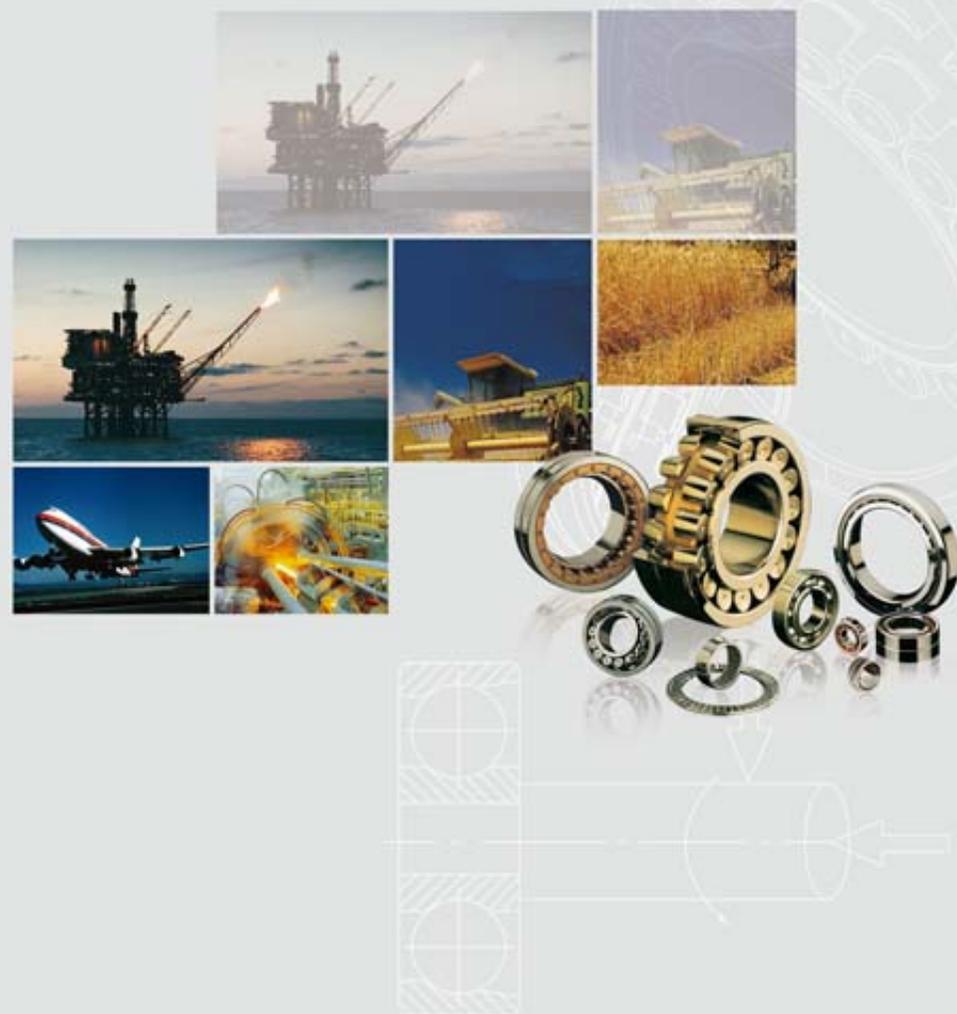


Jiangsu TWB Bearings Co., Ltd
Address: No.8 Rongyang Yi Road, Xishan Economic
Development Zone, Wuxi, Jiangsu
Post Code: 214192
Telephone: 86-510-8562 0688
Sales Tel: 86-510-8562 7206 8562 6109
Fax: 86-510-8562 6208 8562 6308 8562 9206
Website: www.TWB.com.cn

Bearing basic knowledge



TWB® and 帝达贝® are the licensed trademark of Jiangsu TWB Bearings Co., Ltd

© 2007 中国印制
09-20-2007 编号: 1006E

本资料版权归本公司所有, 不得翻印, 违者必究, 如有改动, 恕不另行通知。

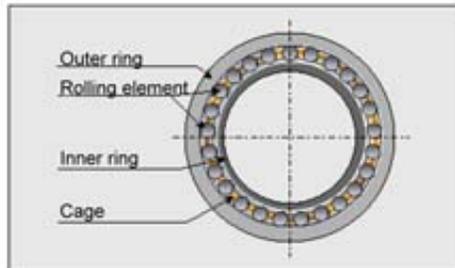
- Centennial Experience,
Brand Commitments
- Professional Techniques,
Lean Manufacture
- Stringent System,
Stable Quality
- Prompt Delivery,
Specialized Service
- East-and-West Merge,
Value Appreciation



1. Internal structure

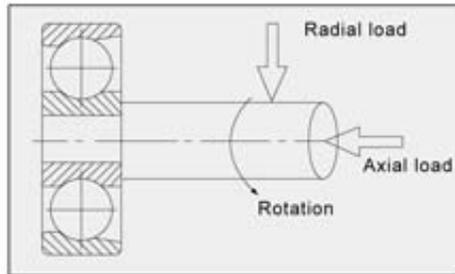
A bearing is composed of inner ring, outer ring, rolling elements and cage that are usually called four parts.

In a sealed bearings there are additional lubricant and sealing part that added above four parts are usually called six parts.

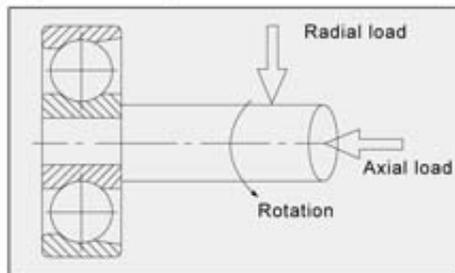


2. Working conditions

A bearing can bear an appropriate radial or/and axial load and rotate at a limited speed.



