

NEEDLE ROLLER BEARINGS

NEEDLE ROLLER BEARINGS
STAINLESS STEEL

NEEDLE ROLLER BEARINGS

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*A Specialist in
Needle Roller Bearing Manufacturing*

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Our needle bearing products boast high-precision, high-rigidity, and high-durability. They are widely used in production lines for advanced products, such as digital home appliances, as well as in manufacturing facilities for semiconductor manufacturing devices, precise construction machinery, and electron microscopes. Our technology supports every type of industry in the world.

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Aside from providing our customers with a stable supply of products, immediate delivery has been the standard at Nose Seiko for many years. We achieve this through our flexible and efficient production system—the result of extensive industry experience—that ensures we are always able to keep an extensive array of products on hand. Nose Seiko strives to provide optimum convenience for customers, responding to emergency orders within the shortest possible delivery time. Our customers appreciate our commitment to high standards.

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A needle roller bearing featuring high-precision rigid outer rings and retainers. Its space-saving design provides low cross-sectional height.



Cam Followers

Our stud-type cam followers have a thick outer ring and can support heavy radial loads. They are designed for applications where the outer ring rotates. Also available in miniature models.



Roller Followers

Our roller followers have a thick outer ring to support large radial loads. This bearing is designed for applications where the outer ring rotates.



Needle Roller Bearings (STAINLESS STEEL)

A durable stainless-steel bearing that is rust- and corrosion-resistant. Used in lithium ion battery intergrated system, semi-conductors, medical equipments, and food machinery.



Cam Followers (STAINLESS STEEL)

A durable stainless-steel bearing that is rust- and corrosion-resistant. Used in cutting-edge technological fields for anticorrosive, clean, and vacuum applications.



Roller Followers (STAINLESS STEEL)

A durable stainless-steel bearing that is rust- and corrosion-resistant. Used in cutting-edge technological fields for anticorrosive, clean, and vacuum applications.

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NEEDLE ROLLER BEARINGS



1 Bearing Life and Load Rating

1-1 Bearing life

Bearings are subjected to certain intensity of repeating stress on their track ring and rolling element even during operation under proper loading, appropriate mounting and sufficient lubrication. The stress may cause scaly damage formed on surface after certain time period due to its concentration at shallow vicinity under the surface. This phenomenon is called flaking (peeling-off of surface). Phenomenon that causes bearing to be unusable due to flaking caused by repeating cyclic stress under normal operating condition is called "life" of the bearing. Generally, bearing life is defined by total number of rotation of the bearing until flaking is generated on track surface. However, recognizing average life as criteria of bearing life is not appropriate for actual selection of bearing since fatigue limit of material varies. It shall be practical to consider the life guaranteed to most bearings (basic rating life) as a criterion. Phenomenon that bearing becomes inoperative due to heat-seizure, wear, fracture, scoring are regarded as "failure" caused by operating conditions and selection of bearing so that they and the life should be considered as different phenomena.

1-2 Basic rating life

Basic rating life of bearing shall be defined as a total number of rotation that 90% of the group of the same bearings can run without causing flaking due to rolling fatigue when they are operated under the same conditions.

In the case of rotation in certain constant speed, the basic rating life can be expressed in a total rotation time as well.

1-3 Basic dynamic load rating

A given static radial load under which a bearing theoretically endures basic rating life of one million rotations is referred to as a basic dynamic load rating.

1-4 Dynamic equivalent load

Dynamic equivalent radial load

A load that is virtually applied to the center of a bearing under which to obtain a life equivalent to that when both radial load and axial load are subjected to the bearing at the same time is called the dynamic equivalent radial load. In the case of needle bearing, its radial type is capable for loading radial load only so that just a radial load will be applied.

1-5 Bearing life calculation formula

The following relationship is applied to basic rating life, basic dynamic load rating and dynamic equivalent load of bearing.

$$L_{10} = (Cr / Pr)^{10/3} \dots\dots\dots (1.1)$$

L_{10} : Basic rating life 10^6 rotation

Cr : Basic dynamic load rating N

Pr : Dynamic equivalent radial load N

Basic rating life time can be expressed as total rotation time with given rotation per minute by the following formula.

$$L_h = 10^6 L_{10} / 60n = 500 f_h^{10/3} \dots\dots\dots (1.2)$$

$$f_h = f_n Cr / Pr \dots\dots\dots (1.3)$$

$$f_n = (33.3 / n)^{3/10} \dots\dots\dots (1.4)$$

L_h : Basic rating life expressed in hour h

n : Rotation per minute rpm

f_h : Bearing life factor

f_n : Speed factor

1-6 Operating conditions and bearing life factor of bearing

Operating machinery and demanded life

Bearings should be selected based on setting up demanded life in accordance with operating machinery and operating condition.

Demanded life is determined by endurance duration for operating machinery and reliable operating periods.

Table-1 indicates demanded life that can be a typical reference.

Table-1 Operating condition and demanded life time factor (reference)

Operating conditions	Bearing life factor f_h				
	~3	2~4	3~5	4~7	6~
Short duration or occasional operation	Home appliance Electrical tools	Agricultural machinery Office equipment			
Short duration or occasional operation, but necessity for ensuring reliable operation	Medical equipment Measuring instrument	Home air conditioning Construction machinery Crane	Elevator	Crane (sheave wheel)	
Long duration operation but not full time		Small size motor General gear system Woodworking machinery Passenger car	Machine tools Factory general purpose motor Crusher	Important gear system Calendar roller for rubber and plastic Printing machine	
Continuous operation over eight hours a day		Rolling machine Escalator Conveyer Centrifugal separator	Air conditioner Large size motor Compressor, pump	Mine hoist Press machine	Pulp, papermaking machine
Operate 24 hours a day and must be non stop without accident					Water-work system Power generator system

1-7 Corrected rating life

Formula for basic rating life described above is applied to bearings whose reliability is 90%, whose material is for general purpose bearing and are manufactured in general quality standard as well as those operated under standard operating conditions. Corrected rating life should be calculated using correction factor a_1 , a_2 and a_3 in the case that the reliability is over 90% or that life needs to be obtained for special bearing properties or for special operating conditions.

$$L_{na} = a_1 a_2 a_3 L_{10} \dots \dots \dots (1.5)$$

- L_{na} : Adjustment rating life 10^6 rotation
- a_1 : Reliability factor
- a_2 : Bearing special properties factor
- a_3 : Operating conditions factor

1-7-1 Reliability factor

Reliability factor a_1

This is the bearing life corrected factor for reliability (100-n) % when probability of failure is n %. Value of the reliability factor a_1 is shown in Table-2.

Table-2 Reliability factor a_1

Reliability (%)	L_n	a_1
90	L_{10}	1
95	L_5	0.62
96	L_4	0.53
97	L_3	0.44
98	L_2	0.33
99	L_1	0.21

1-7-2 Bearing special properties factor

Bearing special properties factor a_2

Bearing special properties factor a_2 is used for adjusting variation of properties concerning life in the case that material type, quality or manufacturing process is special. This factor shall be $a_2=1$ for standard material and manufacturing method. It can be $a_2 > 1$ when special modified material or manufacturing method is used due to improved quality of bearing material or progress of manufacturing technology.

1-7-3 Operating conditions factor

Operating conditions factor a_3

This is a factor to adjust impact of operating conditions of bearing, especially effect of lubrication to fatigue life. Bearing life is essentially a fatigue phenomenon of surface layer which is subjected to repeating cyclic load. Therefore, this factor will be $a_3=1$ under ideal lubrication condition when rolling element and track surface are completely isolated by oil film and surface failure can be ignored. Under poor lubrication condition such as low lubricant viscosity or under significantly slow rotation speed of rolling element, it would be $a_3 < 1$.

On the contrary, it can be $a_3 > 1$ under especially excellent lubrication condition. Generally, the bearing special properties factor a_2 can not be set to value exceeding 1 when $a_3 < 1$.

1-8 Adjustment of Basic Dynamic Load Rating for temperature and hardness factors

1-8-1 Temperature factor

While operating temperature of bearing is individually defined in accordance with material and structure, bearing is capable to be used at temperatures higher than 150 °C by applying special treatment for thermal resistance. However this will cause reduction of basic dynamic load rating as a result of reduction of permissive contact stress. Basic dynamic load rating with consideration for temperature increase is given by the following formula.

$$C_1 = f_1 Cr \dots \dots \dots (1.6)$$

- C_1 : Basic dynamic load rating with consideration for temperature increase N
- f_1 : Temperature factor (Refer to Figure-1)
- Cr : Basic dynamic load rating N

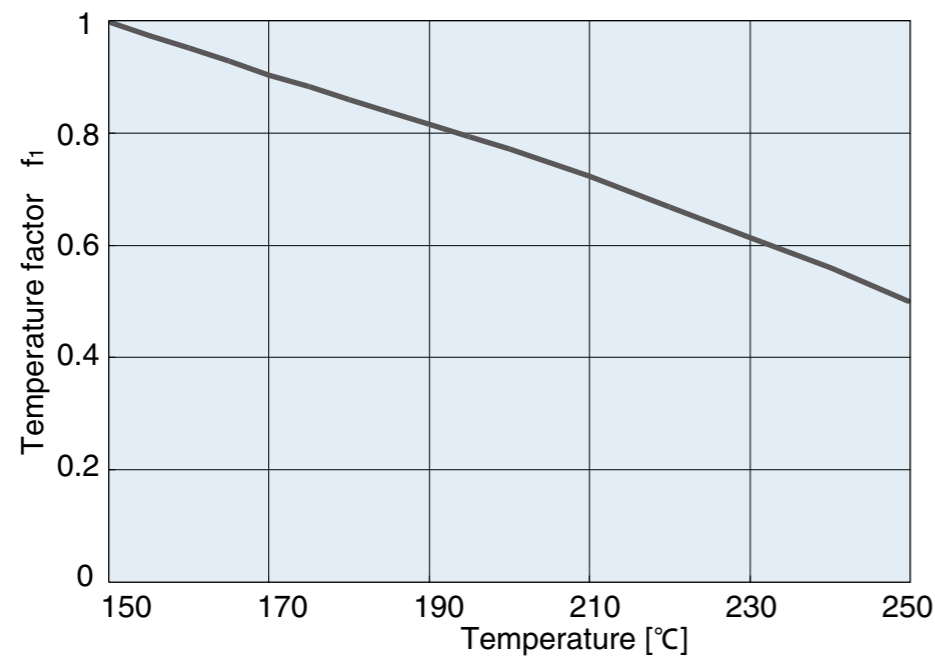


Figure-1

1-8-2 Hardness factor

The raceway surface should be HRC58 to 64 in the case of using shaft or housing as raceway instead of bearing inner ring or outer ring respectively. Basic dynamic load rating may be reduced in the case the surface hardness is lower than HRC58. Basic dynamic load rating with consideration for surface hardness is given by the following formula.

$$C_2 = f_2 Cr \dots \dots \dots (1.7)$$

- C_2 : Basic dynamic load rating with consideration for hardness N
- f_2 : Hardness factor (Refer to Figure-2)
- Cr : Basic dynamic load rating N

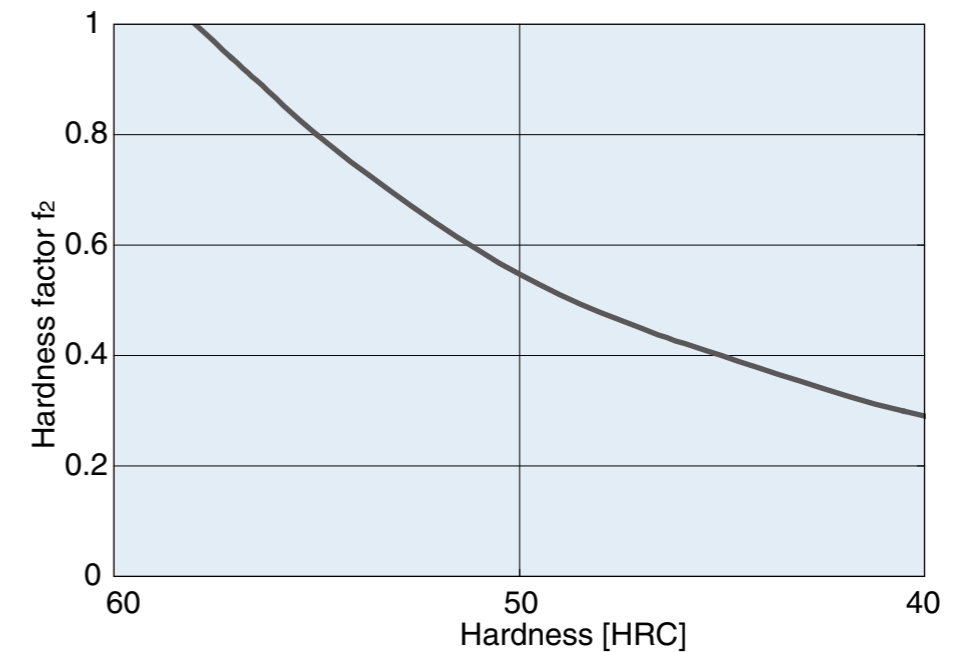


Figure-2

1-9 Basic static load rating

Basic static load rating is specified as a static load which corresponds to contact stress indicated in the table below at rolling element and the center of contact of track that are subjected to the maximum load. Total permanent deformation of rolling element and track occurred by the contact stress may be approximately 0.0001 times of diameter of the rolling element.

Type of bearing	Contact stress MPa
Roller bearing	4000

1-10 Static equivalent load

A load that is virtually applied to the center of a bearing under which to obtain a contact stress equivalent to the maximum contact stress that occurs at contact surface between rolling element and track, when both radial load and axial load are subjected to the bearing at the same time, is called a static equivalent load.

In the case of needle bearing, its radial type is capable for loading radial load only so that just a radial load will be applied.

$$P_{Or} = F_r \dots\dots\dots (1.8)$$

P_{Or} : Static equivalent radial load N

1-11 Static safety factor

Although permissive limit of static equivalent load is typically regarded as basic static load rating, its limit shall be set with consideration for safety since conditions required for bearings broadly vary. The static safety factor f_s is given by the following formula (1.9). Table-3 shows its typical values.

$$f_s = \frac{C_{Or}}{P_{Or}} \dots\dots\dots (1.9)$$

f_s : Safety factor

C_{Or} : Basic static load rating N

Table-3 Static safety factor

Operating conditions of bearing	f_s
With high rotation accuracy With impact load	≥ 3
With standard rotation accuracy	≥ 1.5
With standard rotation accuracy and low speed	≥ 1

1-12 Permissive rotation speed

Increasing bearing rotation speed may cause a rise in bearing temperature due to abrasion heat generated inside of the bearing, which results in failure with heat-seizure. A threshold rotation speed up to which long duration of safe operation is enabled is referred to as a permissive rotation speed.

Permissive rotation speed varies depending on type, size and load of bearing, lubrication method and its radial clearance. It is an experimental value at which operation is enabled without causing heat generation exceeding certain limit.

2 Bearing load

2-1 Load factor

Operation in actual machinery is subjected to a load larger than theoretical axial directional load due to vibration and impact shock.

Actual load is given by calculation of load applied to axes system using load factor shown in Table-4.

$$K = f_w \cdot K_c \dots\dots\dots (2.1)$$

K : Actual load applied to axes system N

K_c : Theoretical calculation value N

f_w : Load factor (Table-4)

Table-4 Load factor

Degree of load	Examples	f_w
Smooth motion without any impacts	Air conditioner, measurement instruments, office equipment	1 ~1.2
With standard rotation	Gear box, vehicle, paper-making machine	1.2~1.5
Operation with vibration and impact shock	Rolling machine, construction machinery, crusher	1.5~3

2-2 Load distribution

Load distribution to bearing

Axis system is assumed as a static beam supported by bearings in order to distribute load acting on the axis system to the bearings. Table-5 shows calculation example of load distribution.

Table-5 Example of calculation of load distribution

Examples	Load calculation
	$F_1 = \frac{W_1(b+c) + W_2c}{a+b+c}$ $F_2 = \frac{W_1a + W_2(a+b)}{a+b+c}$
	$F_1 = \frac{W_1(a+b+c) + W_2c}{b+c}$ $F_2 = \frac{W_2b - W_1a}{b+c}$

2-3 Load transmission

Bearing loads in belt or chain transmission

The force acting on pulley or sprocket wheel when power is transmitted by a belt or chain is given by the following formula.

$$T = 9550P/N \dots \dots \dots (2.2)$$

$$F_t = 2000 \cdot T/d \dots \dots \dots (2.3)$$

- T** : Torque acting on pulley or sprocket wheel N·m
- F_t** : Effective force transmitted by belt or chain N
- P** : Transmitted power kW
- N** : Rotation per minute rpm
- d** : Effective diameter of pulley or sprocket wheel mm

Load F_r acting on pulley shaft is given by multiplying effective transmitted force F_t by belt factor f_b shown in Table-6 in the case of belt transmission.

$$F_r = f_b F_t \dots \dots \dots (2.4)$$

Table-6 Belt factor

Type of belt	f_b
V belt	2 ~2.5
Flat belt (with tension pulley)	2.5~3
Flat belt (without tension pulley)	4 ~5

In the case of chain transmission, load acting on sprocket wheel shaft is given by the formula (2.4) as same as that of belt transmission using value between 1.2 and 1.5 as chain factor corresponding to f_b .

Bearing loads in gear transmission

In the case of power transmission by gear, methods of calculation vary depending on the type of gear since force acting on the gear is divided into radial load and axial load and their direction and ratio vary depending on the type of gear. In the case of the simplest flat gear, direction of load is radial load only and it is given by the following formula.

$$T = 9550P/N \dots \dots \dots (2.5)$$

$$F_t = 2000 \cdot T/d \dots \dots \dots (2.6)$$

$$F_r = F_t \cdot \tan \alpha \dots \dots \dots (2.7)$$

$$F_c = \sqrt{F_t^2 + F_r^2} \dots \dots \dots (2.8)$$

- T** : Torque acting on gear N·m
- F_t** : Force in tangent direction of gear N
- F_r** : Force in radial direction of gear N
- F_c** : Combine force acting perpendicular to gear N
- P** : Transmitted power kW
- N** : Rotation per minute rpm
- d** : Pitch circle diameter of drive gear mm
- α** : Pressure angle of gear

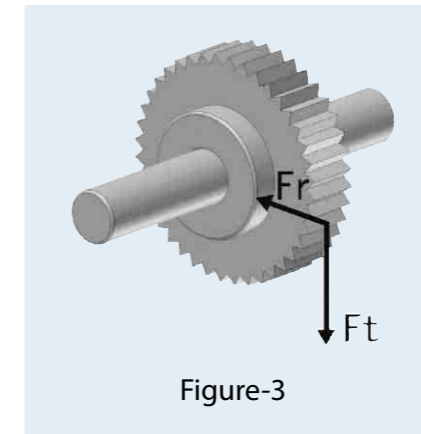


Figure-3

Value that is given by multiplying theoretical load by gear factor f_z in Table-7 shall be used as actual load since degree of vibration and impact shock affecting the theoretical load obtained by the formula above varies depending on the type of gear and accuracy of gear surface finish.

$$F = f_z F_c \dots \dots \dots (2.9)$$

Table-7 Gear factor

Type of gear	f_z
Precision gear (Both of pitch error and geometric error is 0.02 mm or less)	1.05~1.1
Ordinary machined gear (Both of pitch error and geometric error is between 0.02 mm and 0.1 mm)	1.1 ~1.3

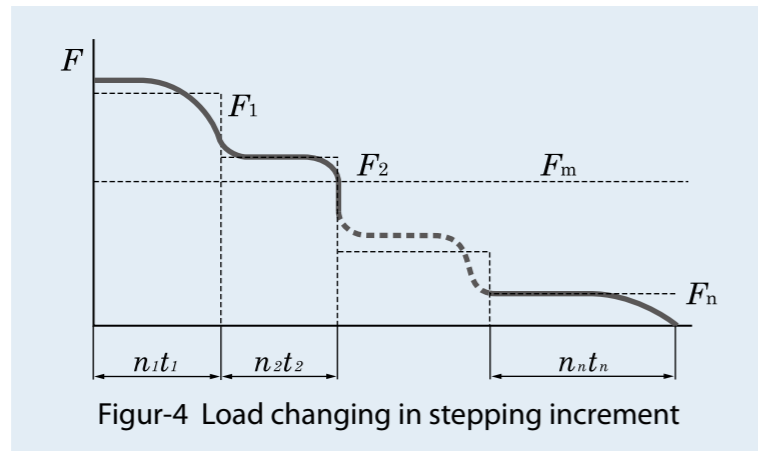
Average load

Average load F_m which is converted so as to apply even life to each bearing may be used in the case that load acting on bearing is unstable and changes in various cycle.

(1) Fluctuating step load

Average load F_m is given by formula (2.10) in the case that bearing load $F_1, F_2, F_3 \dots$ is applied with rotation speed and operation duration of $n_1, n_2, n_3 \dots$ and $t_1, t_2, t_3 \dots$ respectively.

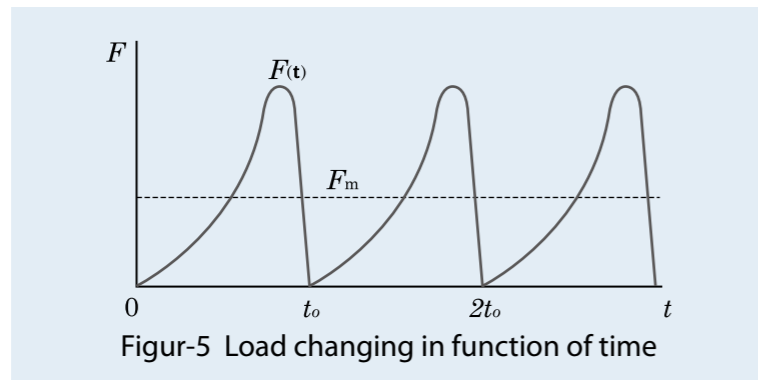
$$F_m = \left[\frac{(F_1^{10/3} \cdot n_1 t_1 + F_2^{10/3} \cdot n_2 t_2 + \dots + F_n^{10/3} \cdot n_n t_n)}{(n_1 t_1 + n_2 t_2 + \dots + n_n t_n)} \right]^{3/10} \dots \dots \dots (2.10)$$



(2) Continuously fluctuating load

Average load is given by formula (2.11) in the case that the load can be expressed in function $F(t)$ of time t with cycle t_0 .

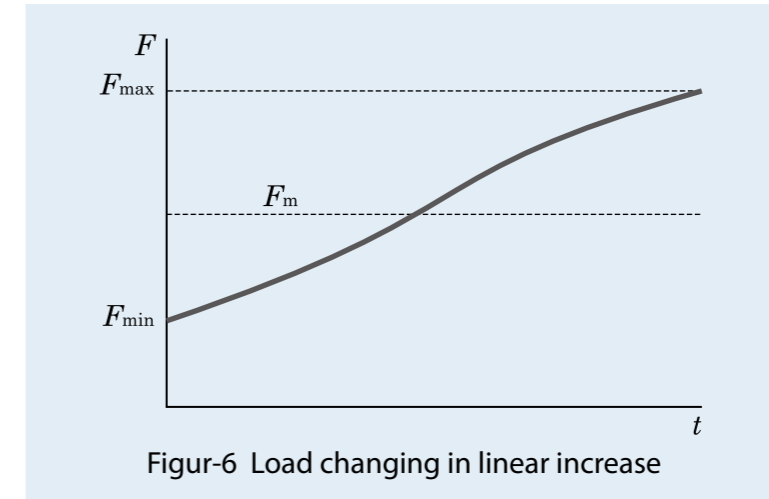
$$F_m = \left[\frac{1}{t_0} \int_0^{t_0} F(t)^{10/3} dt \right]^{3/10} \dots \dots \dots (2.11)$$



(3) Roughly linear load

Average load F_m is approximately given by formula (2.12).

$$F_m = \frac{F_{min} + 2F_{max}}{3} \dots \dots \dots (2.12)$$

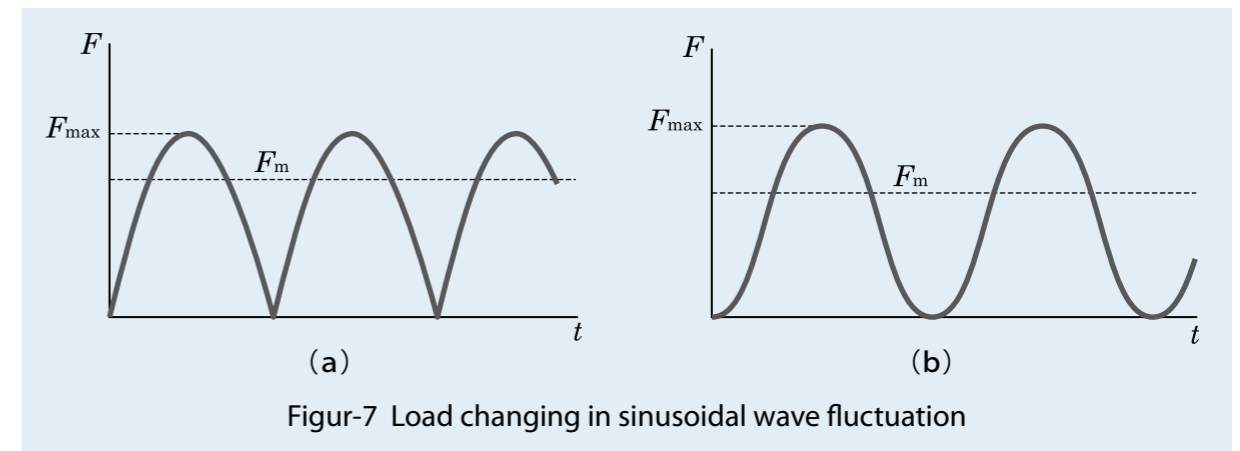


(4) Sinusoidal fluctuating load

Average load F_m is approximately given by formula (2.13) and formula (2.14).

$$(a): F_m = 0.75 F_{max} \dots \dots \dots (2.13)$$

$$(b): F_m = 0.65 F_{max} \dots \dots \dots (2.14)$$



3 Bearing accuracy

3-1 Accuracy

Dimensional accuracy, geometrical accuracy and rotation accuracy of bearing are specified in ISO standards and JIS B 1514 (Rolling bearings - Tolerances of bearings).

