MOTION & CONTROL

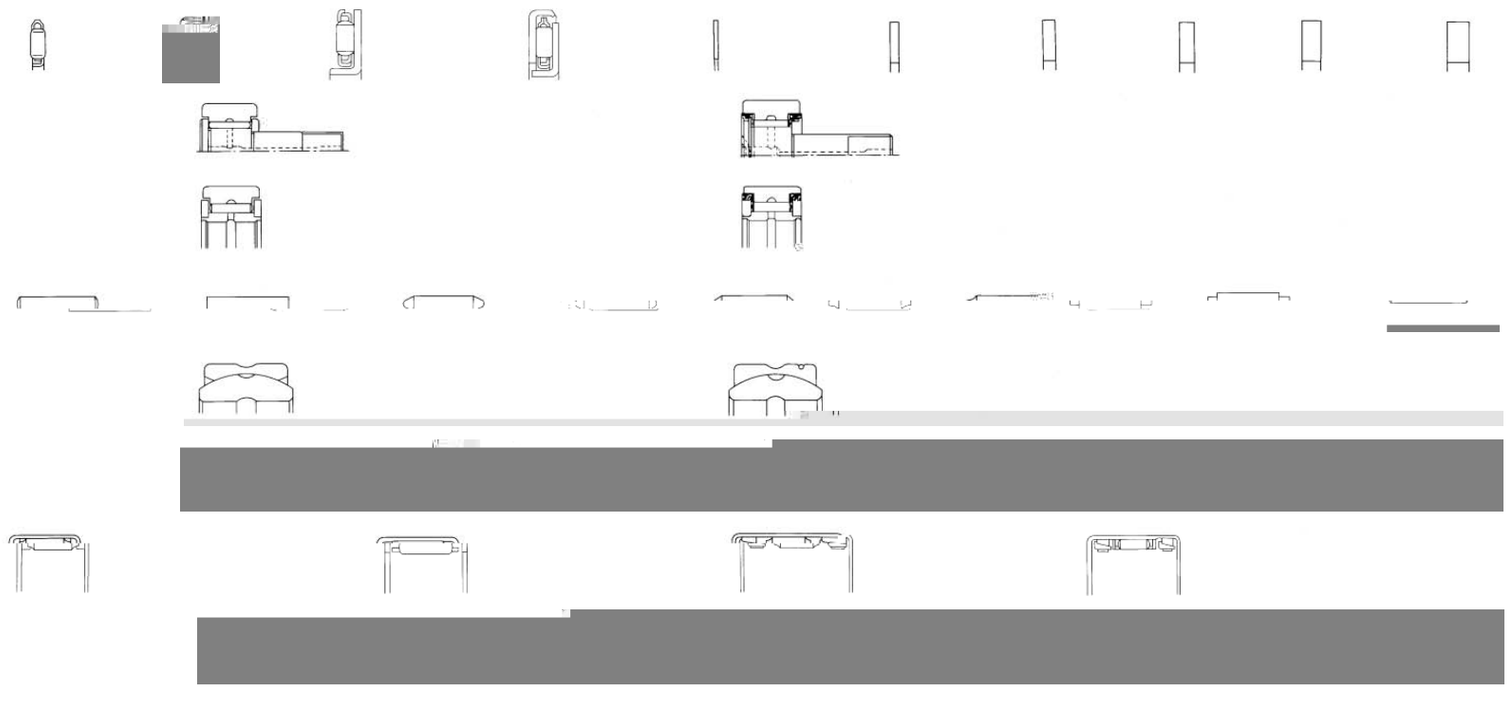
NSK

Needle Roller Bearings

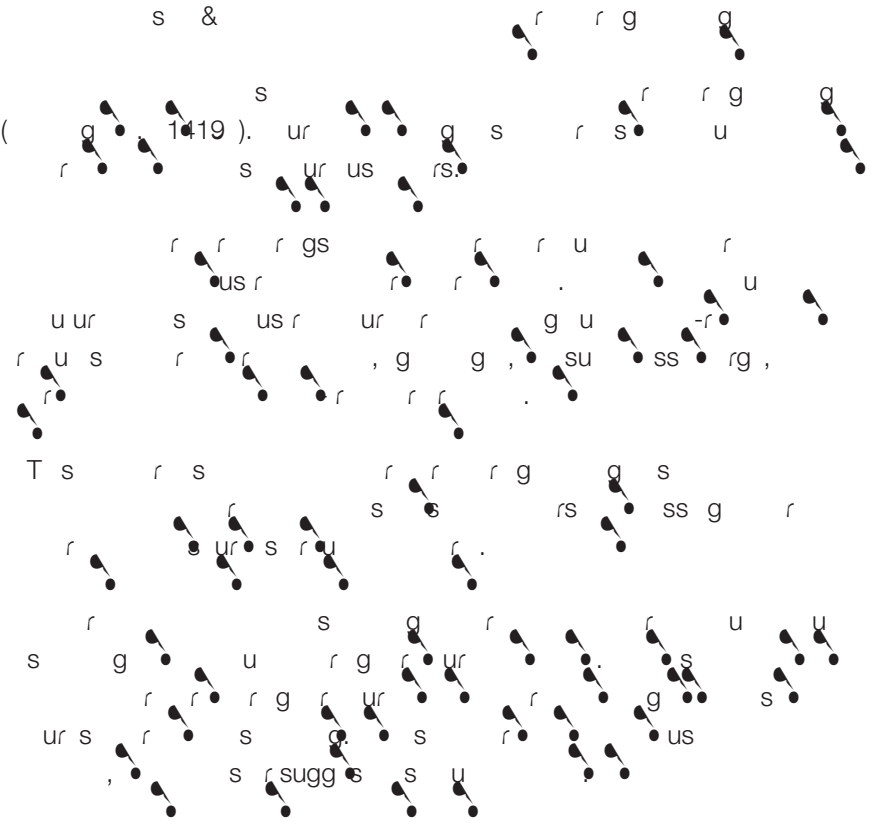


FIR
IR

IR



Introduction





BEARING TABLES Page

Cage & Needle Roller Assemblies ..... B 4
Drawn Cup Needle Roller Bearings ..... B 36
Solid Needle Roller Bearings ..... B 88
Inner Rings for Needle Roller Bearings ... B128
Thrust Bearings..... B162

APPENDICES

Appendix 1 Conversion Table from SI (International Units) System..... C48
Appendix 2 N-kgf Conversion Table C50
Appendix 3 kg-lb Conversion Table C51
Appendix 4 °C-°F Conversion Table..... C52
Appendix 5 Viscosity Conversion Table C53
Appendix 6 Inch-mm Conversion Table C54
Appendix 7 Hardness Conversion Table (Reference)... C56
Appendix 8 Physical and Mechanical Properties of Materials C57
Appendix 9 Tolerances for Shaft Diameters C58
Appendix 10 Tolerances for Housing Bore Diameters ... C60
Appendix 11 Values of Standard Tolerance Grades IT.. C62
Appendix 12 Speed Factor f_n C64
Appendix 13 Fatigue Life Factor f_h and Fatigue Life $L \cdot L_h$..... C65
Appendix 14 Boundary Dimensions of Radial Bearings... C66
Appendix 15 Boundary Dimensions of Thrust Bearings... C67

1. Bearing Types and Features

Needle roller bearings are a type of roller bearings and are classified as either radial or thrust depending on the direction of the load they support. Needle roller bearings include bearings whose rollers slightly exceed the size range of needle rollers as stipulated by ISO.

Needle roller bearings include drawn cup and solid radial bearings, as well as application-specific cam followers, roller followers. Thrust bearings include thrust needle bearings. Although not classified as a rolling bearing, there is also a spherical sliding bearing that supports radial and axial loads.

This catalog presents the various types of needle bearings and their features. For easy reference, the numbers in each section from **1.1** through **1.0** correspond to the numbers in **Figs. 1.1** through **1.9**.

1.1 Cage & Needle Roller Assemblies

1. The cage has a unique structure that facilitates handling by holding the rollers securely in place.
2. The outside surface of the cage serves as a guide face and helps create favorable lubricating conditions.
3. The cage guides the rollers accurately to ensure that stable roller movement is maintained.
4. The single-piece cage has high strength and rigidity and facilitates the free circulation of lubricant.
5. High load capacity is possible due to the presence of many rollers of relatively long length.
6. To prevent stress concentrations on both ends of the rollers (edge loads), appropriate crowning is applied.

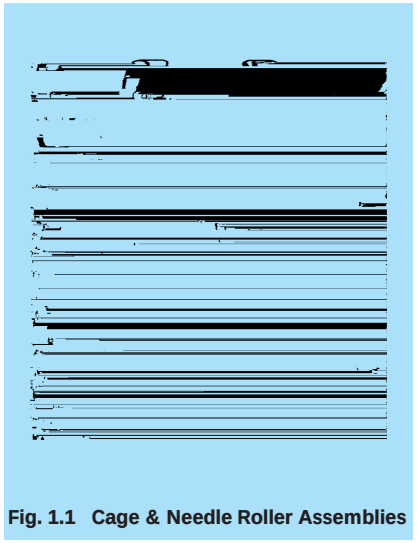


Fig. 1.1 Cage & Needle Roller Assemblies

1.2 Drawn Cup Needle Roller Bearings

1. NSK drawn cup needle roller bearings are available in two types: caged and full complement. Drawn cup outer rings are made of carefully selected alloy steel sheet. They are surface-hardened after precise pressing, giving them a unique structure.
2. The outer ring is precisely pressed and is in tight line contact with the rollers. Optimum heat treatment gives the raceway surface uniform strength and the ability to carry heavy loads.
3. The low height of the bearings saves space so machines can be made more compact and lightweight.
4. The bent part of the drawn cup outer ring securely holds the rollers and/or cage and acts as a labyrinth seal that prevents both the entry of dust and dirt and lubricant leakage. At the same time, it enhances the strength of the outer ring end faces.
5. When the shaft has adequate hardness and is finished to proper dimensional accuracy, the inner ring can be omitted and space in the radial direction can be saved.
6. As securing in the axial direction is achieved by press fitting, a locating snap ring, collar, housing shoulder or the like is not required. This simplifies the housing structure and facilitates low-cost design.
7. Mounting is made easier because press fitting can be performed with an arbor press or the like.
8. Lubricating the bearing is easy and a lubrication hole can also be provided upon request.
9. If a closed type is used at the shaft end, savings can be made on the housing end cover.
10. The full complement roller bearing carries the load on many rollers and thus maximizes load capacity.
11. Among full complement roller bearings, bearings whose rollers are held in place by grease before assembly have the maximum load capacity because the rollers have the longest possible length.
12. The cage of the needle bearing accurately guides the rollers at the pitch diameter of the rollers. The surface of the cage is hardened to reduce frictional torque and increase rigidity and wear resistance.
13. The unique structure of the cage allows extensive space for storing lubricant, thus enabling smooth lubricant circulation and increasing grease life.

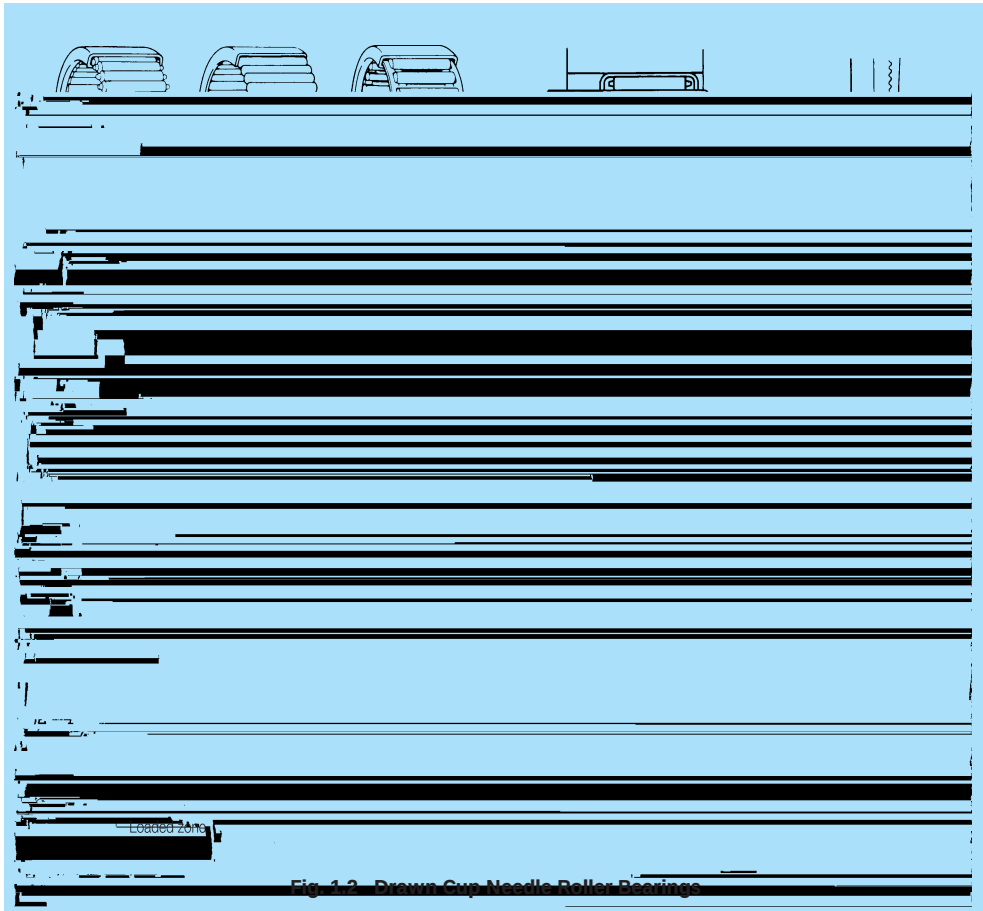


Fig. 1.2 Drawn Cup Needle Roller Bearings

1.3 Solid Needle Roller Bearings

1. The bearing ring can sustain high shock loads because it is precisely ground after being heat treated.
2. Providing high load capacity, many rollers are held in the outer ring by strong integrated ribs.
3. The unique single-piece cage is also excellent for high speeds as the cage accurately guides the rollers at the roller pitch diameter at both ends of the rollers.
4. Considerable space is allotted for lubricant and lubricant life is long.
5. The cage is surface treated, increasing wear resistance and rigidity.
6. Appropriate crowning is applied to the rollers to avoid edge load.
7. Outer rings provided with a lubrication groove and lubrication hole facilitate the replenishment of lubricant.
8. As the size variation per unit of roller diameter is small, the distribution of the roller load is favorable and bearing life is long.



Fig. 1.3 Solid Needle Roller Bearings

1.4 Thrust Bearings

1.4.1 Thrust Needle Bearings

1. Making compact design feasible, the height of the cross-section is similar to that of a conventional thrust washer.
2. The cage, which is made of two steel sheets precisely pressed, holds and accurately guides the rollers. The cage is surface hardened to increase wear resistance and rigidity.
3. There are thrust washers of various thicknesses available to meet the requirements of different applications.

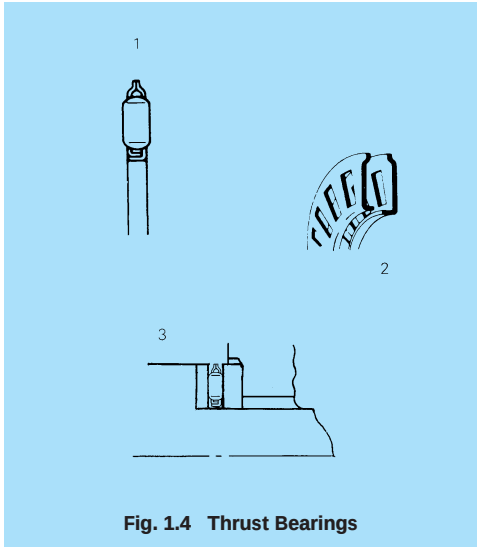


Fig. 1.4 Thrust Bearings

1.5 Cam Followers and Roller Followers

1. The thick-walled outer ring made of high-carbon chromium bearing steel, which is finished by grinding after hardening, has high shock resistance and is highly resistant to deformation.
2. The cam follower has lubrication holes in three places. Lubrication can be provided easily from any of these three locations.
3. Crowning is applied to the rollers in order to avoid edge loading.
4. The labyrinth seal structure reduces friction. In addition, a special thrust washer is integrated in order to enhance heat seizure resistance.
5. Increasing shock resistance, the shaft of the cam follower has a hardened raceway surface.
6. The roller follower can carry heavy loads because both ends are supported.

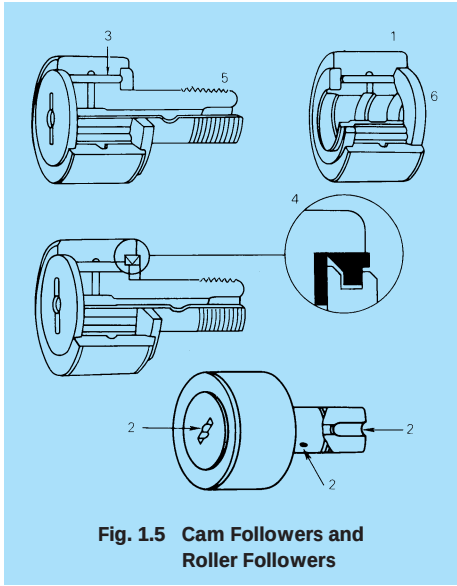


Fig. 1.5 Cam Followers and Roller Followers

1.6 Needle Rollers

There are a variety of end faces available from which an appropriate shape can be selected for specific applications.