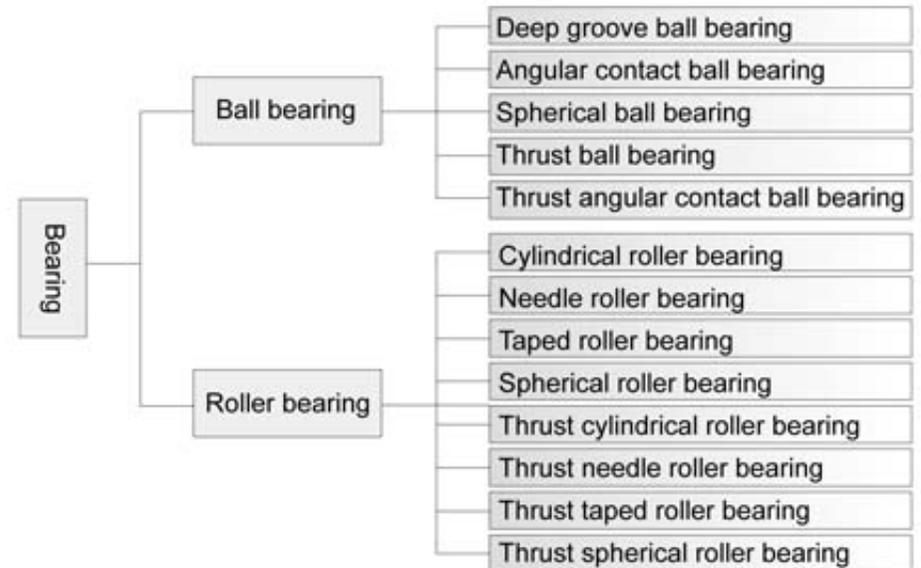
A bearing with different precision has different rotating accuracy.



Selecting a correct bearing based on working conditions can best exert bearing functions and extend the life of bearing. Following conditions shall be considered when select a bearing:

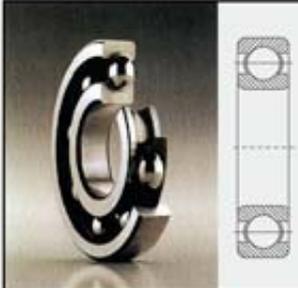
- 1 radial load; 2 axial load;
- 3 rotation speed; 4 radial runout;
- 5 axial runout; 6 working temperature;
- 7 noise requirement; 8 lubrication condition; etc.

3. Basic types





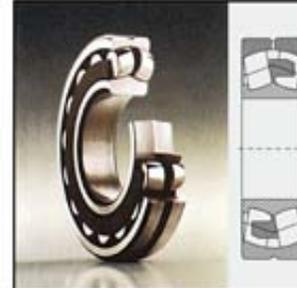
Deep groove ball bearing



Features:

1. High speed
2. High precision
3. Low noise and small vibration
4. Mainly bear radial load
5. Withstand fair axial load too
6. Simple manufacturing, low cost

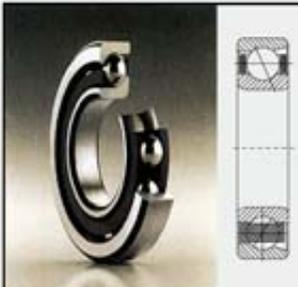
Spherical roller bearing



Features:

1. Low speed, high resistance to impact, vibration
2. able to self-align
3. mainly bear big radial load
4. can bear fair axial load

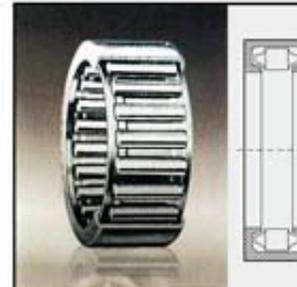
Angular contact ball bearing



Features:

1. High speed
2. High precision
3. Low noise and small vibration
4. Can withstand radial load and axial load simultaneously
5. Can be used in duplex

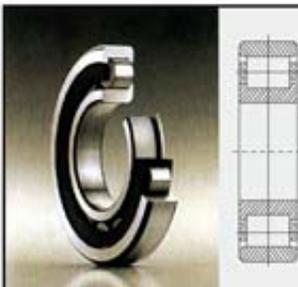
Needle roller bearing



Features:

1. high speed
2. can bear higher radial load than other bearings with the same radial dimension
3. can't stand axial load
4. high rigidity

Cylindrical roller bearing



Features:

1. lower speed than the ball bearing with the same dimension
2. high precision
3. Low noise and small vibration
4. Mainly withstand radial load
5. Can withstand a little axial load if outer ring and inner ring have ribs

Spherical ball bearing



Features:

1. high speed
2. able to self-align
3. low rigidity, low ability to stand impact and vibration



Thrust ball bearing



Features:

1. low speed
2. can only bear single axial load
3. bearing washers need aligned

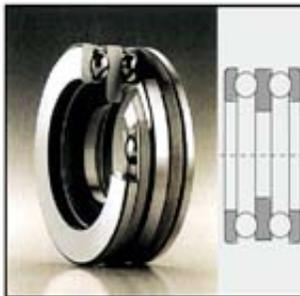
Double row angular contact ball bearing



Features:

1. high speed, high precision
2. lower rigidity, poor compactness
3. back to back arrangement

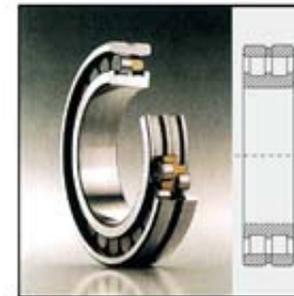
Double row thrust ball bearing



Features:

1. low speed
2. can bear axial load from both directions
3. bearing washers need aligned

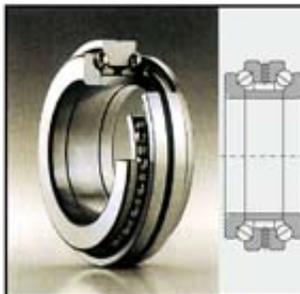
Double cylindrical roller bearing



Features:

1. high speed, high precision
2. fair rigidity and compactness
3. can't withstand axial load

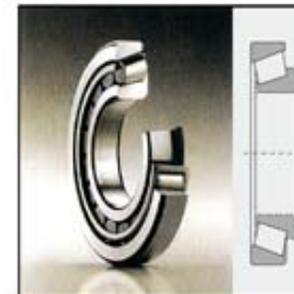
Double row spherical thrust ball bearing



Features:

1. high speed, high precision
2. lower rigidity, poor compactness
3. can bear axial load from both directions
4. bearing washers need aligned

Tapered roller bearing

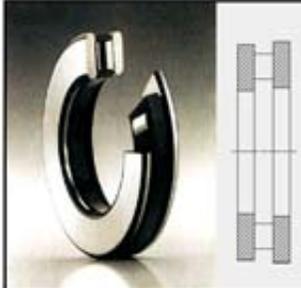


Features:

1. high speed, high precision
2. high rigidity, stand impact and vibration
3. can withstand big axial load



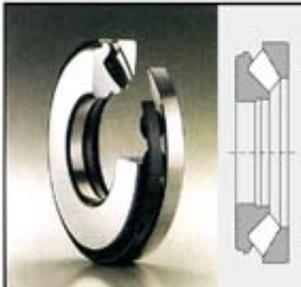
Thrust cylindrical roller bearing



Features:

1. lower speed
2. high rigidity, anti-impact
3. can only stand single side axial load
4. bearing washers need aligned

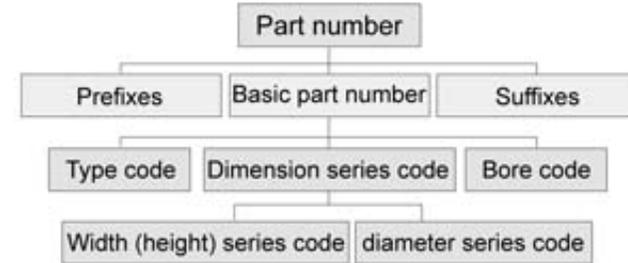
Thrust spherical roller bearing



Features:

1. lower speed
2. high rigidity, anti-impact
3. mainly bear axial load from one direction
4. ability to self-align

4. Part number



1. Basic part number

Basic part number : It is basis of bearing number and represents bearing style, structure and dimension.

Basic part number is consisted of type code, dimension series code and bore code.

1-1 Type code

Expressed in Arabic numbers (hereunder called numbers) or Latin letters (hereunder called letters).

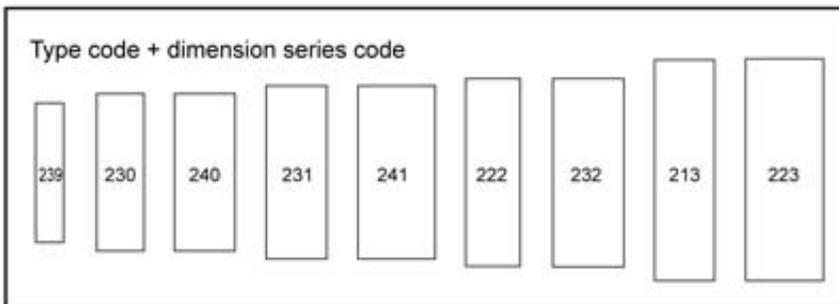
code	Bearing type	code	Bearing code
0	double row angular contact ball bearing	N	cylindrical roller bearing
1	spherical ball bearing	NN	double or multiple row cylindrical roller bearing
2	spherical roller bearing and thrust spherical roller bearing	U	Roller bearing units
3	tapered roller bearing	QJ	four points contact ball bearing
4	double row deep groove ball bearing		
5	Thrust ball bearing		
6	deep groove ball bearing		
7	angular contact ball bearing		
8	thrust cylindrical roller bearing		



1-2 Dimension series code

Consisted of bearing width code and diameter code , expressed in numbers.

Diameter series code	Radial bearing								Thrust bearing			
	Width series code								Height series code			
	8	0	1	2	3	4	5	6	7	9	1	2
	Dimension series code											
7			17		37							
8		08	18	28	38	48	58	68				
9		09	19	29	39	49	59	69				
0		00	10	20	30	40	50	60	70	90	10	
1		01	11	21	31	41	51	61	71	91	11	
2	82	02	12	22	32	42	52	62	72	92	12	22
3	83	03	13	23	33				73	93	13	23
4		04		24					74	94	14	24
5										95		



1-3 Bore code

Represent nominal bore size, expressed in numbers.

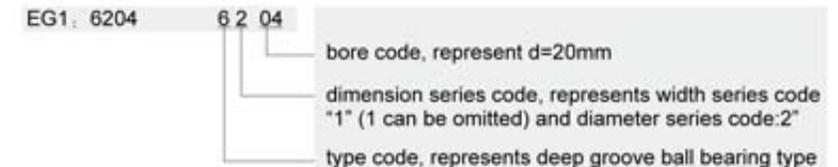
Nominal bore	Bore code	Example
0.6-10 (non-integer)	Expressed directly in nominal bore size. Separated with dimension series code by "f"	Deep groove ball bearing 618/2.5 d=2.5mm
1-9 (integer)	Expressed directly in nominal bore size and a separator "f" ahead	Deep groove ball bearing 618/5 d=5mm
10, 12, 15, 17	00, 01, 02, 03 respectively	Deep groove ball bearing 6200 d=10mm
20-480 (except 22, 28, 32)	Nominal bore size divided by 5. Add "0" ahead if quotient less than 10	Spherical roller bearing 22208 d=40mm
>=500 and 22,28,32	Expressed directly in nominal bore size and a separator "f" ahead	Spherical roller bearing 230/500 d=500mm

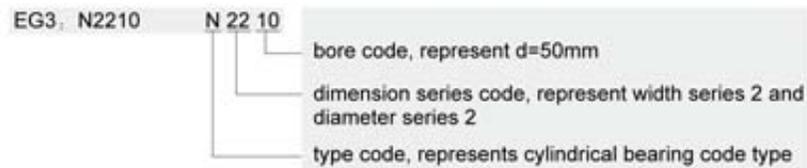
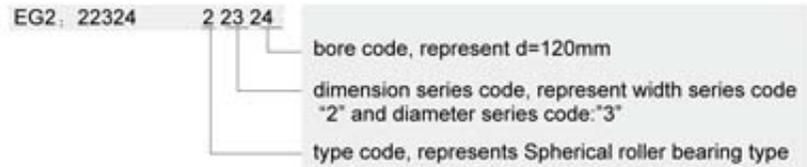
1-4 Basic coding rules

When bearing type code is expressed with a letter, it should be half of Chinese word distance apart from the dimension series code, bore code or fitting character numbers.

EG: N 2324, UC 201

1-5 Example





2. Prefixes, suffixes

2-1 Prefixes and suffixes is supplemental code when bearing structure, dimension, tolerance and technical requirement need to specify.