Accuracy class of needle bearing is specified by four classes from lowest class 0 to 6th, 5th and 4th class in the highest. While high accuracy bearing in 5th or 4th class may be used in application for the case high rotation accuracy is demanded or high speed rotation, class 0 is used in most of general purpose application.

Table-8 Accuracy of inner ring

Unit: μm

d Nominal bearing bore diameter (mm)	Δ_{dmp} Deviation of mean bore diameter in a single plane								V_{dsp} Variation of bore diameter in a single plane				V_{dmp} Variation of mean bore diameter in a single plane				K_{ia} Radial runout of inner ring of assembled bearing				S_d Reference face runout with bore (Inner ring)		Δ_{Bs} Deviation of a single inner ring width				V_{Bs} Variation of inner rings width				d Nominal bearing bore diameter (mm)	
	0	6	5	4	0	6	5	4	0	6	5	4	0	6	5	4	0	6	5	4	5	4	0,6	5,4	0	6	5	4	Over	Incl.		
Over Incl.	high low	high low	high low	high low	max.				max.				max.				max.		high low	high low	max.				Over	Incl.						
2.5 ¹⁾ 10	0 -8	0 -7	0 -5	0 -4	10 9	5 4	6 5	3 2	10 6	4 2.5	7 3	0 -120	0 -40	15 15	5 2.5	2.5 ¹⁾	10															
10 18	0 -8	0 -7	0 -5	0 -4	10 9	5 4	6 5	3 2	10 7	4 2.5	7 3	0 -120	0 -80	20 20	5 2.5	10	18															
18 30	0 -10	0 -8	0 -6	0 -5	13 10	6 5	8 6	3 2.5	13 8	4 3	8 4	0 -120	0 -120	20 20	5 2.5	18	30															
30 50	0 -12	0 -10	0 -8	0 -6	15 13	8 6	9 8	4 3	15 10	5 4	8 4	0 -120	0 -120	20 20	5 3	30	50															
50 80	0 -15	0 -12	0 -9	0 -7	19 15	9 7	11 9	5 3.5	20 10	5 4	8 5	0 -150	0 -150	25 25	6 4	50	80															
80 120	0 -20	0 -15	0 -10	0 -8	25 19	10 8	15 11	5 4	25 13	6 5	9 5	0 -200	0 -200	25 25	7 4	80	120															
120 150	0 -25	0 -18	0 -13	0 -10	31 23	13 10	19 14	7 5	30 18	8 6	10 6	0 -250	0 -250	30 30	8 5	120	150															
150 180	0 -25	0 -18	0 -13	0 -10	31 23	13 10	19 14	7 5	30 18	8 6	10 6	0 -250	0 -250	30 30	8 5	150	180															
180 250	0 -30	0 -22	0 -15	0 -12	38 28	15 12	23 17	8 6	40 20	10 8	11 7	0 -300	0 -300	30 30	10 6	180	250															
250 315	0 -35	0 -25	0 -18	— —	44 31	18 —	26 19	9 —	50 25	13 —	13 —	0 -350	0 -350	35 35	13 —	250	315															

1) 2.5 mm is included in this dimension group

Table-9 Accuracy of outer ring

Unit: μm

D Nominal bearing outside diameter (mm)	Δ_{Dmp} Deviation of mean outside diameter in a single plane								V_{Dsp} Variation of outside diameter in a single plane				V_{Dmp} Variation of mean outside diameter in a single plane				K_{ea} Radial runout of outer ring of assembled bearing				S_D Variation of outside surface generatrix inclination with face (outer ring)		Δ_{cs} Deviation of a single outer ring width		V_{Cs} Variation of outer ring width				D Nominal bearing outside diameter (mm)	
	0	6	5	4	0	6	5	4	0	6	5	4	0	6	5	4	5	4	0,6,5,4	0	6	5	4	Over	Incl.					
Over Incl.	high low	high low	high low	high low	max.				max.				max.				max.		high	low	max.				Over	Incl.				
2.5 ²⁾ 6	0 -8	0 -7	0 -5	0 -4	10 9	5 4	6 5	3 2	15 8	5 3	8 4	Depending on tolerance of Δ_{Bs} for D of the same bearing.	Depending on tolerance of V_{Bs} for D of the same bearing.	5	2.5	2.5 ²⁾	6													
6 18	0 -8	0 -7	0 -5	0 -4	10 9	5 4	6 5	3 2	15 8	5 3	8 4			5	2.5	6	18													
18 30	0 -9	0 -8	0 -6	0 -5	12 10	6 5	7 6	3 2.5	15 9	6 4	8 4			5	2.5	18	30													
30 50	0 -11	0 -9	0 -7	0 -6	14 11	7 6	8 7	4 3	20 10	7 5	8 4			5	2.5	30	50													
50 80	0 -13	0 -11	0 -9	0 -7	16 14	9 7	10 8	5 3.5	25 13	8 5	8 4			6	3	50	80													
80 120	0 -15	0 -13	0 -10	0 -8	19 16	10 8	11 10	5 4	35 18	10 6	9 5			8	4	80	120													
120 150	0 -18	0 -15	0 -11	0 -9	23 19	11 9	14 11	6 5	40 20	11 7	10 5			8	5	120	150													
150 180	0 -25	0 -18	0 -13	0 -10	31 23	13 10	19 14	7 5	45 23	13 8	10 5			8	5	150	180													
180 250	0 -30	0 -20	0 -15	0 -11	38 25	15 11	23 15	8 6	50 25	15 10	11 7			10	7	180	250													
250 315	0 -35	0 -25	0 -18	0 -13	44 31	18 13	26 19	9 7	60 30	18 11	13 8			11	7	250	315													

2) 2.5 mm is included in this dimension group

Table-10 Permissive tolerance of chamfer Unit: mm

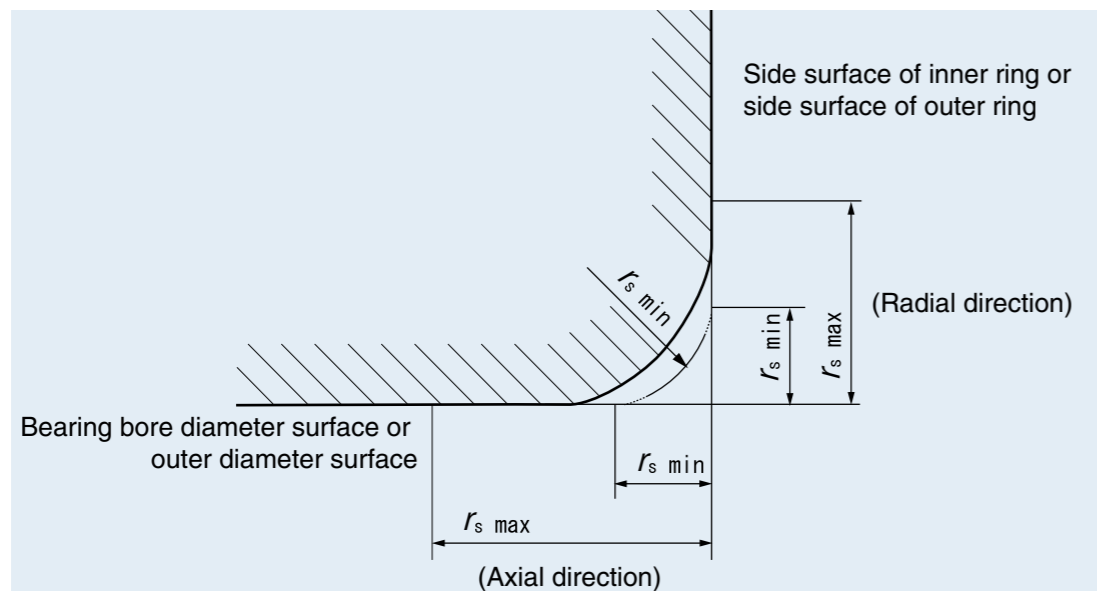
r_s min	d Nominal bearing bore diameter		Radial direction	Axial direction
	Over	Incl.	r_s max	
0.15	—	—	0.3	0.6
0.2	—	—	0.5	0.8
0.3	— 40	40 —	0.6 0.8	1 1
0.6	— 40	40 —	1 1.3	2 2
1	— 50	50 —	1.5 1.9	3 3
1.1	— 120	120 —	2 2.5	3.5 4
1.5	— 120	120 —	2.3 3	4 5
2	— 80 220	80 220 —	3 3.5 3.8	4.5 5 6
2.1	— 280	280 —	4 4.5	6.5 7
2.5	— 100 280	100 280 —	3.8 4.5 5	6 6 7
3	— 280	280 —	5 5.5	8 8
4	—	—	6.5	9

Table-11 Tolerance of minimum value of diameter of inscribed circle to roller Unit: μ m

Fw (mm) Inscribed circle diameter		Dimension difference of Δ Fw min Variation of minimum value of diameter of inscribed circle to roller	
Over	Incl.	high	low
3	6	+18	+10
6	10	+22	+13
10	18	+27	+16
18	30	+33	+20
30	50	+41	+25
50	80	+49	+30
80	120	+58	+36
120	180	+68	+43
180	250	+79	+50
250	315	+88	+56

This means diameter of roller that achieves zero radial clearance in at least one radial direction in the case of using cylindrical roller instead of bearing inner ring.

* Remark Although no particular shape is specified for chamfer surface, its outline in axial plane must be within virtual arc of r_s min radius that is tangent to slope of inner ring and inner diameter face of bearing, or tangent to side of outer ring and bearing outer diameter. (Reference diagram)



3-2 Measurement method

Measurement of single bore diameter

Table-12 Bearing bore diameter

Type and definition of accuracy	
d_{mp} Mean bore diameter in a single plane	Arithmetic mean of maximum and minimum value of the single bore diameters in a single radial plane. $d_{mp} = \frac{d_{sp\ max} + d_{sp\ min}}{2}$ d_{sp} : Single inner diameter in a particular radial plane.
Δ_{dmp} Deviation of mean bore diameter in a single plane	Difference between the mean bore diameter and nominal more diameter. $\Delta_{dmp} = d_{dmp} - d$ d : Nominal bearing bore diameter.
V_{dsp} Variation of single bore diameter in a single plane	Difference between maximum and minimum value of single bore diameter in single radial plane. $V_{dsp} = d_{sp\ max} - d_{sp\ min}$
V_{dmp} Variation of mean bore diameter in a single plane	Difference between maximum and minimum value of the mean bore diameter in a single plane in individual track ring basically with cylindrical inner diameter face. $V_{dmp} = d_{mp\ max} - d_{mp\ min}$
Δ_{ds} deviation of single bore diameter	Difference between single bore diameter and nominal bore diameter. $\Delta_{ds} = d_s - d$ d_s : Distance between two parallel straight lines which are tangent to intersecting line of actual bore diameter face and radial plane.

Method of measurement of bearing bore diameter

Zero the gauge indicator to the appropriate size using gauge blocks or a master ring.

In several angular directions and in a single radial plane, measure and record the largest and the smallest single bore diameters, $d_{sp\ max}$ and $d_{sp\ min}$.

Repeat angular measurements and recordings in several radial planes to determine the largest and the smallest single bore diameter of an individual ring, $d_{s\ max}$ and $d_{s\ min}$.

Table-13 Measurement area limit Unit: mm

r s min		a
Over	or less	
-	0.6	$r_{s\ max} + 0.5$
0.6	-	$1.2 \times r_{s\ max}$

Measurement of single outside diameter

Table-14 Bearing outer diameter

Type and definition of accuracy	
D_{mp} mean outside diameter in a single plane	Arithmetic mean of maximum and minimum value of the single outside diameters in a single radial plane. $D_{mp} = \frac{D_{sp\ max} + D_{sp\ min}}{2}$ D_{sp} : Single outside diameter in a particular radial plane
Δ_{Dmp} Deviation of mean outside diameter in a single plane	Difference between the mean outside diameter in a single plane of cylindrical outside diameter face and nominal outside diameter. $\Delta_{Dmp} = D_{mp} - D$ D : Nominal bearing outside diameter.
V_{Dsp} deviation of single outside diameter	Difference between maximum and minimum value of the mean outside diameter in a single radial plane. $V_{Dsp} = D_{sp\ max} - D_{sp\ min}$
V_{Dmp} Variation of mean outside diameter in a single plane	Difference between maximum and minimum value of the mean outside diameter in a single plane in individual track ring with basically cylindrical outer diameter face. $V_{Dmp} = D_{mp\ max} - D_{mp\ min}$
Δ_{Ds} deviation of single bore diameter	Difference between single outside diameter in basically cylindrical outside diameter face and nominal outside diameter. $\Delta_{Ds} = D_s - D$ D_s : Distance between two parallel straight lines which are tangent to intersecting line of actual outer diameter face and radial plane.

Method of measurement of bearing outer diameter

Zero the gauge indicator to the appropriate size using gauge blocks or a master.

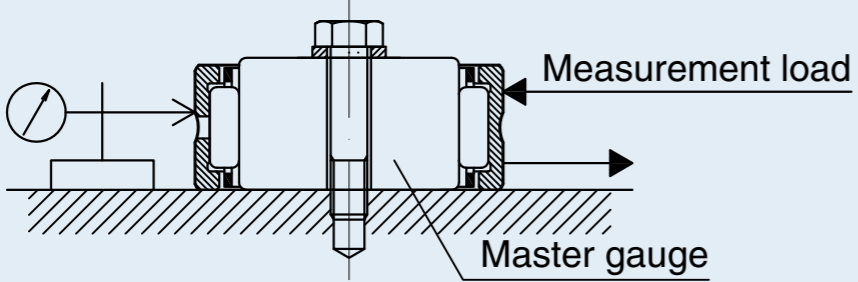
In several angular directions and in a single radial plane, measure and record the largest and the smallest single outside diameters, $D_{sp\ max}$ and $D_{sp\ min}$.

Repeat and record measurements in several radial planes to determine the largest and the smallest single outside diameter of an individual ring, $D_{s\ max}$ and $D_{s\ min}$.

Measurement of single bore diameter of rolling element complement

Table-15 Measurement of single bore diameter of rolling element complement

Type and definition of accuracy	
F_{ws} Nominal bore diameter of rolling element complement	Distance between two parallel straight lines which are tangent to intersecting line of inscribed circle of rolling element complement and radial plane in radial bearing without inner ring.
$F_{ws\ min}$ Minimum nominal bore diameter of rolling element complement	Minimum nominal bore diameter of rolling element complement in radial bearing without inner ring. Remark Minimum nominal bore diameter of rolling element complement is diameter of cylinder whose radial clearance becomes zero in at least one radial direction.



Measurement of single bore diameter of rolling element complement

Fasten the master gauge to a surface plate.

Position the bearing on the master gauge and apply the indicator in the radial direction to the approximate middle of the width on the ring outside surface.

Measure the amount of movement of the outer ring in the radial direction by applying sufficient load on the outer ring in the same radial direction as that of the indicator and in the opposite radial direction.

Record indicator readings at the extreme radial positions of the outer ring. Rotate the bearing and repeat the measurement in several different angular positions to determine the largest and the smallest readings, $F_{ws\ max}$ and $F_{ws\ min}$.

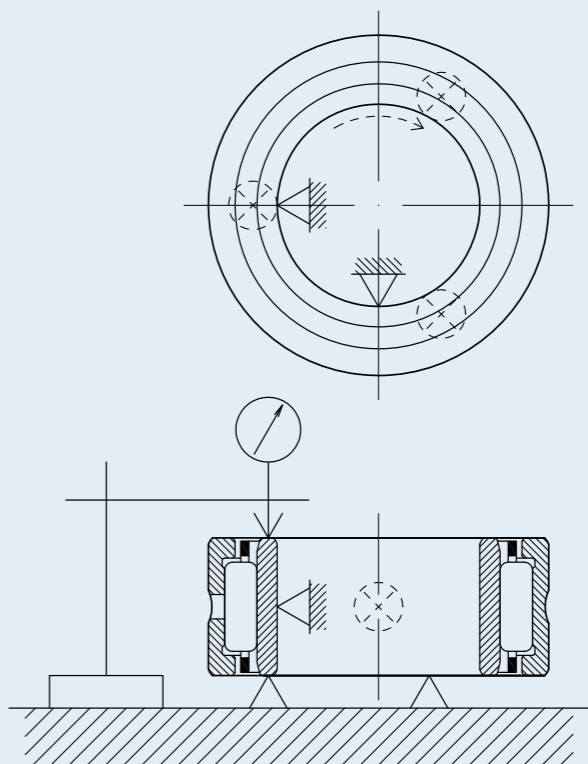
Table-16 Radial measurement load

F_w mm		Measurement load N
Over	Incl.	min.
—	30	50
30	50	60
50	80	70
80	—	80

Measurement of single inner ring width (or outer ring width)

Table-17 Measurement of single inner ring width (or outer ring width)

Type and definition of accuracy	
Δ_{Bs} Deviation of single inner ring width	Difference between single inner ring width and nominal inner ring width. $\Delta_{Bs} = B_s - B$
V_{Bs} Variation of inner ring width	Difference between maximum and minimum value of the single bore diameter width in each inner ring. $V_{Bs} = B_{s\ max} - B_{s\ min}$
Δ_{Cs} Deviation of single outer ring width	Difference between single outer ring width and nominal outer ring width. $\Delta_{Cs} = C_s - C$
V_{Cs} Variation of outer ring width	Difference between maximum and minimum value of the single outer ring width in each outer ring. $V_{Cs} = C_{s\ max} - C_{s\ min}$



Measurement of single inner ring width (or outer ring width)

Zero the gauge indicator to the appropriate height from the reference surface using gauge blocks or a master.

Support one face of the ring on three equally spaced fixed supports of equal height and provide two suitable radial supports on the bore surface set at 90° to each other to center the ring.

Position the indicator against the other face of the ring opposite one fixed support.

Rotate the ring one revolution and measure and record the largest and the smallest single ring width, $B_{s\ max}$ and $B_{s\ min}$ ($C_{s\ max}$ and $C_{s\ min}$).

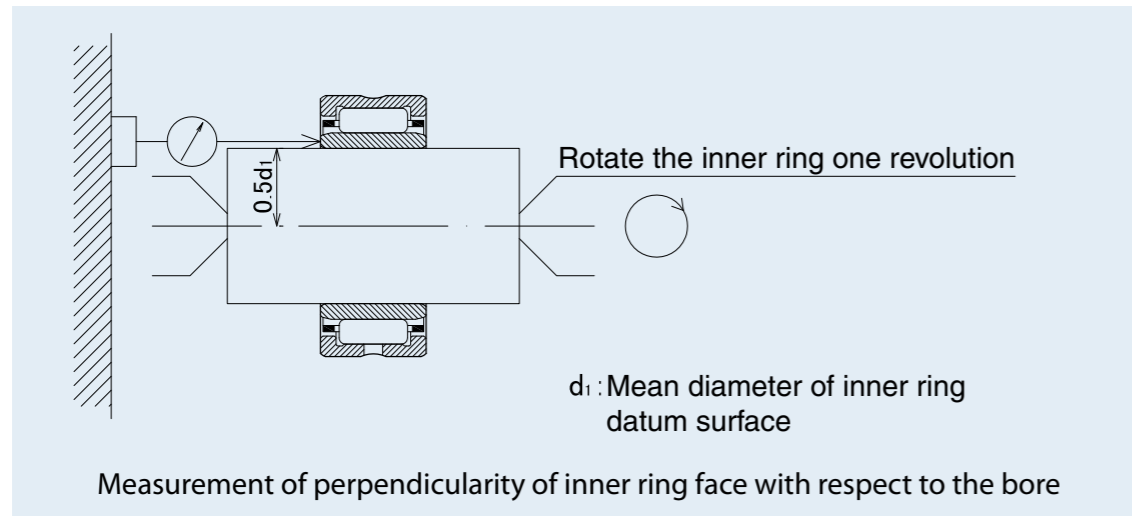
Measurement of perpendicularity of inner ring face with respect to the bore (S_d)

Use a precision arbor having a taper of approximately 1:5000 on diameter.

Mount the bearing assembly on the tapered arbor and place the arbor between two centres so that it can be accurately rotated.

Position the indicator against the reference face of the inner ring at a radial distance from the arbor axis of half the mean diameter of the face.

Take indicator readings while rotating the inner ring one revolution.

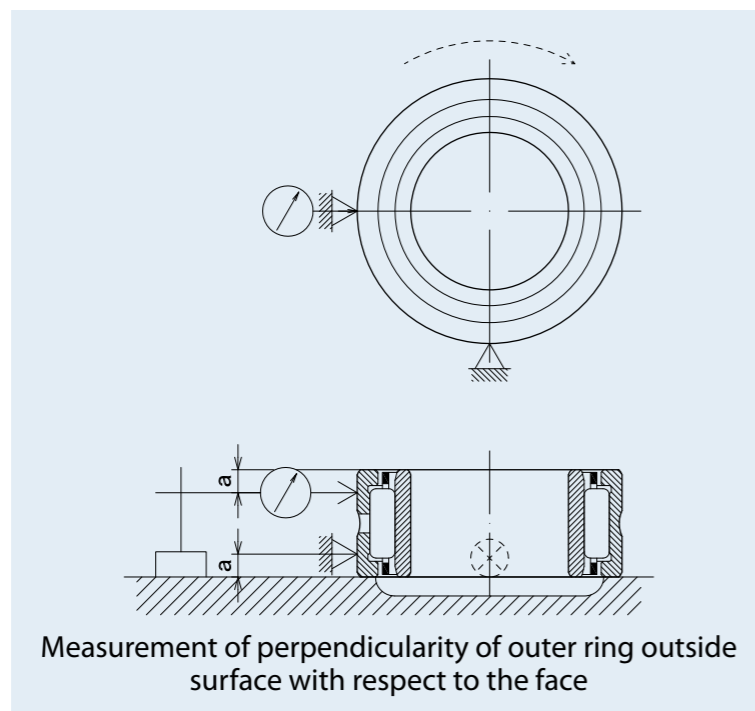


Measurement of perpendicularity of outer ring outside surface with respect to the face (S_D)

Support the reference face of the outer ring on a surface plate leaving the inner ring, if an assembled bearing, free. Locate the outer ring cylindrical outside surface against two supports set at 90° to each other to centre the outer ring.

Position the indicator directly above one support. The indicator and the two supports are axially located at the extremes of the measurement zone.

Take indicator readings while rotating the outer ring one revolution.



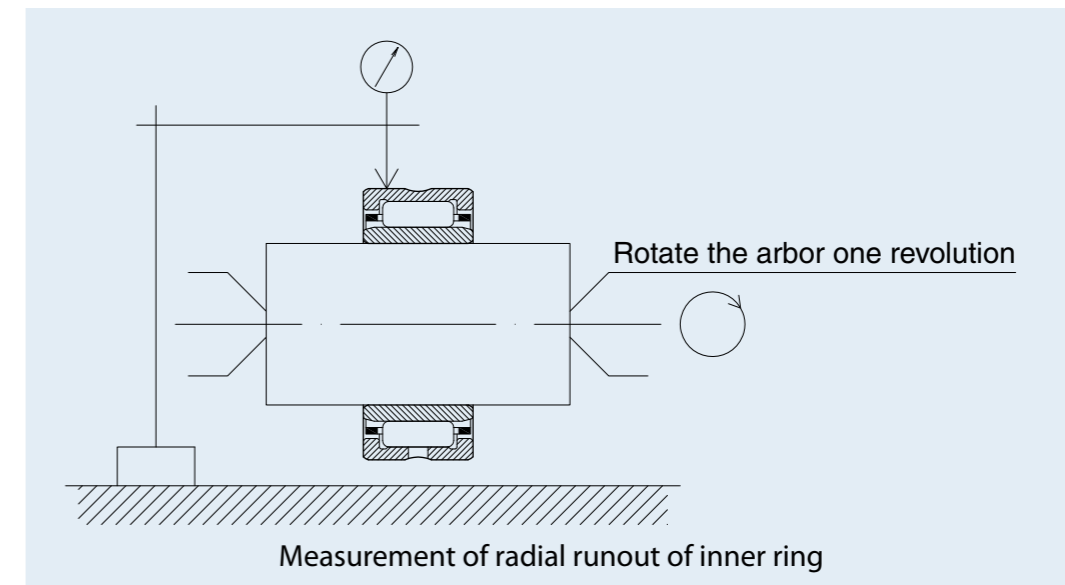
Measurement of radial runout of inner ring (K_{ia})

Use a precision arbor having a taper of approximately 1:5000 on diameter.

Mount the bearing assembly on the tapered arbor and place the arbor between two centres so that it can be accurately rotated.

Position the indicator against the outside surface of the outer ring as close as possible to the middle of the outer ring raceway.

Hold the outer ring to prevent rotation but ensure its weight is supported by the rolling elements. Take indicator readings while rotating the arbor one revolution.



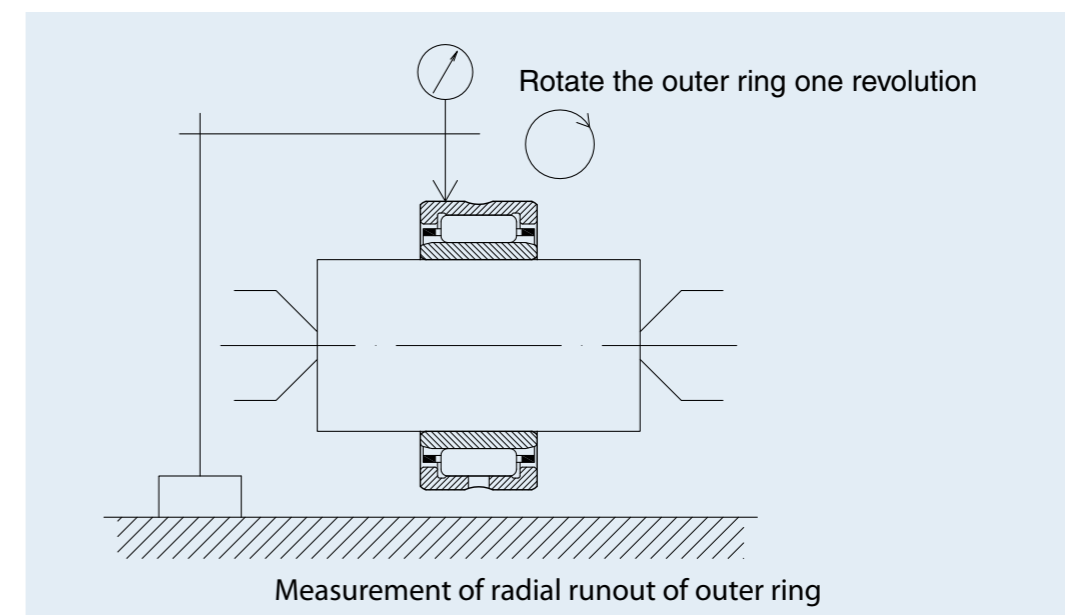
Measurement of radial runout of outer ring (K_{ea})

Use a precision arbor having a taper of approximately 1:5000 on diameter.