1. Rounded rollers are the most widely used.
2. Flat rollers have a longer effective load-carrying length.
3. Crank pin rollers are suitable for where the corner of the shaft or housing step is considerably rounded.
4. Appropriate crowning can be applied for various usage conditions.

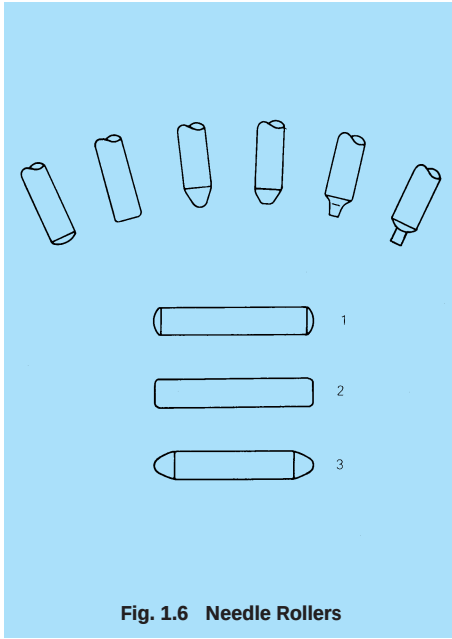


Fig. 1.6 Needle Rollers

1.7 Spherical Plain Bearings

1. Since the structure is composed simply of an inner ring with spherical outside and an outer ring with a spherical bore, this bearing is ideal for applications where the inner and outer rings are misaligned.
2. Carefully selected high-carbon chromium bearing steel is used, and high load capacity is achieved thanks to ideal hardening.
3. Bearings with single-cut outer rings are not separable even without snap rings.
4. Bearings with double-cut outer rings are assembled by a wire snap ring into a single body.
5. The lubrication grooves and lubrication holes provided in the inner and outer rings facilitate re-lubrication.
6. After phosphate coating, a coating of molybdenum disulfide is applied to the whole surface.

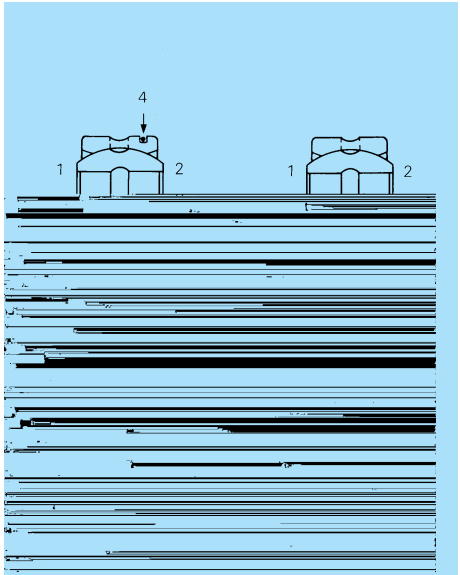


Fig. 1.7 Spherical Plain Bearings

1.8 Needle Roller Bearings for Universal Joints

Needle roller bearings for universal joints include two types: drawn cup and solid.

1. While the tightening method is mainly used for securing drawn cup needle bearings in a yoke hole, another method employs a rose washer and bearing assembly is carried out using special equipment. Universal joints made by assembling drawn cup needle bearings have the following characteristics:
   (a) It is possible to impose a light preload between the bearing inner bottom and cross shaft end.
   (b) It is possible to have the cross shaft's rotating center aligned with the shaft center.
   (c) Universal joints made in this way are economical and contribute to making products more compact and lightweight.
2. As solid needle bearings can sustain heavier loads than drawn cup needle bearings, universal joints with solid needle bearings are suitable for medium and heavy-duty motor vehicles.

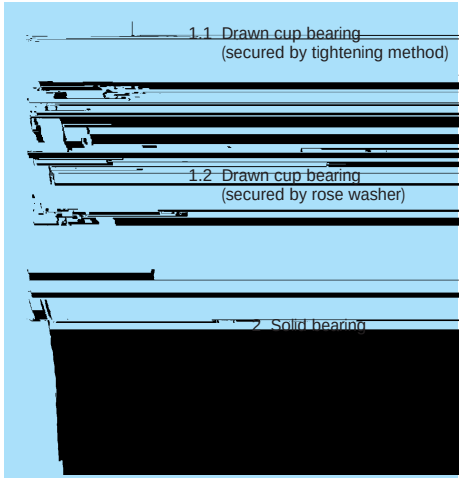


Fig. 1.8 Needle Roller Bearings for Universal Joints

1.9 Drawn Cup Roller Clutches

There are three types with a clutch only: FC, FCL and RC; and three types with a clutch and bearing combined: FCB, RCB and FCBN.

1. The unique structure of the drawn cup outer ring makes the clutch lightweight and compact.
2. The height of the cross-section is the same as standard drawn cup needle bearings and the torque capacity is high.
3. Performance is accurate and friction torque is low during overrunning.
4. Installation can be done in the same way as for drawn cup needle bearings, that is, by simply press fitting the unit into the housing.

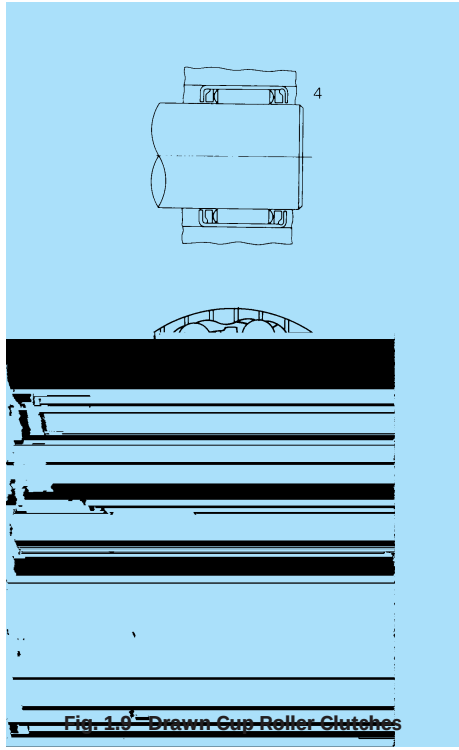


Fig. 1.9 Drawn Cup Roller Clutches

2. Bearing Life and Basic Load Rating

2.3 Life Equation

The following relation exists between the basic dynamic load rating, the bearing load and the rating fatigue life of roller bearings:

.....(**2.3**)

where, L : Rating fatigue life (10^6-revolution unit)
P : Bearing load (equivalent load) (N), {kgf}
C_r, C_a : Basic dynamic load rating of radial bearing and thrust bearing (N), {kgf}

improvements in bearing steel.

NSK now uses vacuum degassed bearing steel, and the results of tests by NSK show that life is greatly improved when compared with earlier materials. The basic load ratings C_r and C_a listed in the bearing tables were calculated

3. Bearing Loads

3.1 Equivalent Load

While in some cases the loads applied to bearings are purely radial or axial loads, in most cases the loads are a combination of both. In addition, loads usually fluctuate in both magnitude and direction. For this reason, the loads actually applied to bearings cannot be used for bearing life calculations. A hypothetical load that has a constant magnitude and passes through the center of the bearing (and will give the same bearing life that the bearing would attain under actual conditions of load and rotation) should therefore be estimated. Such a hypothetical load is called the equivalent load.

In the case of radial needle bearings, as the only load that can be applied is radial, the dynamic equivalent load can be obtained from the following equation:

$$P = F_r \quad \text{.....(3.1)}$$

where, P : Dynamic equivalent load (N), {kgf}
F_r : Radial load imposed on bearing (N), {kgf}

3.2 Calculation of Bearing Loads

The loads applied to bearings generally include the weight of the body to be supported by the bearings, the weight of the revolving elements themselves, the transmission power of gears and belting and the load produced by the operation of the machine in which the bearings are used. These loads can be theoretically calculated, but some of them are difficult to estimate. Therefore, it becomes necessary to correct the estimates using empirically derived data.

3.2.1 Load Factor

When a radial or axial load has been mathematically calculated, the actual load on the bearing may be greater than the calculated load because of vibration and shock present during operation of the machine. Actual loads may be calculated using the following equations:

$$\left.\begin{aligned} F_r &= f_w \cdot F_{rc} \\ F_a &= f_w \cdot F_{ac} \end{aligned}\right\} \quad \text{.....(3.2)}$$

where, F_r, F_a : Loads applied on bearing (N), {kgf}
F_{rc}, F_{ac} : Theoretically calculated load (N), {kgf}
f_w : Load factor

The values given in **Table 3.1** are usually used for the load factor, f_w

3.2.2 Bearing Loads in Belt or Chain Transmission Applications

The force acting on the pulley or sprocket wheel when power is transmitted by a belt or chain is calculated using the following equations:

$$M = 9\,550\,000\frac{H}{N}$$

calculate the actual load, K_b, in the case of a

(2) When the load fluctuates almost linearly (**Fig. 3.2**), an approximate value for the average load may be calculated as follows:

.....(**3.11**)

where, F_{min}: Minimum value of fluctuating load (N), {kgf}
F_{max}: Maximum value of fluctuating load (N), {kgf}

(3) When the load fluctuation is similar to a sine wave, an approximate value for the average load may be calculated from the following equation:

In the case of **Fig. 3.3**
$F_m \fallingdotseq 0.65F_{max}$ .....(**3.12**)

In the case of **Fig. 3.4**
$F_m \fallingdotseq 0.75F_{max}$ .....(**3.13**)

4. Bearing Selection

4.1 Bearing Types

It is important to select the needle roller bearing that is most suited to the particular application. One must fully understand the structure and characteristics of a selected bearing to determine whether it is appropriate for a given application.

When selecting needle bearings, the following factors should be considered:

(1) Amount, direction and condition of bearing load
(2) Rotating speed and which ring is rotating
(3) Required bearing life
(4) Ambient temperature of bearing
(5) Accuracy of bearings
(6) Degree of friction
(7) Noise
(8) Vertical shaft or horizontal shaft
(9) Lubricating method and sealing device
(10) Mounting and dismounting
(11) Space for mounting
(12) Finishing accuracy, rigidity, and materials of shaft and housing
(13) Cost requirements

Weighing these factors along with the characteristics of specific bearings, the best bearing for a particular application can be selected.

The characteristics of various NSK needle roller bearings are compared in **Table 4.1**.

4.1.1 Comparison of Bearings with Cages and Full Complement Bearings

Comparing bearings of the same size, full complement bearings, both at rest and when rotating, have a higher load rating and maximum permissible load than bearings with cages, and are therefore preferred for most applications.

As the rollers are accurately guided in bearings with a cage and no friction occurs between the rollers, the friction torque is lower than in the full complement roller bearings.

Under ideal lubrication conditions and normal load, approximate friction torque can be obtained with the following equation.

Table 4.1 Comparison of Characteristics of Needle Roller Bearings

Bearing Type / Characteristics	Cage & Needle Rollers	Drawn Cup		Solid	Thrust	Needle Roller	Cam Follower/ Roller Follower	
		With Cage	Full Complement	With Cage	Needle		With Cage	Full Complement
	FWJ, WJ, FBN, etc.	FJ, FJL, J, JH, etc.	F, B, BH, etc.	RNA, HJ, RLM, etc.	FNTA, NTA	___	FCJ, FYCJ	FCR, CR, FYCR, YCR
Radial Load Capacity	High	Medium	High	High	None	Very high	Medium	High
Axial Load Capacity	None	None	None	None	High	None	None	None
Maximum Permissible Load	High	Low	Low	High	High	Very high	Low	Low
Limiting Speed	Very high	Very high	Medium	Very high	High	Medium	High	Low
Permissible Shaft Deflection and Mounting Error	Medium	Medium	Low	Medium	Low	Low	Medium	Low
Grease Life	Very high	Very high	Medium	Very high	Low	Medium	High	Low
Friction Torque	Very low	Very low	Low	Very low	Low	Low	Very low	Low
Cross-Section Height	Very low	Very low	Very low	Medium	Very low	Very low	Medium	Medium
Cost performance	High	High	High	Moderate	High	Very high	Moderate	Moderate

Friction torque of a full complement roller bearing:

$$0.0025 \times \text{pitch circle radius of rollers} \times \text{bearing load}$$

Friction torque of cage assembly:

$$0.0015 \times \text{pitch circle radius of rollers} \times \text{bearing load}$$

While full complement roller bearings can be operated at considerably high speeds (see the limiting speeds shown in the Bearing Tables), bearings with cages are recommended for high-speed applications. Bearings with cages are also preferable for applications where shaft deflection or mounting error is relatively high because their rollers are accurately guided and crowned.

4.1.2 Comparison between Drawn Cup and Solid Bearings

Employing a thick, hardened bearing ring, solid bearings can sustain high shock loads and continuous loads. Drawn cup bearings are not to be used beyond the maximum permissible load shown in the Bearing Tables.

Although solid bearings of high rigidity can be used with double-cut, split housings, drawn cup bearings are affected by bore accuracy and housing rigidity due to their thin outer ring. Therefore, double-cut, split housings should be avoided.

When mounting solid bearings, positioning is required to be in line with the shoulder of the housing hole or a snap ring. However, with drawn cup bearings, as through-holes are sufficient for housings, bore processing is easier and more economical.

Operating Periods	Fatigue Life Factor, f_h				
	≤ 3	2 to 4	3 to 5	4 to 7	≥ 6
Infrequently used or only for short periods	· Small motors for home appliances like vacuum cleaners and washing machines · Hand power tools	· Agricultural equipment			
		· Motors for home heaters and air conditioners · Construction equipment	· Conveyors · Elevator cable sheaves		
	· Rolling mill roll necks	· Small motors · Deck cranes · General cargo cranes · Pinion stands · Passenger cars	· Factory motors · Machine tools · Transmissions · Vibrating screens · Crushers	· ~Large motors · · Pinion stands Hand tools	· Large motors ·
		· Escalators	· Centrifugal separators · Air conditioning equipment · Blowers · Woodworking machines · Large motors · Axle boxes on railway rolling stock		

4.2 Machinery in which Bearings are Used and Projected Life

It is not advisable to select bearings with unnecessarily high load ratings, for such bearings may be too large and uneconomical. In addition, the bearing life alone should not be the deciding factor in the selection of bearings. The strength, rigidity, and design of the shaft on which the bearings are to be mounted should also be considered. Bearings are used in a wide range of applicationo(e0.0001 Tc0 Tsmallest)Tj-1 s ar.830.0001 20 Tw<arsh9T*(gospe8rnal >-09.9the free apNSK for further details.picatillontiguein a)TjT-9.819e radialinternal clearance components are)Tj/520 Tsmallest **Table** ex Tsie

load, lubricating method, and cooling conditions, including those of the bearing's surroundings. When bearing load, P, exceeds 8% of the basic load rating, C, the limiting speed shown in the Bearing Tables must be corrected by multiplying it by the correction factor in **Fig. 4.1**.

In the Bearing Tables, the limiting speeds for oil lubrication are shown for each bearing. For grease lubrication, consider 60 to 70% of the oil lubrication values as a guide. Please consult NSK for further details.

4.4 Internal Clearance of Rolling Bearings

The internal clearance of rolling bearings during operation is one of the key features affecting bearing characteristics such as life span, heat generation, vibration and noise. Internal clearance is the space between the raceway ring and the rolling elements. The distance the free ring moves when a specific measured radial load is applied is defined as the radial measured clearance. In roller bearings, since elastic deformation caused by the measured load can be ignored, the measured clearance and geometric clearance (radial internal clearance) are considered to be the same.

Values for the radial internal clearance of metric solid needle bearings with interchangeable rings are shown in **Table 4.3**. These are classified from smallest clearance to largest into C2, CN, C3, C4 and C5. When the clearance range of bearings with interchangeable rings is too wide, matched bearings with the clearances listed in **Table 4.4** (page A23) are available.

The radial internal clearances of inch needle bearings with inner rings, HJ + IR, are shown in **Table 4.5** (page A25). HJ + IR needle bearings

are wide and clearance values are determined broadly based on previous experience to be on the safe side. As the values in **Table 4.3** and **4.4** are also used for cylindrical roller bearings, which are narrower, CN clearance is not commonly used for needle bearings, which are
e is not

4.4.4 Radial Internal Clearance of Drawn Cup Needle Roller Bearings

Because the correct form and dimensional accuracy of drawn cup needle bearings is achieved only after press fitting into a specific housing bore, the method for selecting the internal clearance of solid needle bearings cannot be applied to drawn cup bearings. Please refer to page B39 for the internal clearances of drawn cup needle bearings.

4.5 Bearing Accuracy

NSK needle roller bearings are manufactured in conformity with the accuracy classes set down by ISO. Class 0 is adequate for general use, while bearings with higher accuracy, such as Classes 6, 5, and 4, are recommended for use when extremely low runout is required, when the rotating speed is high, and/or when less friction and shaft fluctuation are required. As various factors, such as bearing type, internal clearance, lubrication, and mounting, should be considered when selecting higher-accuracy bearings, please consult NSK.

As defined by ISO, the boundary dimensions for radial bearings, tolerances for boundary dimensions and running accuracy, and limits for chamfer dimensions are shown in **Table 4.7**. Regarding high-accuracy bearings of Class 6 and higher, please consult NSK.

