	LF-1370ZZ	FLAWBC7-13ZZ
		F687ZZ1	LF-1470ZZ	FLW687AZZ
		F697ZZ1	–	FL697ZZ
		F607ZZ1	RF-1970ZZ	FL607ZZ
		F627ZZ	RF-2270HH	FL627ZZ
8	0.3150	**MF128ZZ1**	LF-1280ZZ	FLAW678AZZ
		MF148ZZ	LF-1480ZZ	FLWBC8-14ZZ
		F688AZZ1	LF-1680HH	FLW688AZZ
		F698ZZ1	RF-1980ZZ	FL698ZZ
		F608ZZ	RF-2280HH	FL608ZZ
9	0.3543	**F689ZZ**	LF-1790ZZ	FLW689ZZ
		F699ZZ1	–	FL699ZZ
如果是不锈钢 In case of stainless steel		JIS 型号在基本编号后带有“-H-” **F694ZZ-H-**	DD ☐	F- ☐
例 Example		特殊尺寸型号是基本编号的开头添加“S” **SMF117ZZ**	DDLF-1170ZZ	F-FLWA677ZZA

(5) 英制系列　单列深沟球轴承（开放型）

Deep groove ball bearings：Open type (Inch series)

轴径 Bore diameter (mm)	(inch)	ISC/NSK	BARDEN	MPB	RMB	NMB	NTN
1.016	0.0400	**R09**	–	2C	UL1304	RI-2X2	R01
1.191	0.0469	**R0**	R0	25C	UL1505	RI-2$\frac{1}{2}$	R0
1.397	0.0550	**R1**	R1	3C	R1706	RI-3	R1
1.984	0.0781	**R1-4**	R1-4	4C	R2508	RI-4	R1-4
2.380	0.0937	**R133**	R133	3332C	UL3006	RI-3332	R133
		R1-5	R1-5	5C	R3010	RI-5	R1-5
3.175	0.1250	**R144**	R144	418C	UL4008	RI-418	R144
		R2-5	R2-5	518C	R4010	RI-518	R2-5
		R2-6	R2-6	618C	–	RI-618	RA2-6
		R2	R2	R2C	R4012	R-2	R2
		R2A	R2A	R2AC	–	–	RA2
3.967	0.1562	**R155**	R155	5532C	UL5010	RI-5532	RA155
4.762	0.1875	**R156**	R156	5632C	UL6010	RI-5632	R156
		R166	R166	6316C	UL6012	RI-6632	R166
		R3	R3	R3C	R6016	R-3	R3
6.350	0.2500	**R168BZZ**	R168	614C	UL8012	RI-614	R168A
		R188	R188	814C	UL8016	RI-814	R188
		R4B	R4	R4C	R8020	R-4	R4
		R4AA	R4A	R4AR	–	RI-1214	–
7.938	0.3125	**R1810**	R1810	8516C	–	RI-8516	–
如果是不锈钢 In case of stainless steel 例 Example		特殊尺寸型号是基本编号的开头添加"S" **SR166**	S ☐ SR166	S ☐ S6316C	☐ X UL6012X	DD ☐ DDRI-6632	F- ☐ F-R166

(6) 英制系列　单列深沟球轴承（两侧防尘盖型）

Deep groove ball bearings：Shielded type (Inch series)