Mount the bearing assembly on the tapered arbor and place the arbor between two centres so that it can be accurately rotated.

Position the indicator against the outside surface of the outer ring as close as possible to the middle of the outer ring raceway.

Hold the inner ring stationary. Take indicator readings while rotating the outer ring one revolution.



4 Internal clearance of bearing

4-1 Radial internal clearance of bearing

Radial internal clearance of bearing means a displacement of either inner ring or outer ring, which is free side, when the specified measurement load is applied to it alternatively in radial direction while locking the opposite component in the condition before mounting the bearing on shaft or housing. This measurement loads are quite small and they are specified in JIS B 1515:2006 (Rolling bearings - Tolerances). Radial internal clearance of needle bearing with inner ring is specified in JIS B 1520:1995 (radial internal clearance of bearing). Clearances shown in Table-18 are categorized in group C2, CN, C3, C4, C5 starting from smaller clearance and group CN is applied to general application.

■ Radial internal clearance of bearing

Table-18 Internal clearance of radial bearing

Category	Description
C2	Radial clearance smaller than standard clearance
CN clearance	Standard radial clearance
C3, C4, C5	Radial clearance larger than standard clearance

Table-19 Value of radial internal clearance of needle bearing

Unit: μm

d Nominal bearing bore diameter (mm)		Clearance category									
		C2		CN		C3		C4		C5	
Over	Incl.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.
-	10	0	25	20	45	35	60	50	75	-	-
10	24	0	25	20	45	35	60	50	75	65	90
24	30	0	25	20	45	35	60	50	75	70	95
30	40	5	30	25	50	45	70	60	85	80	105
40	50	5	35	30	60	50	80	70	100	95	125
50	65	10	40	40	70	60	90	80	110	110	140
65	80	10	45	40	75	65	100	90	125	130	165
80	100	15	50	50	85	75	110	105	140	155	190
100	120	15	55	50	90	85	125	125	165	180	220
120	140	15	60	60	105	100	145	145	190	200	245
140	160	20	70	70	120	115	165	165	215	225	275
160	180	25	75	75	125	120	170	170	220	250	300
180	200	35	90	90	145	140	195	195	250	275	330
200	225	45	105	105	165	160	220	220	280	305	365
225	250	45	110	110	175	170	235	235	300	330	395

Remark Nominal number C2,C3,C4 are displayed as part code suffix for these bearings (excluding CN clearance). Example) NA 4903 C2

4-2 Selection of radial internal clearance of bearing

Selection of clearance

Radial internal clearance of needle bearing in operation may generally becomes smaller than initial radial internal clearance. Temperature difference between inner and outer bearing during operation and fit cause this change. The radial internal clearance has a significant impact to life, vibration and heat generation of bearing.

Typically, larger radial internal clearance causes increase of vibration and smaller one results in heat generation or reduction of life due to excessive force between rolling element and track. Initial radial internal clearance may be selected as slightly larger than zero clearance in consideration for the internal clearance during operation. Bearing is designed to have suitable radial clearance by selecting CN clearance for general application.

Reduction of radial internal clearance due to fits

When bearing is installed to shaft or housing, radial internal clearance reduces due to expansion or shrinking of track with elastic deformation.

Reduction of radial clearance due to temperature difference between inner and outer ring

Friction heat generated by rotation of bearing will be released to outside through shaft and/or housing. In general application, radial internal clearance may be reduced as much as the difference of amount of thermal expansion between inner and outer ring since outer ring becomes cooler than inner ring due to larger heat release from housing than that from shaft.

5 Fits

5-1 Purpose of fits

Purpose of "fits" for a bearing is to fixate a bearing with sufficient "interference" between inner ring and shaft or between outer ring and housing. Insufficient "fits" may cause harmful phenomena which result in damaging bearing or shortening its life such as abnormal wear in fitting surface, abnormal heat by abrasion powder, abnormal rotation and vibration due to slip of fitting surface. Therefore, it is imperative to select proper fits for application.

5-2 Selection of fits

Condition for selection of fits

Selection of bearing "fits" needs to consider following points. Properties and size of load in application, condition of temperature, accuracy of rotation, material, finish, wall thickness of shaft and housing and easiness of assembling/disassembling.

"Fits" as shown in Table-20 is generally determined based on properties of load and condition of rotation.

Table-20 Properties of radial load and fits

Properties of bearing load		Fits		
		Inner ring	Outer ring	
Load with rotating inner ring Load with stationary outer ring		Inner ring: rotation Outer ring: stationary Loading direction: constant	Tight fit	Loose fit
		Inner ring: stationary Outer ring: rotation Loading direction: rotate together with outer ring		
Load with rotating outer ring Load with stationary inner ring		Inner ring: stationary Outer ring: rotation Loading direction: constant	Loose fit	Tight fit
		Inner ring: rotation Outer ring: stationary Loading direction: rotate together with inner ring		
Load in inconsistent direction	Direction of load is inconsistent due to varying load direction or including unbalanced load	Inner ring: rotation or stationary Outer ring: rotation or stationary Loading direction: inconsistent	Tight fit	Tight fit

Selection of fits

It is necessary to take condition of temperature and material of shaft and housing into consideration in addition to properties of load and rotation condition for selection of "fits" as mentioned above. Yet, it is common practice to determine "fits" based on reference to experience and past record because of difficulty for recognizing whole conditions. Table-21 and Table-22 show "fits" for general application and Table-23 shows "fits" for needle bearing without inner ring against shaft.

Table-21 Fits between needle bearing and housing hole

Conditions		Tolerance grade for housing
Load with stationary outer ring	Standard and heavy load	J7
	Split housing with standard load	H7
Load in inconsistent direction	Light load	J7
	Standard load	K7
	Heavy load and impact shock load	M7
Load with rotating outer ring	Light load	M7
	Standard load	N7
	Heavy load and impact shock load	P7
Light load and high rotation accuracy		K6

Table-22 Fits between needle bearing with inner ring and shaft

Conditions		Shaft diameter (mm)		Tolerance grade
		Over	Incl.	
Load with rotating inner ring or Load in inconsistent direction	Light load	—	50	j5
		50	100	k5
	Standard load	—	50	k5
		50	150	m5·m6
Heavy load and impact shock load	150~		m6·n6	
	~150		m6·n6	
	150~		n6·p6	
Load with stationary inner ring	Mid to low speed, light load	All dimension		g6
	Mid to low speed, standard load or heavy load			h6
	With precision rotation accuracy			h5

Remark Light load $P_r \leq 0.06C_r$, Standard load $0.06C_r < P_r \leq 0.12C_r$, Heavy load $P_r > 0.12C_r$,
 P_r : Dynamic equivalent radial load C_r : Basic dynamic load rating

Table-23 Fits between needle bearing without inner ring and shaft

Nominal diameter of inscribed circle F_w (mm)		Radial internal clearance		
		Clearance smaller than CN clearance	CN clearance	Clearance larger than CN clearance
Over	Incl.	Tolerance group grade for shaft		
-	65	k5	h5	g6
65	80	k5	h5	f6
80	160	k5	g5	f6
160	180	k5	g5	e6
180	200	j5	g5	e6
200	250	j5	f6	e6
250	315	h5	f6	e6

Remark Tight fit with housing hole smaller than k7 shall be modified with smaller shaft size in considering diameter shrink of inscribed circle of roller after assembly.

6 Design of shaft and housing

6-1 Accuracy of fitting surface

Correct design and manufacturing of shaft or housing to which needle bearing is assembled are vital for adequate bearing performance since the needle bearing has thinner track ring compared to other types of rolling bearings. Table-26 shows dimension accuracy and geometric accuracy of "fitting" part of shaft and housing in standard application condition, surface roughness and tolerance of runout of shoulder against fitting surface.

Table-26 Accuracy of shaft and housing (recommended)

Item	Shaft	Housing
Roundness tolerance	IT3~IT4	IT4~IT5
Cylindricity tolerance	IT3~IT4	IT4~IT5
Shoulder runout tolerance	IT3	IT3~IT4
Roughness of fitting surface	0.8a	1.6a

6-2 Accuracy of track surface

Needle bearing can be directly attached to shaft or housing as track for compact bearing structure. In this case, accuracy and roughness of track surface must be equivalent to that of bearing track surface in order to ensure bearing life with high rotation accuracy. Since accuracy and roughness of shaft and housing may affect life and the cause of abnormality of the bearing.

Table-27 shows specification for accuracy and roughness of track surface.

Table-27 Accuracy of track surface (recommended)

Item	Shaft	Housing
Roundness tolerance	IT3	IT3
Cylindricity tolerance	IT3	IT3
Shoulder runout tolerance	IT3	IT3
Surface roughness	0.2a	

6-3 Material and heat treatment of track surface

Surface hardness of shaft and housing must be HRC58 to 64 in order to obtain sufficient loading capacity in the case of using them as direct track surface. Table-28 shows recommended heat treatment for their material.

Table-28 Material for track

Type of steel	Representative example	Related standards
High carbon-chromium bearing steel	SUJ2	JIS G 4805
Chromium molybdenum steel	SCM415~435	JIS G 4053
Carbon tool steel	SK85	JIS G 4401
Stainless steel	SUS440C	JIS G 4303

6-4 Skew of bearing

Skew between inner ring and outer ring generated by deflection of shaft due to external force or mounting error may result in reduction of life caused by abnormal wear or heat. While permissible amount of skew varies depending on type of bearing, load and bearing internal clearance, it is recommended to be 1/2000 or less for general application.

6-5 Mounting dimension for bearing

Dimension of shaft and housing for mounting needle bearing (Figure-8) is shown in dimension table for respective bearings.

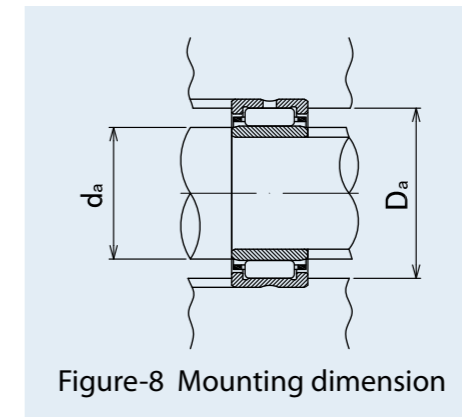


Figure-8 Mounting dimension

Fillet radius and height of shoulder for shaft and housing

Maximum permissible radius ($r_{as\ max}$) of fillet radius for shaft and housing to which needle bearings are assembled corresponds to minimum permissible chamfer dimension ($r_{s\ min}$) of the bearings.

Minimum value of shoulder diameter of the shaft (d_a) shall be nominal bore diameter (d) of bearing plus its shoulder height (h) multiplied by 2. Maximum value of shoulder diameter of the housing (D_a) shall be outer diameter (D) of bearing minus height of its shoulder multiplied by 2.

Table-29 Maximum permissible actual radius of corner R of shaft and housing $r_{as\ max}$

Unit: mm

$r_{s\ min}$ Minimum permissible chamfer dimension	$r_{as\ max}$ Maximum permissible actual radius of corner R of shaft and housing
0.1	0.1
0.15	0.15
0.2	0.2
0.3	0.3
0.4	0.4
0.6	0.6
1	1
1.1	1
1.5	1.5
2	2
2.1	2
2.5	2
3	2.5
4	3
5	4

Height of shoulder and corner R

7 Lubrication

7-1 Purpose of lubrication

Purpose of bearing lubrication is to prevent its heat-seizure by mitigating friction and abrasion of rolling surface and slipping surface. Followings are the detailed explanation.

(1) Mitigation of friction and abrasion

It prevents direct contact between track, rolling element and cage.

It also mitigates friction and abrasion as a result of slip on track surface.

(2) Removal of frictional heat

Lubricant removes abrasion heat inside of bearing or heat propagated from outside to prevent excessive heat-up of the bearing.

(3) Extension of bearing life

Separating rolling element and track by oil film results in extension of bearing life.

(4) Prevention of rust

Oil film of lubricant mitigates oxidation inside and surface of bearing to prevent corrosion.

(5) Prevention of dust

Packed grease in the case of grease lubrication prevent invasion of foreign matter.

Efficient performance of these effects requires using lubrication method suitable for the application as well as selection of proper lubricant, its adequate amount, prevention against invasion of external foreign matter and optimal sealing structure in order to avoid leakage of the lubricant.

7-2 Comparison of grease and oil lubrication

Lubrication method

Lubrication method of bearing consists of grease lubrication and oil lubrication.

Grease lubrication is so popular for broad type of bearing because of its cost efficiency due to its simple sealing structure and a long duration of operating period with single filling. However, its disadvantage is larger flow resistance than oil lubrication in light of efficiency to large cooling capability and high speed application.

Oil lubrication has advantage in large cooling capability and high speed application due to its good flow characteristics. However, it demands design with consideration to sealing structure and leakage prevention. The Table-31 compares the two lubrication methods as a guidance for lubrication method selection.

Table-31 Comparison of grease and oil lubrication

Item	Lubrication method	
	Grease	Oil
Replacement of lubricant	△	○
Lubrication performance	○	◎
Cooling efficiency	×	○
Sealing structure	○	△
Power loss	△	○
Maintenance	○	△
High speed operation	×	○

Table-30 Value of tolerance class IT for reference dimension

Unit: μm

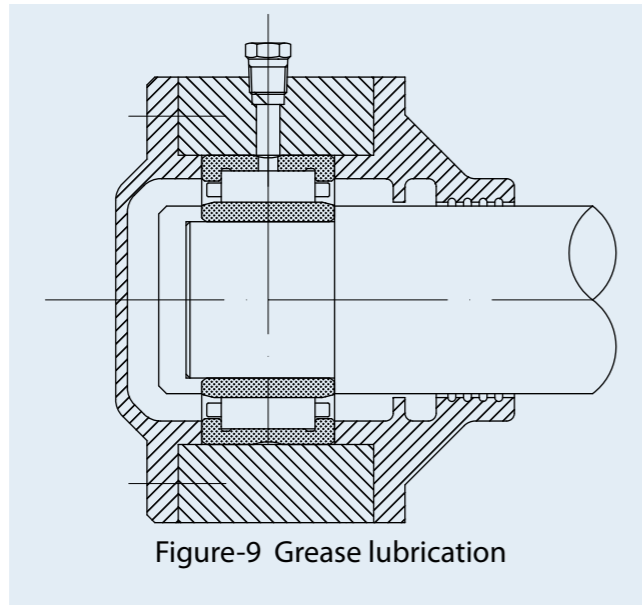
Reference dimension mm		Tolerance class					
Over	Incl.	IT2	IT3	IT4	IT5	IT6	IT7
3	6	1.5	2.5	4	5	8	12
6	10	1.5	2.5	4	6	9	15
10	18	2	3	5	8	11	18
18	30	2.5	4	6	9	13	21
30	50	2.5	4	7	11	16	25
50	80	3	5	8	13	19	30
80	120	4	6	10	15	22	35
120	180	5	8	12	18	25	40
180	250	7	10	14	20	29	46
250	315	8	12	16	23	32	52

7-3 Grease lubrication

Filling amount of grease

Grease shall be packed up to volume approximately one-third to one-half of internal space of bearing or housing. Excessive grease may cause degraded lubrication performance due to leakage of softened grease or oxidation as a result of increased temperature inside of bearing. This should be critical especially in high speed operation.

Figure-9 shows an example of grease replenishment plan from side way using a ring with grease hole. Arranging grease holes evenly on circumference of the ring allows simultaneous entry of replenished grease into bearing for replacing old grease with new one. However, this design also allows standing old grease in opposite side space, which needs to be removed periodically by removing the cover.



Lubrication grease

Grease is a semi-solid lubricant consisting of a base oil (liquid lubrication agent) and a thickener, which are combined on heating.

Table-32 Type and properties of grease (reference)

Name	Lithium grease			Sodium grease	Calcium base grease	Aluminum grease	Non-soap grease	
Thickener	Li soap			Na soap	Ca + Na soap Ca + Li soap	Al soap	Bentonite,urea,etc	
Base oil	Mineral oil	Diester oil	Silicon oil	Mineral oil	Mineral oil	Mineral oil	Mineral oil	Synthetic oil
Dropping point °C	170~190	170~190	200~250	150~180	150~180	70~90	250 or more	250 or more
Working temperature °C	-25~+120	-50~+120	-50~+160	-20~+120	-20~+120	-10~+80	-10~+130	-50~+200
Mechanical stability	Good	Fair	Fair	Good~Fair	Good~Fair	Fair~Poor	Fair	Fair
Pressure resistance	Fair	Fair	Poor	Fair	Good~Fair	Fair	Fair	Fair
Water resistance	Fair	Fair	Fair	Fair~Poor	Fair~Poor	Fair	Fair	Fair
Application	Most various Versatile rolling bearing grease	Superior in low temperature, friction properties	Suitable for high and low temperature Unsuitable for high load due to low oil film strength	Subject to emulsifying by mixing with water Relatively good properties to high temperature	Superior in water resistance and mechanical stability Suitable for bearing being subjected to vibration	Superior in viscosity Suitable for bearing being subjected to vibration	Vast application from low to high temperature It includes types showing superior properties in resistance to high and low temperature, and to chemical by combination with base oil and thickener Versatile rolling bearing grease	

Remark Working temperature range is for general properties only and NOT for guarantee purpose.

1) Base oil

Mineral oil and mixed oil are used for base oil of grease.

Diester oil and silicone oil are used as mixed oil.

Lubrication performance depends on viscosity of the base oil, and generally, low viscosity base oil is suitable for low temperature environment and high speed application, and high viscosity is for high temperature and high load application.

2) Thickener

Thickener is a material to keep grease in semi-solid state. Type of thickener has impact to maximum working temperature, water resistance and mechanical stability.

Metal-soap base is popular for material of thickener. In addition, there are thickeners such as urea base thickener with high heat resistance, and natrium soap-base thickener with poor water resistance due to easiness to emulsifying by mixing with water.

3) Consistency

Consistency refers to the “softness” of grease and it is used as a guideline for showing flow characteristics. The larger the ASTM penetration No. is, the softer the grease is. Table-33 shows typical relationship between consistency of grease and its operating conditions.

Table-33 Consistency of grease and its operating conditions

NLGI Grade No.	ASTM Penetration (1/10mm)	Operating conditions
0	355~385	Centralized lubrication Oscillating application
1	310~340	
2	265~295	General application
3	220~250	General, high temperature application
4	175~205	Grease with sealed application

4) Additives

Additives are material to improve performance of grease, which include antioxidants and extreme pressure additives added as necessary. Condition to use grease for long period without any replenishment requires added antioxidants to prevent oxidation.

Also, grease in operating conditions with heavy load or impact shock shall be selected from those with extreme pressure additives added.

5) Mixing different type greases

In principle, different brands of grease must not be mixed. Mixing different type grease is subject to negative impact each other due to change of consistency and difference of additives.

Table-34 Brand of lubricant grease (reference)

Category	Brand	Manufacturer	Thickener or soap-base	Consistency	Dropping point °C	Working temperature °C	Remark
General purpose	Alvania Grease S1	Showa Shell Sekiyu	Lithium soap	323	180	-35~120	General purpose
	Alvania Grease S2	Showa Shell Sekiyu	Lithium soap	283	181	-25~120	General purpose
	Alvania Grease S3	Showa Shell Sekiyu	Lithium soap	242	182	-20~135	General purpose
Wide working temperature	Fomblin RT-15	Solvay Solexis	PTFE	NO.2	300 or more	-20~250	High temperature
	Fomblin Y-VAC1	Solvay Solexis	PTFE	NO.1	300 or more	-20~250	High vacuum (soft)
	Fomblin Y-VAC2	Solvay Solexis	PTFE	NO.2	300 or more	-20~250	High vacuum (normal)
	Fomblin Y-VAC3	Solvay Solexis	PTFE	NO.3	300 or more	-20~250	High vacuum (rigid)
Low temperature	Multemp PS No.2	KYODO YUSHI	Lithium soap	NO.2	190	-50~130	Low temperature
Other	LOR#101	OIL CENTER RESEARCH	PTFE	295	198	-40~188	Superior in abrasion resistance, load resistance, water resistance and chemical resistance
	HP300	Dow Corning	PTFE	280	-	-65~250	Load resistance, oil resistance, solvent resistance, chemical resistance
	BARRIERTA SUPER IS/V	NOK KLUBER	PTFE	No.2	-	-35~260	High vacuum
	BARRIERTEL/V	NOK KLUBER	PTFE	No.2	-	-65~200	High vacuum
	ISO FLEX TOPAS NB 52	NOK KLUBER	Barium soap	No.2	240 or more	-50~150	Superior in heat resistance, load resistance, water resistance and high speed
	DEMNUM L-200	DAIKIN	PTFE	280	-	-60~300	High temperature stability
	DEMNUM L-65	DAIKIN	PTFE	280	-	-70~200	High temperature stability
	G1/3Grease	The Orelube Corporation	Non-soap grease	No.2	-	-23~180	High temperature, high load
	Shell Cassida Grease RLS2	Showa Shell Sekiyu	Aluminium complex	No.2	240 or more	-30~120	Superior in water resistance, oxidation stability and mechanical stability
	Super Lube item number 82329	Henkel	PTFE	No.2	-	-42~232	Extreme pressure, high temperature
Castrol Microcote 296	Castrol	PTFE	No.2	256	-50~204	Heat stability, low volatility, shear stability, high vacuum	

7-4 Oil lubrication

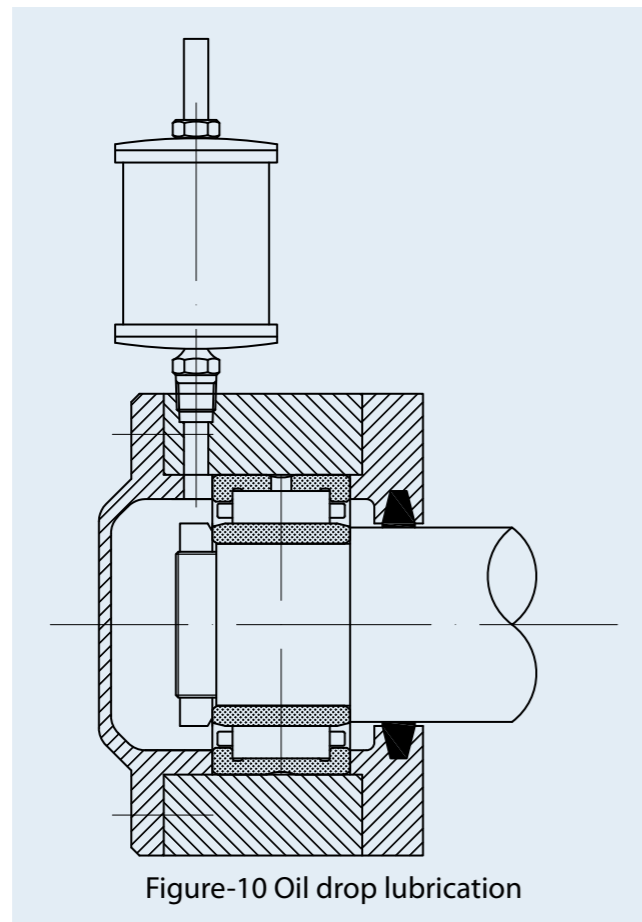
Oil lubrication is more suitable than grease for high speed rotation with superior cooling efficiency. It is suitable for application that requests emission of heat to outside that are generated in bearing or added to the bearing.

1) Oil bath lubrication

Oil bath lubrication is the most popular method used in medium to low speeds. Amount of oil needs to be properly controlled with oil gauge. Most proper oil amount may be with oil level at the center of the lowest needle roller of bearing. Housing design with less variation of oil level is preferable.

2) Oil drop lubrication

Oil drop lubrication is broadly used in application with high speed and medium load due to its better cooling efficiency than oil bath lubrication. Oil dripping through oiler in this method removes friction heat in a method to lubricate with oil fog filling inside of housing by hitting rotating objects such as shafts and nuts. While amount of oil varies depending on type of bearing and speed, general amount should be a couple of drops per minute.

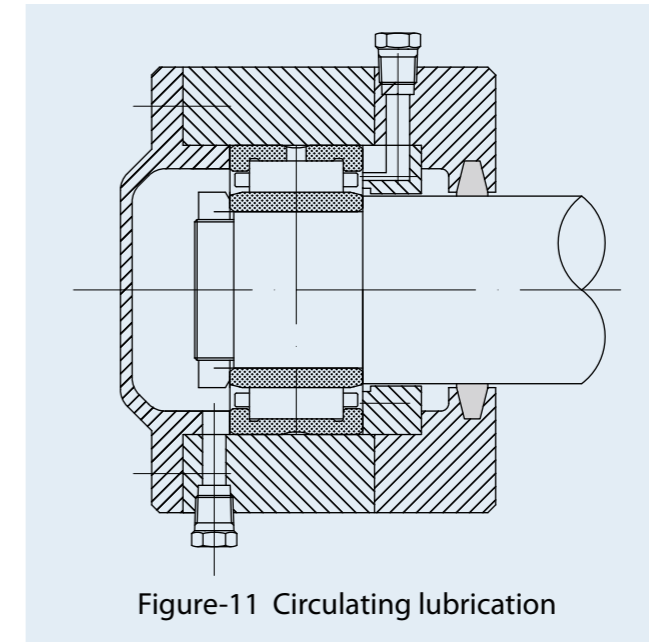


3) Oil splash lubrication

Oil splash lubrication is a method to splash oil with rotation of gear or disc. Unlike oil bath lubrication, it is applicable for relatively higher speed without having bearing in direct soak in oil.