Nominal Bore Diameter d (mm)		Δ_{dmp}(2)				Δ_{ds}(2)	V_{dp}(2)									
		Normal	Class 6	Class 5	Class 4	Class 4	Normal			Class 6			Class 5		Class 4	
						Diameter Series	Diameter Series			Diameter Series			Diameter Series		Diameter Series	
						0,1,2,3,4	9	0,1	2,3,4	9	0,1	2,3,4	9	0,1,2,3,4	9	0,1,2,3,4
over	incl															
0.6	2.5						10	8	6	9	7	5	5			
2.5	10						10	8	6	9	7	5	5			
10	18						10	8	6	9	7	5	5			
18	30						13	10	8	10	8	6	6			
30	50						15	12	9	13	10	8	8			
50	80						19	19	11	15	15	9	9			
80	120						25	25	15	19	19	11	10			
120	150						31	31	19	23	23	14	13			
150	180						31	31	19	23	23	14	13			
180	250						38	38	23	28	28	17	15			
250	315						44	44	26	31	31	19	18			
315	400						50	50	30	38	38	23	23			
400	500						56	56	34	44	44	26	15			

Δ_{dmp}(2)				Δ_{Bs}(or Δ_{Cs})(3)		V_{Bs}(or V_{Cs})				K_{ia}				S_d	
Normal	Class 6	Class 5	Class 4	Single Bearing		Inner Ring (or Outer Ring) (3)		Inner Ring		Normal	Class 6	Class 5	Class 4	Class 5	Class 4
				Normal Class 6	Class 5 Class 4										

5. Shaft and Housing Design

The function of the bearing cannot be achieved fully without adequate design of the bearing abutment, even though appropriate bearings can be selected from a wide range of bearing types. In particular, the raceway ring of needle bearings is very thin compared with other roller bearings, so special consideration should be taken regarding shaft and housing design and fitting.

5.1 Fitting

5.1.1 Purpose of Fitting

The purpose of fitting is to fix an inner ring or outer ring into the shaft or housing and to prevent harmful circumferential slipping, which is called “creep.” Creep between fitting surfaces causes wear and results in abrasive metallic particles entering the bearing, which leads to abnormal temperature rise and vibration. Fitting is also necessary for obtaining the correct form and dimensional accuracy for drawn cup needle bearings.

5.1.2 Type and Volume of Load

It is necessary to know which ring, inner or outer, rotates against the load. In the case of an inner ring rotating load, creep occurs when the fitting between the inner ring and shaft is not tight enough. Because creep cannot be prevented simply by fixing the inner ring axially, the fitting for the inner ring and shaft needs to be tight. However, relatively loose fitting is often employed to make mounting and dismounting easier. In this case, the fitting surfaces must be well lubricated to prevent fretting and scoring.

In the case of an outer ring rotating load, the fitting between the outer ring and housing should be tight. For loads of indeterminate direction, such as unbalanced loads, vibration loads, and irregular dimensional loads, tight fitting of both the inner and outer rings is recommended.

In accordance with the size of the load, the inner ring is compressed in the radial direction and becomes relatively wider while interference decreases. The interference must not, however, be allowed to disappear due to the radial load.

The decrease in interference, Δd_F, is estimated using the following equation:

$$\Delta d_F = 0.08\,\frac{F_r}{B} \times 10^{-3} \quad \text{(mm)} \quad \text{.....(5.1)}$$

where, Δd_F: Decrease in interference of the inner ring (mm)
d: Nominal bore diameter (mm)
B: Nominal inner ring width (mm)
F_r: Radial load applied on bearing (N), {kgf}

5.1.3 Effective Interference and Finish of Shaft and Housing

Since the roughness of fitted surfaces is reduced during fitting, the effective interference becomes less than the apparent interference. The amount of this interference decrease varies depending on the roughness of the surfaces and may be estimated using the following equations:

For ground shafts

$$\Delta d = 0.7\,\Delta d_a \quad \text{.....(5.2)}$$

For machined shafts

$$\Delta d = 0.85\,\Delta d_a \quad \text{.....(5.3)}$$

where, Δd: Effective interference (mm)
Δd_a: Apparent interference (mm)
d : Bearing nominal bore diameter (mm)

According to Equations **5.2** and **5.3**, the effective interference of bearings with a bore diameter of 30 to 150 mm is about 95% of the apparent interference.

5.1.4 Interference Variation Caused by Temperature Difference between Bearing and Shaft or Housing

The effective interference decreases due to the increasing bearing temperature during

Inner ring and shaft Outer ring and housing

to be about (0.1 to 0.15) ΔT in case that the shaft is cooled. The decrease in the interference of the inner ring due to this temperature difference Δd_T may be calculated using Equation **5.4**:

$$\Delta d_T = (0.10 \text{ to } 0.15)\,\Delta T \cdot \alpha \cdot d \fallingdotseq 0.0015\,\Delta T \cdot d \times 10^{-3} \quad \text{(mm)} \quad \text{.....(5.4)}$$

where, Δd_T: Decrease in interference of inner ring due to temperature difference (mm)
ΔT: Temperature difference between bearing interior and surrounding parts (°C)
α: Coefficient of linear expansion of bearing steel $= 12.5 \times 10^{-6}$ (1/°C)
d: Nominal bearing bore diameter (mm)

In addition, depending on the temperature difference between the outer ring and housing, or difference in their coefficients of linear expansion, the interference may increase.

5.1.5 Deformation and Stress Caused by Fitting

When mounting a bearing with an interference fit, deformation and stress of the rings result. Calculations of surface pressure, stress, and expansion and contraction of inner and outer rings during fitting are the same as those of a thick cylinder to which is applied internal or external pressure. These calculations are compiled and shown in **Table 5.1**. The modulus of longitudinal elasticity and Poisson’s ratio of shaft and housing are calculated as the inner and outer rings are the

same. Circumferential stress at the inner ring bore surface should be equal to or less than 127 N/mm², {13 kgf/mm²}.

Table 5.1 does not apply to drawn cup needle bearings.

5.1.6 Recommended Fitting

As discussed above, selecting appropriate fitting requires knowledge of various conditions such as the actual volume and type of load applied to the bearing, temperature conditions, and other conditions affected by fitting. However, it is very difficult to obtain accurate data for all factors involved. Fitting, therefore, is often determined based on previous experience and records. Standard fittings for needle bearings are shown in **Tables 5.2** and **5.3**. Generally, when mounting a bearing in a thin-wall housing or on a hollow shaft, tighter fitting is required.

A split housing cannot be used with drawn cup needle bearings. If there are no alternatives, a bearing press-fitted into a cylindrical sleeve can be used. It is recommended not to use fitting tighter than that of JS7 (J7) for solid bearings in split housings.

The fitting examples shown in **Tables 5.2** and **5.3** (page A33) can be applied to solid shafts and steel or cast iron thick−wall housings. For mounting needle bearings on hollow shafts and in thin-wall or light metal housings, fitting should be tighter than the values shown in **Tables 5.2** and **5.3**. When higher bearing accuracy is especially required, it is necessary to enhance the accuracy of the shafts and housings.

As correct form and dimensional accuracy of the outer ring of drawn cup needle bearings are obtained only after press fitting into a specific housing bore, please refer to page B40 for fittings for drawn cup needle bearings. However, for the fittings for the inner ring and shaft being used for drawn cup needle bearings, refer to the values in **Table 5.2**.

Tolerances for shafts and housing bore diameters are listed in **Appendices 9** and **10** at the end of this volume.

Table 5.2 Fittings between Inner Rings and Shafts of Needle Roller Bearings

Load Conditions		Examples	Shaft Diameter (mm)	Tolerance of Shaft
Rotating Outer Ring Load	Medium-speed rotation with light or normal load	Wheels on stationary axles, rope sheaves, tension pulleys, idle gears	All shaft diameters	g6
	Medium-speed rotation with heavy load			h6
	Accuracy required			h5
Rotating Inner Ring Load or Indeterminate Directional Load	Light loads (less than or equal to 0.06 C_r(1))	Electric appliances, precision machinery, machine tools, pumps, blowers, transport vehicles	≤ 18	h5 or js5 (j5)
			≤ 50	js5 (j5)
			From more than 50 to 150	k6
			≥ 150	m6
	Normal loads (0.06 to 0.13 C_r(1))	General bearings, pumps, main bearings of medium and large engines, woodworking machinery, gears	≤ 50	js5 (j5) or k5
			From more than 50 to 100	m5
			From more than 100 to 150	m6
			From more than 150 to 200	n6
			> 200	p6
	Heavy load (more than 0.13 C_r(1)) or shock loads	Industrial vehicles, construction equipment, crushers	From more than 50 to 150	n6
			> 150	p6

Note (1) C_r represents the basic dynamic load rating of each bearing.

Remarks 1. This table is applicable only to solid steel shafts.
2. For metric bearings, bearings with clearance larger than CN are used when the fitting is greater than k.

Table 5.3 Fittings between Solid Needle Roller Bearings and Housing Bores

Load Conditions		Examples	Tolerance of Bores
Rotating Outer Ring Load	Light or variable loads	Conveyors, rope sheaves, tension pulleys	M7
	Normal or heavy loads	Wheel hubs, crankshafts, connecting rods	N7
	Heavy shock load	Flywheels	P7
Indeterminate Directional Load	Accurate running under light loads	Main spindles of machine tools	K6
	Light or normal loads	Crankshafts, pumps, compressors, large high-speed gears, blowers	JS7 (J7)
	Normal or Heavy Loads		K7
	Shock loads	Eccentric cams	M7
Rotating Inner Ring Load	Accurate running under light or normal loads	Main spindles of machine tools	JS6 (J6)
	Light or normal load	Gears, plummer blocks	H7
	Loads of all kings	General applications	H7 or G7
	Shock loads	Industrial vehicles, construction equipment, crushers	JS7 (J7)

Remarks 1. This table is not applicable to drawn cup needle bearings.
2. This table is applicable to steel and cast iron housings. For light metal housings, fitting should be tighter than in this table.
3. For metric bearings, bearings with clearance larger than CN are used when the fitting is greater than K.

5.2 Accuracy and Roughness

5.2.1 Accuracy and Roughness of Fitting Surfaces

Since the raceway rings of needle bearings are extremely thin, the raceway surface is greatly affected by the accuracy of the shaft and housing. For general operating conditions, a turned finish, smooth bored finish, or reaming finish is acceptable. For high accuracy and low noise under heavy load, however, a grinding finish is required.

A finish roughness of less than1.6μmRa is desirable. As a split housing may deform the outer ring of a thin-wall needle bearing, care should be exercised with the bearing's finish, such as putting a relief on the machining surface of the mating parts. Accuracy and roughness for machining surfaces are shown in **Table 5.4**.

5.2.2 Accuracy and Roughness of the Raceway Surface

The shaft and housing bore are often used as raceway surfaces of needle bearings in order to achieve the most compact bearing design and enhance shaft rigidity, load capacity and accuracy. In this case, accuracy and roughness of the raceway surface greatly affect the life, noise and accuracy of bearings. Therefore, shape, accuracy and roughness have to be treated with great care. In particular, harmful circumferential waviness and a polygonal shape are not desirable. Accuracy and roughness for raceway surfaces are shown in **Table 5.4**. These values may be changed depending on the desired performance.

5.2.3 Shaft Inclination

Shaft inclination caused by external force elastic deflection and mounting error should be less than the values indicated below. If shaft inclination exceeds the values in the table, please consult NSK.

Bearing Width (mm)	Permissible Inclination (mm/mm)	
	With Cage	Full Complement
≤ 25	0.0015	0.0010
(25) to 50	0.0010	0.0005
> 50	0.0005	0.0005

5.3 Materials and Heat Treatment of Raceway Surface

The raceway rings and rollers of needle bearings are repeatedly stressed on their relatively small contact surfaces. The materials for raceway rings, rollers and shafts and housings that function as raceways must therefore have high hardness, resistance to permanent deformation and long rolling fatigue life. These materials are also required to be resistant to wear and shock, and have good dimensional stabilization. Common materials used for shafts and housings that function as bearing raceways include:

High-carbon chromium bearing steel (for through hardening)
SUJ2 (JIS G 4805)

Carbon steel for machine construction (for carburizing)
S15CK (JIS G 4051)

Chrome molybdenum steel (for carburizing)
SCM415 to 421 (JIS G 4053)

Chrome steel (for carburizing)
SCr415, 420 (JIS G 4053)

Nickel chrome steel (for carburizing)
SNC415 to 815 (JIS G 4053)

Nickel chrome molybdenum steel (for carburizin)
SNCM220, 415, 420 (JIS G 4053)

Other materials, such as S50C and S55C, can be utilized with through hardening or induction hardening.

The hardened layer, which is tempered at 160 to 180°C after hardening, has to develop a martensite structure that has an even distribution of very fine carbides. In the case of cemented or induction hardening of the raceway surface, the surface hardness should not only be HRC58 to 64 (HRC60 to 64 is preferable), but also the hardened layers with Vickers hardness of HV653 (HRC58) and HV550 (HRC52.3) have to reach appropriate depths. When the values of hardness are below these values, bearing fatigue life significantly decreases (see page A14). The hardened layer depth (up to HV550) after grinding finish is estimated by using the following equation:

$$t \geqq (0.08 \text{ to } 0.10)\, D_w \quad \text{.....(5.5)}$$

where, t : Effective hardened layer depth (mm)
D_w: Roller diameter (mm)

Core hardness is generally HRC30 to 45.

5.4 Abutment and Fillet Dimensions

The outer ring of solid needle bearings should be positioned in the axial direction using the housing shoulder, collar and snap ring. When mounting, the unmarked side should touch the housing shoulder.

The radius r_a at the rounded fillet of the housing should be less than the minimum value of the bearing's chamfer dimension r. When mounting the inner ring on the shaft, the same consideration should be taken (refer to **Table 5.5**).

Table 5.5 Fillet Radius r_a of Shaft and Housing

Units: mm

Minimum Permissible Chamfer Dimension r	Fillet Radius r_a of Shaft and Housing (max)
0.15	0.15
0.2	0.2
0.3	0.3
0.5	0.5
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

The shoulder height *h* should be less than the width of the side face of the outer ring and less than the thickness of the inner ring. It should also have sufficient surface contact. The shaft and housing shoulder need to be finished with a right angle against the shaft center (**Fig. 5.1**).

The marked side of drawn cup needle bearings should be in contact with the mounting jig, and mounted onto the step-less through hole. Drawn cup needle bearings should not be positioned in the axial direction by either a snap ring or collar. The side face of the drawn cup outer ring has to be 0.25

6. Lubrication and Lubricating Methods

6.1 Friction and Lubrication

Low friction in a bearing means low power loss and temperature rise, which together enable machines to achieve higher speeds. Friction in a machine may vary depending on bearing type, structure, dimensions, as well as the finishing accuracy of the rolling and sliding contact surfaces. It is also influenced by operational conditions, such as bearing load, rotating speed and lubrication. With light load and high-speed rotation, lubrication largely affects the starting torque, while with heavy load and low rotating speed, the load's effect dominates. Torque converts itself into thermal energy causing temperature rise in bearings. The degree of temperature rise is determined by the difference between the amount of heat generated and that dissipated. When bearing temperature exceeds 120°C, the characteristics of the bearing's material are changed and the lubricating agent is deteriorated.

6.1.1 Purposes of Lubrication

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

(1) Reduction of Friction and Wear

In needle bearings, it is necessary to lubricate the area where sliding occurs between the raceway surface and rollers due to roller skew and elastic deformation during operation in order to reduce sliding friction and wear between the cage and rollers, the cage and guide surface of the rotating ring, and the roller end face and the ring's rib face.

(2) Extension of Fatigue Life

The rolling fatigue life of bearings depends greatly upon the viscosity and film thickness between the rolling contact surfaces. A heavy film thickness prolongs the fatigue life, but it is shortened if the viscosity of the oil is too low so the film thickness is insufficient.

(3) Dissipation of Frictional Heat and Cooling

Circulation lubrication may be used to carry away frictional heat or heat transferred from overheating and the oil from deteriorating.

(4) Others

Adequate lubrication also helps to prevent foreign material from entering the bearings and guards against corrosion or rusting.

6.2 Lubricants

6.2.1 Lubricating Grease

Grease is a semi-solid lubricant consisting of a base oil and a thickener. The main types and general properties of grease are shown in **Table 6.1**. It should be remembered that different brands of the same type of grease may have different properties.

(1) Base Oil

Mineral oils or synthetic oils such as silicone or diester oil are mainly used as the base oil for grease. The lubrication properties of grease depend mainly on the characteristics of its base oil. Therefore, the viscosity of the base oil is just as important when selecting grease as when selecting an oil. Usually, greases made with low-viscosity base oils are more suitable for high speeds and low temperatures, while greases made with high-viscosity base oils are more suited for high temperatures and heavy loads. However, as the thickener also influences the lubricating properties of grease, the selection criteria for grease are not the same as for lubricating oil.