軸径 Bore diameter (mm)	(inch)	ISC/NSK	BARDEN	MPB	RMB	NMB	NTN
1.191	0.0469	**R0ZZ**	R0SS	25CHH	ULZ1505	RI-2$\frac{1}{2}$ZZ	RA0ZZA
1.397	0.0550	**R1ZZ**	R1SS	3CHH	RX1706	RI-3ZZ	RA1ZZA
1.984	0.0781	**R1-4ZZ**	R1-4SS	4CHH	RX2508	RI-4ZZ	RA1-4ZZA
2.380	0.0937	**R133ZZS**	R133SS	3332CHH	ULZ3006	RI-3332ZZ	RA133ZZA
		R1-5ZZ	R1-5SS	5CHH	RX3010	RI-5ZZ	RA1-5ZZA
3.175	0.1250	**R144ZZ**	R144SS	418CHH	ULZ4008	RI-418ZZ	RA144ZZA
		R2-5ZZ	R2-5SS	518CHH	RX4010	RI-518ZZ	RA2-5ZZ
		R2-6ZZ	R2-6SS	618CHH	–	RI-618ZZ	RA2-6ZZA
		R2ZZ	R2SS	R2CHH	RX4012	R-2ZZ	RA2ZZA
		R2AZZ	R2ASS	R2ACHH	–	–	RA2ZZ
3.967	0.1562	**R155ZZ**	R155SS	5532CHH	ULZ5010	RI-5532ZZ	RA155ZZA
4.762	0.1875	**R156ZZ**	R156SS	5632CHH	ULZ6010	RI-5632ZZ	RA156ZZ
		R166ZZ	R166SS	6316CHH	ULZ6012	RI-6632ZZ	RA166ZZ
		R3ZZ	R3SS	R3CHH	RX6016	R-3HH	RA3ZZ
6.350	0.2500	**R168BZZS**	R168SS	614CHH	ULZ8012	RI-614ZZ	R168AZZ
		R188ZZ	R188SS	814CHH	ULZ8016	RI-814ZZ	RA188ZZA
		R4BZZ	R4SS	R4CHH	RX8020	R-4KK	R4ZZ
		R4AAZZ	R4ASS	R4ARHH	–	RI-1214ZZ	RA4ZZ
7.938	0.3125	**R1810ZZ**	R1810SS	8516CHH	–	RI-8516ZZ	–
如果是不锈钢 In case of stainless steel 例 Example		特殊尺寸型号是基本编号的开头添加"S" **SR166ZZ**	S ☐ SR166SS	S ☐ S6316CHH	☐ X ULZ6012X	DD ☐ DDRI-6632ZZ	F- ☐ F-RA166ZZ

(7) 英制系列　带挡边的深沟球轴承（开放型）

Deep groove ball bearings with flanged outer ring : Open type (Inch series)

轴径 Bore diameter (mm)	(inch)	ISC/NSK	BARDEN	MPB	RMB	NMB	NTN
1.191	0.0469	**FR0**	FR0	25FC	ULK1505	RIF-2 $\frac{1}{2}$	FLR0
1.397	0.0550	**FR1**	FR1	3FC	RK1706	RIF-3	FLR1
1.984	0.0781	**FR1-4**	FR1-4	4FC	RK2508	RIF-4	FLR1-4
2.380	0.0937	**FR133**	FR133	3332FC	ULK3006	RIF-3332	FLR133
		FR1-5	FR1-5	5FC	RK3010	RIF-5	FLR1-5
3.175	0.1250	**FR144**	FR144	418FC	ULK4008	RIF-418	FLR144
		FR2-5	FR2-5	518FC	RK4010	RIF-518	FLR2-5
		FR2-6	FR2-6	618FC	–	RIF-618	FLR2-6
		FR2	FR2	R2FC	RK4012	RF-2	FLR2
3.967	0.1562	**FR155**	FR155	5532FC	ULK5010	RIF-5532	FLR155
4.762	0.1875	**FR156**	FR156	5632FC	ULK6010	RIF-5632	FLR156
		FR166	FR166	6316FC	ULK6012	RIF-6632	FLR166
		FR3	FR3	–	RK6016	–	FLRA3
6.350	0.2500	**FR168B**	FR168	614FC	ULK8012	RIF-614	FLR168
		FR188	FR188	814FC	ULK8016	RIF-814	FLR188
		FR4B	FR4	R4FC	RK8020	RF-4	FLR4
7.938	0.3125	**FR1810**	FR1810	8516FC	–	RIF-8516	–
如果是不锈钢 In case of stainless steel 例 Example		特殊尺寸型号是基本编号的开头添加"S" **SFR166**	S ☐ SFR166	S ☐ S6316FC	☐ X ULK6012X	DD ☐ DDRIF-6632	F- ☐ F-FLR166

(8) 英制系列　带挡边的深沟球轴承（两侧防尘盖型）

Deep groove ball bearings with flanged outer ring : Shielded type (Inch series)