4) Oil circulating lubrication

Oil circulating lubrication is widely used in application whose purpose is in cost efficiency for automatic lubrication with large number of lubrication spots, or is in cooling bearing. This lubrication method enables cooling or maintaining cleanness of lubricant with oil cooler and filters installed in oil circulation system. As shown in Figure-11, to make sure that lubrication oil is drained off certainly, it is important to have as much large outlet port as practical or forced outlet, setting inlet and outlet port of lubrication oil to opposite side each other to bearing.



Lubrication oil

Highly refined mineral oil such as spindle oil, machine oil or turbine oil, or mixed oil are used as lubrication oil for bearing. Additives such as antioxidants, extreme pressure additives or deparant are selectively used as necessary in accordance with application.

It is important to select oil with proper viscosity for operation temperature. Too low viscosity causes insufficient formation of oil film which results in abrasion or heat-seizure. Too high viscosity causes heat generation or loss of power due to viscosity resistance. In general, oil with higher viscosity is used for higher load and lower viscosity for higher speeds.

8 Bearing handling

8-1 Precaution

Bearings are an extremely precision mechanical components. Exercise great care for its handling. Followings are precautions for the handling.

1) Keep bearings and surroundings clean

Foreign matters invaded inside of bearings such as dust and dirt have harmful effect in rotation or operation life on the bearings. Take extra precaution to maintain cleanness of bearing, surrounding components, work tools, lubricants, lubrications oil and working environment.

2) Handle bearings carefully

Shocks such as caused by falling bearing may result in damage or impressions on track or rolling elements. They can be a cause of failure so that handle bearings carefully.

3) Use proper tools

Make it sure to use work tools properly for bearing type for assembling and disassembling.

4) Pay attention to rust

Although bearings are applied with anti-rust oil, handling with bare hands may cause generation of rust with perspiration from hands. Exercise care and use rubber gloves or apply mineral oil to hands when handling with bare hands.

8-2 Mounting

Preparation

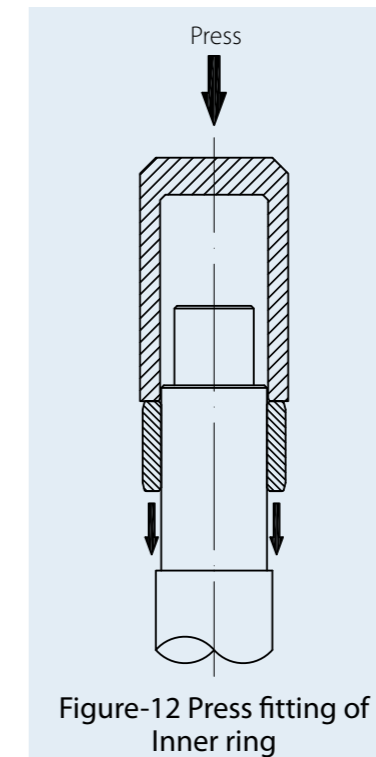
Bearings should be mounted in clean and dry circumstance. Dirt on mounting tools should be removed prior to mounting work, then verify that dimension accuracy, shaft and housing roughness and geometric accuracy are within designed tolerance.

Packing of bearings should be opened just before start mounting. Fill lubrication grease without washing bearing in the case of grease lubrication. Washing is generally not required for oil lubrication as well. Still it is recommended to thoroughly wash out oil and grease when application demands high accuracy or lubricating performance is degraded by mixing lubricant and anti-rust agents.

Mounting method

1) Press fitting

In mounting bearings from small to medium sizes which don't need large forces, press fittings in room temperature are conducted widely. In this case, use pressing fixture as shown in Figure-12 to apply force evenly at side of bearing and press it in carefully. Applying high viscosity oil on fitting surface during work may reduce friction on the surface.



2) Shrink fitting

Shrink fitting is broadly used for tighter interference or mounting large size bearing. How to fit is heating housing for outer ring and inner ring for shaft respectively with pure mineral oil with less corrosivity in order to expand their inner diameter for mounting onto the shaft. Heating temperature must not exceed 120° C. During mounting, inner ring could expand toward shaft direction so that it needs to be pressed against shoulder until completion of cool down to avoid gap between the inner ring and the shoulder.

8-3 Operation inspection

Operation inspection needs to be performed in order to confirm that bearings is properly mounted. Power operation at given speed without operation inspection may result in damage of bearings or heat-seizure due to lubrication failure in the case that mounting is insufficient. Shaft or housing should be rotated by hand after bearing mounting to confirm if there is no abnormality followed by check (or inspection) in stepping increase of speed from no load, low speed operation with power up to loaded operation.

Followings are typical abnormal items and major causes that can be checked in the operation inspection.

1) Check item in operation by hand

- Fluctuation in rotation torque, Insufficient mounting
- Sticks and abnormal noise, Impression, damage, invasion of dirt or foreign matters in track surface
- Excessive torque, Insufficiently small clearance

2) Check item in operation by power

- Abnormal noise, vibration ····· Impression, invasion of dirt or foreign matters in track surface, excessive clearance
- Abnormal temperature ······· Insufficient lubrication, insufficient mounting, insufficiently small clearance

8-4 Removing

Bearing may be removed for periodical machine maintenance or repair for trouble. Bearing and other components should be carefully disassembled in the same manner as the mounting in the case of re-using disassembled bearing or researching trouble condition.

Bearings should be carried out in an appropriate manner in accordance with type of bearing and condition of fits. Structure design should take disassembling work into consideration at planning stage of construction around the bearing since it would be difficult to disassemble especially the tight fit bearing.

Removing outer ring

Installing bolts for disassembling outer ring at several locations in circumference of housing will allow removing outer ring assembled with tight fits easily by tightening-up the screws evenly as shown in Figure-13.

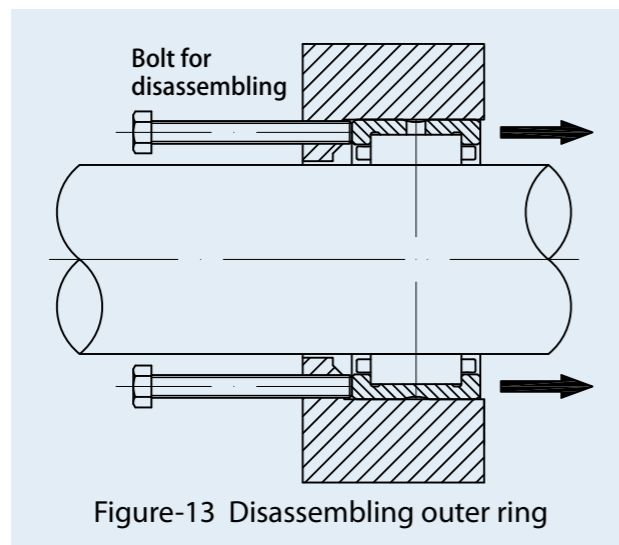


Figure-13 Disassembling outer ring

Disassembling inner ring

Inner rings can be carried out most easily by pulling out by press (Figure-14). Dedicated removal tool (Figure-15) designed in accordance with dimension of the bearing is in use as well.

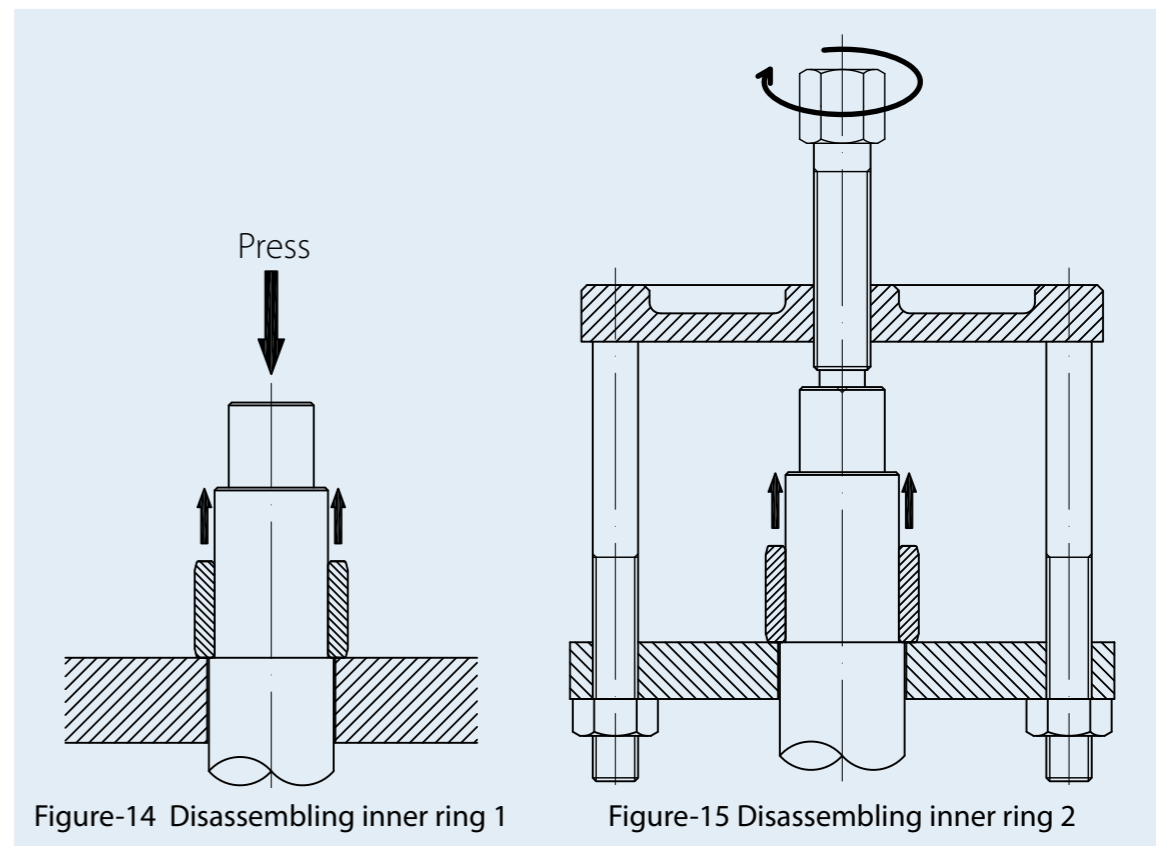


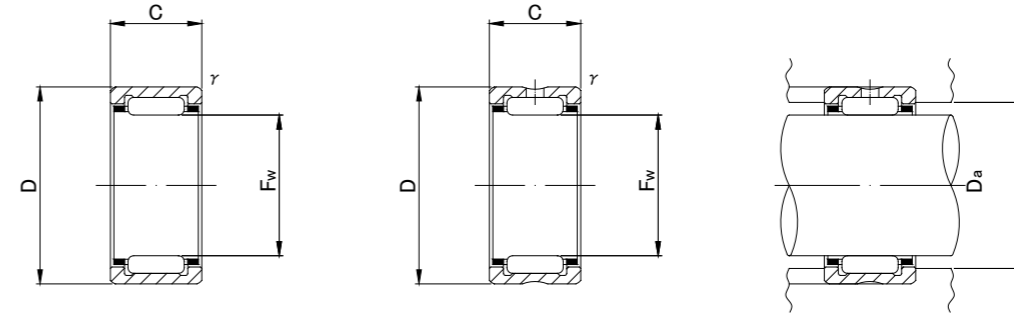
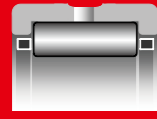
Figure-14 Disassembling inner ring 1

Figure-15 Disassembling inner ring 2

8-5 Maintenance and inspection

Periodical maintenance and inspection are essential for maximizing performance and prolonged usage of bearing as well as early discovery of abnormality of the bearings. Inspection items of bearings under operation include temperature, operation sound, vibration of bearings and condition of lubricant, whose observation enables judging timing of lubricant replenishment and replacement of components.

MACHINED RING NEEDLE ROLLER BEARINGS WITHOUT INNER RING



NK($F_w \leq 10$)

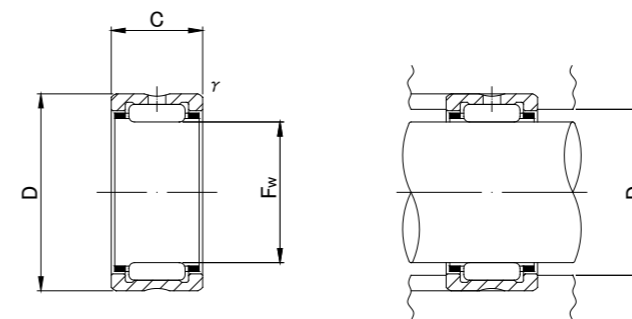
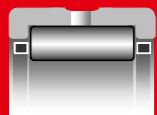
RNA49, RNA59, RNA69($F_w \leq 35$), NK

RNA49, RNA59, RNA69, RNA48, NK TYPE

Shaft Diameter (mm)	Designation					Dimensions (mm)				Standard mounting dimensions (mm)	Basic dynamic load rating	Basic static load rating	Limiting speed *	Mass	Usable bearing designation	
	RNA 49	RNA 59	RNA 69	RNA 48	NK	Fw	D	C	<i>f</i> s min	Da MAX	Cr N	Cor N	rpm	g (approx)	INNER RING	WITH INNER RING
5	—	—	—	—	NK5/10 NK5/12	5 +0.018	10	10	0.15	6.5	2 420	1 950	40 000	3.4	—	—
	—	—	—	—		5 +0.010	10	12	0.15	6.5	3 080	2 660	40 000	4.2	—	—
6	—	—	—	—	NK6/10 NK6/12	6 +0.018	12	10	0.015	7.5	2 700	2 320	37 000	5.3	—	—
	—	—	—	—		6 +0.010	12	12	0.15	7.5	3 440	3 170	37 000	6.4	—	—
7	RNA 495	—	—	—	—	7	13	10	0.15	8.5	2 960	2 690	34 000	5.9	IR5710	NA495
	—	—	—	—	NK7/10 NK7/12	7 +0.022	14	10	0.3	8.5	3 600	2 960	34 000	6.9	—	—
	—	—	—	—		7 +0.013	14	12	0.3	8.5	4 610	4 050	34 000	8.3	—	—
8	RNA 496	—	—	—	—	8	15	10	0.15	13.8	3 900	3 400	32 000	7.3	IR6810	NA496
	—	—	—	—	NK8/12 NK8/16	8 +0.022	15	12	0.3	13	5 100	4 700	32 000	9	IR5812	NKI 5/12
	—	—	—	—		8 +0.013	15	16	0.3	13	7 100	7 300	32 000	13	IR5816	NKI 5/16
9	—	—	—	—	NK9/12 NK9/16	9	16	12	0.3	14	5 500	5 300	30 000	10	IR6912	NKI 6/12
	—	—	—	—		9 +0.022	16	16	0.3	14	7 600	8 200	30 000	13.2	IR6916	NKI 6/16
	RNA 497	—	—	—	—	9 +0.013	17	10	0.15	15.8	4 500	3 600	30 000	9.3	IR7910	NA497
10	—	—	—	—	NK10/12 NK10/16	10	17	12	0.3	15	5 900	6 000	28 000	10.7	IR71012	NKI 7/12
	—	—	—	—		10 +0.022	17	16	0.3	15	8 200	9 200	28 000	14.3	IR71016	NKI 7/16
	RNA 498	—	—	—	—	10 +0.013	19	11	0.2	17.4	6 200	5 000	28 000	12.6	IR81011	NA498
12	—	—	—	—	NK12/12 NK12/16	12	19	12	0.3	17	6 600	7 300	26 000	12.2	IR91212	NKI 9/12
	—	—	—	—		12 +0.027	19	16	0.3	17	9 200	11 200	26 000	16.3	IR91216	NKI 9/16
	RNA 499	—	—	—	—	12 +0.016	20	11	0.3	18	6 600	6 300	26 000	13.6	IR91211	NA499

* Suitable for oil lubrication. In case of grease lubrication, down to 60% of this value.

MACHINED RING NEEDLE ROLLER BEARINGS WITHOUT INNER RING



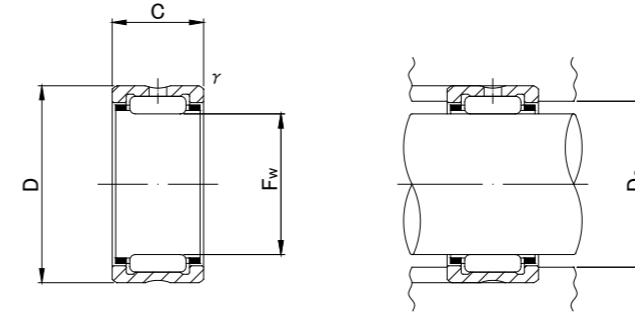
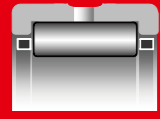
RNA49, RNA59, RNA69 (Fw ≤ 35), NK

RNA49, RNA59, RNA69, RNA48, NK TYPE

Shaft Diameter (mm)	Designation					Dimensions (mm)				Standard mounting dimensions (mm)	Basic dynamic load rating	Basic static load rating	Limiting speed *	Mass	Usable bearing designation										
	RNA 49	RNA 59	RNA 69	RNA 48	NK	Fw	D	C	f _s min	Da MAX	Cr N	Cor N	rpm	g (approx)	INNER RING	WITH INNER RING									
14	RNA 4900	—	—	—	—	14	22	13	0.3	20	9 200	10 100	24 000	16.5	IR101413	NA4900									
	—	—	—	—	NK14/16	14											16	0.3	20	11 800	13 700	24 000	21	IR101416	NKI 10/16
	—	—	—	—	NK14/20	14											20	0.3	20	14 800	18 500	24 000	26.5	IR101420	NKI 10/20
15	—	—	—	—	NK15/16	15	23	16	0.3	21	12 400	14 900	23 000	22.5	—	—									
	—	—	—	—	NK15/20	15											20	0.3	21	15 600	20 200	23 000	28	—	—
16	RNA 4901	—	—	—	—	16	24	13	0.3	22	9 700	11 100	23 000	18.1	IR121613	NA4901									
	—	—	—	—	NK16/16	16											16	0.3	22	12 300	15 100	23 000	23	IR121616	NKI 12/16
	—	—	—	—	NK16/20	16											20	0.3	22	15 600	20 400	23 000	29	IR121620	NKI 12/20
	—	—	RNA 6901	—	—	16											22	0.3	22	17 100	23 000	23 000	30	IR121622	NA6901
17	—	—	—	—	NK17/16	17	25	16	0.3	23	12 800	16 300	22 000	24.5	—	—									
	—	—	—	—	NK17/20	17											20	0.3	23	16 300	22 100	22 000	30.5	—	—
18	—	—	—	—	NK18/16	18	26	16	0.3	24	13 400	17 500	21 000	25.5	—	—									
	—	—	—	—	NK18/20	18											20	0.3	24	17 000	23 600	21 000	32	—	—
19	—	—	—	—	NK19/16	19	27	16	0.3	25	14 000	18 700	21 000	27	IR151916	NKI 15/16									
	—	—	—	—	NK19/20	19											20	0.3	25	17 700	25 300	21 000	34	IR151920	NKI 15/20
20	RNA 4902	—	—	—	—	20	28	13	0.3	26	10 900	13 800	20 000	21.5	IR152013	NA4902									
	—	—	—	—	NK20/16	20											16	0.3	26	13 900	18 700	20 000	27.5	—	—
	—	RNA 5902	—	—	—	20											18	0.3	26	15 700	22 100	20 000	33	IR152018	NA5902
	—	—	—	—	NK20/20	20											20	0.3	26	17 600	25 400	20 000	35.5	—	—
	—	—	RNA 6902	—	—	20											23	0.3	26	19 300	28 700	20 000	37	IR152023	NA6902

* Suitable for oil lubrication. In case of grease lubrication, down to 60% of this value.

MACHINED RING NEEDLE ROLLER BEARINGS WITHOUT INNER RING



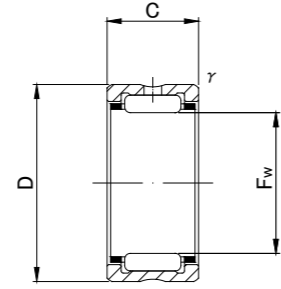
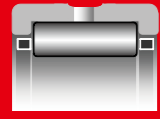
RNA49, RNA59, RNA69 (Fw ≤ 35), NK

RNA49, RNA59, RNA69, RNA48, NK TYPE

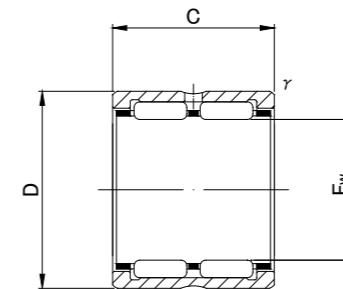
Shaft Diameter (mm)	Designation					Dimensions (mm)				Standard mounting dimensions (mm)	Basic dynamic load rating	Basic static load rating	Limiting speed *	Mass	Usable bearing designation								
	RNA 49	RNA 59	RNA 69	RNA 48	NK	Fw	D	C	f _s min	Da MAX	Cr N	Cor N	rpm	g (approx)	INNER RING	WITH INNER RING							
21	—	—	—	—	NK21/16 NK21/20	21 +0.033	29	16	0.3	27	14 400	20 000	19 000	29	IR172116	NKI 17/16							
	—	—	—	—		21 +0.020	29	20	0.3								27	18 200	27 100	19 000	36	IR172120	NKI 17/20
22	RNA 4903	—	—	—	—	22	30	13	0.3	28	11 800	15 600	18 000	23.5	IR172213	NA4903							
	—	—	—	—	NK22/16	22	30	16	0.3								28	14 900	21 200	18 000	30	—	—
	—	RNA 5903	—	—	—	22 +0.033	30	18	0.3								28	16 900	24 900	18 000	35	IR172218	NA5903
	—	—	—	—	NK22/20	22 +0.020	30	20	0.3								28	18 900	28 700	18 000	37.5	—	—
	—	—	RNA 6903	—	—	22	30	23	0.3								28	20 800	32 500	18 000	40.5	IR172223	NA6903
24	—	—	—	—	NK24/16 NK24/20	24 +0.033	32	16	0.3	30	15 300	22 600	17 000	32	IR202416	NKI 20/16							
	—	—	—	—		24 +0.020	32	20	0.3								30	19 400	30 500	17 000	40.5	IR202420	NKI 20/20
25	—	—	—	—	NK25/16 NK25/20	25	33	16	0.3	31	15 800	23 700	16 000	33.5	—	—							
	—	—	—	—		25	33	20	0.3								31	20 000	32 200	16 000	42	—	—
	RNA 4904	—	—	—	—	25 +0.033	37	17	0.3								35	21 000	25 000	16 000	55.5	IR202517	NA4904
	—	RNA 5904	—	—	—	25 +0.020	37	23	0.3								35	29 400	38 600	16 000	84	IR202523	NA5904
	—	—	RNA 6904	—	—	25	37	30	0.3								35	35 400	48 800	16 000	95.5	IR202530	NA6904
26	—	—	—	—	NK26/16 NK26/20	26 +0.033	34	16	0.3	32	16 300	24 900	15 000	34.5	IR222616	NKI 22/16							
	—	—	—	—		26 +0.020	34	20	0.3								32	20 600	33 700	15 000	43.5	IR222620	NKI 22/20
28	—	—	—	—	NK28/20 NK28/30	28	37	20	0.3	35	21 700	37 100	14 000	51.5	—	—							
	—	—	—	—		28	37	30	0.3								35	31 100	58 900	14 000	83.5	—	—
	RNA 49/22	—	—	—	—	28 +0.033	39	17	0.3								37	21 400	28 800	14 000	56.5	IR222817	NA49/22
	—	RNA 59/22	—	—	—	28 +0.020	39	23	0.3								37	29 800	44 400	14 000	92	IR222823	NA59/22
	—	—	RNA 69/22	—	—	28	39	30	0.3								37	36 300	56 900	14 000	97.5	IR222830	NA69/22
29	—	—	—	—	NK29/20 NK29/30	29 +0.033	38	20	0.3	36	21 600	37 200	14 000	57	IR252920	NKI 25/20							
	—	—	—	—		29 +0.020	38	30	0.3								36	30 900	59 000	14 000	85	IR252930	NKI 25/30

* Suitable for oil lubrication. In case of grease lubrication, down to 60% of this value.