(2) Thickener

Thickeners for lubricating grease include several types of metallic soaps, inorganic thickeners such as silica gel and bentonite, and heat-resistant organic thickeners such as polyurea and fluoric compounds. The type of thickener is closely related to the grease dropping point ([1]): generally, grease with a high dropping point also has high-temperature capability. This said, grease does not have a

Table 6.1 Grease Properties

Name (Popular name)	Lithium Grease			Sodium Grease (Fiber Grease)	Calcium Grease (Cup Grease)	Mixed Base Grease
Thickener	Li Soap			Na Soap	Ca Soap	Na+Ca Soap, Li+Ca Soap, etc.
Base Oil	Mineral Oil	Diester Oil, Polyatomic Ester Oil	Silicon Oil	Mineral Oil	Mineral Oil	Mineral Oil
Properties						
Dropping Point, °C	170 to 195	170 to 195	200 to 210	170 to 210	70 to 90	160 to 190
Working Temperatures, °C	−20 to + 110	−50 to + 130	−50 to + 160	−20 to + 130	−20 to + 60	−20 to + 80
Working Speed, % (1)	70	100	60	70	40	70
Mechanical Stability	Good	Good	Good	Good	Poor	Good
Pressure Resistance	Fair	Fair	Poor	Fair	Poor	Fair to Good
Water Resistance	Good	Good	Good	Poor	Good	Poor for Na Soap Grease
Rust Prevention	Good	Good	Poor	Poor to Good	Good	Fair to Good
Remarks	General purpose grease used for numerous applications	Good low temperature and torque characteristics. Often used for small motors and instrument bearings. Pay attention to rust caused by insulation varnish.	Mainly for high-temperature applications. Unsuitable for bearings for high and low speeds or heavy loads or those having numerous sliding-contact areas (roller bearings, etc.)	Long and short fiber types are available. Long fiver grease is unsuitable for high speeds. Attention to water and high temperature is required.	Extreme pressure grease containing high-viscosity mineral oil and extreme pressure additive (Pb soap, etc.) has high pressure resistance.	Often used for roller bearings and large ball bearings.

Note (1) The values listed are percentages of the limiting speeds given in the bearing tables.
Remarks The grease properties shown here can vary between brands.

	180 to 300		
	−20 to + 130		
	70		
	Good		
	Fair to Good		
	Good		
	Fair to Good		
	Suitable for extreme pressures mechanically stable		

high working temperature unless its base oil is heat-resistant. The highest possible working temperature for grease should be determined considering the heat resistance of the base oil. The water resistance of grease depends upon the type of thickener. Sodium soap grease or compound grease containing sodium soap emulsifies when exposed to water or high humidity and therefore cannot be used where moisture is prevalent.

(3) Additives

Grease often contains various additives such as antioxidants, corrosion inhibitors, and extreme pressure additives to give it special properties. It is recommended that extreme pressure additives be used in heavy load applications. For long use without replenishment, an antioxidant should be added.

(4) Consistency

Consistency refers to the "softness" of grease. **Table 6.2** shows the relation between consistency and working conditions.

(5) Mixing Different Types of Grease

In general, different brands of grease must not be mixed. Mixing grease with different types of thickeners may destroy its composition and physical properties. Even if the thickeners are of the same type, possible differences in additives may cause detrimental effects.

6.2.2 Lubricating Oil

Highly refined mineral or synthetic oil is used as lubricant for rolling bearings. The first point to consider when selecting lubricating oil is appropriate viscosity. This varies depending on the type of needle bearings. Under regular operating conditions, lubricating oil with a viscosity of 13 mm^2/s (cSt) or more at the operating temperature should be selected. For thrust bearings, oil with a higher viscosity should be chosen. Generally, higher rotational speeds require lower viscosity and larger loads and larger bearing sizes require higher viscosity.

In addition to proper viscosity, characteristics required of lubricating oil include cleanliness, resistance to corrosion, high lubrication performance, superior oxidation resistance, fluidity at low temperatures and pressure resistance. **Fig. 6.1** shows the temperature-viscosity chart for general oil. The viscosity change at a given operating temperature, as well as the appropriate viscosity can be determined from this curve. The method for selecting lubricating oil under various operating conditions is illustrated in **Table 6.3**.

6.3 Lubricating Methods

6.3.1 Comparison of Grease Lubrication and Oil Lubrication

The lubrication methods for rolling bearings are generally classified into grease lubrication and oil lubrication. Grease lubrication can last from six months to two years before being replenished. It is therefore ideal for reducing maintenance. However, oil lubrication is preferred if the design allows because of its many advantages over grease, including higher limiting speed, longer lubricant life and better cooling properties. **Table 6.4** compares grease and oil lubrication.

6.3.2 Grease Lubrication

With grease lubrication, the internal space in the housing is required to be only 1.5 times the bearing's volume. Generally, the bearing is fully packed with grease before mounting and the amount packed into the housing is 1/4 to 1/3 the volume of the free internal space. When the internal space of the housing is less than 1.5 times the bearing's volume, it is appropriate that the filling amount for the housing be 1/2 to 2/3 the volume of the free space including the bearing itself. Grease should be supplied not only to the space inside the housing, but to the inside of the bearing as well.

If too much grease is supplied, churning of the grease will result and the bearing's temperature will rise. This causes deterioration and softening of the grease resulting in leakage. Generally, once grease is packed, refilling isn't necessary for a long period of time. However, the housing should be designed for easy refilling and changing of grease. When frequent refilling of grease is required, such as at high rotating speeds, a grease nipple should be installed and use of a grease gun for refilling is advisable.

6.3.3 Replenishing Interval

Even if high-quality grease is used, there is deterioration of its properties with time so periodic replenishment is required. **Fig. 6.2** shows the replenishment time intervals for various bearing types running at different speeds. This figure applies only if the temperature of the bearing is less than 70˚CHdB8.862

influences are present, it is necessary to shorten the refilling interval.

6.3.4 Oil Lubrication

(1) Oil Bath Lubrication

Oil bath lubrication is a widely used method in the case of low or medium speeds. The oil level should be at the center of the lowest roller. It is desirable to provide a sight gauge so the proper oil level may be maintained.

(2) Splash Lubrication

With this lubricating method, oil is splashed onto the bearing by a gear or rotating disc installed near the bearing. The entry of oil into the bearing depends on the position of the bearing, bearing type, how the splash is produced, and other factors. Improper lubrication at the beginning of rotation occurs in some cases due to the insufficient supply of oil. The reduction gear with an oil reservoir and device for maintaining the oil level shown in **Fig. 6.3** provides an example of how to prevent such insufficient initial-stage lubrication.

Another effective method of splash lubrication involves an oil reservoir with a V-shaped oil groove and the positioning of the oil drain in a high location. Additionally, installing a device with a magnetic plug to protect against the penetration of wear particles generated by gears is effective.

(3) Circulating Lubrication

Circulating lubrication is commonly used for high-speed operation requiring bearing cooling and for bearings used at high temperatures. As shown in **Fig. 6.4**, oil is supplied by the pipe on the right side, it travels through the bearing and drains out through the pipe on the left. After being cooled in a reservoir, it returns to the bearing through a pump and filter. The oil discharge pipe should be larger than the supply pipe so an excessive amount of oil will not back up in the housing.

(4) Drip Feed Lubrication

This method uses an oiler from which a small amount of oil drips into the bearing. The amount of oil supplied varies depending on bearing type. For smaller bearings, the oil supply rate is generally one drop every three to eight seconds. This method can be used at relatively high speeds for normal or light loads.

(5) Other Oil Lubrication Methods

Other methods include jet lubrication and oil mist lubrication. For needle bearings, however, these are not commonly used because of the limitation on limiting speed and space in the vicinity of the bearing.

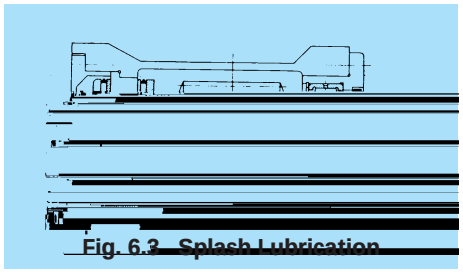


Fig. 6.3 Splash Lubrication

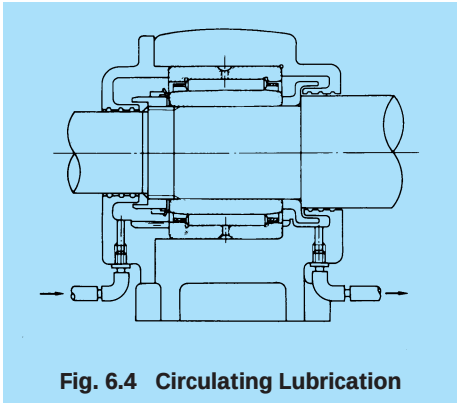


Fig. 6.4 Circulating Lubrication

7. Bearing Seals

To ensure the longest possible life of a bearing, it may be necessary to provide seals to prevent leakage of lubricant and entry of dust, water and other harmful material like metallic particles. The seals must be free from excessive running friction and the probability of seizure. They should also be easy to assemble and disassemble. It is necessary to select a suitable seal for each application considering the lubricating method.

Contact seals are effective because of the contact they maintain with the shaft. They are made of synthetic rubber, synthetic resin, felt or other materials, depending on operating conditions and type of lubricant. Oil seals with synthetic rubber lips are the most common.

7.1 Oil Seals

Synthetic rubber oil seals are usually used in environments where large amounts of dust, dirt, water and other foreign matter can easily enter bearings. Oil seals are standardized in JIS B2402. Suitable oil seals for NSK drawn cup needle roller bearings are listed in the bearing tables on page B242.

When mounting a synthetic rubber oil seal, lubricant should be applied to the seal lip because wear and heat generation easily occur if there is no oil film between the seal lip and shaft. When oil seals are used at high peripheral surface speed or under high internal pressure, the contact surface of the shaft must be smoothly finished and the shaft eccentricity should be 0.02 to 0.05 mm or less.

The contact surface of the shaft should be hardened to enhance its resistance to wear. Generally, hardness of the shaft surface should be higher than HRC40. However, under high-wear conditions, it should be higher than HRC55.

Permissible peripheral speeds and temperature ranges are shown in **Table 7.1**, and criteria for the relationship between shat peripheral surface speed and the roughness of contact surfaces are shown in **Table 7.2**.

Seal Materials			
Synthetic Rubber	Nitrile Rubber	≤ 16	−25 to +100
	Acrylic Rubber	≤ 25	−15 to +130
	Silicone Rubber	≤ 32	−
	Fluorine Rubber	≤ 32	
Tetrafluoroethylene Resin			

7.2 Oil Grooves

Oil grooves, flingers and labyrinths function as non-contact seals. Sealing is achieved by several grooves provided on either or both the shaft and housing. Applying grooves on both surfaces is more efficient for oil lubrication. The clearance between the shaft and housing should be as small as possible. Recommended clearance values are shown in **Table 7.3**.

The recommended groove width is approximately 3 to 5 mm, with a depth of about 4 to 5 mm.

When using only grooves for sealing, three or more of them should be used. This sealing method is frequently used to prevent leakage of

oil when the presence of dust and foreign particles is relatively low. Oil grooves are efficient for both oil and grease lubrication at low-speed operation. Filling the groove with grease of a consistency of approximately 200 is most effective.

7.3 Flingers (Slingers)

Flingers use centrifugal force to throw off oil and dust, and at the same time act as a pump to prevent the leakage of oil and entry of dust.

As shown in **Fig. 7.2**, a flinger used for preventing the entry of dust is effective when combined with other bearing seals. However, due to the fact that the centrifugal force of the flinger pulls the oil inside the housing, care should be exercised during design.

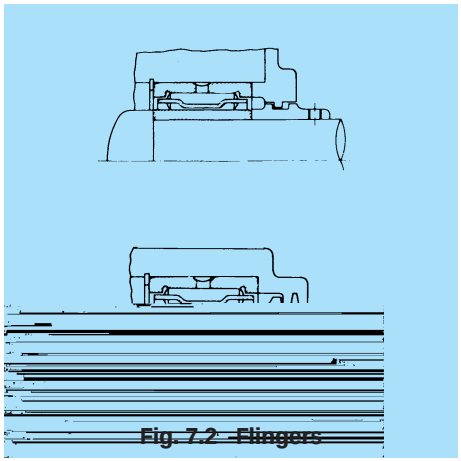


Fig. 7.2 Flingers

7.4 Labyrinth Seals

Among non-contact methods, the labyrinth seal is the most effective and appropriate for preventing oil leakage from a high-speed shaft. The clearance values shown in **Table 7.4** for labyrinth seals are recommended. The sealing effect can be enhanced by filling the clearance with grease. Various structures for labyrinth seals exist. An example is shown in **Fig. 7.3**.

Table 7.4 Clearance for Labyrinth Seals

Units: mm

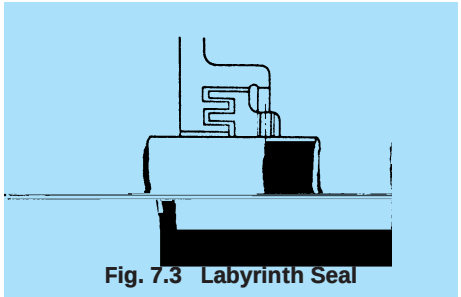


Fig. 7.3 Labyrinth Seal

8. Bearing Handling

8.1 Precautions for Proper Handling of Bearings

Rolling bearings are high-precision machine parts and must be handled accordingly. Even if high-quality bearings are used, their expected performance cannot be achieved if they are not handled properly. The main precautions to be observed are as follows:

(1) Keep Bearings and Surrounding Area Clean

Dust and dirt, even if invisible to the naked eye, have harmful effects on bearings. It is necessary to prevent the entry of dust and dirt by keeping the bearings and their environment as clean as possible.

(2) Handle Bearings Carefully

Heavy shocks during handling may cause bearings to be scratched or otherwise damaged, possibly resulting in their failure. Excessively strong impacts may cause brinelling, breaking, or cracking.

(3) Use Proper Tools

Always use the proper equipment when handling bearings and avoid general-purpose tools.

(4) Prevent Corrosion

As perspiration from hands and various other contaminants may cause corrosion, keep hands clean when handling bearings. Wear gloves if possible. Take care to prevent rusting of bearings caused by corrosive gasses.

8.2 Mounting

Mounting methods vary depending on bearing type and conditions. It is important to fully understand each bearing and handle it properly. In this section, general mounting methods are described. Please note that special precautions apply when mounting drawn cup needle bearings (see page B41).

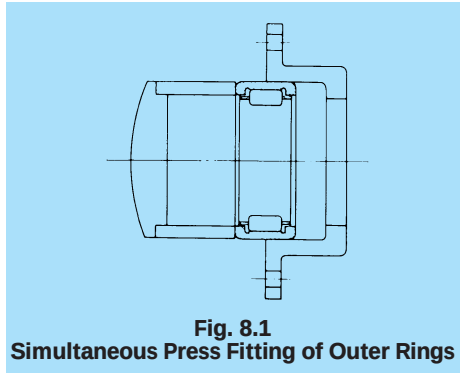


Fig. 8.1
Simultaneous Press Fitting of Outer Rings

(1) Press Fits

Fitting with a press is very common. The mounting dolly is placed onto a raceway ring (an inner or outer bearing ring) that is on the insertion side, then the ring is pushed up into position slowly by a press. An example for an outer ring is shown in **Fig. 8.1**.

(2) Shrink Fits

When mounting an inner ring onto a shaft, shrink fitting is widely used. The maximum heating temperature of the bearing must be no

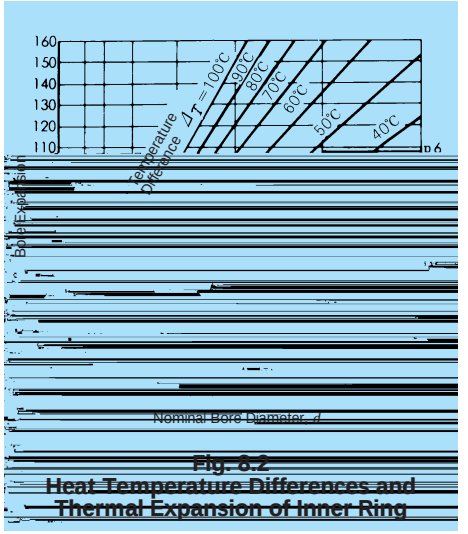


Fig. 8.2
Heat Temperature Differences and Thermal Expansion of Inner Ring

are considered only as guide values. When designing withdrawal tools, rigidity tolerances should be 5 to 6 times the values found in the figures.

8.4 Operating Inspection

After mounting has been completed, a running test should be conducted to determine if the bearing has been properly mounted. Any sharp increase in speed to normal levels should be avoided as this could cause damage in the bearing in the event of improper mounting or heat seizure of the bearing in the event of incorrect lubrication.