轴径 Bore diameter (mm)	(inch)	ISC/NSK	BARDEN	MPB	RMB	NMB	NTN
1.191	0.0469	**FR0ZZ**	FR0SS	25FCHH	ULKZ1505	RIF-2 $\frac{1}{2}$ZZ	FLRA0ZZA
1.397	0.0550	**FR1ZZ**	FR1SS	3FCHH	RKX1706	RIF-3ZZ	FLRA1ZZA
1.984	0.0781	**FR1-4ZZ**	FR1-4SS	4FCHH	RKX2508	RIF-4ZZ	FLRA1-4ZZA
2.380	0.0937	**FR133ZZS**	FR133SS	3332FCHH	ULKZ3006	RIF-3332ZZ	FLRA133ZZA
		FR1-5ZZ	FR1-5SS	5FCHH	RKX3010	RIF-5ZZ	FLRA2-5ZZA
3.175	0.1250	**FR144ZZ**	FR144SS	418FCHH	ULKZ4008	RIF-418ZZ	FLRA144ZZA
		FR2-5ZZ	FR2-5SS	518FCHH	RKF4010	RIF-518ZZ	FLRA2-5ZZ
		FR2-6ZZ	FR2-6SS	618FCHH	–	RIF-618ZZ	FLRA2-6ZZA
		FR2ZZ	FR2SS	R2FCHH	RKF4012	RF-2ZZ	FLR2ZZA
3.967	0.1562	**FR155ZZ**	FR155SS	5532FCHH	ULKZ5010	RIF-5532ZZ	FLRA155ZZA
4.762	0.1875	**FR156ZZ**	FR156SS	5632FCHH	ULKZ6010	RIF-5632ZZ	FLRA156ZZ
		FR166ZZ	FR166SS	6316FCHH	ULKZ6012	RIF-6632ZZ	FLRA166ZZ
		FR3ZZ	FR3SS	R3FCHH	RKF6016	RF-3ZZ	FLRA3ZZ
6.350	0.2500	**FR168BZZ**	FR168SS	614FCHH	ULKZ8012	RIF-614ZZ	FLRA168ZZA
		FR188ZZ	FR188SS	814FCHH	ULKZ8016	RIF-814ZZ	FLRA188ZZA
		FR4BZZ	FR4SS	R4FCHH	RKF8020	RF-4HH	FLR4ZZ
7.938	0.3125	**FR1810ZZ**	FR1810SS	8516FCHH	–	RIF-8516ZZ	–
如果是不锈钢 In case of stainless steel 例 Example		特殊尺寸型号是基本编号的开头添加"S" **SFR166ZZ**	S ☐ SFR166SS	S ☐ S6316FCHH	☐ X ULKZ6012X	DD ☐ DDRIF-6632ZZ	F- ☐ F-FLRA166ZZ

（9）英制系列　内轮宽幅形深沟球轴承（开放型）

Deep groove ball bearings with extended inner ring : Open type (Inch series)

轴径 Bore diameter (mm)	(inch)	ISC/NSK	BARDEN	MPB	RMB	NMB	NTN
1.191	0.0469	**RW0**	RW0	25CE	ULU1505	RI-2 1/2 EE	RW0
1.397	0.0550	**RW1**	RW1	3CE	RU1706	RI-3EE	RW1
1.984	0.0781	**RW1-4**	RW1-4	4CE	–	RI-4EE	RW1-4
2.380	0.0937	**RW133**	RW133	3332CE	ULU3006	RI-3332EE	RW133
		RW1-5	RW1-5	5CE	RU3010	RI-5EE	RW1-5
3.175	0.1250	**RW144**	RW144	418CE	ULU4008	RI-418EE	RW144
		RW2-5	RW2-5	518CE	RU4010	RI-518EE	RW2-5
		RW2-6	RW2-6	618CE	–	RI-618EE	RW2-6
		RW2	RW2	R2CE	–	R-2EE	RW2
3.967	0.1562	**RW155**	RW155	5532CE	–	RI-5532EE	RW155
4.762	0.1875	**RW156**	–	5632CE	ULU6010	RI-5632EE	RW156
		RW166	RW166	6316CE	ULU6012	RI-6632EE	RW166
6.350	0.2500	**RW3**	RW3	R3CE	–	–	–
		RW168B	RW168	614CE	ULU8012	RI-614EE	RW168A
		RW188	RW188	814CE	–	RI-814EE	RW188
7.938	0.3125	**RW4B**	RW4B	R4CE	–	–	–
		RW1810	RW1810	8516CE	–	RI-8516EE	RW1810
如果是不锈钢 In case of stainless steel 例 Example		特殊尺寸型号是基本编号的开头添加"S" **SRW166**	S □ SRW166	S □ S6316CE	□ X ULU6012X	DD □ DDRI-6632EE	F- □ F-RW166