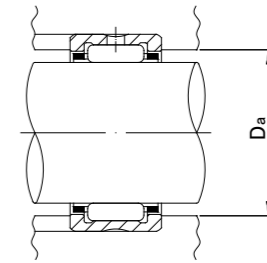
MACHINED RING NEEDLE ROLLER BEARINGS WITHOUT INNER RING



RNA49, RNA59, RNA69 (Fw ≤ 35), NK



RNA69

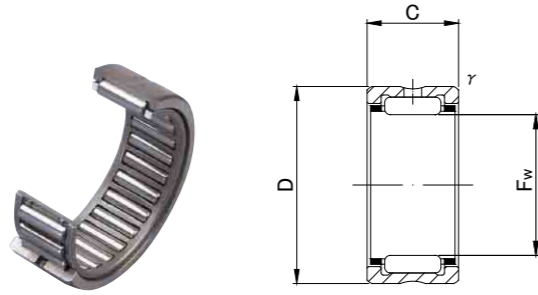
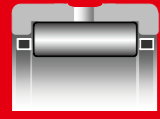


RNA49, RNA59, RNA69, RNA48, NK TYPE

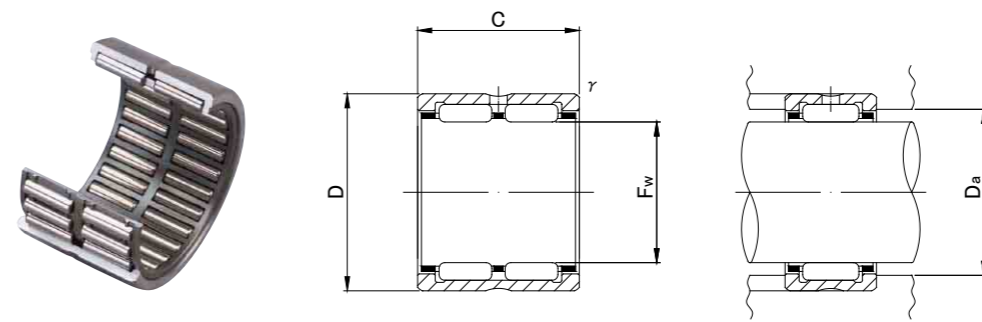
Shaft Diameter (mm)	Designation					Dimensions (mm)				Standard mounting dimensions (mm)	Basic dynamic load rating	Basic static load rating	Limiting speed *	Mass	Usable bearing designation	
	RNA 49	RNA 59	RNA 69	RNA 48	NK	Fw	D	C	fs min	Da MAX	Cr N	Cor N	rpm	g (approx)	INNER RING	WITH INNER RING
30	—	—	—	—	NK30/20	30	40	20	0.3	38	25 100	40 100	13 000	64.5	—	—
	—	—	—	—	NK30/30	30	40	30	0.3	38	36 000	63 800	13 000	97.5	—	—
	RNA 4905	—	—	—	—	30 ^{+0.033}	42	17	0.3	40	23 700	30 700	13 000	64	IR253017	NA4905
	—	RNA 5905	—	—	—	30 ^{+0.020}	42	23	0.3	40	33 200	47 500	13 000	101	IR253023	NA5905
	—	—	RNA 6905	—	—	30	42	30	0.3	40	42 100	64 200	13 000	111	IR253030	NA6905
32	—	—	—	—	NK32/20	32	42	20	0.3	40	25 700	42 200	13 000	68	IR283220	NKI 28/20
	—	—	—	—	NK32/30	32	42	30	0.3	40	36 900	67 100	13 000	102	IR283230	NKI 28/30
	RNA 49/28	—	—	—	—	32 ^{+0.041}	45	17	0.3	43	24 500	32 700	13 000	76.5	IR283217	NA49/28
	—	RNA 59/28	—	—	—	32 ^{+0.025}	45	23	0.3	43	34 300	50 500	13 000	108	IR283223	NA59/28
	—	—	RNA 69/28	—	—	32	45	30	0.3	43	41 800	64 700	13 000	133	IR283230	NA69/28
35	—	—	—	—	NK35/20	35	45	20	0.3	43	27 000	46 200	11 000	73.5	IR303520	NKI 30/20
	—	—	—	—	NK35/30	35	45	30	0.3	43	38 600	73 500	11 000	112	IR303530	NKI 30/30
	RNA 4906	—	—	—	—	35 ^{+0.041}	47	17	0.3	45	25 200	34 700	11 000	72.5	IR303517	NA4906
	—	RNA 5906	—	—	—	35 ^{+0.025}	47	23	0.3	45	35 200	53 700	11 000	108	IR303523	NA5906
	—	—	RNA 6906	—	—	35	47	30	0.3	45	43 100	69 000	11 000	125	IR303530	NA6906
37	—	—	—	—	NK37/20	37 ^{+0.041}	47	20	0.3	45	28 200	50 100	11 000	77.5	IR323720	NKI 32/20
	—	—	—	—	NK37/30	37 ^{+0.025}	47	30	0.3	45	40 500	79 800	11 000	117	IR323730	NKI 32/30
38	—	—	—	—	NK38/20	38 ^{+0.041}	48	20	0.3	46	28 100	50 200	11 000	79	—	—
	—	—	—	—	NK38/30	38 ^{+0.025}	48	30	0.3	46	40 300	80 000	11 000	119	—	—
40	—	—	—	—	NK40/20	40	50	20	0.3	48	29 400	54 100	10 000	83	IR354020	NKI 35/20
	—	—	—	—	NK40/30	40	50	30	0.3	48	42 300	86 100	10 000	125	IR354030	NKI 35/30
	RNA 49/32	—	—	—	—	40 ^{+0.041}	52	20	0.6	48	31 300	47 900	10 000	96	IR324020	NA49/32
	—	RNA 59/32	—	—	—	40 ^{+0.025}	52	27	0.6	48	41 900	69 900	10 000	149	IR324027	NA59/32
	—	—	RNA 69/32	—	—	40	52	36	0.6	48	53 500	95 700	10 000	172	IR324036	NA69/32
42	—	—	—	—	NK42/20	42	52	20	0.3	50	29 900	56 200	9 500	86.5	—	—
	—	—	—	—	NK42/30	42	52	30	0.3	50	43 000	89 500	9 500	130	—	—
	RNA 4907	—	—	—	—	42 ^{+0.041}	55	20	0.6	51	32 000	50 200	9 500	113	IR354220	NA4907
	—	RNA 5907	—	—	—	42 ^{+0.025}	55	27	0.6	51	42 900	73 200	9 500	176	IR354227	NA5907
	—	—	RNA 6907	—	—	42	55	36	0.6	51	54 800	100 000	9 500	200	IR354236	NA6907

* Suitable for oil lubrication. In case of grease lubrication, down to 60% of this value.

MACHINED RING NEEDLE ROLLER BEARINGS WITHOUT INNER RING



RNA49, RNA59, RNA48, NK



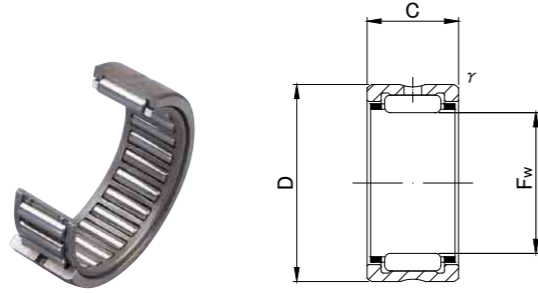
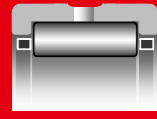
RNA69

RNA49, RNA59, RNA69, RNA48, NK TYPE

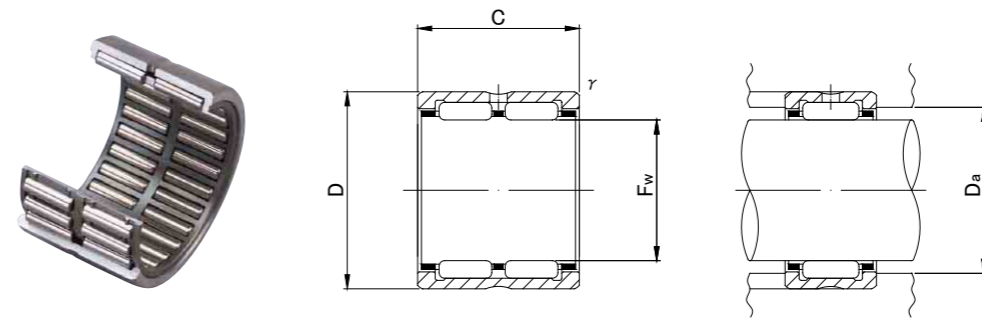
Shaft Diameter (mm)	Designation					Dimensions (mm)				Standard mounting dimensions (mm)	Basic dynamic load rating	Basic static load rating	Limiting speed *	Mass	Usable bearing designation	
	RNA 49	RNA 59	RNA 69	RNA 48	NK	Fw	D	C	rs min	Da MAX	Cr N	Cor N	rpm	g (approx)	INNER RING	WITH INNER RING
43	—	—	—	—	NK43/20 NK43/30	43 +0.041	53	20	0.3	51	30 500 43 700	58 100 92 500	9 500 9 500	88.5 133	IR384320 IR384330	NKI 38/20 NKI 38/30
	—	—	—	—		43 +0.025	53	30	0.3							
45	—	—	—	—	NK45/20 NK45/30	45 +0.041	55	20	0.3	53	31 100 44 500	60 100 95 700	9 000 9 000	92 138	IR404520 IR404530	NKI 40/20 NKI 40/30
	—	—	—	—		45 +0.025	55	30	0.3							
47	—	—	—	—	NK47/20 NK47/30	47 +0.041	57	20	0.3	55	31 500 45 200	62 300 99 000	8 500 8 500	95 144	IR424720 IR424730	NKI 42/20 NKI 42/30
	—	—	—	—		47 +0.025	57	30	0.3							
48	RNA 4908	—	—	—	—	48 +0.041	62	22	0.6	58	41 600 58 000 71 300	67 400 103 000 134 400	8 500 8 500 8 500	152 225 275	IR404822 IR404830 IR404840	NA4908 NA5908 NA6908
	—	RNA 5908	—	—		48 +0.025	62	30	0.6							
	—	—	RNA 6908	—		48	62	40	0.6							
50	—	—	—	—	NK50/25 NK50/35	50 +0.041	62	25	0.6	58	43 000 58 100	85 200 125 500	8 000 8 000	159 225	IR455025 IR455035	NKI 45/25 NKI 45/35
	—	—	—	—		50 +0.025	62	35	0.6							
52	RNA 4909	—	—	—	—	52 +0.049	68	22	0.6	64	43 500 60 700 74 600	73 400 112 000 147 100	7 500 7 500 7 500	197 232 355	IR455222 IR455230 IR455240	NA4909 NA5909 NA6909
	—	RNA 5909	—	—		52 +0.030	68	30	0.6							
	—	—	RNA 6909	—		52	68	40	0.6							
55	—	—	—	—	NK55/25 NK55/35	55 +0.049	68	25	0.6	64	45 400 61 300	94 100 138 300	7 500 7 500	193 255	IR505525 IR505535	NKI 50/25 NKI 50/35
	—	—	—	—		55 +0.030	68	35	0.6							

* Suitable for oil lubrication. In case of grease lubrication, down to 60% of this value.

MACHINED RING NEEDLE ROLLER BEARINGS WITHOUT INNER RING



RNA49, RNA59, RNA48, NK



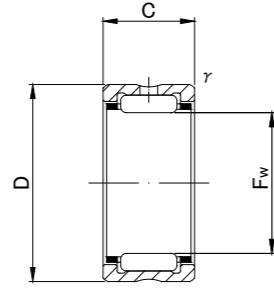
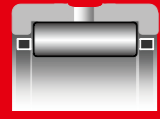
RNA69

RNA49, RNA59, RNA69, RNA48, NK TYPE

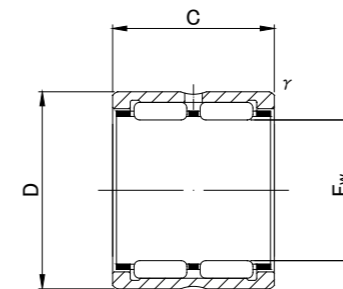
Shaft Diameter (mm)	Designation					Dimensions (mm)				Standard mounting dimensions (mm)	Basic dynamic load rating	Basic static load rating	Limiting speed *	Mass	Usable bearing designation	
	RNA 49	RNA 59	RNA 69	RNA 48	NK	Fw	D	C	r _s min	Da MAX	Cr N	Cor N	rpm	g (approx)	INNER RING	WITH INNER RING
58	RNA 4910	—	—	—	—	58	72	22	0.6	68	46 200	82 100	7 000	179	IR505822	NA4910
	—	RNA 5910	—	—	—	58 ^{+0.049}	72	30	0.6	68	64 400	126 000	7 000	289	IR505830	NA5910
	—	—	RNA 6910	—	—	58 ^{+0.030}	72	40	0.6	68	79 100	163 800	7 000	320	IR505840	NA6910
60	—	—	—	—	NK60/25	60 ^{+0.049}	72	25	0.6	68	47 500	103 000	6 500	187	IR556025	NKI 55/25
	—	—	—	—	NK60/35	60 ^{+0.030}	72	35	0.6	68	64 100	151 000	6 500	260	IR556035	NKI 55/35
63	RNA 4911	—	—	—	—	63	80	25	1	75	57 600	97 300	6 500	265	IR556325	NA4911
	—	RNA 5911	—	—	—	63 ^{+0.049}	80	34	1	75	82 600	154 000	6 500	367	IR556334	NA5911
	—	—	RNA 6911	—	—	63 ^{+0.030}	80	45	1	75	99 000	194 200	6 500	475	IR556345	NA6911
65	—	—	—	—	NK65/25	65 ^{+0.049}	78	25	0.6	74	49 600	111 800	6 000	225	—	—
	—	—	—	—	NK65/35	65 ^{+0.030}	78	35	0.6	74	67 000	164 800	6 000	315	—	—
68	—	—	—	—	NK68/25	68	82	25	0.6	78	54 800	116 700	6 000	250	IR606825	NKI 60/25
	—	—	—	—	NK68/35	68	82	35	0.6	78	72 100	165 700	6 000	350	IR606835	NKI 60/35
	RNA 4912	—	—	—	—	68 ^{+0.049}	85	25	1	80	60 100	104 900	6 000	285	IR606825	NA4912
	—	RNA 5912	—	—	—	68 ^{+0.030}	85	34	1	80	86 100	167 000	6 000	408	IR606834	NA5912
	—	—	RNA 6912	—	—	68	85	45	1	80	103 000	210 800	6 000	510	IR606845	NA6912
70	—	—	—	—	NK70/25	70 ^{+0.049}	85	25	0.6	81	55 500	120 600	5 500	280	—	—
	—	—	—	—	NK70/35	70 ^{+0.030}	85	35	0.6	81	73 000	170 600	5 500	395	—	—
72	RNA 4913	—	—	—	—	72	90	25	1	85	62 800	113 800	5 500	325	IR657225	NA4913
	—	RNA 5913	—	—	—	72 ^{+0.049}	90	34	1	85	89 900	180 000	5 500	462	IR657234	NA5913
	—	—	RNA 6913	—	—	72 ^{+0.030}	90	45	1	85	107 900	226 500	5 500	585	IR657245	NA6913

* Suitable for oil lubrication. In case of grease lubrication, down to 60% of this value.

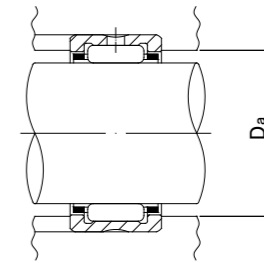
MACHINED RING NEEDLE ROLLER BEARINGS WITHOUT INNER RING



RNA49, RNA59, RNA48, NK



RNA69

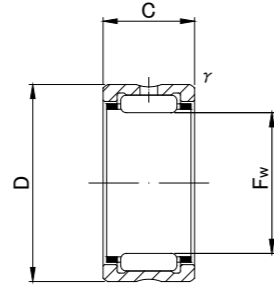
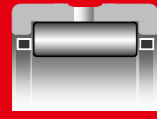


RNA49, RNA59, RNA69, RNA48, NK TYPE

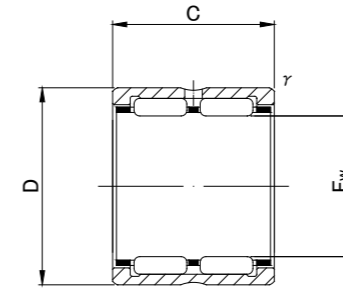
Shaft Diameter (mm)	Designation					Dimensions (mm)				Standard mounting dimensions (mm)	Basic dynamic load rating	Basic static load rating	Limiting speed *	Mass	Usable bearing designation		
	RNA 49	RNA 59	RNA 69	RNA 48	NK	Fw	D	C	fs min	Da MAX	Cr N	Cor N	rpm	g (approx)	INNER RING	WITH INNER RING	
73	—	—	—	—	NK73/25 NK73/35	73 +0.049	90	25	0.6	86	61 100 80 400	126 500 180 400	5 500 5 500	335 475	— IR657335	— NKI 65/35	
	—	—	—	—		73 +0.030	90	35	0.6								
75	—	—	—	—	NK75/25 NK75/35	75 +0.049	92	25	0.6	88	62 200 82 700	130 400 186 300	5 500 5 500	345 485	— —	— —	
	—	—	—	—		75 +0.030	92	35	0.6								
80	—	—	—	—	NK80/25 NK80/35 — — —	80	95	25	1	90	59 400 78 100 83 200 112 000 133 400	137 300 194 200 157 900 232 000 310 900	5 000 5 000 5 000 5 000 5 000	315 445 495 706 910	IR708025 IR708035 IR708030 IR708040 IR708054	NKI 70/25 NKI 70/35 NA4914 NA5914 NA6914	
	—	—	—	—		80 +0.049	95	35	1								90
	RNA 4914	—	—	—		80 +0.030	100	30	1								95
	—	RNA 5914	—	—		80	100	40	1								95
	—	—	RNA 6914	—		80	100	54	1								95
85	—	—	—	—	NK85/25 — NK85/35 — —	85	105	25	1	100	76 400 86 200 102 000 116 000 138 300	145 100 169 700 209 900 249 000 330 500	4 500 4 500 4 500 4 500 4 500	435 525 610 745 960	IR758525 IR758530 IR758535 IR758540 IR758554	NKI 75/25 NA4915 NKI 75/35 NA5915 NA6915	
	—	—	—	—		85 +0.058	105	30	1								100
	—	—	—	—		85 +0.036	105	35	1								100
	—	RNA 5915	—	—		85	105	40	1								100
	—	—	RNA 6915	—		85	105	54	1								100
90	—	—	—	—	NK90/25 — NK90/35 — —	90	110	25	1	105	77 400 87 400 103 000 117 000 143 200	150 000 174 600 216 700 257 000 350 100	4 500 4 500 4 500 4 500 4 500	456 550 640 787 1 010	IR809025 IR809030 IR809035 IR809040 IR809054	NKI 80/25 NA4916 NKI 80/35 NA5916 NA6916	
	—	—	—	—		90 +0.058	110	30	1								105
	—	—	—	—		90 +0.036	110	35	1								105
	—	RNA 5916	—	—		90	110	40	1								105
	—	—	RNA 6916	—		90	110	54	1								105
95	—	—	—	—	NK95/26 NK95/36	95 +0.058	115	26	1	110	79 700 106 900	158 900 230 500	4 200 4 200	495 690	IR859526 IR859536	NKI 85/26 NKI 85/36	
	—	—	—	—		95 +0.036	115	36	1								
100	—	—	—	—	NK100/26 — NK100/36 — —	100	120	26	1	115	82 500 109 800 109 800 144 000 172 600	168 700 244 200 244 200 346 000 466 800	4 000 4 000 4 000 4 000 4 000	525 705 725 1 000 1 300	IR9010026 IR8510035 IR9010036 IR8510046 IR8510063	NKI 90/26 NA4917 NKI 90/36 NA5917 NA6917	
	—	—	—	—		100 +0.058	120	35	1.1								113.5
	—	—	—	—		100 +0.036	120	36	1								115
	—	RNA 5917	—	—		100	120	46	1.1								113.5
	—	—	RNA 6917	—		100	120	63	1.1								113.5

* Suitable for oil lubrication. In case of grease lubrication, down to 60% of this value.

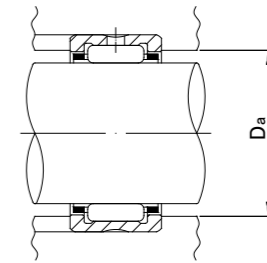
MACHINED RING NEEDLE ROLLER BEARINGS WITHOUT INNER RING



RNA49, RNA59, RNA48, NK



RNA69

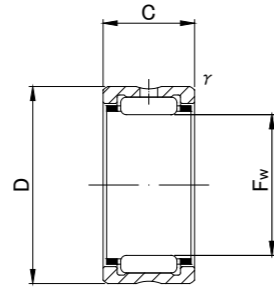
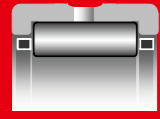


RNA49, RNA59, RNA69, RNA48, NK TYPE

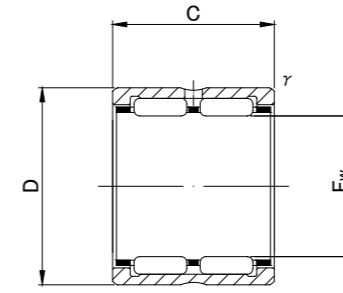
Shaft Diameter (mm)	Designation					Dimensions (mm)				Standard mounting dimensions (mm)	Basic dynamic load rating	Basic static load rating	Limiting speed *	Mass	Usable bearing designation	
	RNA 49	RNA 59	RNA 69	RNA 48	NK	Fw	D	C	f _s min						Da MAX	Cr N
105	—	—	—	—	NK105/26	105	125	26	1	120	84 700	177 500	3 800	545	IR9510526	NKI 95/26
	RNA 4918	—	—	—	—	105	125	35	1.1	118.5	112 800	257 900	3 800	740	IR9010535	NA4918
	—	—	—	—	NK105/36	105 ^{+0.058}	125	36	1	120	112 800	257 900	3 800	760	IR9510536	NKI 95/36
	—	RNA 5918	—	—	—	105 ^{+0.036}	125	46	1.1	118.5	148 000	365 000	3 800	1 040	IR9010546	NA5918
	—	—	RNA 6918	—	—	105	125	63	1.1	118.5	177 500	490 300	3 800	1 360	IR9010563	NA6918
110	—	—	—	—	NK110/30	110	130	30	1.1	123.5	105 900	239 300	3 600	660	IR10011030	NKI 100/30
	RNA 4919	—	—	—	—	110	130	35	1.1	123.5	116 700	270 700	3 600	770	IR9511035	NA4919
	—	—	—	—	NK110/40	110 ^{+0.058}	130	40	1.1	123.5	133 400	323 600	3 600	880	IR10011040	NKI 100/40
	—	RNA 5919	—	—	—	110 ^{+0.036}	130	46	1.1	123.5	152 000	384 000	3 600	1 130	IR9511046	NA5919
	—	—	RNA 6919	—	—	110	130	63	1.1	1 123.5	182 400	514 800	3 600	1 420	IR9511063	NA6919
115	RNA 4920	—	—	—	—	115 ^{+0.058} ^{+0.036}	140	40	1.1	133.5	145 000	329 000	3 500	1 190	IR10011540	NA4920
120	—	—	—	RNA 4822	—	120 ^{+0.058} ^{+0.036}	140	30	1	135	93 000	239 000	3 500	790	IR11012030	NA4822
125	RNA 4922	—	—	—	—	125 ^{+0.068} ^{+0.043}	150	40	1.1	143.5	152 000	357 000	3 000	1 280	IR11012540	NA4922
130	—	—	—	RNA 4824	—	130 ^{+0.068} ^{+0.043}	150	30	1	145	97 000	259 000	3 000	850	IR12013030	NA4824
135	RNA 4924	—	—	—	—	135 ^{+0.068} ^{+0.043}	165	45	1.1	158.5	187 000	435 000	3 000	1 930	IR12013545	NA4924

* Suitable for oil lubrication. In case of grease lubrication, down to 60% of this value.

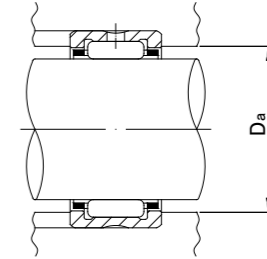
MACHINED RING NEEDLE ROLLER BEARINGS WITHOUT INNER RING



RNA49, RNA59, RNA48, NK



RNA69

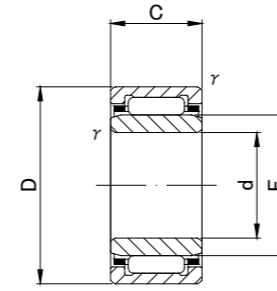
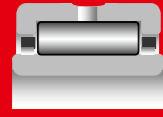


RNA49, RNA59, RNA69, RNA48, NK TYPE

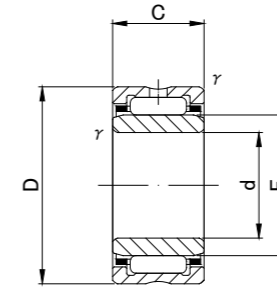
Shaft Diameter (mm)	Designation					Dimensions (mm)				Standard mounting dimensions (mm)	Basic dynamic load rating	Basic static load rating	Limiting speed *	Mass	Usable bearing designation	
	RNA 49	RNA 59	RNA 69	RNA 48	NK	Fw	D	C	f's min	Da MAX	Cr N	Cor N	rpm	g (approx)	INNER RING	WITH INNER RING
145	—	—	—	RNA 4826	—	145 ^{+0.068} / _{+0.043}	165	35	1.1	158.5	117 000	340 000	3 000	1 100	IR13014535	NA4826
150	RNA 4926	—	—	—	—	150 ^{+0.068} / _{+0.043}	180	50	1.5	172	216 000	540 000	2 500	2 360	IR13015050	NA4926
155	—	—	—	RNA 4828	—	155 ^{+0.068} / _{+0.043}	175	35	1.1	168.5	121 000	363 000	2 500	1 170	IR14015535	NA4828
160	RNA 4928	—	—	—	—	160 ^{+0.068} / _{+0.043}	190	50	1.5	182	224 000	580 000	2 500	2 500	IR14016050	NA4928
165	—	—	—	RNA 4830	—	165 ^{+0.068} / _{+0.043}	190	40	1.1	183.5	168 000	446 000	2 500	1 750	IR15016540	NA4830
175	—	—	—	RNA 4832	—	175 ^{+0.068} / _{+0.043}	200	40	1.1	193.5	173 000	474 000	2 500	1 850	IR16017540	NA4832

* Suitable for oil lubrication. In case of grease lubrication, down to 60% of this value.