During the operating inspection, it is necessary to check for the following items to determine if there are any abnormalities:

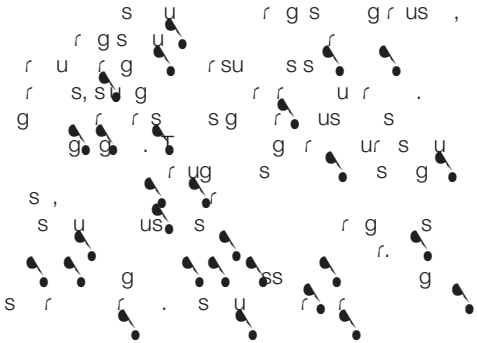
(1) Manual Inspection

- Sticking (dust and dirt, flaws)
- Uneven torque (improper mounting)
- Excessive torque (inadequate clearance, high seal friction)

(2) Pcp2 1 6ecwManual Inspection

- Sticking (duadequate clearancehe event of

8.6 Cleaning



BEARING TABLES

BEARING TABLE CONTENTS

Page

CAGE & NEEDLE ROLLER ASSEMBLIES ..... B 4 – B 35
- **Metric Design Cage and Roller Assemblies**
  - Inscribed Circle Diameter 4–150 mm ..... B 12 – B 29
- **Inch Design Cage and Roller Assemblies**
  - Inscribed Circle Diameter 9.525–127.000 mm ..... B 30 – B 33
- **Cage & Needle Roller Assemblies for Large Ends of Connecting Rods**
  - Inscribed Circle Diameter 12 – 30 mm ..... B 34
- **Cage & Needle Roller Assemblies for Small Ends of Connecting Rods**
  - Inscribed Circle Diameter 9 – 19 mm ..... B 35

DRAWN CUP NEEDLE ROLLER BEARINGS ..... B 36 – B 87
- **METRIC DESIGN** ..... B 46 – B 63
  - **Open Type with Cage, Closed End Type with Cage**
    - Inscribed Circle Diameter 10 – 55 mm ..... B 46 – B 53
  - **Sealed Type with Cage** Inscribed Circle Diameter 8 – 50 mm ..... B 54 – B 57
  - **Thin, Open Type with Cage** Inscribed Circle Diameter 18 – 82 mm ..... B 58 – B 59
  - **Full Complement Open Type and Full Complement Closed End Type**
    - Inscribed Circle Diameter 8 – 55 mm ..... B 60 – B 63
- **INCH DESIGN** ..... B 64 – B 79
  - **Open Type with Cage, Closed End Type with Cage**
    - Inscribed Circle Diameter 9.525 – 50.800 mm ..... B 64 – B 67
  - **Full Complement Open Type and Full Complement Closed End Type**
    - Inscribed Circle Diameter 11.112 – 50.800 mm ..... B 68 – B 75
  - **Full Complement, Grease-Retained Roller Type**
    - Inscribed Circle Diameter 3.969 – 47.625 mm ..... B 76 – B 79
- **EXTRA SMALL · MINIATURE** ..... B 80 – B 87
  - **Metric Design Open Type with Cage and Closed End Type with Cage**
    - Inscribed Circle Diameter 3 – 9 mm ..... B 80 – B 81
  - **Metric Design Full Complement Open Type and Full Complement Closed End Type**
    - Inscribed Circle Diameter 3.036 – 9 mm ..... B 82 – B 83
  - **Inch Design Open Type with Cage and Closed End Type with Cage**
    - Inscribed Circle Diameter 3.175 – 9.525 mm ..... B 84 – B 85
  - **Inch Design Full Complement Open Type and Full Complement Closed End Type**
    - Inscribed Circle Diameter 3.175 – 9.525 mm ..... B 86 – B 87

SOLID NEEDLE ROLLER BEARINGS ..... B 88 – B127
- **METRIC DESIGN** ..... B 96 – B121
  - **RLM · LM, RNA · NA** Inscribed Circle Diameter 8 – 115 mm ..... B 96 – B109
  - **RNA · NA** Inscribed Circle Diameter 120 – 490 mm ..... B110 – B113
  - **RNAF · NAF, RNAFW · NAFW** Inscribed Circle Diameter 10 – 100 mm ..... B114 – B117
  - **RNA···TT, NA···TT** Inscribed Circle Diameter 14 – 125 mm ..... B118 – B121
- **INCH DESIGN** ..... B122 – B127
  - **HJ, HJ+IR** Inscribed Circle Diameter 15.875 – 234.950 mm ..... B122 – B127

INNER RINGS FOR NEEDLE ROLLER BEARINGS ..... B128 – B161
- **DRAWN CUP TYPE** ..... B130 – B137
  - **Metric Design (FIR)** Bore Diameter 7 – 45 mm ..... B130 – B135
  - **Inch Design (IR)** Bore Diameter 9.525 – 38.100 mm ..... B136 – B137

Page

- **SOLID TYPE** ..... B138 – B161
  - **Metric Design (FIR)** Bore Diameter 5 – 220 mm ..... B138 – B151
  - **Metric Design (FIR)** Bore Diameter 8 – 50 mm ..... B152 – B155
  - **Inch Design (IR)** Bore Diameter 9.525 – 203.200 mm ..... B156 – B161

THRUST BEARINGS ..... B162 – B175
- **CAGE & NEEDLE ROLLER ASSEMBLIES FOR THRUST NEEDLE BEARINGS** ..... B168 – B171
  - **Metric Design** Bore Diameter 10 – 100 mm ..... B168 – B169
  - **Inch Design** Bore Diameter 6.350 – 104.775 mm ..... B170 – B171
- **THRUST NEEDLE BEARINGS WITH INTEGRATED RACEWAY WASHERS** ..... B172 – B175
  - **Metric Design (FB)** Bore Diameter 20 – 55 mm ..... B172 – B173
  - **Metric Design (FH, FG)** Bore Diameter 22.6 – 43 mm ..... B174 – B175

CAM FOLLOWERS ..... B176 – B189
- **Metric Design** Outside Diameter 10 – 90 mm ..... B182 – B185
- **Inch Design** Outside Diameter 12.700 – 152.400 mm ..... B186 – B189

ROLLER FOLLOWERS ..... B190 – B197
- **Metric Design** Bore Diameter 5 – 50 mm ..... B194 – B195
- **Inch Design** Bore Diameter 6.350 – 57.150 mm ..... B196 – B197

NEEDLE ROLLERS ..... B198 – B207
- **Metric Design** Roller Diameter 1 – 5 mm B200
- **Inch Design** Roller Diameter 0.792 – 6.350 mm B207

SPHERICAL PLAIN BEARINGS ..... B208 – B219
- **Metric Design** Bore Diameter 12 – 160 mm ..... B214 – B217
- **Inch Design** Bore Diameter 12.700 – 152.400 mm ..... B218 – B219

NEEDLE ROLLER BEARINGS FOR UNIVERSAL JOINTS ..... B220 – B227
- **Drawn Cup Type** Inscribed Circle Diameter 10 – 21.3 mm ..... B224 – B225
- **Solid Type** Inscribed Circle Diameter 12.170 – 32.600 mm ..... B226 – B227

DRAWN CUP ROLLER CLUTCHES ..... B228 – B237
- **FC, FLC, RC** Inscribed Circle Diameter 4 – 30 mm ..... B234 – B235
- **FCB, FCBN, RCB** Inscribed Circle Diameter 4 – 30 mm ..... B236 – B237

OIL SEALS FOR NEEDLE ROLLER BEARINGS ..... B238 – B242
- **Single-Lip Synthetic Rubber Seals** B242
- **Double-Lip Synthetic Rubber Seals** B242

CAGE & NEEDLE ROLLER ASSEMBLIES

Pages

Metric Design Cage & Needle Roller Assemblies

Inscribed Circle Diameter 4–150 mm B12–B29

Inch Design Cage & Needle Roller Assemblies

Inscribed Circle Diameter 9.525–127.000 mm B30–B33

Cage & Needle Roller Assemblies for Large Ends of Connecting Rods

Inscribed Circle Diameter 12–30 mm B34

Cage & Needle Roller Assemblies for Small Ends of Connecting Rods

Inscribed Circle Diameter 9–19 mm B35

NSK cage & Needle roller assemblies consist of a complement of needle rollers held in place by a cage. Their unitized design makes for easy handling and installation. With no inner or outer ring, the low cross-section provides maximum load-carrying capability within the smallest envelope. Properly lubricated, they can operate at high speeds thanks to the unique cage, which guides the rollers precisely. The controlled contour rollers in cage & Needle roller assemblies have an optimum profile which reduces end stresses, allows operation under moderate misalignment and prolongs bearing life.

DESIGN AND TYPES

The most common cage used in cage & Needle roller assemblies is the M-type. M-type cages are either pressed from steel plate or machined. These cages undergo surface hardening after processing to attain high wear resistance and rigidity. The cages facilitate optimum lubrication conditions because lubricant can be easily replenished. Other cages include those made by precision pressing, welded cages and polyamide molded cages. Welded cages, which are produced by welding pressed steel, as especially suited for mass production. Applying its considerable experience and knowledge, NSK supplies cage & Needle roller assemblies of the highest quality.

Codes for the various types of cage & Needle roller assemblies are shown in **Table 1**. There are many types of cage & Needle roller assemblies other than those in **Table 1**, including split cages. Cage & Needle roller assemblies for engine connecting rods are included on page B9 as one of a special series.

Table 1 Cage & Needle Roller Assembly Codes

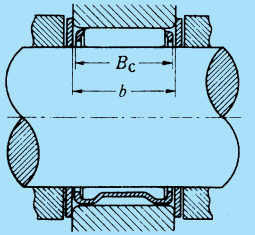
Cage Type		Code	
		Metric	Inch
Single Row	M Cage	WFJ, FWF	WJ
	FBN Cage	FBN	—
	Welded Cage	FWJC, FWJW	WJC
	Polymide Cage	FBNP	—
Double Row	M Cage	FWF ... W, FDJ	DJ
	FBN Cage	FBN ... W	—
	Welded Cage	FDJC	DJC
	Polymide Cage	FBNP ... W	—

An example of a bearing number is as follows:

(Example) FWD-202620

- Width (mm)
- Circumscribed Circle Diameter (mm)
- Inscribed Circle Diameter (mm)
- Code

						Deviation in length, (2) $\Delta 0$
2	0	−5	1	1	2	h13
3	0	−5	1.5	1.5	3	h13
5	0	−5	2	2.5	5	h13



Fitting Tolerances for Shafts and Housing Bores

Fitting tolerances for shafts and housing bores under various operating conditions are shown in **Table 5**.

Table 5 Fitting Tolerances for Shafts and Housing Bores

Operating Conditions		High Accuracy, Oscillating Motion	Normal	High Temperature, Large Shaft Deflection, Mounting Error
Fitting Tolerance for Housing Bore		G6	G6	G6
Fitting Tolerance for Shaft	$F_w \leqq 50$mm	j5	h5	f6
	$F_w > 50$mm	h5	g5	

Shaft Inclination

Permissible shaft inclinations from elastic deflection by external force and mounting error are shown in **Table 6**. When shaft inclination exceeds that in this table, please consult NSK because it is necessary to change the amount of the rollers' crowning and increase the internal clearance.

Table 6 Shaft Inclination

Cage Width (mm)	Permissible Inclination (mm/mm) max
$\leq$ 25	0.0015
(25) to 50	0.0010
$>$ 50	0.0005

Cage & Needle Roller Assemblies for Connecting Rods

Cage & Needle roller assemblies for connecting rods used in small general-purpose engines such as those in compact cars, motorcycles, outboard marine motors, snow-mobiles and chain-saws operate in harsh conditions characterized by shock loads, complex motion, high temperatures, and lubrication difficulties. Cage & Needle roller assemblies FWF ... E, FBN ... E are specially designed for such conditions. Cage & Needle roller assemblies for connecting rods contain a highly rigid and wear-resistant lightweight cage and high-accuracy rollers with special crowning.

TYPES

Cage & Needle Roller Assemblies for the Large Ends of Connecting Rods FWF ... E

FWF ... E Cage & Needle roller assemblies for large ends of connecting rods are lightweight and highly rigid. Their outside surface is accurately finished to maintain proper guide clearance during operation. Special steel that is hardened to the proper depth by carbonitriding is used as material for the cages. Depending on operating conditions, wear resistance is enhanced by surface treatment with non-ferrous metal.

For integrated one-piece crankshafts, split cage & Needle roller assemblies are also manufactured.

Cage & Needle Roller Assemblies for the Small Ends of Connecting Rods FBN ... E

Owing to their high static load rating, cage & Needle roller assemblies for small ends of connecting rods contain many long rollers with diameters of 1.5 to 2.5 mm, lowering the contact pressure within the load zone. Depending on the structure of the engine, a bore surface-guided or outside diameter-guided cage is used.

APPLICATIONS

Specifications for Connecting Rods, Crank Pins and Gudgeon Pins

The small and large end bores of the connecting rod, which function as the raceway surface of the cage & Needle roller assemblies, and the outside diameter of the crank pin and gudgeon pin must have the following specifications in order to obtain the beat performance, even under harsh operating conditions, from cage & Needle roller assemblies for connecting rods.

(1) Raceway Surface Roughness

The roughness of the raceway surface of the crank pin and gudgeon pin, which can lead to premature wear under severe operating conditions, should be approximately 0.1μmR_{max}. Roughness for the large end bore and small end bore of the connecting rod should be 0.25μmRa or less.

(2) Raceway Surface Hardness and Effective Hardened Layer Depth

The surface hardness of the raceway should be HRC60 to 64. The effective hardened layer depth (depth to HV550) varies depending on load conditions, but should range from 0.6 to 1.2 mm.

(3) Raceway Accuracy

Requirements for out-of-roundness and cylindricity of the raceway are listed in **Table 1**.

Table 1 Out-of-Roundness and Cylindricity of Raceway

Units: μm

Diameter Classification (mm)		Large/Small End Bore		Crank Pin/Gudgeon Pin	
over	incl	Out-of-roundness max	Cylindricity max	Out-of-roundness max	Cylindricity max
—	18	5	3	4	2
18	30	6	4	4	2
30	40	8	4	5	3

(4) Parallelism for Large and Small End Bores of Connecting Rods

Improper parallelism between the large end bore and small end bore of the connecting rod decreases engine performance. The two bores therefore have to be finished with a high degree of accuracy. It is recommended that parallelism is less than or equal to 0.04 mm for each 100 mm for normal and low speeds, and less than or equal to 0.02 mm for each 100 mm for high speeds.

(5) Abutment Tolerance for Mounting

Radial internal clearance in cage & Needle roller assemblies for connecting rod large and small ends should be determined by engine type, characteristics, and operating conditions. In general, h5 for the piston diameter, G6 for the samall end bore, g5 or f5 for the crank pin diameter, and G6 for the large end bore should be applied. When the radial internal clearance has to be strictly limited, it is recommended to use the values in **Table 2**. As to the large end, the upper limit of the internal clearance should be the target value under high-speed rotation.

Table 2 Recommended Radial Internal Clearance

Units: μm

Shaft Diameter Classification (mm)		Large End		Small End	
over	incl	min	max	min	max
6	10	—	—	5	15
10	18	12	24	6	18
18	30	14	28	7	20
30	—	18	34	—	—

FWF

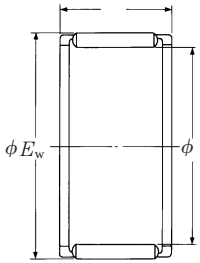
FBN • FBNP

Inscribed Circle Diameter 4 — 12 mm

Boundary Dimensions (mm)								
4	7	7	1 710	1 220	175	124	120 000	＊**FBNP-477** 0.5
5	8	8	2 330	1 860	237	189	95 000	＊**FBNP-588** 1.0
6	9	8	2 200	1 780	224	182	75 000	＊**FBNP-698** 1.2
	9	10	2 980	2 630	305	268	75 000	＊**FBNP-6910** 1.5
	10	13	4 300	3 600	435	365	80 000	＊**FBNP-61013** 2.8
7	10	8	2 840	2 560	290	261	67 000	＊**FBNP-7108** 1.3
	10	10	3 650	3 550	375	360	67 000	＊**FBNP-71010** 1.6
8	11	8	3 050	2 900	310	296	56 000	＊**FBNP-8118** 1.4
	11	10	3 500	3 450	360	355	56 000	＊**FBNP-81110** 1.8
	11	13	4 750	5 150	485	525	56 000	＊**FBNP-81113** 2.6
9	12	10	3 750	3 850	380	395	50 000	＊**FBNP-91210** 2.0
	12	13	5 100	5 750	520	585	50 000	＊**FBNP-91213** 2.6
10	13	8	3 450	3 600	355	365	45 000	**FBN-10138** 2.0
	13	10	3 950	4 300	405	435	45 000	**FBN-101310** 2.2
	13	11	4 450	5 000	455	505	45 000	**FBN-101311** 2.4
	13	13	5 400	6 350	550	650	45 000	**FBN-101313** 2.9
	14	8	3 750	3 300	385	340	45 000	**FBN-10148** 2.5
	14	10	5 350	5 300	545	540	45 000	**FWF-101410** 3.1
	14	13	6 500	6 750	660	690	45 000	**FWF-101413** 4.0
	16	12	7 700	6 650	785	680	48 000	**FWF-101612** 6.0
11	14	10	3 950	4 350	400	440	40 000	**FBN-111410** 2.6
12	15	9	4 350	5 100	445	520	36 000	**FBN-12159** 2.4
	15	10	4 350	5 100	445	520	36 000	**FBN-121510** 2.6
	15	12	5 400	6 750	555	690	36 000	**FBN-121512** 3.1
	15	13	5 950	7 600	605	775	36 000	**FBN-121513** 3.4
	16	10	5 700	5 950	580	610	38 000	**FWF-121610** 3.6
	16	13	7 350	8 350	750	850	38 000	**FWF-121613** 4.6
	17	13	8 250	8 350	840	855	38 000	**FWF-121713** 6.0
	18	12	9 150	8 650	935	885	38 000	**FWF-121812** 6.9