（10）英制系列　内轮宽幅形深沟球轴承（两侧防尘盖型）

Deep groove ball bearings with extended inner ring : Shielded type (Inch series)

轴径 Bore diameter (mm)	(inch)	ISC/NSK	BARDEN	MPB	RMB	NMB	NTN
1.191	0.0469	**RW0ZZ**	–	25CHHE	–	RI-2 1/2 ZZEE	RAW0ZZA
1.397	0.0550	**RW1ZZ**	–	3CHHE	–	RI-3ZZEE	RAW1ZZA
1.984	0.0781	**RW1-4ZZ**	RW1-4SS	4CHHE	–	RI-4ZZEE	RAW1-4ZZA
2.380	0.0937	**RW133ZZS**	RW133SS	3332CHHE	–	RI-3332ZZEE	RAW133ZZA
		RW1-5ZZ	RW1-5SS	5CHHE	–	RI-5ZZEE	RAW1-5ZZA
3.175	0.1250	**RW144ZZ**	RW144SS	418CHHE	ULUZ4008	RI-418ZZEE	RAW144ZZA
		RW2-5ZZ	RW2-5SS	518CHHE	–	RI-518ZZEE	RAW2-5ZZA
		RW2-6ZZS	RW2-6SS	618CHHE	–	RI-618ZZEE	RAW2-6ZZA
		RW2ZZ	RW2SS	R2CHHE	–	R-2ZZEE	RW2ZZA
3.967	0.1562	**RW155ZZS**	RW155SS	5532CHHE	ULUZ5010	RI-5532ZZEE	RAW155ZZA
4.762	0.1875	**RW156ZZS**	RW156SS	5632CHHE	ULUZ6010	RI-5632ZZEE	RAW156ZZA
		RW166ZZ	RW166SS	6316CHHE	ULUZ6012	RI-6632ZZEE	RW166ZZA
6.350	0.2500	**RW3ZZ**	RW3SS	R3CHHE	–	–	–
		RW168BZZ	RW168SS	614CHHE	ULUZ8012	RI-614ZZEE	RW168AZZA
		RW188ZZ	RW188SS	814CHHE	–	RI-814ZZEE	RAW188ZZA
7.938	0.3125	**RW4BZZ**	RW4BSS	–	–	–	–
		RW1810ZZ	RW1810SS	8516CHHE	–	RI-8516EE	RW1810ZZA
如果是不锈钢 In case of stainless steel 例 Example		特殊尺寸型号是基本编号的开头添加"S" **SRW166ZZ**	S □ SRW166SS	S □ S6316CHHE	□ X ULUZ6012X	DD □ DDRI-6632ZZEE	F- □ F-RW166ZZA

（11）英制系列　带挡边内轮宽幅形深沟球轴承（开放型）

Deep groove ball bearings with extended inner ring, flanged, open type (Inch series)