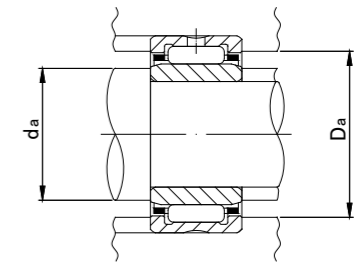
MACHINED RING NEEDLE ROLLER BEARINGS WITH INNER RING



NKI(d ≤ 8)



NA49,NA59,NA69(d ≤ 30),NKI



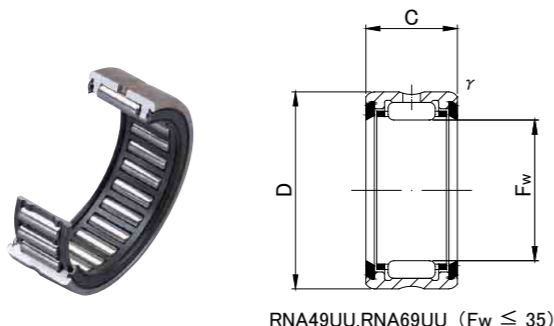
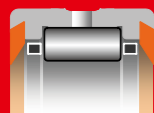
NA49,NA59,NA69,NA48,NKI TYPE

Shaft Diameter (mm)	Designation					Dimensions (mm)						Standard mounting dimensions (mm)			Basic dynamic load rating	Basic static load rating	Limiting speed*	Mass	Usable bearing designation	
	NA 49	NA 59	NA 69	NA48	NKI	d	D	C	f's min	F	da		Da MAX	Cr N	Cor N	rpm	g (approx)	OUTER RING	INNER RING	
											MIN	MAX								
5	NA495	—	—	—	—	5	13	10	0.15	7	6.2	6.7	11.8	2 960	2 690	34 000	7.3	RNA495	IR5710	
	—	—	—	—	NKI 5/12	5 ⁰	15	12	0.3	8	7	7.7	13	5 100	4 700	32 000	11.9	NK8/12	IR5812	
	—	—	—	—	NKI 5/16	5 ^{-0.008}	15	16	0.3	8	7	7.7	13	7 100	7 300	32 000	16.7	NK8/16	IR5816	
6	NA 496	—	—	—	—	6	15	10	0.15	8	7.2	7.7	13.8	3 900	3 400	32 000	9.1	RNA496	IR6810	
	—	—	—	—	NKI 6/12	6 ⁰	16	12	0.3	9	8	8.7	14	5 500	5 300	30 000	13	NK9/12	IR6912	
	—	—	—	—	NKI 6/16	6 ^{-0.008}	16	16	0.3	9	8	8.7	14	7 600	8 200	30 000	17.5	NK9/16	IR6916	
7	NA 497	—	—	—	—	7	17	10	0.15	9	8.2	8.7	15.8	4 500	3 600	30 000	11.2	RNA497	IR7910	
	—	—	—	—	NKI 7/12	7 ⁰	17	12	0.3	10	9	9.7	15	5 900	6 000	28 000	14.3	NK10/12	IR71012	
	—	—	—	—	NKI 7/16	7 ^{-0.008}	17	16	0.3	10	9	9.7	15	8 200	9 200	28 000	19.2	NK10/16	IR71016	
8	NA 498	—	—	—	—	8	19	11	0.2	10	9.2	9.7	17.4	6 200	5 000	28 000	15	RNA498	IR81011	
9	—	—	—	—	NKI 9/12	9	19	12	0.3	12	11	11.5	17	6 600	7 300	26 000	16.7	NK12/12	IR91212	
	—	—	—	—	NKI 9/16	9 ⁰	19	16	0.3	12	11	11.5	17	9 200	11 200	26 000	22.5	NK12/16	IR91216	
	NA 499	—	—	—	—	9 ^{-0.008}	20	11	0.3	12	11	11.5	18	6 600	6 300	26 000	16.7	RNA499	IR91211	
10	NA 4900	—	—	—	—	10	22	13	0.3	14	12	13	20	9 200	10 100	24 000	24	RNA4900	IR101413	
	—	—	—	—	NKI 10/16	10 ⁰	22	16	0.3	14	12	13	20	11 800	13 700	24 000	30	NK14/16	IR101416	
	—	—	—	—	NKI 10/20	10 ^{-0.008}	22	20	0.3	14	12	13	20	14 800	18 500	24 000	38	NK14/20	IR101420	
12	NA 4901	—	—	—	—	12	24	13	0.3	16	14	15	22	9 700	11 100	23 000	26.5	RNA4901	IR121613	
	—	—	—	—	NKI 12/16	12 ⁰	24	16	0.3	16	14	15	22	12 300	15 100	23 000	33.5	NK16/16	IR121616	
	—	—	—	—	NKI 12/20	12 ^{-0.008}	24	20	0.3	16	14	15	22	15 600	20 400	23 000	42.5	NK16/20	IR121620	
	—	—	NA 6901	—	—	12	24	22	0.3	16	14	15	22	17 100	23 000	23 000	44.5	RNA6901	IR121622	

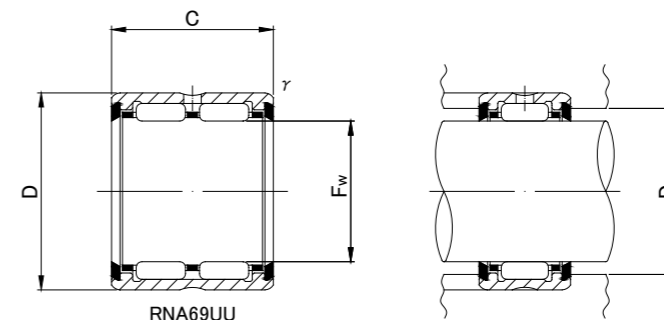
* Suitable for oil lubrication. In case of grease lubrication, down to 60% of this value.

MACHINED RING NEEDLE ROLLER BEARINGS

SEALED, WITHOUT INNER RING



RNA49UU, RNA69UU (Fw ≤ 35)



RNA69UU

RNA UU

RNA UU

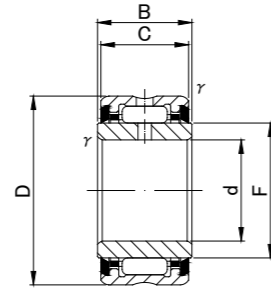
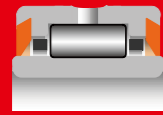
RNA49UU, RNA69UU, SEALED TYPE

Prepacked Grease

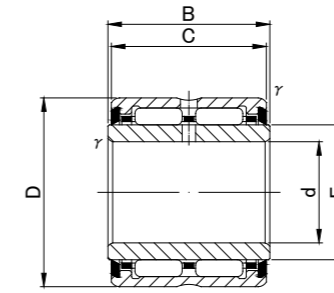
Shaft Diameter (mm)	Designation		Dimensions (mm)				Standard mounting dimensions (mm)	Basic dynamic load rating	Basic static load rating	Limiting speed (GREASE)	Mass	Usable bearing designation	
	RNA 49UU	RNA 69UU	Fw	D	C	r/s min						Da MAX	Cr N
14	RNA 4900UU	—	14 ^{+0.027} / _{+0.016}	22	13	0.3	20	8 000	8 500	14 000	16	IRZ101414	NA4900UU
16	RNA 4901UU	—	16 ^{+0.027} / _{+0.016}	24	13	0.3	22	8 400	9 300	12 000	18	IRZ121614	NA4901UU
	—	RNA 6901UU	16 ^{+0.027} / _{+0.016}	24	22	0.3	22	15 600	20 400	12 000	30	IRZ121623	NA6901UU
20	RNA 4902UU	—	20 ^{+0.033} / _{+0.020}	28	13	0.3	26	9 600	11 700	9 500	22	IRZ152014	NA4902UU
	—	RNA 6902UU	20 ^{+0.033} / _{+0.020}	28	23	0.3	26	18 400	27 100	9 500	38	IRZ152024	NA6902UU
22	RNA 4903UU	—	22 ^{+0.033} / _{+0.020}	30	13	0.3	28	10 300	13 100	8 500	23	IRZ172214	NA4903UU
	—	RNA 6903UU	22 ^{+0.033} / _{+0.020}	30	23	0.3	28	19 800	30 600	8 500	40	IRZ172224	NA6903UU
25	RNA 4904UU	—	25 ^{+0.033} / _{+0.020}	37	17	0.3	35	17 900	20 500	7 500	55	IRZ202518	NA4904UU
	—	RNA 6904UU	25 ^{+0.033} / _{+0.020}	37	30	0.3	35	33 000	44 500	7 500	96	IRZ202531	NA6904UU
30	RNA 4905UU	—	30 ^{+0.033} / _{+0.020}	42	17	0.3	40	20 300	25 100	6 500	63	IRZ253018	NA4905UU
	—	RNA 6905UU	30 ^{+0.033} / _{+0.020}	42	30	0.3	40	39 200	58 600	6 500	110	IRZ253031	NA6905UU
35	RNA 4906UU	—	35 ^{+0.041} / _{+0.025}	47	17	0.3	45	21 600	28 400	5 500	71	IRZ303518	NA4906UU
	—	RNA 6906UU	35 ^{+0.041} / _{+0.025}	47	30	0.3	45	40 100	63 100	5 500	130	IRZ303531	NA6906UU
42	RNA 4907UU	—	42 ^{+0.041} / _{+0.025}	55	20	0.6	51	30 100	46 300	4 500	110	IRZ354221	NA4907UU
	—	RNA 6907UU	42 ^{+0.041} / _{+0.025}	55	36	0.6	51	51 600	92 600	4 500	200	IRZ354237	NA6907UU
48	RNA 4908UU	—	48 ^{+0.041} / _{+0.025}	62	22	0.6	58	37 200	58 300	4 000	150	IRZ404823	NA4908UU
	—	RNA 6908UU	48 ^{+0.041} / _{+0.025}	62	40	0.6	58	63 700	116 700	4 000	270	IRZ404841	NA6908UU
52	RNA 4909UU	—	52 ^{+0.049} / _{+0.030}	68	22	0.6	64	38 800	63 400	3 500	190	IRZ455223	NA4909UU
	—	RNA 6909UU	52 ^{+0.049} / _{+0.030}	68	40	0.6	64	66 700	126 500	3 500	355	IRZ455241	NA6909UU
58	RNA 4910UU	—	58 ^{+0.049} / _{+0.030}	72	22	0.6	68	41 300	71 100	3 500	180	IRZ505823	NA4910UU
	—	RNA 6910UU	58 ^{+0.049} / _{+0.030}	72	40	0.6	68	70 800	142 200	3 500	320	IRZ505841	NA6910UU

MACHINED RING NEEDLE ROLLER BEARINGS

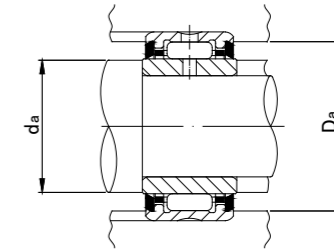
SEALED, WITH INNER RING



NA49UU, NA69UU (d ≤ 30)



NA69UU

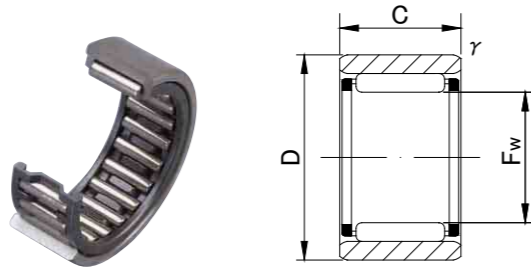
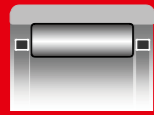


NA49UU, NA69UU, SEALED TYPE

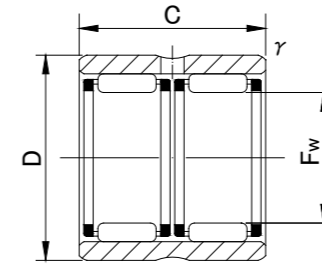
Prepacked Grease

Shaft Diameter (mm)	Designation		Dimensions (mm)						Standard mounting dimensions (mm)			Basic dynamic load rating	Basic static load rating	Limiting speed (GREASE)	Mass	Usable bearing designation	
	NA 49UU	NA 69UU	d	D	C	B	r/s min	F	da		Da MAX	Cr N	Cor N	rpm	g (approx)	OUTER RING	INNER RING
								MIN	MAX								
10	NA 4900UU	—	10 ⁰ _{-0.008}	22	13	14	0.3	14	12	13	20	8 000	8 500	14 000	25	RNA4900UU	IRZ101414
12	NA 4901UU	—	12 ⁰ _{-0.008}	24	13	14	0.3	16	14	15	22	8 400	9 300	12 000	28	RNA4901UU	IRZ121614
	—	NA 6901UU	12 ⁰ _{-0.008}	24	22	23	0.3	16	14	15	22	15 600	20 400	12 000	46	RNA6901UU	IRZ121623
15	NA 4902UU	—	15 ⁰ _{-0.008}	28	13	14	0.3	20	17	19	26	9 600	11 700	9 500	36	RNA4902UU	IRZ152014
	—	NA 6902UU	15 ⁰ _{-0.008}	28	23	24	0.3	20	17	19	26	18 400	27 100	9 500	63	RNA6902UU	IRZ152024
17	NA 4903UU	—	17 ⁰ _{-0.008}	30	13	14	0.3	22	19	21	28	10 300	13 100	8 500	40	RNA4903UU	IRZ172214
	—	NA 6903UU	17 ⁰ _{-0.008}	30	23	24	0.3	22	19	21	28	19 800	30 600	8 500	69	RNA6903UU	IRZ172224
20	NA 4904UU	—	20 ⁰ _{-0.010}	37	17	18	0.3	25	22	24	35	17 900	20 500	7 500	78	RNA4904UU	IRZ202518
	—	NA 6904UU	20 ⁰ _{-0.010}	37	30	31	0.3	25	22	24	35	33 000	44 500	7 500	140	RNA6904UU	IRZ202531
25	NA 4905UU	—	25 ⁰ _{-0.010}	42	17	18	0.3	30	27	29	40	20 300	25 100	6 500	93	RNA4905UU	IRZ253018
	—	NA 6905UU	25 ⁰ _{-0.010}	42	30	31	0.3	30	27	29	40	39 200	58 600	6 500	162	RNA6905UU	IRZ253031
30	NA 4906UU	—	30 ⁰ _{-0.010}	47	17	18	0.3	35	32	34	45	21 600	28 400	5 500	106	RNA4906UU	IRZ303518
	—	NA 6906UU	30 ⁰ _{-0.010}	47	30	31	0.3	35	32	34	45	40 100	63 100	5 500	185	RNA6906UU	IRZ303531
35	NA 4907UU	—	35 ⁰ _{-0.012}	55	20	21	0.6	42	39	41	51	30 100	46 300	4 500	179	RNA4907UU	IRZ354221
	—	NA 6907UU	35 ⁰ _{-0.012}	55	36	37	0.6	42	39	41	51	51 600	92 600	4 500	320	RNA6907UU	IRZ354237
40	NA 4908UU	—	40 ⁰ _{-0.012}	62	22	23	0.6	48	44	47	58	37 200	58 300	4 000	245	RNA4908UU	IRZ404823
	—	NA 6908UU	40 ⁰ _{-0.012}	62	40	41	0.6	48	44	47	58	63 700	116 700	4 000	440	RNA6908UU	IRZ404841
45	NA 4909UU	—	45 ⁰ _{-0.012}	68	22	23	0.6	52	49	51	64	38 800	63 400	3 500	290	RNA4909UU	IRZ455223
	—	NA 6909UU	45 ⁰ _{-0.012}	68	40	41	0.6	52	49	51	64	66 700	126 500	3 500	510	RNA6909UU	IRZ455241
50	NA 4910UU	—	50 ⁰ _{-0.012}	72	22	23	0.6	58	54	57	68	41 300	71 100	3 500	300	RNA4910UU	IRZ505823
	—	NA 6910UU	50 ⁰ _{-0.012}	72	40	41	0.6	58	54	57	68	70 800	142 200	3 500	530	RNA6910UU	IRZ505841

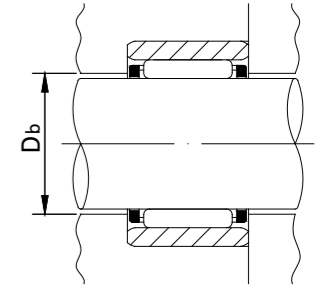
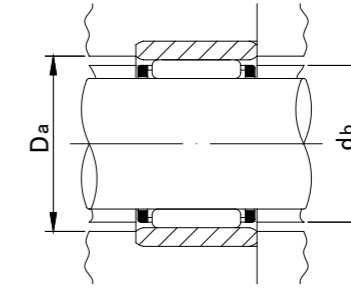
MACHINED RING NEEDLE ROLLER BEARINGS WITHOUT INNER RING



RNAF



RNAFW

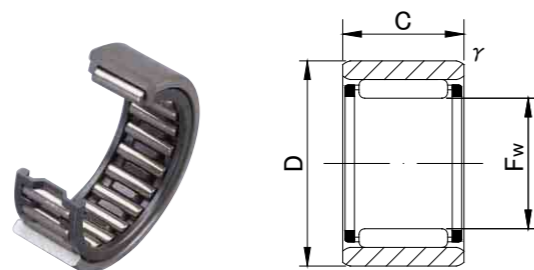


RNAF(W) TYPE

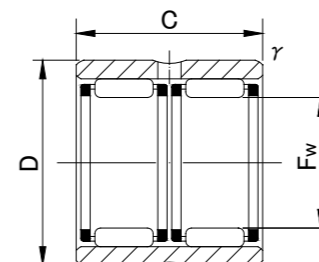
Shaft Diameter (mm)	Designation	Dimensions (mm)				Standard mounting dimensions (mm)			Basic dynamic load rating	Basic static load rating	Limiting speed*	Mass	Usable bearing designation	
		Fw	D	C	r/s min	db	Da MAX	Db					INNER RING	WITH INNER RING
5	RNAF5108	5 ^{+0.018} / _{+0.010}	10	8	0.2	6.7	8.4	5.4	2 500	2 000	40 000	3	—	—
6	RNAF6138	6 ^{+0.018} / _{+0.010}	13	8	0.3	8.4	11	6.4	2 500	2 100	37 000	5.5	—	—
7	RNAF7148	7 ^{+0.022} / _{+0.013}	14	8	0.3	9.4	12	7.4	2 900	2 600	34 000	6	—	—
8	RNAF81510	8 ^{+0.022} / _{+0.013}	15	10	0.3	10.4	13	8.4	3 600	3 600	32 000	8	—	—
	RNAFW81620	8 ^{+0.022} / _{+0.013}	16	20	0.3	10.8	14	8.4	6 200	7 200	32 000	20	—	—
10	RNAF101710	10 ^{+0.022} / _{+0.013}	17	10	0.3	12.4	15	10.4	4 100	4 500	28 000	10	IR61010	NAF61710
	RNAF102012	10 ^{+0.022} / _{+0.013}	20	12	0.3	13.5	18	10.4	6 000	6 000	28 000	19	IR71012	NAF72012
12	RNAF122212	12 ^{+0.027} / _{+0.016}	22	12	0.3	17.5	20	12.4	9 000	8 400	26 000	19	IR91212	NAF92212
14	RNAF142213	14 ^{+0.027} / _{+0.016}	22	13	0.3	17.6	20	14.6	7 800	9 400	24 000	18	IR101413	NAF102213
	RNAFW142220	14 ^{+0.027} / _{+0.016}	22	20	0.3	17.6	20	14.6	10 800	14 200	24 000	28	IR101420	NAFW102220
	RNAF142612	14 ^{+0.027} / _{+0.016}	26	12	0.3	19.4	24	14.6	9 800	9 700	24 000	29	IR101412	NAF102612
15	RNAF152313	15 ^{+0.027} / _{+0.016}	23	13	0.3	18.6	21	15.6	8 200	10 200	23 000	20	—	—
	RNAFW152320	15 ^{+0.027} / _{+0.016}	23	20	0.3	18.6	21	15.6	11 400	15 400	23 000	31	—	—
16	RNAF162413	16 ^{+0.027} / _{+0.016}	24	13	0.3	19.6	22	16.6	8 600	11 000	23 000	21	IR121613	NAF122413
	RNAFW162420	16 ^{+0.027} / _{+0.016}	24	20	0.3	19.6	22	16.6	11 900	16 700	23 000	32	IR121620	NAFW122420
	RNAF162812	16 ^{+0.027} / _{+0.016}	28	12	0.3	21.4	26	16.6	10 500	10 900	23 000	32	IR121612	NAF122812
17	RNAF172513	17 ^{+0.027} / _{+0.016}	25	13	0.3	20.6	23	17.6	9 000	11 900	22 000	22	—	—
	RNAFW172520	17 ^{+0.027} / _{+0.016}	25	20	0.3	20.6	23	17.6	12 400	17 900	22 000	33	—	—
18	RNAF182613	18 ^{+0.027} / _{+0.016}	26	13	0.3	21.6	24	18.6	9 300	12 700	21 000	23	—	—
	RNAFW182620	18 ^{+0.027} / _{+0.016}	26	20	0.3	21.6	24	18.6	12 800	19 100	21 000	35	—	—
	RNAF183012	18 ^{+0.027} / _{+0.016}	30	12	0.3	23.4	28	18.6	11 800	13 000	21 000	35	—	—
	RNAFW183024	18 ^{+0.027} / _{+0.016}	30	24	0.3	23.4	28	18.6	20 200	26 200	21 000	70	—	—

* Suitable for oil lubrication. In case of grease lubrication, down to 50% of this value.

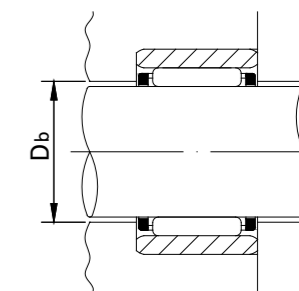
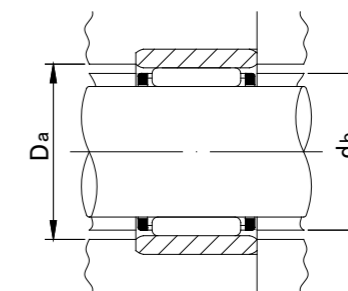
MACHINED RING NEEDLE ROLLER BEARINGS WITHOUT INNER RING



RNAF



RNAFW

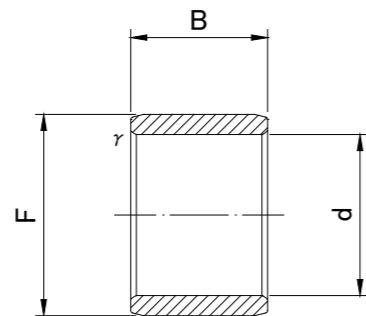


RNAF(W) TYPE

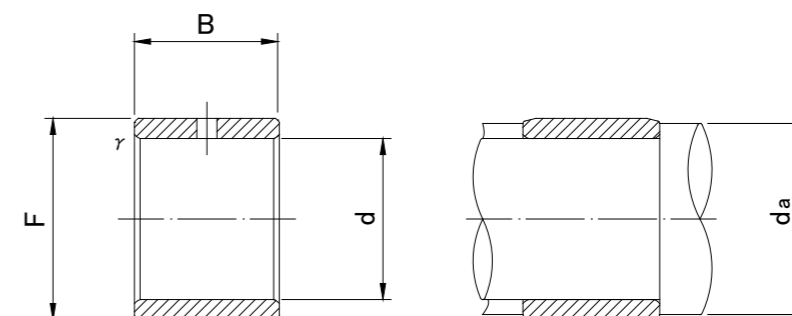
Shaft Diameter (mm)	Designation	Dimensions (mm)				Standard mounting dimensions (mm)			Basic dynamic load rating	Basic static load rating	Limiting speed*	Mass	Usable bearing designation	
		Fw	D	C	r/s min	db	Da MAX	Db					INNER RING	WITH INNER RING
55	RNAF556820	55	68	20	0.6	59.5	64	55.8	28 500	66 000	7 500	167	IR505520	NAF506820
	RNAFW556840	55 +0.049	68	40	0.6	59.5	64	55.8	48 900	132 400	7 500	330	IR505540	NAFW506840
	RNAF557220	55 +0.030	72	20	0.6	60.9	68	55.8	37 400	66 400	7 500	215	IR455520	NAF457220
	RNAFW557240	55	72	40	0.6	60.9	68	55.8	64 100	132 400	7 500	435	IR455540	NAFW457240
60	RNAF607820	60 +0.049	78	20	1	66.3	73	60.8	38 900	71 700	6 500	255	IR506020	NAF507820
	RNAFW607840	60 +0.030	78	40	1	66.3	73	60.8	66 700	143 200	6 500	510	IR506040	NAFW507840
65	RNAF658530	65 +0.049	85	30	1	72	80	66	59 300	127 500	6 000	465	IR556530	NAF558530
	RNAFW658560	65 +0.030	85	60	1	72	80	66	102 000	254 000	6 000	950	IR556560	NAFW558560
70	RNAF709030	70 +0.049	90	30	1	77	85	71	61 200	135 300	5 500	500	IR607030	NAF609030
	RNAFW709060	70 +0.030	90	60	1	77	85	71	104 900	271 600	5 500	1 000	IR607060	NAFW609060
75	RNAF759530	75 +0.049	95	30	1	82	90	76	63 200	144 200	5 500	530	IR657530	NAF659530
	RNAFW759560	75 +0.030	95	60	1	82	90	76	108 900	289 300	5 500	1 050	IR657560	NAFW659560
80	RNAF8010030	80 +0.049	100	30	1	87	95	81	64 900	153 000	5 000	560	IR708030	NAF7010030
	RNAFW8010060	80 +0.030	100	60	1	87	95	81	111 800	306 000	5 000	1 120	IR708060	NAFW7010060
85	RNAF8510530	85 +0.058 +0.036	105	30	1	92	100	86	66 600	160 800	4 800	590	IR758530	NAF7510530
90	RNAF9011030	90 +0.058 +0.036	110	30	1	97	105	91	69 500	173 600	4 500	620	IR809030	NAF8011030
95	RNAF9511530	95 +0.058 +0.036	115	30	1	102	110	96	70 900	182 400	4 200	650	IR859530	NAF8511530
100	RNAF10012030	100 +0.058 +0.036	120	30	1	107	115	101	72 600	191 200	4 000	690	IR9010030	NAF9012030

* Suitable for oil lubrication. In case of grease lubrication, down to 50% of this value.