FWF • FWJ

Inscribed Circle Diameter 14 — 17 mm



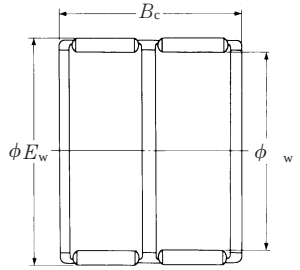
14	18	10	6 750	7 750	690	790	32 000	**FWF-141810**	4.1
	18	11	6 650	7 600	675	775	32 000	**FWF-141811**	4.5
	18	13	8 050	9 750	820	995	32 000	**FWF-141813**	5.3
	18	17	10 700	14 100	1 090	1 430	32 000	**FWF-141817**	6.9
	18	20	12 100	16 400	1 230	1 670	32 000	**FWF-141820**	10
	20	12	9 850	9 800	1 010	1 000	32 000	**FWF-142012**	7.8
	20	17	13 400	14 600	1 370	1 490	32 000	**FWF-142017**	11
15	19	10	7 050	8 400	720	855	28 000	**FWF-151910**	4.3
	19	13	8 400	10 500	860	1 070	28 000	**FWF-151913**	5.6
	19	17	11 200	15 200	1 140	1 550	28 000	**FWF-151917**	7.4
	20	13	9 950	11 300	1 010	1 150	30 000	**FWF-152013**	7.2
	21	15	12 600	13 600	1 280	1 380	30 000	**FWF-152115**	10
	21	17	13 400	14 800	1 370	1 510	30 000	**FWF-152117**	12
	21	21	16 300	18 900	1 660	1 930	30 000	**FWF-152121A**	14
16	20	10	7 350	9 000	750	920	26 000	**FWF-162010**	4.6
	20	13	8 800	11 300	895	1 150	26 000	**FWF-162013**	6.0
	20	17	11 700	16 300	1 190	1 660	26 000	**FWF-162017**	7.8
	21	13	10 500	12 300	1 070	1 250	28 000	**FWF-162113**	7.7
	21	17	13 000	16 200	1 330	1 660	28 000	**FWF-162117**	10
	21	26	20 000	28 200	2 040	2 880	28 000	**FWF-162126**	15
	21	27	20 800	29 600	2 120	3 000	28 000	**FWF-162127**	16
	22	12	10 500	10 900	1 070	1 120	28 000	**FWF-162212**	8.7
	22	13	10 900	11 500	1 120	1 180	28 000	**FWF-162213**	9.4
	22	17	14 700	16 900	1 500	1 720	28 000	**FWF-162217**	12
	22	20	17 000	20 300	1 730	2 070	28 000	**FWF-162220**	14
	22	22	18 700	22 900	1 900	2 340	28 000	**FWF-162222**	16
	22	24	20 300	25 600	2 070	2 610	28 000	**FWF-162224**	17
	24	20	20 800	22 200	2 120	2 270	30 000	**FWF-162420**	20
17	21	10	7 650	9 650	780	985	26 000	**FWF-172110**	4.8
	21	13	10 200	14 000	1 040	1 420	26 000	**FWJ-172113**	6.3
	21	15	10 800	15 000	1 100	1 530	26 000	**FWF-172115**	7.5
	21	16	11 500	16 300	1 170	1 670	26 000	**FWF-172116**	8.0
	21	17	11 500	16 300	1 170	1 670	26 000	**FWF-172117**	8.2
	22	20	15 400	20 400	1 570	2 080	26 000	**FWF-172220**	16
	23	17	15 100	17 800	1 540	1 810	26 000	**FWF-172317**	14

FWF • FWJ

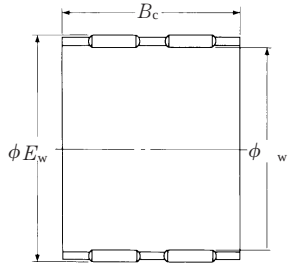
FWF···W

FBN···W

Inscribed Circle
Diameter 17.57 — 21 mm



FWF···W



FBN···W

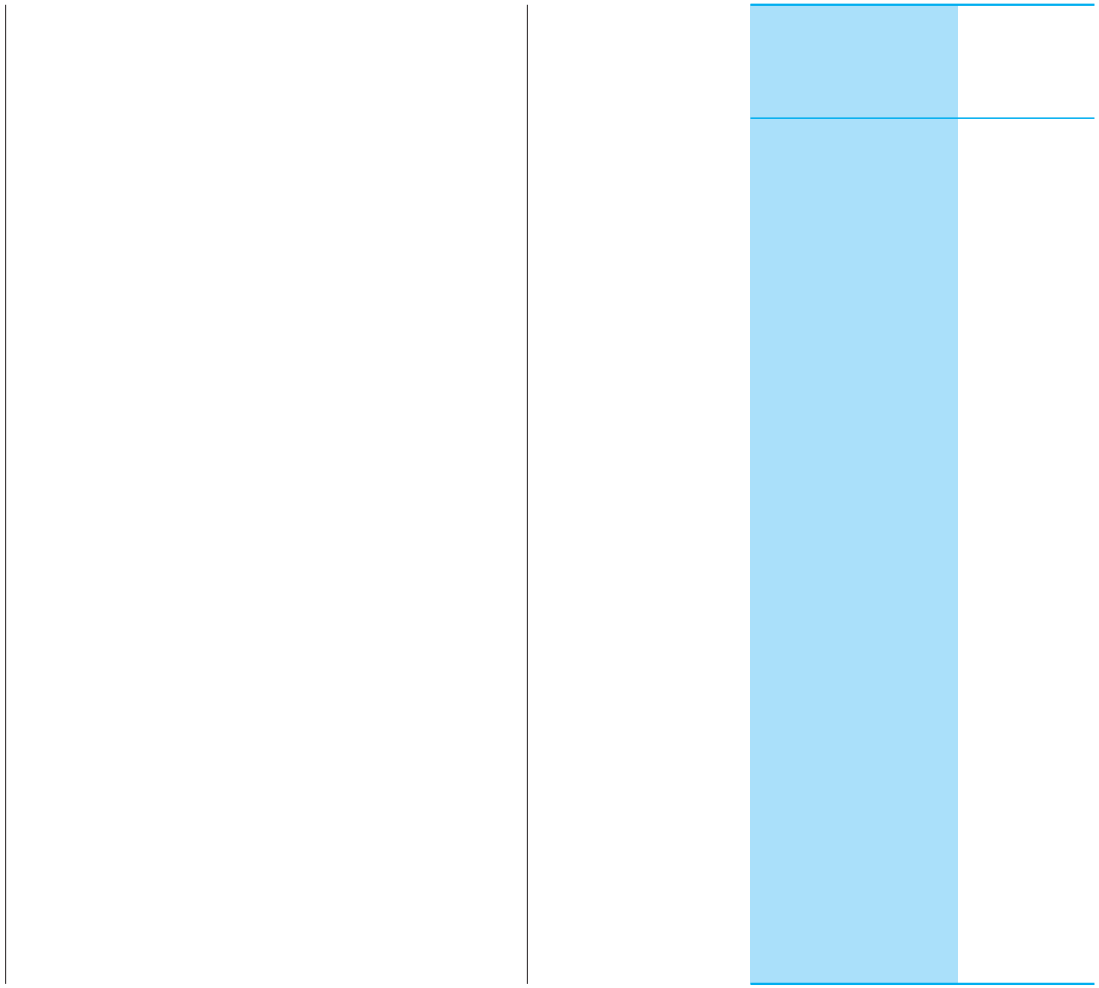
17.57	22.6	21	16 600	22 700	1 700	2 320
	23.6	32	29 300	42 000	2 990	4 300
18	22	10	7 900	10 300	805	1 050
	22	13	9 450	12 900	965	1 310
	22	17	12 600	18 600	1 280	1 900
	22	28	16 100	25 400	1 640	2 590
	23	20	16 600	22 900	1 690	2 340
	24	12	11 700	13 000	1 190	1 320
	24	13	12 800	14 600	1 300	1 490
	24	17	17 400	21 600	1 770	2 21(2 21(jT*(1 320 -1.057 TDjT*(1 900)Tj0 -1.86930)Tj0 -1.8623 TD(1SW4(1 690)TjT*(1 190)Tj0 -1.862 -1.86930)Tj0 -1.8623 TD(1SW4(1 690)T90)Tj -1.8622 TD(1 190)4(1 690)T90)Tj -1.8024(.(1 690)T90)Tj -1.80
	24	20	18 900	24 100	1 930	
	25	14	14 200	15 200	1 450	233W1 690 -1.8024(.0c94)Tj0 -1.
	25	17	16 500	18 300	1 680	
	25	22	21 300	25 500	2 170	
19	23	13	9 900	13 900	1 010	
	23	17	12 300	18 500	1 260	
	24	28	23 800	37 000	2 420	
	31	24	31 500	31 500	3 200	
19.1	31.1	24	31 000	30 500	3 150	
20	24	10	8 000	10 700	815	
	24	13	9 700	13 700	990	
	24	17	12 400	18 800	1 260	
	25	40	30 000	50 500	3 050	
	26	12	12 200	14 100	1 250	
	26	13	13 100	15 500	1 340	
	26	16	16 600	21 000	1 700	
	26	17	18 000	23 200	1 830	
	26	20	19 200	25 200	1 960	
	26	24	23 200	32 000	2 360	
	28	20	19 800	21 700	2 020	
21	25	13	10 500	15 500	1 070	
	25	17	13 100	20 600	1 340	

FWF • FWJ

FBN

FBN···W

Inscribed Circle
Diameter 22 — 26 mm



22	26
	26
	26
	26
	27
	28
	28
	28
	29
	30
23	28
24	28
25	
26	

FWF • FWJ

FWF···W

FBN···W

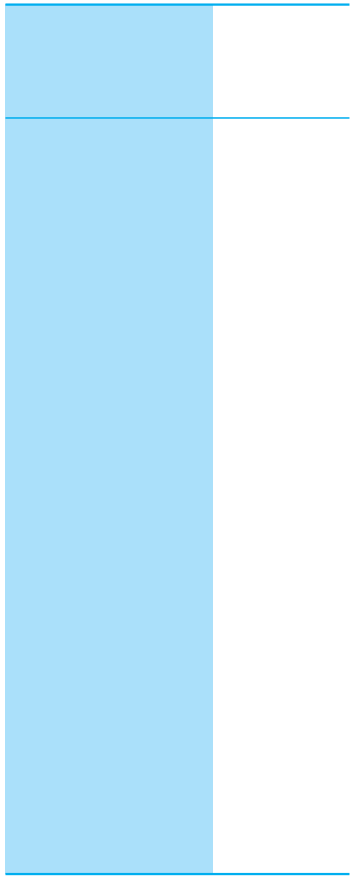
Inscribed Circle
Diameter 28 — 34 mm

FWF • FWJ

FBN

Inscribed Circle
Diameter 35 — 38.1 mm

35	40	13	14 900
	40	17	20 500
	40	20	26 400
	40	25	27 200
	40	26	27 200
	40	27	31 500
	40	30	34 000
	40	32.7	30 500
	42	16	22 700
	42	18	25 900
	42	20	30 000
	42	30	43 000
	44	18	29 600
36	41	26	30 000
	41	30.5	32 000
	48	22.5	45 500
	48	25	48 500
37	42	13	16 500
	42	14.5	15 400
	42	17	20 300
	42	27	31 500
	42	30	
	44	18	20 300
38	43	13	
	43	17	
	43	27	
	44	27	
	46	20	
	46	32	
38.1	50.8	24.7	

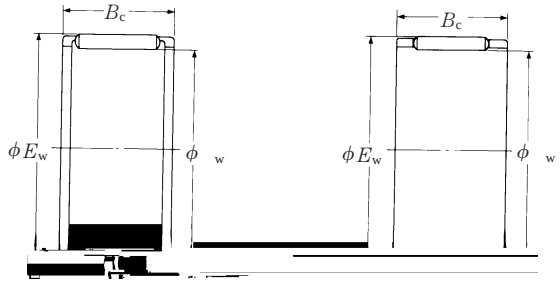


FWF • FWJ

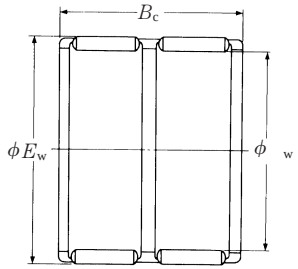
FWF···W

FBN

Inscribed Circle
Diameter 40 — 52 mm



FWF, FWJ　　FBN



FWF···W

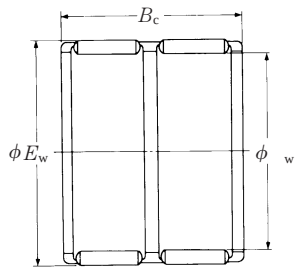
Boundary Dimensions (mm)			Basic Load Ratings (N)		Basic Load Ratings {kgf}		Limiting Speeds (min^{-1})	Bearing Numbers	Mass (g)
F_w	E_w	B_c $^{-0.2}_{-0.55}$	C_r	C_{or}	C_r	C_{or}	Oil		approx
40	45	13	15 700	27 500	1 610	2 800	10 000	**FWF-404513**	18
	45	17	21 000	40 000	2 150	4 050	10 000	**FWF-404517A**	23
	45	27	32 000	68 000	3 250	6 900	10 000	**FWF-404527**	36
	45	30	35 000	77 000	3 600	7 850	10 000	**FWJ-404530**	40
	46	30	35 000	67 000	3 550	6 800	10 000	**FWF-404630**	50
	48	20	32 500	49 500	3 300	5 050	10 000	**FWF-404820**	45
	48	25	40 500	66 500	4 150	6 800	10 000	**FWF-404825**	56
	48	34	53 500	95 000	5 450	9 700	10 000	**FWF-404834**	76
42	47	17	19 600	37 000	2 000	3 750	10 000	**FBN-424717**	24
	47	27	30 500	65 000	3 100	6 600	10 000	**FBN-424727**	38
	50	20	33 000	52 500	3 400	5 350	10 000	**FWF-425020**	47
43	48	17	22 800	45 500	2 330	4 650	9 500	**FWF-434817**	25
	48	27	33 500	75 000	3 450	7 650	9 500	**FWF-434827**	39
	49	31	44 000	92 000	4 450	9 400	9 500	**FWJ-434931**	55
45	50	17	21 600	43 000	2 200	4 350	9 000	**FWF-455017**	26
	50	27	34 000	77 500	3 500	7 900	9 000	**FWF-455027**	41
	51	35	46 000	99 500	4 700	10 100	9 000	**FWJ-455135**	61
	53	20	34 000	55 000	3 450	5 600	9 500	**FWF-455320**	50
	53	25	44 000	77 000	4 500	7 850	9 500	**FWF-455325**	62
46	52	37	43 500	94 000	4 450	9 600	9 000	**FWF-465237W**	75
47	52	17	23 400	48 500	2 390	4 900	8 500	**FWF-475217**	27
	52	27	34 500	79 500	3 500	8 150	8 500	**FWF-475227**	43
	52	30	36 500	86 000	3 750	8 750	8 500	**FWF-475230**	47
	55	28	51 500	96 000	5 250	9 800	9 000	**FWF-475528**	73
48	53	23.5	30 000	67 000	3 050	6 850	8 500	**FBN-485323Z**	47
	54	20	29 800	58 500	3 050	5 950	8 500	**FWF-485420**	39
50	55	20	26 900	59 000	2 750	6 050	8 000	**FWF-505520**	37
	55	27	35 000	83 000	3 600	8 450	8 000	**FWF-505527**	50
	55	30	39 500	96 500	4 000	9 800	8 000	**FWF-505530**	56
	56	20	28 100	54 500	2 870	5 600	8 000	**FBN-505620**	51
	58	20	38 500	67 500	3 950	6 900	8 500	**FWF-505820**	61
	58	25	48 500	90 500	4 950	9 200	8 500	**FWF-505825**	77
51	56	50.8	60 000	166 000	6 100	16 900	8 000	**FWF-515650WZ**	95
52	60	24	46 000	86 000	4 700	8 750	8 000	**FWF-526024**	46

FWF

FWF···W

FBN

Inscribed Circle
Diameter 55 — 73 mm



FWF···W

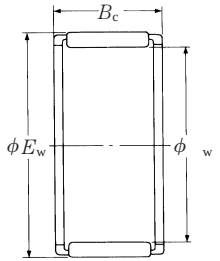
55	60	20	27 500	62 500	2 800
	60	27	36 000	89 000	3 700
	60	30	41 000	105 000	4 200
	61	20	31 000	64 000	3 150
	61	30	47 000	109 000	4 750
	63	20	40 000	73 000	4 100
	63	25	50 000	97 500	5 100
56	61	30	38 500	97 500	3 950
	61	33.5	41 000	105 000	4 150
57	73	30	89 500	129 000	9 150
58	64	40	54 000	132 000	5 500
	65	26.5	45 000	95 000	4 600
60	65	20	29 000	69 000	2 960
	65	27	38 000	98 500	3 900
	65	41	50 500	141 000	5 150
	66	20	33 000	71 500	3 350
	66	30	50 000	122 000	5 100
	67	23	41 500	86 500	4 250
	68	20	41 500	78 000	4 200
	68	23	47 500	94 000	4 850
	68	25	52 000	105 000	5 300
	68	27	51 500	103 000	5 250
65	70	20	27 900	67 500	2 850
	70	30	44 500	123 000	4 550
	73	30	61 000	132 000	6 200
68	74	20	33 000	74 000	3 350
	74	30	52 000	135 000	5 300
70	76	20	35 500	82 500	3 600
	76	30	53 500	141 000	5 450
	78	30	63 000	140 000	6 400
72	78	40	60 000	163 000	6 100
	79	21	42 000	93 000	4 300
73	79	20	36 000	85 500	3 650
	79	30	55 000	147 000	**5 600**