轴径 Bore diameter (mm)	(inch)	ISC/NSK	BARDEN	MPB	RMB	NMB	NTN
1.191	0.0469	**FRW0**	FRW0	25FCE	ULKU1505	RIF-2 $\frac{1}{2}$ EE	FLRW0
1.397	0.0550	**FRW1**	FRW1	3FCE	RKU1706	RIF-3EE	FLRW1
1.984	0.0781	**FRW1-4**	FRW1-4	4FCE	–	RIF-4EE	FLRW1-4
2.380	0.0937	**FRW133**	FRW133	3332FCE	ULKU3006	RIF-3332EE	FLRW133
		FRW1-5	FRW1-5	5FCE	RKU3010	RIF-5EE	FLRW1-5
3.175	0.1250	**FRW144**	FRW144	418FCE	ULKU4008	RIF-418EE	FLRW144
		FRW2-5	FRW2-5	518FCE	RKU4010	RIF-518EE	FLRW2-5
		FRW2-6	FRW2-6	618FCE	–	RIF-618EE	FLRW2-6
		FRW2	FRW2	R2FCE	–	RF-2EE	FLRW2
3.967	0.1562	**FRW155**	FRW155	5532FCE	–	RIF-5532EE	FLRW155
4.762	0.1875	**FRW156**	FRW156	5632FCE	ULKU6010	RIF-5632EE	FLRW156
		FRW166	FRW166	6316FCE	ULKU6012	RIF-6632EE	FLRW166
6.350	0.2500	**FRW3**	FRW3	R3FCE	–	–	–
		FRW168B	FRW168	614CE	ULKU8012	RIF-614EE	FLRW168A
		FRW188	FRW188	814CE	–	RIF-814EE	FLRW188
7.938	0.3125	**FRW4B**	FRW4B	R4FCE	–	–	–
		FRW1810	FRW1810	8516CE	–	RIF-8516EE	–
如果是不锈钢 In case of stainless steel 例 Example		特殊尺寸型号是基本编号的开头添加"S" **SFRW166**	S □ SFRW166	S □ S6316FCE	□ X ULKU6012X	DD □ DDRIF-6632EE	F- □ F-FLRW166

（12）英制系列　带挡边内轮宽幅形深沟球轴承（两侧防尘盖型）

Deep groove ball bearings with extended inner ring, flanged, shielded type (Inch series)

轴径 Bore diameter (mm)	(inch)	ISC/NSK	BARDEN	MPB	RMB	NMB	NTN
1.191	0.0469	**FRW0ZZ**	–	25FCHHE	–	RIF-2 $\frac{1}{2}$ ZZEE	FLRAW0ZZA
1.397	0.0550	**FRW1ZZ**	–	3FCHHE	–	RIF-3ZZEE	FLRAW1ZZA
1.984	0.0781	**FRW1-4ZZ**	FRW1-4SS	4FCHHE	–	RIF-4ZZEE	FLRAW1-4ZZA
2.380	0.0937	**FRW133ZZS**	FRW133SS	3332FCHHE	–	RIF-3332ZZEE	FLRAW133ZZA
		FRW1-5ZZ	FRW1-5SS	5FCHHE	–	RIF-5ZZEE	FLRAW1-5ZZA
3.175	0.1250	**FRW144ZZ**	FRW144SS	418FCHHE	ULKUZ4008	RIF-418ZZEE	FLRAW144ZZA
		FRW2-5ZZ	FRW2-5SS	518FCHHE	–	RIF-518ZZEE	FLRAW2-5ZZA
		FRW2-6ZZS	FRW2-6SS	618FCHHE	–	RIF-618ZZEE	FLRAW2-6ZZA
		FRW2ZZ	FRW2SS	R2FCHHE	–	RIF-2ZZEE	FLRW2ZZA
3.967	0.1562	**FRW155ZZS**	FRW155SS	5532FCHHE	ULKUZ5010	RIF-5532ZZEE	FLRAW155ZZA
4.762	0.1875	**FRW156ZZS**	FRW156SS	5632FCHHE	ULKUZ6010	RIF-5632ZZEE	FLRAW156ZZA
		FRW166ZZ	FRW166SS	6316FCHHE	ULKUZ6012	RIF-6632ZZEE	FLARW166ZZA
6.350	0.2500	**FRW3ZZ**	–	R3FCHHE	–	–	–
		FRW168ZZ	FRW168SS	614FCHHE	ULKUZ8012	RIF-614ZZEE	FLARW168AZZA
		FRW188ZZ	FRW188SS	814FCHHE	–	RIF-814ZZEE	FLRAW188ZZA
7.938	0.3125	**FRW4BZZ**	–	R4FCHHE	–	–	–
		FRW1810ZZ	FRW1810SS	8516FCHHE	–	RIF-8516ZZEE	–
如果是不锈钢 In case of stainless steel 例 Example		特殊尺寸型号是基本编号的开头添加"S" **SFRW166ZZ**	S □ SFRW166SS	S □ S6316FCHHE	□ X ULKUZ6012X	DD □ DDRIF-6632ZZEE	F- □ F-FLARW166ZZA