Bearing code									
Prefixes	Basic code	Suffix code							
		1	2	3	4	5	6	7	8
Bearing parts		Internal structure	Seal and dust protest; ring deformation	Cage and its material	Bearing material	Tolerance	Clearance	Fitting	Others

2-2 Prefixes

Prefixes are expressed in letters

Codes	Explanation	Examples
L	Inner or outer ring of separable bearing	LNU 207 LN 207
R	Bearing with inseparable inner or outer ring(NA type for needle roller bearing)	RNU 207 RNA6904
K	Roller and cage assembly	K 81107
WS	Shaft washers of thrust cylindrical roller bearing	WS 81107
GS	Housing washers of thrust cylindrical roller bearing	GS 81107
F	Ball bearing with flanged outer ring	F618 / 4
KOW-	Thrust bearing without shaft washer	KOW-51 108
KIW-	Thrust bearing without housing washer	KIW-51 108
LR	Rolling elements assembly with separable inner or outer ring	--

2-3 Suffixes

Suffixes are expressed in letters (or a number added)

2-3-1 The rule of suffixes

a. The suffix is on the right side of the basic code and half Chinese-character distance apart from it except separator "-" or "/" is used... If more than one suffix exist, they should ranked from left to right

b. When more than one items have separator "/" ahead, the second separator "/" can be omitted:

For example: 22308CA/C3/W33 can simplified to 22308CA/C3W33

c. When two items may be confused, half Chinese-character distance should be added.

For example: 6208 / P63 V1



2-3-2 Suffixes and explanation

a. Internal structure code

Codes	Explanation	Examples
B	(1) represent changes in internal structure (2) represent standard design which changes with different bearing types and structures	(1) angular contact ball bearing Nominal contact angle =40 7210 B (2) taper roller bearing contact angle bigger 32310B
C		(1) angular contact ball bearing Nominal contact angle =15 7210C (2) spherical roller bearing C type 23122C
E		Enhanced NU207E
AC		(1) angular contact ball bearing Nominal contact angle =25 7210 AC

Codes	Explanation	Example
D	split bearing	K50×55×20D
ZW	Double row needle roller cage assembly	K20 × 25×40ZW
A	1) Double row angular contact ball bearing or deep groove ball bearing without slot. 2) Needle roller bearing with two lock rings on outer ring (D>9MM, FW>12MM) 3) Deep groove ball bearing without ribs.	3205A - -
C	C design of spherical roller bearing, inner ring without ribs, movable spacer, stamped cage, enhanced symmetric roller	23122C
CA	CA design of spherical roller bearing, inner ring with flanges, movable spacer, machined cage	22208CA
CC	C design of spherical roller bearing, improved roller guiding	22205CC
CAB		-
CABC	CAB design of spherical roller bearing, improved roller guiding	-
CAC	CA design of spherical roller bearing, improved roller guiding	22222 CAC

b. Seal, dust-proof and external shape deformation code

Code	Explanation	Example
K	Tapered bore bearing with cone of 1:12 ...	1210K
K30	Tapered bore bearing with cone of 1:30	24122 K30
R	Snap rings on outer ring (not available for radial ball bearing which bore dimension is less than 10 mm)	30307R
N	Snap groove on bearing outer ring	6210N
NR	Snap groove and snap ring on bearing outer ring	6210NR
-RS	One contact seal	6210-RS
-2RS	Two contact seals	6210-2RS
-RZ	One non-contact seal	6210-RZ
-2RZ	Two non-contact seals	6210-2RZ
-Z	One shield	6210-Z
-2Z	Two shields	6210-2Z
-RSZ	One contact seal, the other shielded	6210-RSZ
-RZZ	One non-contact seal, the other shield	6210-RZZ
-ZN	One shield, snap groove on the outer ring of the other side	6210-ZN
-ZNR	One shield, snap groove and snap ring on the outer ring of the other side	6210-ZNR
-ZNB	One shield, snap groove on the outer ring of the other side	6210-ZNB
-2ZN	Two shields, snap groove on outer ring	6210-2ZN
U	Thrust ball bearing with washes	53210 U
CA	Angular contact ball bearing which can be matched randomly	7328 BCB
CB	Smaller axial internal clearance than normal when mounted face to face or back to back: small (CA) middle(CB), big(CC)	
CC		
GA	Angular contact ball bearing which can match randomly.	
GB	Preload than normal when mounted face to face or back to back: small (CA) middle(GB), big(GC)	7206 BGB
GC		



Code	Explanation	Example
-FS	Felt seal on one side	6203-FS
-2FS	Felt seals on two sides	6230-2FS
-LS	One contact seal, no groove on rings	-
-2LS	two contact seal, no groove on rings	-
PP	With two soft seals	NATR 8PP
-2K	Double tapered bore bearing cone of 1:12	QF 23082K
D	1) double row angular contact ball bearing ,double inner ring, contact angle=45 2) double row tapered roller bearing, no spacers, no grinding end face.	3307D -
DC	Double row angular contact ball bearing, double outer ring	3924-2KDC
D1	double row tapered roller bearing, no spacers, grinding end face.	-
DH	Single direction thrust bearing with two housing washers	-
DS	Single direction thrust bearing with two shaft washers	-
N1	One positioning groove on outer ring	-
N2	Two or more symmetric positioning groove on outer ring	-
N4	N+N2 positioning groove and snap groove are not on one side	-
N6	N+N2 positioning groove and snap groove are on one side	-
P	Double half-outer ring spherical roller bearing	-
PR	The same as P, spacer ring between two half-outer ring	-
S	1) bearing outer ring surface is spherical 2)	- NA4906 S
WB	Wide inner ring bearing (two side) Wb1- one side...	-
WC	Wide outer ring bearing	-
SC	Radial bearing with jacket	-
X	Track roller bearing with cylindrical outer rings	KR 30X
Z	Assembly needle bearing with jacket	NK 25Z
ZH	Thrust bearing, with shield on housing washes.	-
ZS	Thrust bearing, with shield on shaft washes.	-