WJ

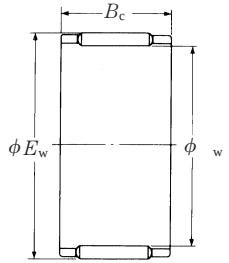
WJC

WJP

Inscribed Circle
Diameter 9.525 — 44.450 mm



WJ



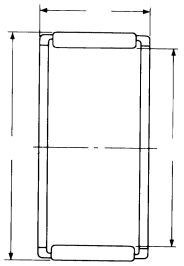
WJC, WJP

Boundary Dimensions (mm, inch) F_w		E_w		B_c $^{0}_{-0.38}$		Basic Load (N) C_r	C_{or}	Ratings {kgf} C_r	C_{or}	Limiting Speeds (min^{-1}) Oil	Bearing Numbers	Mass (g) approx
9.525	0.3750	12.700	0.5000	9.52	0.3750	3 900	4 000	400	410	45 000	**WJC-060806**	3
		12.700	0.5000	12.70	0.5000	5 450	6 150	555	625	45 000	**WJC-060808**	4
12.700	0.5000	15.875	0.6250	12.70	0.5000	6 350	8 100	645	825	34 000	**WJC-081008**	4
		15.875	0.6250	15.88	0.6250	8 000	10 900	815	1 110	34 000	**WJC-081010**	6
14.288	0.5625	17.462	0.6875	12.70	0.5000	6 900	9 350	705	955	30 000	**WJC-091108**	6
15.875	0.6250	19.050	0.7500	12.70	0.5000	7 100	10 000	725	1 020	26 000	**WJC-101208**	6
		22.225	0.8750	15.88	0.6250	15 400	17 300	1 570	1 770	28 000	**WJ-101410**	13
		22.225	0.8750	22.22	0.8750	21 100	25 900	2 150	2 640	28 000	**WJ-101414**	18
19.050	0.7500	25.400	1.0000	25.40	1.0000	26 600	36 500	2 710	3 750	22 000	**WJ-121616**	25
20.638	0.8125	26.988	1.0625	22.22	0.8750	24 600	33 500	2 510	3 450	20 000	**WJ-131714**	21
22.225	0.8750	28.575	1.1250	25.40	1.0000	29 000	42 500	2 960	4 350	20 000	**WJ-141816**	28
25.400	1.0000	33.338	1.3125	19.05	0.7500	27 800	36 000	2 830	3 700	17 000	**WJ-162112**	35
		33.338	1.3125	25.40	1.0000	36 500	51 500	3 700	5 250	17 000	**WJ-162116**	43
28.575	1.1250	38.100	1.5000	25.40	1.0000	42 000	56 500	4 300	5 750	15 000	**WJ-182416**	58
		38.100	1.5000	31.75	1.2500	51 500	73 500	5 250	7 500	15 000	**WJ-182420**	72
31.750	1.2500	41.275	1.6250	19.05	0.7500	33 000	42 500	3 350	4 350	14 000	**WJ-202612**	51
		41.275	1.6250	25.40	1.0000	44 000	61 000	4 450	6 250	14 000	**WJ-202616**	61
		41.275	1.6250	31.75	1.2500	53 500	79 500	5 500	8 100	14 000	**WJ-202620**	73
		41.275	1.6250	38.10	1.5000	63 000	98 000	6 450	10 000	14 000	**WJ-202624**	105
34.925	1.3750	44.450	1.7500	25.40	1.0000	45 500	66 000	4 650	6 700	12 000	**WJ-222816**	67
		44.450	1.7500	31.75	1.2500	55 500	85 500	5 700	8 750	12 000	**WJ-222820**	83
38.100	1.5000	47.625	1.8750	25.40	1.0000	47 000	70 500	4 800	7 200	11 000	**WJ-243016**	78
		47.625	1.8750	31.75	1.2500	57 500	91 500	5 850	9 350	11 000	**WJ-243020**	90
		47.625	1.8750	38.10	1.5000	68 000	113 000	6 900	11 500	11 000	**WJ-243024**	120
41.275	1.6250	57.150	2.2500	42.86	1.6875	96 500	130 000	9 850	13 300	11 000	＊**WJP-263627**	205
44.450	1.7500	53.975	2.1250	19.05	0.7500	39 000	58 000	4 000	5 950	9 500	**WJ-283412**	62
		53.975	2.1250	25.40	1.0000	51 500	83 500	5 250	8 500	9 500	**WJ-283416**	84
		53.975	2.1250	38.10	1.5000	74 500	134 000	7 600	13 700	9 500	**WJ-283424**	145

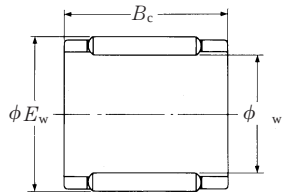
* These bearings have polyamide cages. The maximum permissible operating temperature for these bearings is 100˚C for continued operation and 120˚C for short periods.

WJ

Inscribed Circle Diameter 50.800 — 127.000 mm



50.800	2.0000	60.325	2.3750	19.05	0.7500	42 500	67 500	4 300	6 850	8 500	**WJ-323812**	85
		60.325	2.3750	25.40	1.0000	56 000	96 500	5 700	9 850	8 500	**WJ-323816**	105
		60.325	2.3750	31.75	1.2500	68 500	126 000	7 000	12 800	8 500	**WJ-323820**	125
		60.325	2.3750	38.10	1.5000	81 000	155 000	8 250	15 800	8 500	**WJ-323824**	145
52.388	2.0625	61.912	2.4375	25.40	1.0000	57 500	101 000	5 850	10 300	8 000	**WJ-333916**	99
53.975	2.1250	63.500	2.5000	25.40	1.0000	53 000	92 000	5 400	9 400	8 000	**WJ-344016**	100
		63.500	2.5000	38.10	1.5000	78 000	151 000	7 950	15 400	8 000	**WJ-344024**	150
55.562	2.1875	65.088	2.5625	19.05	0.7500	44 000	73 500	4 500	7 500	7 500	**WJ-354112**	85
		65.088	2.5625	25.40	1.0000	58 500	105 000	5 950	10 700	7 500	**WJ-354116**	105
57.150	2.2500	66.675	2.6250	25.40	1.0000	53 500	94 000	5 450	9 600	7 500	**WJ-364216**	105
60.325	2.3750	69.850	2.7500	38.10	1.5000	81 000	165 000	8 300	16 800	7 100	**WJ-384424**	185
63.500	2.5000	73.025	2.8750	25.40	1.0000	55 500	102 000	5 650	10 400	6 700	**WJ-404616**	135
		73.025	2.8750	38.10	1.5000	82 500	171 000	8 450	17 500	6 700	**WJ-404624**	180
69.850	2.7500	79.375	3.1250	25.40	1.0000	57 500	110 000	5 850	11 200	6 000	**WJ-445016**	125
76.200	3.0000	85.725	3.3750	25.40	1.0000	59 000	118 000	6 050	12 000	5 300	**WJ-485416**	160
		85.725	3.3750	38.10	1.5000	85 000	189 000	8 700	19 200	5 300	**WJ-485424**	215
82.550	3.2500	92.075	3.6250	25.40	1.0000	61 000	126 000	6 200	12 900	5 000	**WJ-525816**	145
		92.075	3.6250	38.10	1.5000	87 500	201 000	8 950	20 500	5 000	**WJ-525824**	220
88.900	3.5000	98.425	3.8750	25.40	1.0000	62 500	134 000	6 400	13 700	4 500	**WJ-566216**	175
		101.600	4.0000	25.40	1.0000	79 000	147 000	8 050	15 000	4 500	**WJ-566416**	215
		101.600	4.0000	38.10	1.5000	113 000	234 000	11 500	23 800	4 500	**WJ-566424**	360
101.600	4.0000	114.300	4.5000	25.40	1.0000	83 000	163 000	8 450	16 600	4 000	**WJ-647216**	240
		114.300	4.5000	38.10	1.5000	119 000	259 000	12 100	26 400	4 000	**WJ-647224**	370
127.000	5.0000	152.400	6.0000	38.10	1.5000	211 000	360 000	21 500	36 500	3 400	**WJ-809624**	1 000



FBN···E

12	16	10	6 100	6 500	620	665		4.0
14	19	10	7 800	8 050	795	820		6.2
	20	12	8 900	8 600	910	880		8.3
15	19	9	5 650	6 250	575	640		4.1
	20	10	7 300	7 600	745	775		6.0
	21	10	7 950	7 500	810	765		8.5
16	21	11	8 650	9 600	880	980		7.5
	22	12	9 500	9 600	965	980		9.5
18	23	14	11 800	14 800	1 200	1 510		10
	24	12	10 000	10 600	1 020	1 080		11
20	26	12	12 200	14 100	1 250	1 440		13
	26	17	16 800	21 200	1 710	2 160		17
	28	18	18 100	19 400	1 840	1 970		25
22	28	14	13 900	17 100	1 420	1 740		14
	29	15	16 300	19 000	1 660	1 930		19
	32	16	19 700	19 400	2 010	1 970		31
23	31	16	17 600	19 400	1 800	1 980		23
24	30	15	15 600	20 300	1 590	2 070		177(30 -1.05696 lS0.85 w1.26 105.52 m402.522 T69[614r22 45-1.0309)10 /52.522 T69002.862077 m138.89828 TDFWF-121616-E5696 lSFWF-141410-E5696 lSFV
	30	17	17 900	24 300	1 830	2 480		
	31	20	21 600	27 800	2 200	2 840		
25	32	16	17 700	21 900	1 810	2 230		
28	35	16	18 400	23 700	1 880	2 410		
29.75	36.75	16.5	19 600	26 000	1 990	2 650		
30	37	16	21 900	30 500	2 230	3 100		
	38	18	25 500	34 000	2 600	3 450		

9	12	11.5	4 200	4 500	430	460	**FBN-91211Z-E**	3.5
10	14	12.7	5 900	5 950	605	610	**FBN-101412Z-E**	5.0
12	15	14.3	6 400	8 400	655	855	**FBN-121514Z-E**	4.8
	16	13	7 250	8 200	740	835	**FBN-121613-E**	6.4
	16	15.5	8 500	10 000	865	1 020	**FBN-121615Z-E**	7.0
	16	16	8 500	10 000	865	1 020	**FBN-121616-E**	7.5
14	18	12	6 950	8 050	710	820	**FBN-141812-E**	6.5
	18	16.5	9 250	11 600	945	1 180	**FBN-141816Z-E**	8.5
	18	18	10 700	14 000	1 090	1 430	**FBN-141818-E**	11.5
	18	20	9 550	12 000	975	1 230	**FBN-141820-E1**	13
15	19	18	11 300	15 300	1 150	1 560	**FBN-151918-E**	11
	21	18	12 900	13 900	1 310	1 420	**FBN-152118-E**	13
16	20	22	13 700	20 000	1 400	2 040	**FBN-162022-E**	14
	20	23.5	14 900	22 300	1 520	2 280	**FBN-162023Z-E**	15
	21	20	14 200	18 100	1 450	1 840	**FBN-162120-E**	16
17	21	23	14 800	22 500	1 510	2 290	**FBN-172123-E**	16
18	22	17	14 500	16 500	1 470	1 680	**FBN-182217-E**	12
	22	22	14 200	21 600	1 440	2 200	**FBN-182222-E**	15
	22	23.6	15 400	24 100	1 570	2 460	**FBN-182223Z-E**	16
19	23	23.7	16 000	25 800	1 630	2 630	**FBN-192323Z-E**	17

DRAWN CUP NEEDLE ROLLER BEARINGS

METRIC DESIGN Pages

Open Type with Cage and Closed End Type with Cage
Inscribed Circle Diameter 10–55 mm B46–B53
Sealed Type with Cage — Inscribed Circle Diameter 8–50 mm B54–B57
Thin, Open Type with Cage — Inscribed Circle Diameter 18–82 mm B58–B59
Full Complement Open Type and Full Complement Closed End Type
Inscribed Circle Diameter 8–55 mm B60–B63

INCH DESIGN

Open Type with Cage and Closed End Type with Cage
Inscribed Circle Diameter 9.525–50.800 mm..... B64–B67Full Co

–B75Full Co

–B79

EXTRA SMALL · MINIATURE

Metric Design Open Type with Cage and Closed End Type with Cage
Inscribed Circle Diameter 3–9 mm B80–B81
Full Complement Metric Design Open Type and Full Complement Closed End TypeInscribed Circle Diameter 3.175

–9.525 mm B86–B87

NSK drawn cup needle roller bearings (with a cage and full complement of rollers) have a unique outer ring structure. They have the following features: the thinnest outer ring among rolling bearings, high load capacity, high maximum permissive load owing to the use of carefully selected special alloy steel plates, a surface-hardened cage with high resistance to wear, high limiting speed, and ease of mounting.

DESIGN AND TYPES

NSK drawn cup needle roller bearings consist of an outer ring made of carefully selected alloy steel that is surface-hardened after precise pressing, rollers made of vacuum-degassed bearing steel that are given a grinding finish after through-hardening, and a cage that guides the rollers correctly on the pitch diameter.

The bent lip of the drawn cup, which is the outer ring, improves rigidity, holds the rollers and cage in place, and functions as a labyrinth seal to prevent foreign matter from entering and lubrication from leaking. The inside of the outer ring's bending part is hardened, and has sufficient wear resistance against the contact of the roller or cage.

The bearing numbers of NSK drawn cup bearings are shown in combination with bearing codes and dimension numbers.

The bearing codes are shown in **Table 1**.

Table 1 Bearing Codes

Items		With Cage Assembly		Full Complement	
		Open	Closed End	Open	Closed End
Standard Series	Metric	FJ, FJP	MFJ	F, NF, DD	MF, MNF
	Inch	J, JP	MJ	B, Y	M
High Load Series	Metric	FJL, FJH	MFJL, MFJH	FH, NFH	MFH
	Inch	JH	MJH	BH, YH	MH

The dimension number has the following meaning:

Metric	The first one or two digits indicate the shaft's dimensions, and the following digits indicate the width, both expressed in mm units.
Inch	The first one or two digits indicate the shaft's dimensions, and the following digits indicate the width, both expressed in units of 1/16 of an inch. With closed ends, the number "1" is added following the dimension number.

(Example) FJ-1612-OH

Special Specification Code

Special Specifications

The bearing is manufactured in accordance with special specifications depending on operating conditions. In this case, the code is indicated with the bearing number followed by a hyphen and a letter or alphanumeric combination.

(Example) OH .... outer ring with oil hole

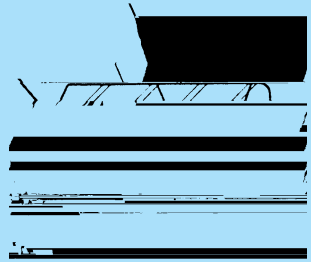
ACCURACY

Although standard drawn cup needle bearings perform well for general use, higher-accuracy drawn cup needle bearings are sometimes required such as when dispersion of radial internal clearance needs to be sharply decreased, when eccentric effects should be minimized, or when using only a few bearings to share the load evenly. However, standard bearings are still sufficient for almost all other occasions. Considering the higher cost of high-accuracy bearings, please consult NSK when selecting such bearings.

INTERNAL CLEARANCE

The radial internal clearance when a drawn cup needle bearing is mounted in a housing varies depending on the bearing, shaft and housing bore tolerances. Therefore, the tolerances for the shaft and housing bore should be narrower when reducing the range of radial internal clearance.

When the dimensional tolerance for each part is as shown in **Fig. 1** (Example of **F-3020-1**), the radial internal clearance ranges from 0.015 to 0.074 mm.



APPLICATION

Shaft and housing specifications

For drawn cup needle bearings, the shaft is generally used as a substitute for the inner ring. Since the outer ring of drawn cup needle bearings is made of a thin steel plate, the correct shape and dimensional accuracy are achieved after press fitting the regular housing. The dimensional accuracy and hardness of the shaft and housing bore directly affect bearing performance. Therefore, the following specifications should be satisfied.

(1) Accuracy, Roughness and Hardness

Accuracy, roughness and hardness of the shaft and housing bore should satisfy the specifications shown in **Table 2**.

(2) Shaft Inclination

Shaft inclination due to deflection by external force and mounting error of the bearing should be within the values found in **Table 3**.

Table 3 Permissible Shaft Inclination

(3) Housing Rigidity

To maintain the accuracy of drawn cup needle bearings, it is necessary to design the housing thick enough to minimize deformation when load is applied.

Split housings can only be used with drawn cup needle bearings after press fitting the bearing into a cylindrical sleeve.

FITTING

Drawn cup needle bearings perform as designed only after proper fitting. It is necessary to use the fitting tolerances shown in **Table 4** for the shaft and housing bore.

The figures in **Table 4** are for fits when housing materials are rigid steel or cast iron.

The fit should be adjusted as follows in accordance with operating conditions:

(1) Oscillating motion

In order to reduce radial internal clearance, the shaft's fitting tolerance should be js6 (j6).

(2) Outer ring rotation

For metric bearings, the fitting tolerances of the shaft and housing bore should be f6 and R7, respectively.

For inch bearings, 0.013 mm should be reduced from both fitting tolerances of shaft and housing bore.