INNER RINGS



IR

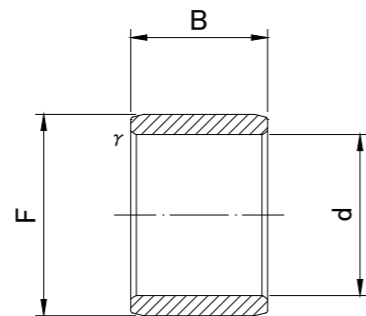


IRZ

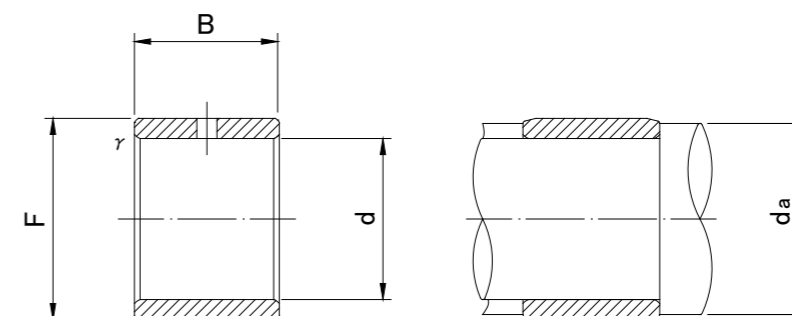
IR,IRZ TYPE

Shaft Diameter (mm)	Designation		Dimensions (mm)				Standard mounting dimensions (mm)		Mass (g approx)	Usable bearing designation						
	IR	IRZ	d	F	B	r/s min	da			RNA 49	RNA 59	RNA 69	RNA 48	NK	RNAF	
							MIN	MAX								
5	IR 5812	—	5 ⁰	8	12	0.3	7	7.7	3	—	—	—	—	NK 8/12	—	
	IR 5816	—	5 ^{-0.008}	8	16	0.3	7	7.7	4	—	—	—	—	NK 8/16	—	
6	IR 6810	—	6 ⁰	8	10	0.15	7.2	7.7	1.7	RNA 496	—	—	—	—	—	
	IR 6912	—	6 ⁰	9	12	0.3	8	8.7	3.2	—	—	—	—	NK 9/12	—	
	IR 6916	—	6 ^{-0.008}	9	16	0.3	8	8.7	4.3	—	—	—	—	NK 9/16	—	
	IR 61010	—	6	10	10	0.3	8	9.7	4	—	—	—	—	—	RNAF 101710	
7	IR 7910	—	7	9	10	0.15	8.2	8.7	1.9	RNA 497	—	—	—	—	—	
	IR 71010.5	—	7	10	10.5	0.3	9	9.7	3.2	—	—	—	—	—	—	
	IR 71012	—	7 ⁰	10	12	0.3	9	9.7	3.6	—	—	—	—	NK 10/12	RNAF 102012	
	IR 71012.5	—	7 ^{-0.008}	10	12.5	0.3	9	9.7	3.9	—	—	—	—	—	—	
	IR 71015.5	—	7	10	15.5	0.3	9	9.7	4.8	—	—	—	—	—	—	
	IR 71016	—	7	10	16	0.3	9	9.7	5	—	—	—	—	NK 10/16	—	
8	IR 81011	—	8	10	11	0.15	9.2	9.7	2.4	RNA 498	—	—	—	—	—	
	IR 81210	—	8	12	10	0.3	10	11	4.8	—	—	—	—	—	—	
	IR 81210.5	—	8 ⁰	12	10.5	0.3	10	11	5.1	—	—	—	—	—	—	
	IR 81212.5	—	8 ^{-0.008}	12	12.5	0.3	10	11	6	—	—	—	—	—	—	
	IR 81215.5	—	8	12	15.5	0.3	10	11	7.5	—	—	—	—	—	—	
9	IR 91211	—	9	12	11	0.3	11	11.5	3.1	RNA 499	—	—	—	—	—	
	IR 91212	—	9 ⁰	12	12	0.3	11	11.5	4.5	—	—	—	—	NK 12/12	RNAF 122212	
	IR 91216	—	9 ^{-0.008}	12	16	0.3	11	11.5	6	—	—	—	—	NK 12/16	—	
10	IR 101312.5	—	10	13	12.5	0.3	12	12	5.2	—	—	—	—	—	—	
	IR 101412	—	10	14	12	0.3	12	13	7	—	—	—	—	—	RNAF 142612	
	IR 101412.5	—	10	14	12.5	0.3	12	13	7.2	—	—	—	—	—	—	
	IR 101413	—	10	14	13	0.3	12	13	7.5	RNA 4900	—	—	—	—	RNAF 142213	
	—	IRZ 101414	—	10	14	14	0.3	12	13	8	RNA 4900UU	—	—	—	—	—
	IR 101416	—	10	14	16	0.3	12	13	9	—	—	—	—	NK 14/16	—	
	IR 101416.5	—	10 ⁰	14	16.5	0.3	12	13	9.6	—	—	—	—	—	—	
	IR 101420	—	10 ^{-0.008}	14	20	0.3	12	13	11.5	—	—	—	—	NK 14/20	RNAFW 142220	
	IR 101420.5	—	10	14	20.5	0.3	12	13	11.9	—	—	—	—	—	—	
	IR 101510.5	—	10	15	10.5	0.3	12	14	7.9	—	—	—	—	—	—	
	IR 101515.5	—	10	15	15.5	0.3	12	14	11.7	—	—	—	—	—	—	
	IR 101520.5	—	10	15	20.5	0.3	12	14	15.5	—	—	—	—	—	—	
	IR 101525.5	—	10	15	25.5	0.3	12	14	19.3	—	—	—	—	—	—	

INNER RINGS



IR

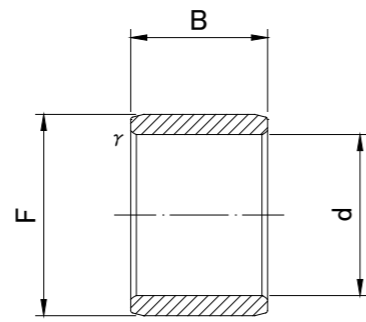


IRZ

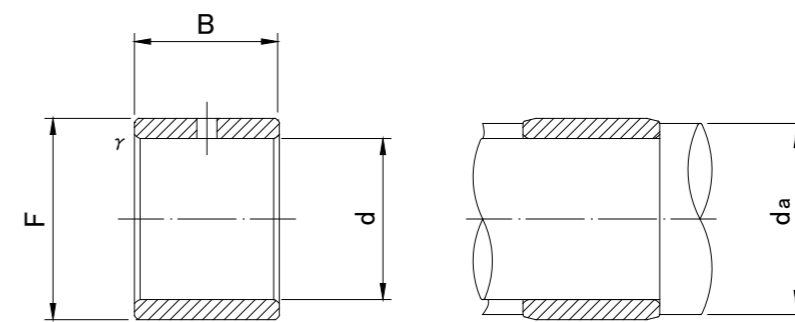
IR,IRZ TYPE

Shaft Diameter (mm)	Designation		Dimensions (mm)				Standard mounting dimensions (mm)		Mass (g approx)	Usable bearing designation					
	IR	IRZ	d	F	B	r/s min	da			RNA 49	RNA 59	RNA 69	RNA 48	NK	RNAF
							MIN	MAX							
22	IR 222616	—	22	26	16	0.3	24	25	17.5	—	—	—	—	NK 26/16	—
	IR 222620	—	22	26	20	0.3	24	25	24	—	—	—	—	NK 26/20	—
	IR 222817	—	22 ⁰	28	17	0.3	24	27	30.5	RNA 49/22	—	—	—	—	—
	IR 222820.5	—	22 ^{-0.010}	28	20.5	0.3	24	27	37	—	—	—	—	—	—
	IR 222823	—	22	28	23	0.3	24	27	42	—	RNA 59/22	—	—	—	—
	IR 222830	—	22	28	30	0.3	24	27	55	—	—	RNA 69/22	—	—	—
25	IR 252920	—	25	29	20	0.3	27	28	25	—	—	—	—	NK 29/20	—
	IR 252930	—	25	29	30	0.3	27	28	38	—	—	—	—	NK 29/30	—
	IR 253015	—	25	30	15	0.3	24	29	24.5	—	—	—	—	—	—
	IR 253015.5	—	25	30	15.5	0.3	24	29	25.5	—	—	—	—	—	—
	IR 253016	—	25	30	16	0.3	27	29	28	—	—	—	—	—	RNAF 304216
	IR 253017	—	25	30	17	0.3	27	29	28.5	RNA 4905	—	—	—	—	RNAF 304017
	—	IRZ 253018	25	30	18	0.3	27	29	29.5	RNA 4905UU	—	—	—	—	—
	IR 253020	—	25	30	20	0.3	24	29	33	—	—	—	—	—	—
	IR 253020.5	—	25 ⁰	30	20.5	0.3	24	29	34	—	—	—	—	—	—
	IR 253023	—	25 ^{-0.010}	30	23	0.3	27	29	38	—	RNA 5905	—	—	—	—
	IR 253025.5	—	25	30	25.5	0.3	24	29	42.5	—	—	—	—	—	—
	IR 253026	—	25	30	26	0.3	27	29	44.5	—	—	—	—	—	RNAFW 304026
	IR 253026.5	—	25	30	26.5	0.3	24	29	44	—	—	—	—	—	—
	IR 253030	—	25	30	30	0.3	27	29	49	—	—	RNA 6905	—	—	—
	IR 253030.5	—	25	30	30.5	0.3	24	29	50.5	—	—	—	—	—	—
	—	IRZ 253031	25	30	31	0.3	27	29	51	—	—	RNA 6905UU	—	—	—
IR 253032	—	25	30	32	0.3	27	29	54	—	—	—	—	—	RNAFW 304232	
IR 253038.5	—	25	30	38.5	0.3	24	29	64	—	—	—	—	—	—	
28	IR 283217	—	28	32	17	0.3	30	31	24.5	RNA 49/28	—	—	—	—	—
	IR 283220	—	28	32	20	0.3	30	31	28.5	—	—	—	—	NK 32/20	—
	IR 283220.5	—	28 ⁰	32	20.5	0.3	30	31	29.5	—	—	—	—	—	—
	IR 283223	—	28 ^{-0.010}	32	23	0.3	30	31	34	—	RNA 59/28	—	—	—	—
	IR 283230	—	28	32	30	0.3	30	31	43	—	—	RNA 69/28	—	NK 32/30	—
	IR 283230.5	—	28	32	30.5	0.3	30	31	44	—	—	—	—	—	—

INNER RINGS



IR



IRZ

IR,IRZ TYPE

Shaft Diameter (mm)	Designation		Dimensions (mm)					Standard mounting dimensions (mm)		Mass (g approx)	Usable bearing designation					
	IR	IRZ	d	F	B	r/s min	da		RNA 49		RNA 59	RNA 69	RNA 48	NK	RNAF	
							MIN	MAX								
110	IR 11012030	—	110 ⁰	120	30	1.0	115	118	410	—	—	—	RNA 4822	—	—	
	IR 11012540	—	110 ^{-0.020}	125	40	1.1	116.5	123	840	RNA 4922	—	—	—	—	—	
120	IR 12013030	—	120 ⁰	130	30	1.0	125	128	450	—	—	—	RNA 4824	—	—	
	IR 12013545	—	120 ^{-0.020}	135	45	1.1	126.5	133	1 030	RNA 4924	—	—	—	—	—	
130	IR 13014535	—	130 ⁰	145	35	1.1	136.5	143	860	—	—	—	RNA 4826	—	—	
	IR 13015050	—	130 ^{-0.025}	150	50	1.5	138	148	1 670	RNA 4926	—	—	—	—	—	
140	IR 14015535	—	140 ⁰	155	35	1.1	146.5	153	930	—	—	—	RNA 4828	—	—	
	IR 14016050	—	140 ^{-0.025}	160	50	1.5	148	158	1 790	RNA 4928	—	—	—	—	—	
150	IR 15016540	—	150 ⁰ -0.025	165	40	1.1	156.5	163	1 130	—	—	—	RNA 4830	—	—	
160	IR 16017540	—	160 ⁰ -0.025	175	40	1.1	166.5	173	1 200	—	—	—	RNA 4832	—	—	

CAM FOLLOWERS



Cam follower with pre-installed grease nipple

Newly available versatile cam follower which has conquered disadvantages in traditional products!!

CF..AB
Standard type

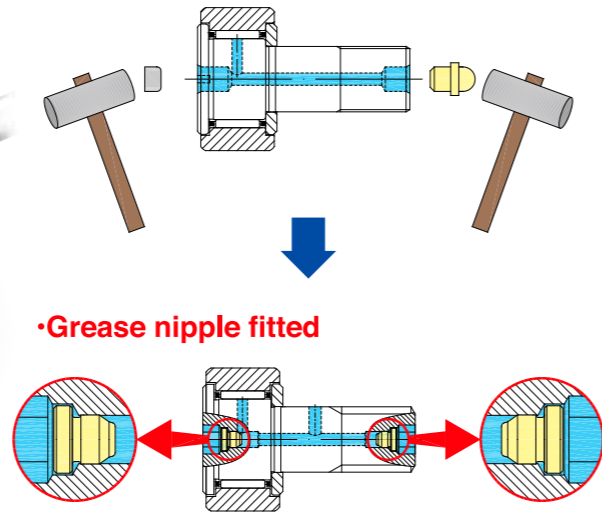
CF..MAB
Stainless type

CFH..AB
Eccentric type

CFH..MAB
Eccentric stainless type

Ready use instantly after unpack the box thanks to pre-installed grease nipple.

•Conventional type: Need to fit a nipple

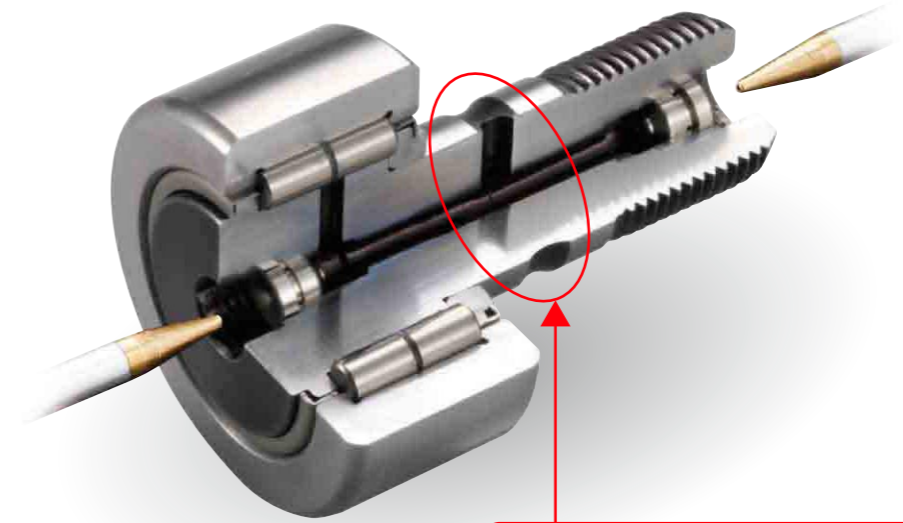


Lubrication available from both stud head side and thread side.No restriction for mounting location.

NUCF..AB

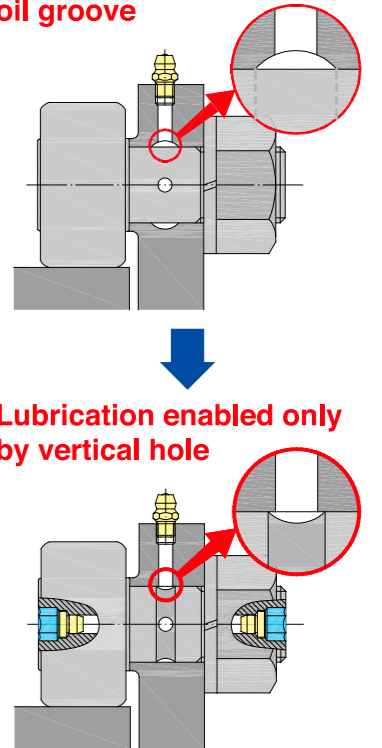
Double-row cylindrical roller type

stud diameter
16 to 30mm



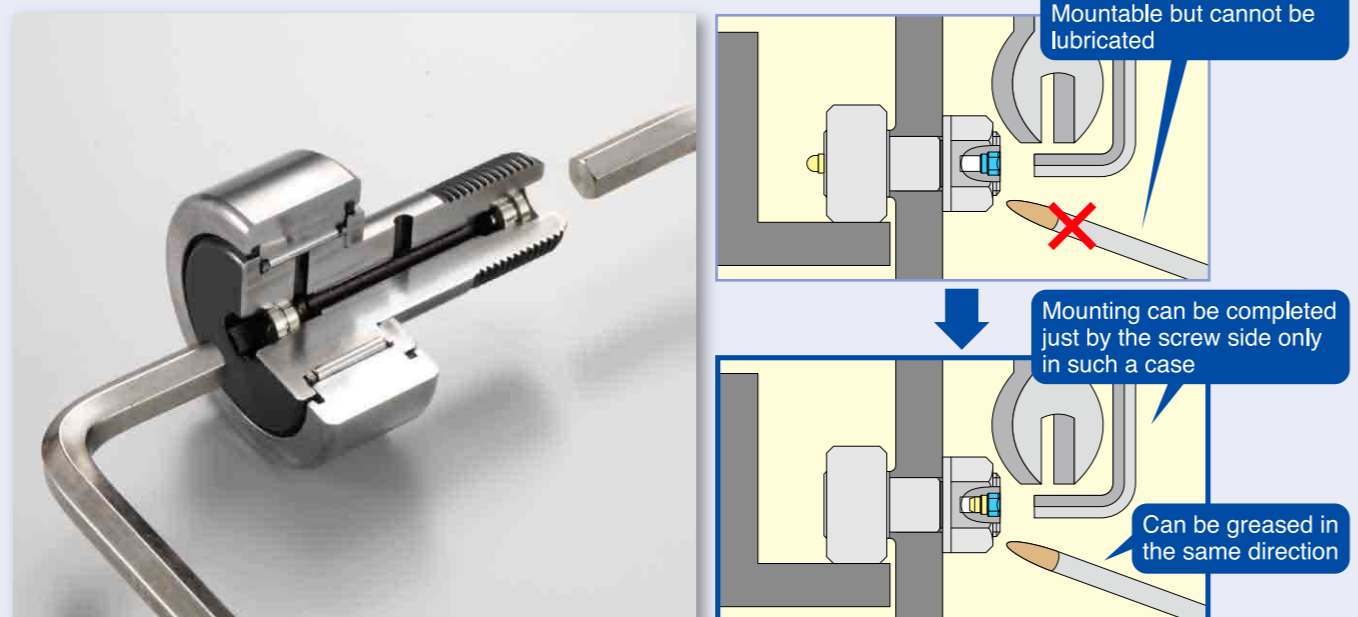
Lubrication area at the side of stud has an oil groove to eliminate bothersome groove machining process in the mounting side(NUCF type).

•Need to machine an internal oil groove

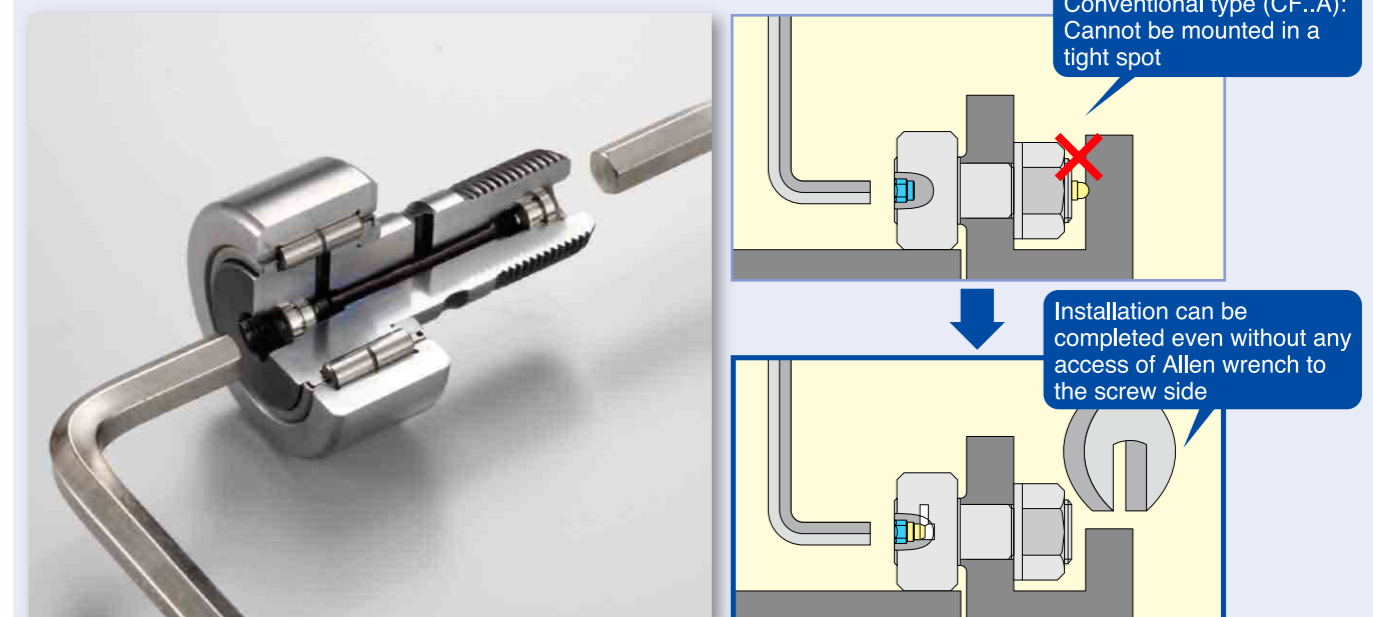


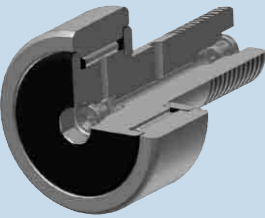
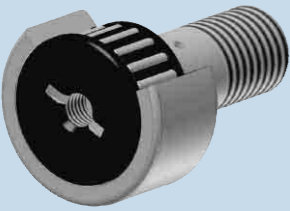
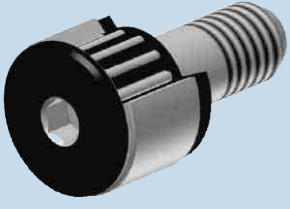
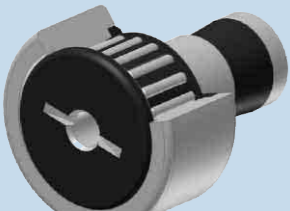
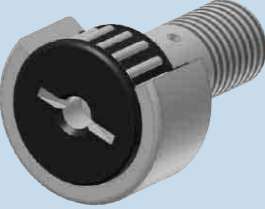
•Lubrication enabled only by vertical hole

No restriction for mounting location thanks to hexagon socket shape in stud head and thread side.Easy mounting and removal is available thanks to having hexagon socket shape in both side.



No restriction for mounting location thanks to hexagon socket shape in stud head and thread side.Easy mounting and removal is available thanks to having hexagon socket shape in both side.



Type	Applicable axis diameter	Feature	Part Code
 <p>CFH-AB</p>	φ 12 ~ φ 30	Eccentric cam follower with integrated concave grease nipples on both sides. Available for mounting and lubrication with hexagon holes on both sides. Available with stainless steel type (code M) for higher corrosive resistance.	<p>V: Full complement None: With cage</p> <p>UU: With seal None: With shield</p> <p>R: Crowned outer ring None: Cylindrical outer ring</p> <p>CFH 16 V M UU R AB</p> <p>Type ↑ M: Stainless steel None: High carbon steel</p> <p>AB: with hexagon socket on both sides (Applicable shaft diameter φ 12~ φ 30) (With integrated concave nipple)</p>
 <p>CFT Lubrication tap hole</p>	φ 6 ~ φ 30	Cam follower with tap for piping at stud head and thread of general type. Optimal for location that requires concentrated lubrication piping. Available with stainless steel type (code M) for higher corrosive resistance.	<p>V: Full complement None: With cage</p> <p>UU: With seal None: With shield</p> <p>R: Crowned outer ring None: Cylindrical outer ring</p> <p>CFT 16 V M UU R A</p> <p>CFT: Standard typed CFHT: Eccentric type</p> <p>M: Stainless steel None: High carbon steel</p> <p>A: with hexagon socket on the stud head (Applicable shaft diameter φ 12 ~ φ 30) B: with hexagon socket on the thread side (Applicable shaft diameter φ 12 ~ φ 30) None: Standard typed</p>
 <p>CFS Compact outer ring</p>	φ 2.5 ~ φ 6	Built-in very thin needle roller. Enables compact design due to very small outer ring diameter in comparison to stud diameter. Available with stainless steel type (code M) for higher corrosive resistance.	<p>CFS 6 V M A</p> <p>Type ↑</p> <p>V: Full complement None: With cage</p> <p>M: Stainless steel None: High carbon steel</p> <p>A: with hexagon socket on the stud head</p>
 <p>CF-SFU Easy mounting</p>	φ 6 ~ φ 20	A type with step on stud to allow easy mounting. Optimal for devices with limited space for stud tightening. Available with seal only.	<p>V: Full complement None: With cage</p> <p>CF-SFU 16 V R</p> <p>Type ↑</p> <p>R: Crowned outer ring None: Cylindrical outer ring</p>
 <p>CR Inch type</p>	φ 4.826 ~ φ 22.225	Cam followers in inch dimension.	<p>R: Crowned outer ring None: Cylindrical outer ring</p> <p>CR 16 UU R</p> <p>Type ↑</p> <p>UU: With seal None: With shield</p>

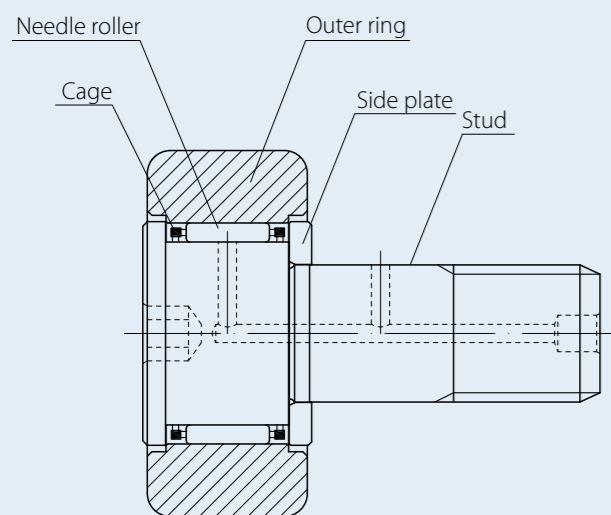
Structure and Features

Cam followers are compact and high rigid bearings with stud. It has a structure that an outer ring with built-in "roller" rolls over a track (raceway) and is utilized as guide roller for cam mechanism or linier motion. The cam follower is designed with a thick-walled outer ring in order to provide high rigidity to endure heavy load or impact load at contact portion with the track.