c. Code for cage structure/material change

(1)No suffixes when the cage use default structure/material as folowings

Item	Bearing type	Cage structure and material
1	Deep groove ball bearing	(1) steel sheet(belt)or brass sheet(belt)stamped cage for the bearing diameter <=400mm (2) machined brass cage for the bearing diameter >400mm
2	Spherical ball bearing	(1) steel sheet(belt) stamped cage for the bearing diameter <=200mm (2) machined brass cage for the bearing diameter >200mm
3	Cylindrical roller bearing	(1) cylindrical roller bearing : steel sheet(belt) stamped cage for the bearing diameter <=400mm , machined steel cage for the bearing diameter >400mm
4	Spherical roller bearing	(2) double row cylindrical roller bearing: machined brass cage (1) Symmetric spherical roller bearing with movable spacer
5	Needle roller bearing	(2) machined brass cage for other spherical roller bearing (1) steel sheet or hard aluminum stamped cage
6	Angular contact ball bearing	(2) steel sheet(belt)stamped cage (1) separable angular contact ball bearing: high performance plastic cage (2) double half inner ring or half outer ring (three ,four point contact) bearing: machined aluminum cage (3) Angular contact ball bearing and it's modification: If bearing OD<=250mm, angular=15°, 25°, cage material is high performance plastic; angular= 40°, cage material is stamped steel. If bearing OD>=250mm, cage material is machined brass or aluminum; for P5, P4,P2 bearing, If bearing OD<=250mm, angular=15°, 25°, cage material is high performance plastic; angular= 40°, cage material is stamped steel. If locking rib is on inner ring, the cage material is high performance plastic.



Item	Bearing type	Cage structure and material
7	Tapered roller bearing	(1) steel sheet stamped cage for bearing diameter $D \leq 650\text{mm}$ (2) machined steel cage for bearing diameter $D > 650\text{mm}$
8	Thrust ball bearing	(1) steel sheet stamped cage for bearing diameter $D \leq 250\text{mm}$ (2) machined cage for bearing diameter $D > 250\text{mm}$
9	Thrust roller bearing	(1) machined cage for thrust cylindrical roller bearing (2) machined cage for thrust spherical roller bearing (3) machined cage for thrust tapered roller bearing (4) stamped cage for thrust needle roller bearing

(2) A cage structure/material change code should be used when cage is not made from above

(A) Cage material

F—with additional numbers to represent different material for steel, spheroidal graphite cast iron or machined powder metallurgy cage

F1—carbon steel, F2- graphitic steel, F3- spheroidal graphite cast iron, F4- powder metallurgy

Q—machined bronze cage, with additional numbers to represent different material

Q1—aluminum iron manganese bronze steel

M—machined brass cage

L—light alloy cage, with additional numbers to represent different material

L1—LY11CZ , L2—LY12CZ

T—high performance plastic

TH—glass fiber reinforced phenolic resin cage

TN—engineering plastic cage, with additional numbers to represent different material

TN1—nylon, TN2—Polysulfone, TN3—polyimide, TN4—polycarbonate, TN5—polyformaldehyde

J—steel sheet stamped cage, followed with additional number when the material changes

Y—copper sheet stamped cage, followed with additional number when the material changes

SZ—the cage is made of spring steel

(B) Cage structure and surface treatment

H-self-locked pocket cage

w-welded cage

R-riveted cage (for large bearing)

E-phosphatization cage

D-carbonitriding cage

D1-carburization cage

C-coating cage

A-outer ring guidance

B-Inner ring guidance

P-window cage with drawing or punching holes, inner ring or outer ring guidance

S-lubrication groove on guidance surface(note: this code only can be used with (A)

Eg. MPS-machined brass cage with drawing or punching window, outer ring or inner ring guidance, lubrication groove on guidance surface

JA-steel sheet stamping cage, outer ring guidance

FE-machined steel cage after phosphatization

V-full complement rolling element

Eg. 6208V-full complement deep groove ball bearing



d. Code for bearing material change

Generally, the bearing materials are bearing steel, GCr9, GCr15, GCr15SiMn

Bearing material change code is needed when bearing material changes

Code	Explanation	Example
/HE	Ring, roller and cage, or only ring and roller, are made from electroslag remelting bearing steel ZGCr15	6204/HE
/HA	Ring, roller and cage, or only ring and roller, are made from vacuum melting bearing steel	6204/HA
/HU	Ring, roller and cage, or only ring and roller, are made from non hardenable stainless steel 1Cr18Ni9Ti	6004/HU
/HV	Ring, roller and cage or only ring and roller are made from non hardenable stainless steel(/HV-9Cr18;/HV-9Cr18Mo)	6014/HV
/HN	Ring and roller are made from heat proof steel()	NU 208/HN
/HC	Ring and roller or only ring is made from carburization steel()	-
/HP	Ring and roller are made from beryllium bronze or other antimagnetic material, use additional number to represent material change	-
/HQ	Ring and roller are made from non-common used material(/Hq-plastic; /HQ1-ceramet)	-
/HG	Ring and roller or only ring are made from other bearing steel()	-

e. Tolerance grade code

Code	Explanation	Example
/PO	Grade O according to the standard. Omitted in code	6203
/P6	Grade 6 according to the standard	6203/P6
/P6x	Grade 6x according to the standard	30210/P6x
/P5	Grade 5 according to the standard	6203/P5
/P4	Grade 4 according to the standard	6203/P4
/P2	Grade 2 according to the standard	6203/P2
/SP	Dimension precision is grade P5, rotation precision is grade P4	234420/SP
/UP	Dimension precision is grade P4, rotation precision is higher than grade P4	234730/UP

f. Clearance grade code

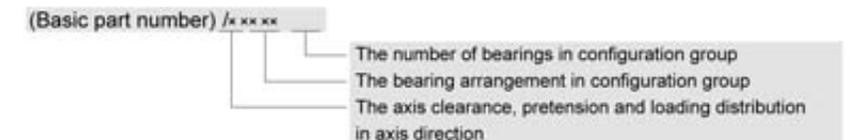
Code	Explanation	Example
/C1	Grade 1 according to the standard	6210/C2
/C2	Grade 2 according to the standard	6210/C1
-	Grade 0 according to the standard	6210
/C3	Grade 3 according to the standard	6210/C3
/C4	Grade 4 according to the standard	6210/C4
/C5	Grade 5 according to the standard	6210/C5
/CN	Grade 0 . /CN combined with H, M or L means half reduction of clearance range, or combined with P means clearance range offset. eg, /CNH grade 0 clearance half reduction, lies at the top half /CNM grade 0 clearance half reduction, lies at the middle /CNL grade 0 clearance half reduction, lies at the bottom half /CNP clearance range lies at the top half of Grade 0 and the bottom half of grade C3	-
/C9	Clearance is different from the current standard	6210/C9

It can be simplified when tolerance code and clearance code are used together. Use the the combination of tolerance grade code plus clearance code (grade 0 is omitted)

Eg. /P63 represent bearing tolerance grade P6, radial clearance C3

/P52 represent bearing tolerance grade P5, radial clearance C2

g. Configuration code



(1) Bearing numbers in matched group

/D-two bearings;/T-three bearings;/Q-four bearings;/P-five bearings;/S-six bearings

(2) Bearing arrange in matched group

B—back to back;F—face to face;T—tandem;BT—back to back and tandem;FT—face to face and tandem;FC—face to face of double tandem couple



(3) Axial clearance, preload and axial load distribution in matching

- GA—light preload (deep groove and angular contact ball bearing)
- GB—middle preload (deep groove and angular contact ball bearing)
- GC—heavy preload (deep groove and angular contact ball bearing)

Note: "G" is omitted for angular contact ball bearing

- G special preload, with additional number represent preload extent
- CA small axial clearance (deep groove and angular contact ball bearing)
- CB axial clearance bigger than CA (deep groove and angular contact ball bearing)
- CC axial clearance bigger than CB (deep groove and angular contact ball bearing)
- CG—axial clearance 0 (tapered roller bearing)
- R—radial load distributed evenly

(4) Examples

7210 C/DBA—angular contact ball bearing 7210C with contact angle=15°, back to back duplex, light preload

6210/DFGA—deep groove ball bearing, after grinding the surface, face to face duplex, light preload

7210 C/TFT—angular contact ball bearing 7210C with contact angle=15°, three fitting, two tandem and one face to face triplex

7210 AC/QBT—angular contact ball bearing 7210AC with contact angle=25°, three tandem and one back to back quadruplex

NU 210/QTR—cylindrical roller bearing NU210, quadruplex, evenly preload

7210 C/PT—angular contact ball bearing 7210C with contact angle=15°, five tandem

h. Other characteristic codes

Code	Explanation	Example
/Z	group of maximum vibration acceleration, additional number to represent different maximum Z1- maximum vibration acceleration conform with Z1 group of standard Z2- maximum vibration acceleration conform with Z2 group of standard Z3- maximum vibration acceleration conform with Z3 group of standard	6204/Z1 6204/Z2 6204/Z3
/V	group of maximum vibration velocity, with additional number to represent different maximum V1- maximum vibration velocity conform with V1 group of standard V2- maximum vibration velocity conform with V2 group of standard V3- maximum vibration velocity conform with V3 group of standard	6204/V1 6204/V2 6204/V3
/ZC	Bearing maximum noise is specified, additional number represent different maximum	
/T	Starting moment is required. Additional number represent starting moment	
/RT	Rotating moment is required. Additional number represent rotating moment	
/S0	S0- bearing working temperature reaches 150°C after rings was high temperature tempered.	N210/S0
	S1- bearing working temperature reaches 200°C after rings was high temperature tempered.	N210/S1
	S2- bearing working temperature reaches 250°C after rings was high temperature tempered.	N210/S2
	S3- bearing working temperature reaches 300°C after rings was high temperature tempered.	N210/S3
	S4- bearing working temperature reaches 350°C after rings was high temperature tempered	N210/S4
/W20	Three lubrication hole on bearing outer ring	
/W26	Six lubrication hole on bearing outer ring	
/W33	Lubrication groove on bearing outer ring and three lubrication hole	22228/W33
/W33X	Lubrication groove on bearing outer ring and six lubrication hole	
NV513	W26+W33	
/W518	W20+W26	
/AS	Oil hole on outer ring, additional number represent oil hole number (needle roller bearing)	HK 2020/AS1
/IS	Oil hole on inner ring, additional number represent oil hole number (needle roller bearing) "R" after AS, IS means lubrication hole and groove on inner ring or outer ring	NAO 15 × 30 × 13/IS1 NAO 15 × 30 × 13/ASR
/HT	Special high temperature lubrication grease filled in bearing. Use different letters when the grease amount is different from standard: A-grease amount less than standard B-grease amount more than standard C-grease amount more than B(full)	NA 6909/ISR/HT



Code	Explanation	Example
/LT	Special low temperature lubrication grease filled in bearing. additional letter meaning same as HT	-
/MT	Special middle temperature lubrication grease filled in bearing. additional letter meaning same as HT	-
/LHT	Special high, low temperature lubrication grease filled in bearing. additional letter meaning same as HT	-
/Y	The combination of Y and another letter(A,B) or additional number to identify the non-serial changes that can't be represented by existing suffix	-
	YA-structure change(comprehensive expression)	-
	YA1-difference between bearing outer ring outer surface and standard design	-
	YA2-difference between bearing inner ring bore and standard design	-
	YA3- difference between bearing rings surface and standard design	-
	YA4- difference between bearing rings raceway and standard design	-
	YA5- difference between bearing rollers and standard design	-
	YB-technical condition changes(comprehensive expression)	-
	YB1-coating on bearing rings surface	-
	YB2-bearing dimension and tolerance requirement change	-
	YB3-bearing rings surface roughness requirement change	-
	YB4-heat treatment requirement(eg. hardness)change	-

4.3 Needle roller bearing basic code

Needle roller bearing basic code is consisted of bearing type code and dimension representing bearing fitting characteristic

Bearing types	Types code	Dimension representing fitting characteristic	Bearing part number
Needle roller and cage assembly	K	Fw × Ew × Bc	KFw × Ew × Bc
Thrust needle roller and cage assembly	AXK	Dci Dc	AXK Dci Dc
Needle roller bearing	NA	4800	NA 4800
		4900	NA 4900
		6900	NA 6900
Perforation stamped outer ring needle roller bearing	HK	Fw B	HK Fw B
Sealed stamped outer ring needle roller bearing	BK	Fw B	BK Fw B

4.4 Non-standard bearing and Inch system part number

4-4-1 Non-standard bearing part number

Bearings with special structure, non-standard external dimension are called non-standard bearing. The coding approach is detailed in JB/T2974-93(supplemental rule for rolling bearing code)

4-4-2 Inch system code

The coding approach of bearings made according to Inch system is not specified in detail. Generally it can be coded in another way after the agreement is made between user and manufacturer.