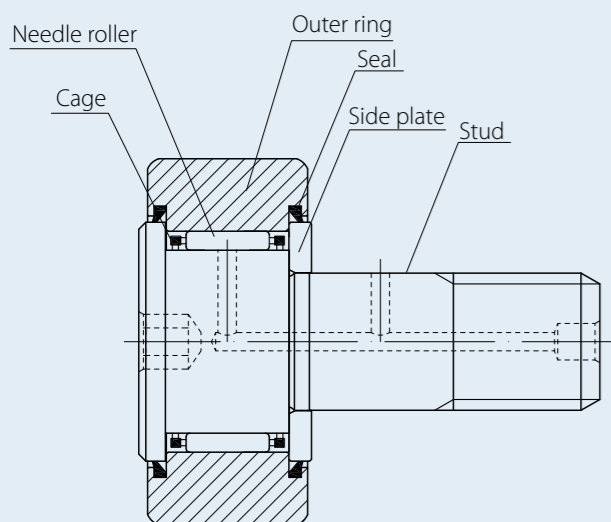
Outer rings have two shapes – crowned outer ring and cylindrical outer ring. The cylindrical outer ring is effective for heavy duty applications since it contacts with large contact area of the associated objects so that can mitigate the contact surface pressure. The crowned outer ring is suited for absorbing eccentric load since it absorbs angular misalignment due to a mount error. They have two internal structures – one with cage and one with full complement. Caged type cam followers are suited for high speed application, since the guiding feature of cage enables the rotation of "rollers" to be stable. Compared with caged type cam followers, full complement type is effective for applications with low-speed operation of heavy load due to its larger load rating. Full complement type also includes double-row cylindrical roller type which allows moderate axial loading.

Cam followers shall be fixed by tightening hexagon nut at stud thread by holding the stud with screw driver or hex-wrench.

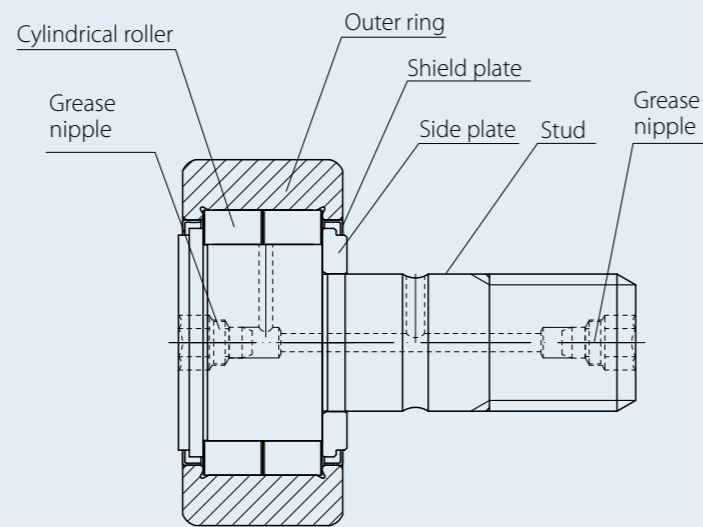
Cam followers with eccentric axis on the stud thread have an advantage to adjust the variation of mounting position within its eccentric range, without requesting high machining accuracy of mounting hole position.



CF--Structure of type A



CF--UU Structure of type A



NUCF--Structure of type AB

Accuracy standard

Accuracy of cam follower is indicated in Table-1 and Table-2 below.

Unit: μm

Name	Category	Cam follower series in metric (CF--, NUCF--)		Compact type (CFS--)	Cam follower series in inch (CR--)	
		Crowned outer ring	Cylindrical outer ring	Cylindrical outer ring	Crowned outer ring	Cylindrical outer ring
Dimension tolerance of outer ring outer diameter (D)		0 -50	Refer to Table-2	Refer to Table-2	0 -50	0 -25
Dimension tolerance of stud diameter (d)		h7		h6	+25 0	
Dimension tolerance of outer ring width (C)		0 -120		0 -120	0 -130	

Unit: μm

Nominal outer ring outer diameter D (mm)		Dimension tolerance of mean outside diameter in a single plane Δ_{Dmp}		Radial runout of outer ring K_{ea}
Over	Incl.	high	low	max.
6 (5 or more)	18	0	-8	15
18	30	0	-9	15
30	50	0	-11	20
50	80	0	-13	25
80	120	0	-15	35

Radial internal clearance

Table below indicates radial internal clearance of cam follower.

Table-3 Radial internal clearance

Unit: μm

Part code				Radial internal clearance	
Cam follower series in metric (CF)	Compact type (CFS)	Double-row cylindrical roller cam follower (NUCF)	Inch type series (CR)	min.	max.
CF3 ~ 5	CFS2.5 ~ 5		CR8 ~ 8-1	3	17
CF6 ~ 8	CFS6		CR10 ~ 10-2	5	20
CF10 ~ 12-1			CR12 ~ 22	5	25
CF16 ~ 20-1			CR24 ~ 26	10	30
CF24 ~ 30-2				10	40
		NUCF16 ~ 24		0	25
		NUCF24-1 ~ 30-2		5	30

Fits

Cam followers require machining of mounting hole to eliminate play at fitting portion especially for the portion which is subjected to impact shock due to its application in cantilevered mounting. Table-4 indicates recommended fits between cam follower and its mounting hole.

Table-4 Dimension tolerance of stud mounting hole

Part code	Dimension tolerance of stud mounting hole
Cam follower series in metric (CF)	H7
Compact type (CFS)	H6
Double-row cylindrical roller cam follower (NUCF)	H7
Cam follower series in inch (CR)	F7

Maximum permissible load

Permissible load of cam follower is subjected to change in accordance with bending strength and shear strength of its stud in addition to standard rating load of needle bearing due to its design with stud. This load is indicated as maximum permissible load.

Track load capacity

Track load capacity means a permissible load under which the outer ring of cam follower and the mating surface are allowable to be used over a long period without causing any deformation nor compression mark. Track load capacity depicted in dimension table indicates a value for which hardness of steel mating material is assumed to be HRC40. In the case that the hardness of mating material is not HRC40, track load capacity in the dimension table shall be multiplied by value of track load factor obtained by Figure-1.

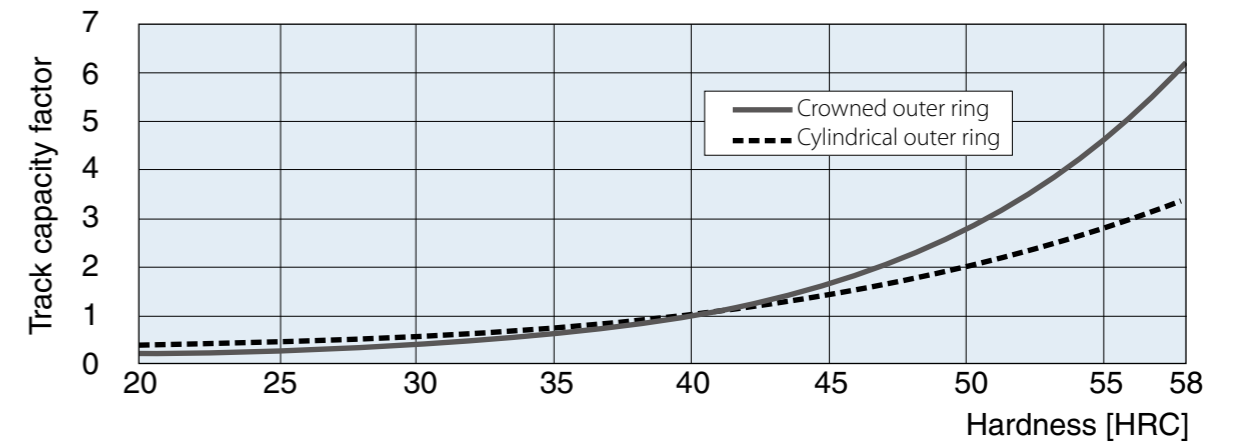


Figure-1 Track capacity factor

Lubrication

All the JNS cam followers are lubricated with pre-packed high quality lithium soap-based grease grade 2 (RoHS compliant) so that they are ready to use. For applications requiring high prevention measure against invasion of foreign matter or leakage of lubricant, products with seal(part code--UU) which integrate special synthetic lubber with high abrasion resistance are also available.

Grease shall be packed up to volume approximately one-third to one-half of internal space of bearing. Lubrication interval varies depending on operation condition. Referential interval may be every six to twenty four months for cam followers with cages and every one to six months for full complement type with grease in the same type.

Some excessive grease may leak at the beginning of usage or immediately after re-greasing even for the products with seal. Aging operation period is recommended prior to application in which no contamination by grease is allowed in and around device. Wipe and clean any leaked extra grease after this operation.

Dedicated grease nipple shall be knocked in onto cam follower by pressing flange portion of the nipple using fixture shown in Figure-2.

Accessories

Accessories for cam follower of standard specification are shown in Table-5. Dedicated grease nipple is available upon customer request by ordering products with suffix "N" added to part code.

Also, type CF-AB and type NUCF-AB have integrated dedicated concave grease nipples installed at both sides.

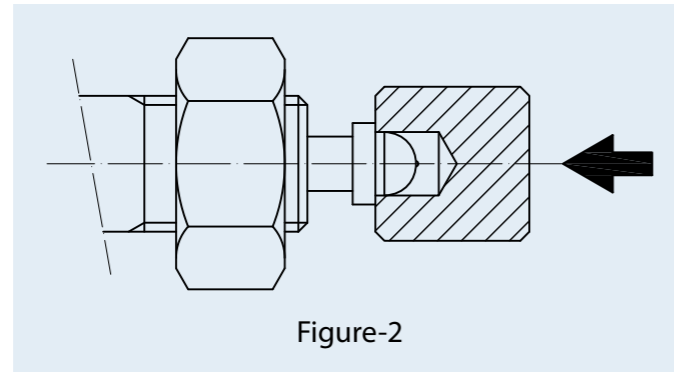





Figure-2

Example) CF 12 UUR-N
└─ Dedicated grease nipple

Table-5 Accessories

Part code		 Stop plug ^{*1)}	 Resin plug ^{*2)}	 Hexagon nuts style 2	Grease
CF CFH CR	Without seal	Attached	Attached	Attached	Packed
	With seal	Attached	Attached	Attached	Packed
CFT	Without seal	—	—	Attached	Packed
	With seal	—	—	Attached	Packed
CFS		—	—	Attached	Packed
CF-SFU		Attached	Attached	—	Packed
NUCF		—	—	Attached	Packed

*1) Stop plug is used for plugging unused lubrication hole(s).

*2) Resin plug is used for preventing leakage of grease.

DIMENSIONS OF GREASE NIPPLES

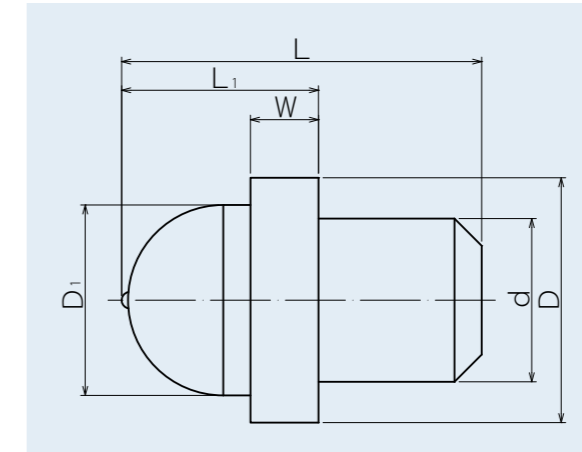


Table-6

Applicable part code	Nipple dimension					
	d	D	D ₁	L	L ₁	W
CF, CFH						
CF5	3.2	7.5	6	9	5.5	1.5
CF6 ~ CF10-1	4	7.5	6	10	5.5	1.5
CF12 ~ CF18	6	8	6	11	6	2
CF20 ~ CF30-2	8	10	6	16	7	3

Dimensions of supply nozzle for CF..AB type

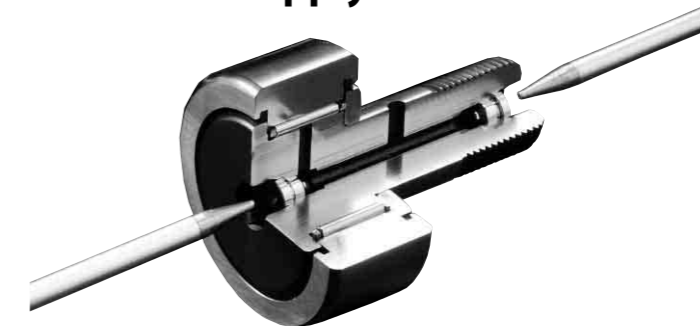
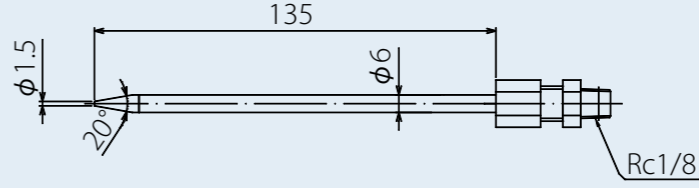
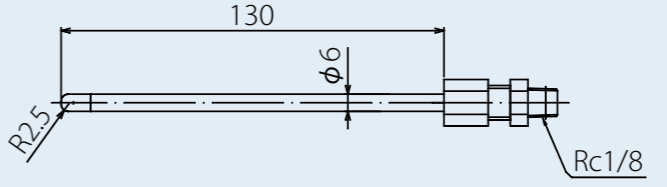


Table-7 Dimension of recommended lubrication nozzle (for CF..AB, NUCF..AB)

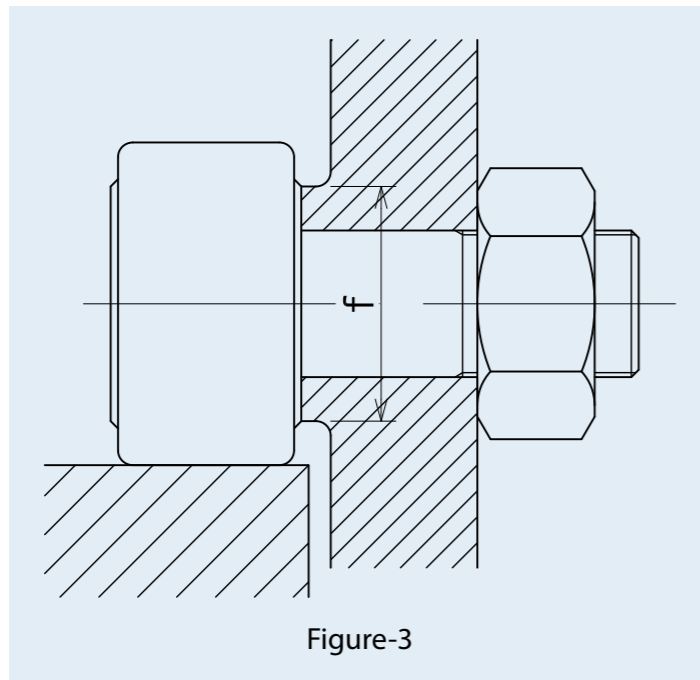
Type	Dimension and shape	Applied model number	
NPAB-1		CF10ABK(M10 × 1)	NUCF16AB
		CF10-1ABK(M10 × 1)	NUCF18AB
		CF12AB	
		CF12-1AB	
		CF16AB	
		CF18AB	
NPAB-2		CF20AB	NUCF20AB
		CF20-1AB	NUCF20-1AB
		CF24AB	NUCF24AB
		CF24-1AB	NUCF24-1AB
		CF30AB	NUCF30AB
		CF30-1AB CF30-2AB	NUCF30-2AB

Mounting

Mounting part

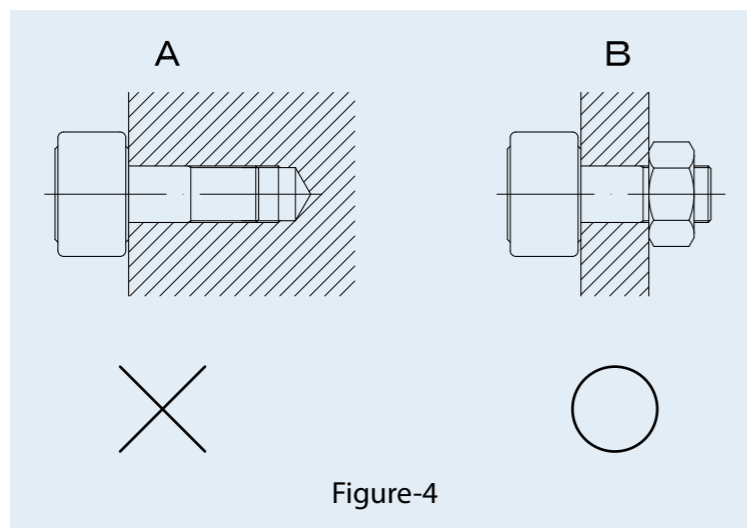
Hole for stud shall be perpendicular to mounting surface so as to ensure even contact between outer ring and rolling surface of mating material. Corner chamfer of hole shall be as small as around C0.5. Counter bore diameter shall be dimension f or more as described in the dimension table.

Type CF-R with crowned outer ring is recommended in the case of application with insufficient contact between outer ring and rolling surface of mating material.

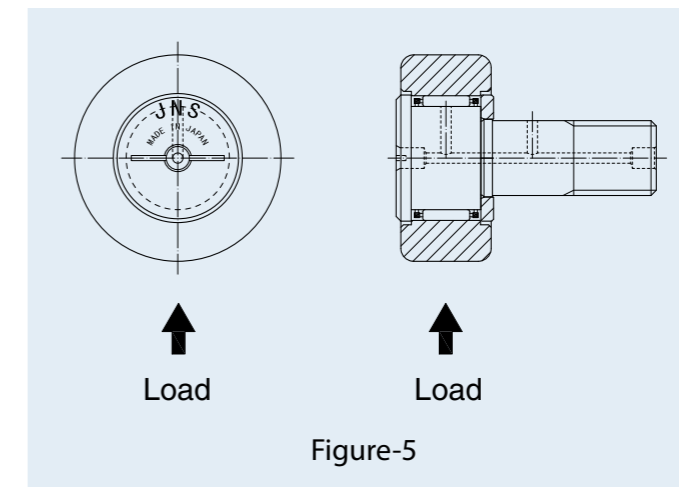


Mounting method

- Cam follower shall be mounted so as not to incline against direction of the motion.
- Mounting method to tighten cam follower directly to bracket by adding female thread to it without using nut as depicted in Figure-4 (A) is NOT recommended. This method may cause damage on stud due to concentration of bending stress in male thread portion in the event of loosening since it is difficult to tighten the stud sufficiently.



- For application with heavy load, lubrication hole of stud shall be located outside of loading range (on the side to receive load). Location of the lubrication hole is indicated by "JNS" marking on the side of stud flange. (Refer to Figure-5)
Hole at the center of stud is used as stopper for tightening or lubricant supply hole for grease lubrication.



Precaution for using spring washer

It is important to ensure that spring washer used for mounting cam follower has no burr or sharp edge. Debris scraped from nut or mounting bracket by burr or shape edge of washer during tightening can invade stud thread and can cause insufficient tightness or damage to thread.

Tightening torque of stud

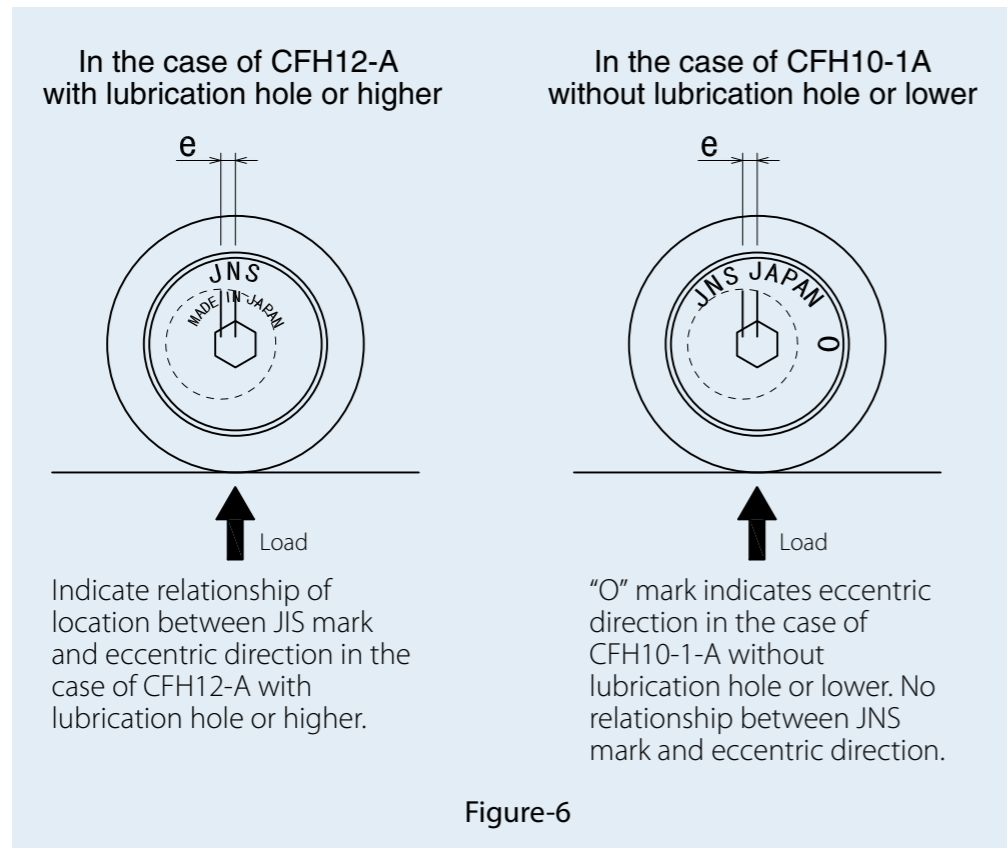
Stud of cam follower is subjected to bending stress or tensile stress by bearing load. Tightening torque shall be set not to exceed the value in the dimension table.

Using double spring washers, double thin nut of JIS B 1181 or special nut with locking feature is recommended in the case of possible loosening of mounting screw due to vibration or impact shock.

Mounting of eccentric cam follower

Adjustment of eccentric shall be performed in accordance with the following procedure.

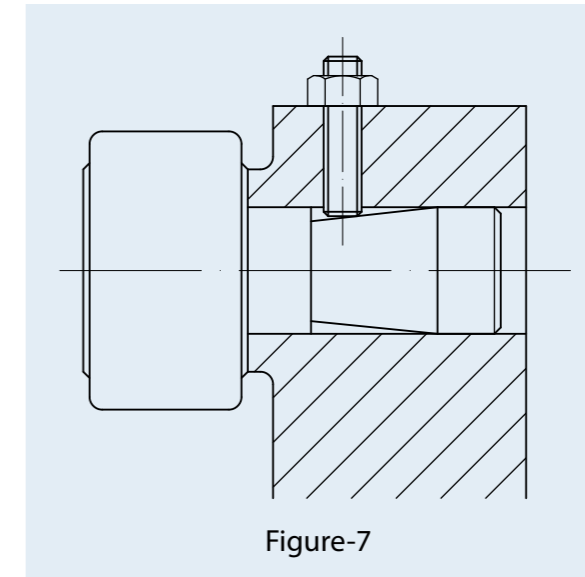
- (1) Insert stud to mounting hole and tighten nut as the stud can turn loosely. Marking of stud shall face location indicated in Figure-6 in relation to direction of load.
- (2) Gap between cam follower and mating contact surface may be adjusted by turning stud using hexagon hole on the stud head.
- (3) After completing adjustment, tighten nut with holding rotation of stud. Make it sure not to exceed maximum tightening torque of the nut.



Mounting of CF-SFU type

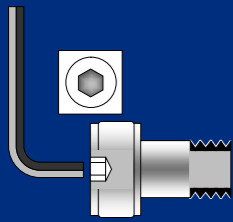
Refer to Figure-7 for mounting method of easy mounting of CF-SFU type.

Type CF-SFU is NOT recommended for application in the part subjected to vibration or shock impact as much as its mounting is simple. Standard cam followers with nut are recommended for application with possible vibration or shock impact.



CAM FOLLOWERS

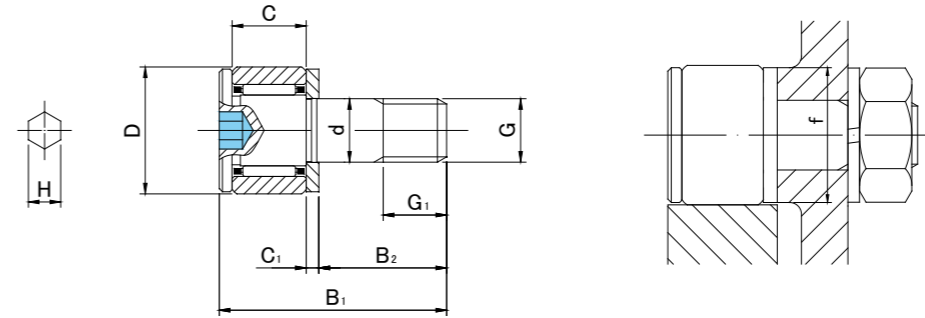
MINIATURE TYPE
HEXAGON SOCKET ON STUD HEAD



CFS..A



CFS..VA



CFS..A TYPE

Prepacked Grease

Stud diameter (mm)	Designation	Dimensions (mm)											Basic dynamic load rating	Basic static load rating	Largest permissible load	Max tightening torque	Mass
		Cylindrical outer ring		D	C	d	G	G1	B1	B2	C1	H					
h6 tolerance	With cage	Full roller	Cr N										Cor N	N	N-m	g (approx)	
2.5	CFS 2.5A	—	5	3	2.5	M2.5×0.45	2.5	9.5	5	0.7	0.9	4.8	410	335	260	0.2	1
	0 -0.006	—											CFS 2.5VA	1 000	1 080		
3	CFS 3A	—	6	4	3	M3×0.5	3	11.5	6	0.7	1.5	5.8	630	610	360	0.3	2
	0 -0.006	—											CFS 3VA	1 370	1 770		
4	CFS 4A	—	8	5	4	M4×0.7	4	15	8	1	2	7.7	1 080	1 080	780	0.6	4
	0 -0.008	—											CFS 4VA	2 350	3 040		
5	CFS 5A	—	10	6	5	M5×0.8	5	18	10	1	2.5	9.6	1 570	1 860	1 420	1.3	7
	0 -0.008	—											CFS 5VA	3 140	4 710		
6	CFS 6A	—	12	7	6	M6×1	6	21.5	12	1.2	3	11.6	2 060	2 160	2 110	2.3	13
	0 -0.008	—											CFS 6VA	4 610	6 270		

OUTER RINGS TOLERANCE (μm)

TYPE	Cylindrical outer ring
CFS2.5,CFS3,CFS4,CFS5,CFS6	0/-8

ACCESSORIES

TYPE	
All types	NUT Attached