4.5 part number of bearing with accessory

Name of accessory	Code of bearing with accessory	example
With adapter sleeve	Bearing code+ adapter sleeve code	22208 K+H308
With withdrawal sleeve	Bearing code+ withdrawal sleeve	22208 K+AH308
With inner ring	Bearing code + IR (applicable to needle roller bearing, needle roller assembly bearing without inner ring)	HKX 30+IR
With oblique flange	Bearing code+ oblique flange code(applicable to cylindrical roller bearing)	NJ 210+HJ 210

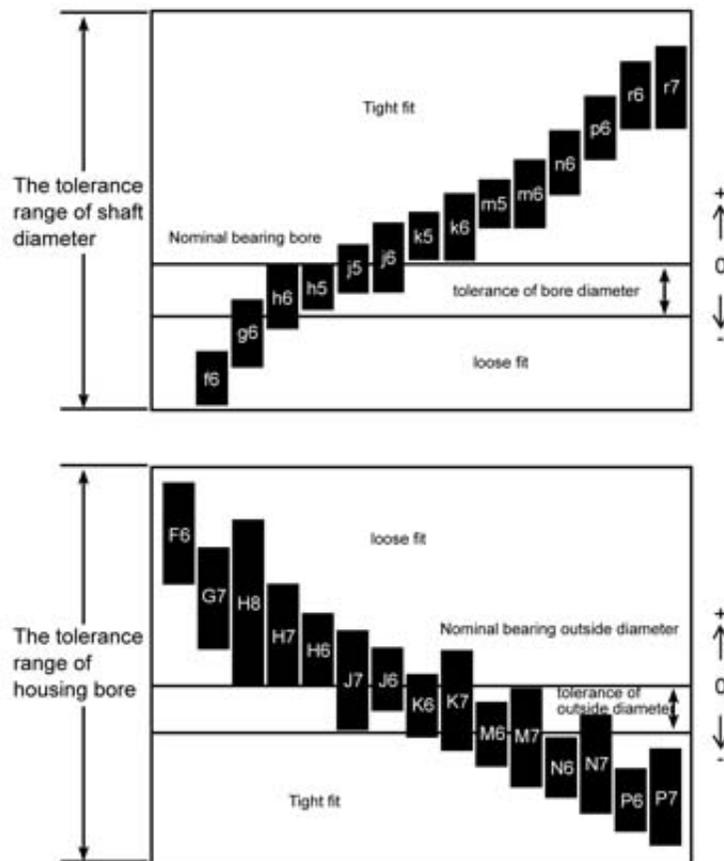


5. Fits

5.1 Fit with housing

Radial ball, spherical roller, cylindrical roller bearing

The graph below is the option of bearing and shaft/housing comply with ISO standard.. The symbol block g6, h6 means the diameter and tolerance range at the condition of different load and rings rotation for meeting different loose and tight fitting.



5.2 Roughness and form & position tolerance

Roughness and form & position tolerance affect products working property directly, for example, wear ability, corrosion resistivity and fitting property. So it is very important to specify the form & position tolerance between shaft and housing hole and raise the fitting surface roughness requirement for stabilizing the fitting property and enhancing the jointing strength of interference fit. Roughness and form & position tolerance of fitting surface between shaft and housing hole is in chart 1, chart 2 and graph 1.

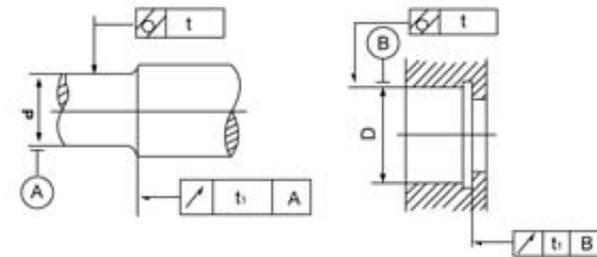


Figure 1

Chart 1 Roughness of fitting surface

Fitting surface	Bearing tolerance grade	Dimensional tolerance of fitting surface	Bearing nominal bore or diameter(mm)	
			-80	> 80-500
			Roughness parameter Ra according to GB1031-95	
Bearing neck	P0	IT6	1	1.60
	P6	IT5	0.63	1
	P5		0.40	0.63
	P4		0.25	0.40
Housing hole	P0	IT7	1.60	2.50
	P6	IT6	1	1.60
	p5		0.63	1
	p4		0.40	0.63
Shaft collar and housing hole collar surface	p0		2	2.50
	P6		1.25	2
	P5		1	1.60
	P4		0.80	1.25

Note: when the bearing is fitted on adapter sleeve or withdrawal sleeve, the roughness of shaft collar surface Ra should not exceed 2.5um.



Chart 2 shaft and housing form & position tolerance

Basic dimension (mm)		Cylindricity t				Surface runout t1			
		Shaft neck		Housing hole		Shaft collar		Housing hole collar	
		Bearing tolerance grade							
		P0	P6	P0	P6	P0	P6	P0	P6
from	to	Tolerance um							
	6	2.5	1.5	4	2.5	5	3	8	5
6	10	2.5	1.5	4	2.5	6	4	10	6
10	18	3	2	5	3	8	5	12	8
18	30	4	2.5	6	4	10	6	15	10
30	50	4	2.5	7	4	12	8	20	12
50	80	5	3	8	5	15	10	25	15
80	120	6	4	10	6	15	10	25	15
120	180	8	5	12	8	20	12	30	20
180	250	10	7	14	10	20	12	30	20

6 Internal clearance

6.1 The importance of selecting right clearance

Bearing radial(axial) clearance means the radial (axial) distance moved by one ring vs another ring from one radial(axial) extreme position to the opposite extreme position when the bearing has no external load. In reality, it should be average value of the radial (axial) displacement under different rings direction and rings/rolling element different relative position due to the rings form error and rolling element disconformity

Clearance is an important technical parameter of bearing which directly affect the bearing technical characteristic such as the load distribution, vibration, noise, friction, temperature rise, life and mechanical rotating tolerance. Excessive clearance will cause bearing internal load area decrease, contact area stress increase so that bearing life is shortened. Excessive clearance will also cause bearing working tolerance decrease, vibration and noise increase. Undersize clearance negative clearance (interference) in real function may appear which causes friction heat increase, temperature rise increase so that the valid clearance decrease or interference increase. Such vicious circle will cause bearing jammed.

6.2 clearance under different status

Initial clearance Δ_0 : clearance under the status that the bearing is not mounted and without load, also called incoming clearance.

Residual clearance Δ_r : clearance after bearing mounting. Inner ring expand and outer ring contract due to fitting function after bearing mounting, so $\Delta_r = \Delta_0 - \delta_{fo} - \delta_{fi}$ (1)

δ_{fo} means clearance decrease amount caused by outer ring and housing fitting

δ_{fi} means clearance decrease amount caused by inner ring and housing fitting

Valid clearance Δ_e : clearance in real working. Clearance decreases as inner ring temperature is higher than outer ring affected by temperature rise and heat elimination condition in real working. So $\Delta_e = \Delta_r - \delta_t$ (2)

δ_t means clearance decrease amount caused by temperature difference between inner ring and outer ring. (1) and (2) can lead to (3).

$$\Delta_e = \Delta_0 - \delta_{fo} - \delta_{fi} - \delta_t \quad (3)$$

6.3 valid clearance calculations

As long as the factors above are calculated, the valid clearance of bearing can be calculated according to (3)

6.3.1 mounting influence

$$\delta_{fi} = \Delta_0 \frac{d}{d_i} \frac{1 - \left(\frac{d_i}{d}\right)^2}{1 - \left(\frac{d}{d_i}\right)^2} \quad (\text{mm})$$

$$\delta_{fo} = \Delta_0 \frac{D_o}{D} \frac{1 - \left(\frac{D}{D_o}\right)^2}{1 - \left(\frac{D_o}{D}\right)^2} \quad (\text{mm})$$

Δd -Interference between bore and shaft (mm)

ΔD -Interference between diameter and shaft (mm)

d- Bearing bore (mm)

D-Bearing diameter (mm)

De-Average bore of bearing outer ring (mm)



De can be estimated according to below if no exact figures

$$De = (7D + 3d) / 10$$

di- average diameter of inner ring

di can be estimated according to below if no exact figures

$$di = (3D + 7d) / 10$$

d0- hollow shaft bore (mm), eg. Solid shaft

$$d0 = 0$$

Dh- bearing housing diameter, eg. Rigid bearing housing

$$Dh = \infty$$

6.3.2 temperature influence

Where: α -bearing steel coefficient of thermal expansion
(1/°C)

Δt -the temperature difference of inner and outer ring (°C)

D_o -raceway diameter of outer ring (mm)

If δ_{f0} has no detail value, the value can be calculated as follow:

For ball and spherical roller bearing:

$$\delta_{f0} = (4D + d) / 5$$

For cylindrical roller bearing:

$$\delta_{f0} = (3D + d) / 4$$

E.g. bearing 23132 CA

The solid shaft tolerance is ± 0.025 , housing tolerance is ± 0.028 . Inner ring temperature is 10°C higher than outer ring. Try to checking valid clearance.

23132CA figures: D=270mm, bore d=160mm, contact angle $\alpha=11^\circ 45'$, outer ring De=248mm, inner ring di=190mm, outer ring raceway diameter Do=248mm, basic clearance, max0.17, min0.11

$$\delta_{fi} = \Delta_{di} \frac{d}{di} \frac{1 - \left(\frac{d}{di}\right)^2}{1 - \left(\frac{D_i}{di}\right)^2} = (0.068 + 0.025) \times 160 / 190 = 0.078$$

$$\delta_{f0} = \Delta_{D_o} \frac{D_o}{D} \frac{1 - \left(\frac{D_o}{D}\right)^2}{1 - \left(\frac{D_o}{D_h}\right)^2} = 0.028 \times \frac{248}{270} \frac{1 - \left(\frac{270}{330}\right)^2}{1 - \left(\frac{248}{330}\right)^2} = 0.019$$

$$\delta_t = \alpha \Delta t D_o = 1.12 \times 10^{-5} \times 10 \times 248 = 0.028$$

$$\Delta_{emh} = \Delta_{D_o} - \delta_{f0} - \delta_{fi} - \delta_t = 0.11 - 0.078 - 0.019 - 0.028 = -0.015 \text{ mm}$$

After checking, bearing valid clearance is less than 0 which means possible working under interference. If change to C3 clearance (max0.22, min0.17), then min valid clearance

$$\Delta_{emh} = \Delta_{D_o} - \delta_{f0} - \delta_{fi} - \delta_t = 0.17 - 0.078 - 0.019 - 0.028 = 0.045 \text{ mm}$$

6.4 clearance selection

TWB can provide standard clearance bearing C2 C0 C3 C4 C5, which is the same as other domestic and foreign bearing manufacturer. Detailed clearance (initial clearance) can be found on the catalogue. Customers need to add clearance code in bearing part number when ordering the goods. C0 can be omitted. For example: C3 group standard clearance 23132CA bearing should be written as 23132 CA/C3. Customers should check valid clearance according to formulation (3) when selecting clearance. Ideal valid clearance should be 0 as the best load distribution and longest life can be attained. In order to get relevantly higher rigidity and rotating precision, bearing can work under negative clearance. But when working condition changes greatly, fitting is not controlled strictly and inner ring heat emission is bad, some valid clearance should be kept or calculated at worst condition. If customers can't do clearance checking, the chart below can be referred to select clearance.



Working conditions	Application examples	Clearance selected
<ul style="list-style-type: none"> ● Fitting precisely or non-interference fitting; ● Control vibration and noise strictly; ● Radial and axial positioning precisely 	Testing equipment, device, low noise, small motor, precise rolling mill	C2
<ul style="list-style-type: none"> ● General fitting condition(recommended by catalogue) ● General load and speed, working temperature is not high 	General machinery Reducer machine, driving mechanism	C0
<ul style="list-style-type: none"> ● Inner ring and outer ring interference fitting, and one parts has large interference; ● Inner ring heat emission is difficult; ● Spherical roller bearing is mainly for carrying load, working condition changes greatly 	Railway vehicle Papermaking dryer mining machinery	C3
<ul style="list-style-type: none"> ● Inner ring and outer ring interference fitting and interference is large; ● High working temperature rise and inner ring heat emission is difficult; ● Angular contact ball bearing; inner and outer ring axial line incline 	vibrating screen, dryer, car back wheel	C4
<ul style="list-style-type: none"> ● Inner ring and out ring interference fitting and interference is large; ● High working temperature rise and inner ring heat emission is difficult; 	vibratory roller	C5

If bearing working condition is very special and the five standard clearances above can't meet the requirement, then non-standard clearance C9 can be selected. Customers should remark the specific initial clearance. Customers can also change the selected clearance according to previous using condition and problem founded. For example, if bearing heats seriously or lock appears, then larger clearance should be selected.