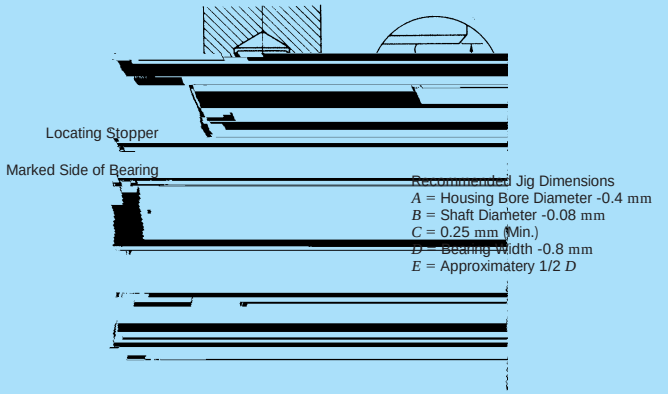
(3) The housing is made from light alloy or steel with a thickness of less than 6 mm.

The fitting tolerances of housing bore should be minimized to approximately 0.013 to 0.025 mm, provided that the optimized value should be determined by mounting into the actual housing because the value may vary depending on housing material and shape. Please contact NSK for details.

MOUNTING

When an drawn cup needle roller bearing is pressed into a housing bore, it is necessary to use an appropriate jig to prevent deformation of and damage to the outer ring, as shown in **Fig. 2**. The following precautions apply when mounting:

(1) The marked-side face should be placed onto the shoulder of the jig.
(2) A hand press should be used for press fitting. Avoid using a hammer or other such instruments.
(3) No snap ring or shoulder to determine the position of the bearing is necessary. However, when using a housing with a shoulder, the bearing side face should not touch the shoulder, in order to prevent bearing deformation.
(4) The guide and locaing stopper (**Fig. 2**) are installed in order to apply press fitting accurately. The ball detent shown in **Fig. 2** helps the jig hold the bearing and prevent roller inclination while facilitating mounting work.



Inspection of Drawn Cup Needle Bearings

Deformation to a certain degree due to heat treatment is inevitable even though the outer ring of drawn cup needle bearings is processed by precise deep drawing. However, once the bearing is pressed into the regular housing, this deformation is corrected and the bearing performs to the full potential. Therefore, it is not appropriate to measure the drawn cup outside diameter before mounting. Correct inspection is carried out according to following procedures:

(1) The bearing that is to be subject to the test is pressed into a ring gauge of given dimensions.
(2) The inscribed circle diameter at the GO and NO-GO plug gauges is inspected. Metric inspection gauge dimensions are shown in **Table 5**.

Table 6 shows tolerance for the roller inscribed circle diameter based on ISO standards.

For bearings based on ISO standards, "-1" is added at the end of the bearing number. **Table 7** shows inch inspection gauge dimensions.

Table 5 Inspection Gauge Dimensions (General Metric)

Units: mm

Nominal Roller Inscribed Circle Diameter, F_w	Bore Diameter of Ring Gauge		Plug Gauge	
	F, MF, FH, MFH, NF, MNF, NFH, FJ, MFJ	FJL, MFJL	GO Gauge	NO-GO Gauge
4	7.996	—	4.023	4.048
5	8.996	—	5.023	5.048
6	9.996	—	6.028	6.053
7	10.995	—	7.031	7.056
8	11.995	15.010	8.031	8.056
9	12.995	16.010	9.031	9.056
10	13.995	17.010	10.031	10.056
12	15.995	19.012	12.031	12.056
FH12	17.995	—	12.031	12.056
13	18.993	—	13.034	13.059
14	19.993	22.012	14.034	14.059
NF14	18.993	—	14.034	14.059
15	20.993	22.012	15.034	15.059
16	21.993	24.012	16.034	16.059
17	22.972	23.991	17.013	17.038
18	23.972	24.991	18.013	18.038
20	25.972	26.991	20.013	20.038
22	27.972	28.991	22.013	22.038
NFH22	30.987	—	24.015	24.035
24	—	30.989	24.013	24.038
NFH24	31.967	—	24.013	24.038
25	31.967	32.989	25.013	25.038
28	34.967	36.989	28.013	28.038
30	36.967	39.989	30.013	30.038
32	—	41.989	32.013	32.038
35	41.967	44.989	35.013	35.043
40	46.967	49.989	40.013	40.043
45	51.961	54.988	45.013	45.043
50	57.961	61.988	50.013	50.043
55	62.961	66.988	55.013	55.043

Remarks This is the gauge dimension for inspection of minimum diameter, F_w, of roller inscribed circle diameter.

Table 6 Ring Gauge of Drawn Cup Needle Roller Bearings and Tolerance of Roller Inscribed Circle Diameter (ISO Standerds)

[FJ, FJH, MFJ and MFJH
F, FH, MF and MFH]

Units: mm

Nominal Roller Inscribed Circle Diameter, F_w	Bore Diameter of Ring Gauge	Tolerance for Roller Inscribed Circle Diameter, F_w(1)	
		min	max
3	6.484	3.007	3.021
4	7.984	4.010	4.028
5	8.984	5.010	5.028
6	9.984	6.010	6.028
7	10.980	7.013	7.031
8	11.980	8.013	8.031
H 8	13.980	8.013	8.031
9	12.980	9.013	9.031
H 9	14.980	9.013	9.031
10	13.980	10.013	10.031
H10	15.980	10.013	10.031
12	15.980	12.016	12.034
H12	17.980	12.016	12.034
13	18.976	13.016	13.034
14	19.976	14.016	14.034
15	20.976	15.016	15.034
16	21.976	16.016	16.034
17	22.976	17.016	17.034
18	23.976	18.016	18.034
20	25.976	20.020	20.041
22	27.976	22.020	22.041
25	31.972	25.020	25.041
28	34.972	28.020	28.041
30	36.972	30.020	30.041
35	41.972	35.025	35.050
40	46.972	40.025	40.050
45	51.967	45.025	45.050
50	57.967	50.025	50.050
55	62.967	55.030	55.060

Note (1) When using a cylinder instead of an inner ring, $F_{w\ mn}$ is the diameter of the cylinder at which the internal clearance is zero in at least one radial direction. ($F_{w\ mn}$ is the minimum diameter of each inscribed circle diameter where deviation is suspected.)

Remarks To measure the roller inscribed circle diameter, use the followung plug gauges:
GO gauge: The same dimensions as the minimum tolerance of the roller inscribed circle diameter, F_w
NO-GO gauge: The dimensions should be the maximum tolerance of roller inscribed circle diameter, F_w, plus 0.002 mm

3.175(1/8)	6.363	
3.969(5/32)	7.155	
4.762(3/16)	8.730	
6.350(1/4)	11.125	
7.938(5/16)	12.713	
9.525(3/8)	14.300	
11.112(7/16)	15.888	
12.700(1/2)	17.475	
14.288(9/16)	19.063	
15.875(5/8)	20.650	
17.462(11/16)	22.238	
19.050(3/4)	25.387	
20.638(13/16)	26.975	
22.225(7/8)	28.562	
23.812(15/16)	30.150	
25.400(1)	31.737	
26.988(1 1/16)	33.325	
28.575(1 1/8)	34.912	
30.162(1 3/16)	38.087	
31.750(1 1/4)	38.087	
33.338(1 5/16)	41.262	
34.925(1 3/8)	41.262	
38.100(1 1/2)	47.612	
41.275(1 5/8)	50.787	
44.450(1 3/4)	53.962	
47.625(1 7/8)	57.137	
50.800(2)	60.312	

7.938(5/16)	14.300	
9.525(3/8)	15.888	
11.112(7/16)	17.475	
12.700(1/2)	19.063	
14.288(9/2	20.650	
	22.238	
	23.825	
	26.975	
	28.562	
	30.150	
	33.325	
	38.087	
	41.262	
	44.437	

Drawn Cup Needle Bearings with Seals

Drawn cup needle roller-bearing with seals can be sealed on one or both sides. The bearings are packed with lithium soap-based grease and can be operated under regular conditions in normal operating ranges for long periods without replenishment. The seale made of nitrile synthetic rubber reinforced with a steel plate and serves as a guide for the side face of the cage. The operating temperature range is limited because of the rubber seal, ranging from -10˚C to +100˚C for continuous use from -25˚C to +120˚C for short periods of use.

The various types of drawn cup needle bearings with seals are shown in **Table 8**.

With Cage

FJ (Open Type)

FJL

MFJ (Closed Type)

MFJL

Inscribed Circle Diameter 17 — 25 mm

23	12	8 450	860	4 450	19 000
23	16	12 100	1 230	7 100	19 000
24	15	10 800	1 110	5 700	20 000
24	20	15 400	1 570	8 950	20 000
24	25	19 600	2 000	12 200	20 000
24	12	7 650	780	4 200	
24	16	11 200	1 140	6 800	
25	13	9 300	945	4 700	
25	15	11 400	1 160	6 100	
25	17	13 300	1 360	7 500	
25	20	16 100	1 640	9 600	
25	25	20 500	2 090	13 100	
26	12	8 150	835	4 650	
26	16	11 900	1 210	7 550	
26	20	15 300	1 560	10 500	
27	15	12 300	1 260	6 900	
27	20	17 500	1 790	10 900	
27	25	22 300	2 270	14 800	
27	30	26 800	2 730	18 700	
28	12	8 650	880	5 150	
28	16	12 600	1 290	8 350	
28	20	16 200	1 660	11 500	
29	10	7 950	810	4 000	
29	15	12 700	1 300	7 300	
29	20	18 100	1 840	11 500	
29	25	23 000	2 350	15 700	
29	30	27 700	2 820	19 800	
32	16	15 200	1 550	9 350	
32	20	19 800	2 020	13 100	
32	26	26 200	2 670	18 800	
33	10	8 800	895	4 300	
33	15	15 400	1 570	8 800	
33	20	21 900	2 240	13 900	
33	25	28 000	2 850	19 000	
33	30	33 500	3 450	24 100	

With Cage

FJ (Open Type)

FJL

MFJ (Closed Type)

MFJL

Inscribed Circle Diameter 28 — 40 mm

35	16	15 600	1 590	9 950	1 020	11 000
35	20	20 500	2 090	14 200	1 450	11 000
35	26	26 900	2 750	20 200	2 060	11 000
37	20	25 400	2 590	15 500	1 580	11 000
37	30	39 000	4 000	27 100	2 760	11 000
37	16	15 600	1 590	10 100	1 030	10 000
37	20	19 400	1 970	13 300	1 360	10 000
37	26	26 000	2 660	19 500	1 990	10 000
40	15	17 200	1 750	9 100	925	11 000
40	20	25 800	2 630	15 300	1 560	11 000
40	25	33 500	3 450	21 600	2 200	11 000
40	30	41 000	4 200	27 800	2 840	11 000
42	20	26 700	2 720	16 200	1 650	10 000
42	30	42 500	4 300	29 400	3 000	10 000
42	12	12 000	1 230	7 550	770	9 000
42	16	18 100	1 850	12 800	1 300	9 000
42	20	23 600	2 410	17 900	1 830	9 000
42	26	31 500	3 200	25 800	2 630	9 000
45	12	13 200	1 350	6 650	680	9 000
45	15	18 200	1 860	10 100	1 030	9 000
45	20	27 400	2 790	17 000	1 740	9 000
45	25	36 000	3 650	24 000	2 450	9 000
45	30	43 500	4 450	31 000	3 150	9 000
47	16	18 600	1 890	13 600	1 390	7 500
47	20	23 500	2 400	18 500	1 890	7 500
47	26	31 500	3 200	26 900	2 740	7 500
50	15	19 900	2 030	11 600	1 180	8 000
50	20	29 900	3 050	19 600	2 000	8 000
50	25	39 000	3 950	27 600	2 810	8 000
50	30	47 500	4 850	35 500	3 650	8 000

FJ-2816		**MFJ-2816**		27	31	**FIR-222816** —
FJ-2820		**MFJ-2820**		34	38	**FIR-222820** —
FJ-2826		**MFJ-2826**		45	49	**FIR-222826** —
	FJL-2820L		**MFJL-2820L**	44	48	**FIR-222820** —
	FJL-2830L		**MFJL-2830L**	65	72	**FIR-222830** —
FJ-3016L		**MFJ-3016L**		26	31	— —
FJ-3020		**MFJ-3020**		35	39	**FIR-253020** —
FJ-3026		**MFJ-3026**		46	50	**FIR-253026** —
	FJL-3015L		**MFJL-3015L**	49	55	**FIR-253015** —
	FJL-3020L		**MFJL-3020L**	52	58	**FIR-253020** —
	FJL-3025L		**MFJL-3025L**	65	72	**FIR-253025** —
	FJL-3030L		**MFJL-3030L**	78	86	**FIR-253030** —
	FJL-3220		**MFJL-3220**	55	62	**FIR-283220** —
	FJL-3230		**MFJL-3230**	82	91	**FIR-283230** —
FJ-3512		**MFJ-3512**		24.3	30	**FIR-303512** —
FJ-3516		**MFJ-3516**		32	38	— —
FJ-3520		**MFJ-3520**		41	45	**FIR-303520** —
FJ-3526		**MFJ-3526**		54	58	**FIR-303526** —
	FJL-3512		**MFJL-3512**	36	40	**FIR-303512** —
	FJL-3515		**MFJL-3515**	44	49	**FIR-303515** —
	FJL-3520L		**MFJL-3520L**	60	67	**FIR-303520** —
	FJL-3525L		**MFJL-3525L**	74	82	**FIR-303525** —
	FJL-3530L		**MFJL-3530L**	90	100	**FIR-303530** —
FJ-4016		**MFJ-4016**		34		— —
FJ-4020		**MFJ-4020**		46		**FIR-354020** —
FJ-4026		**MFJ-4026**		60		**FIR-354026** —
	FJL-4015L		**MFJL-4015L**	50		**FIR-354015** —
	FJL-4020L		**MFJL-4020L**	67		**FIR-354020** —
	FJL-4025L		**MFJL-4025L**	84		**FIR-354025** —
	FJL-4030L		**MFJL-4030L**	100		**FIR-354030** —

J -3020 EN

With Cage

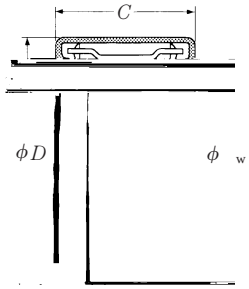
FJ (Open Type)

FJL

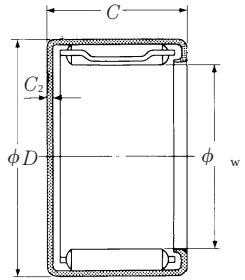
MFJ (Closed Type)

MFJL

Inscribed Circle Diameter 45 — 55 mm



Open Type



Closed Type

Boundary Dimensions (mm)				Basic Dynamic Load Ratings (N)	{kgf}	Limiting Loads (N)	{kgf}	Limiting Speeds (min^{-1})
F_w	D	C $^{0}_{-0.25}$	C_2 max	C_r		P_{max}		Oil
45	52	16	1.0	19 900	2 030	15 400	1 570	6 700
	52	20	1.0	25 500	2 600	21 200	2 160	6 700
	52	26	1.0	34 000	3 450	30 500	3 100	6 700
	55	20	1.3	31 000	3 200	21 300	2 170	7 100
	55	25	1.3	40 500	4 150	30 000	3 050	7 100
	55	30	1.3	49 500	5 050	38 500	3 950	7 100
50	58	20	1.1	28 900	2 940	23 100	2 350	6 300
	58	24	1.1	36 000	3 700	30 500	3 150	6 300
	62	12	1.3	21 200	2 160	11 600	1 180	6 300
	62	15	1.3	24 200	2 470	13 800	1 400	6 300
	62	20	1.3	37 000	3 800	23 700	2 420	6 300
	62	25	1.3	48 500	4 950	33 500	3 450	6 300
	62	30	1.3	59 500	6 050	43 500	4 450	6 300
55	63	20	1.1	30 000	3 100	25 100	2 560	5 600
	63	24	1.1	37 500	3 850	33 500	3 400	5 600
	67	30	1.3	62 500	6 350	47 500	4 850	5 600
	67	40	1.3	81 500	8 350	67 000	6 850	5 600

Bearing Numbers				Mass (g)		Matching Inner Rings	
Open		Closed		approx			
FJ	FJL	MFJ	MFJL	Open	Closed		
FJ-4516		**MFJ-4516**		39	50	—	—
FJ-4520		**MFJ-4520**		53	59	**FIR-404520**	—
FJ-4526		**MFJ-4526**		68	74	**FIR-404526**	—
	FJL-4520L		**MFJL-4520L**	74	82	**FIR-404520**	—
	FJL-4525L		**MFJL-4525L**	94	105	**FIR-404525**	—
	FJL-4530L		**MFJL-4530L**	110	125	**FIR-404530**	—
FJ-5020L		**MFJ-5020**		56	71	**FIR-455020**	—
FJ-5024		**MFJ-5024**		69	84	—	—
	FJL-5012L		**MFJL-5012L**	60	66	**FIR-455012**	—
	FJL-5015L		**MFJL-5015L**	75	83	**FIR-455015**	—
	FJL-5020L		**MFJL-5020L**	100	110	**FIR-455020**	—
	FJL-5025L		**MFJL-5025L**	125	140	**FIR-455025**	—
	FJL-5030L		**MFJL-5030L**	150	165	**FIR-455030**	—
FJ-5520		**MFJ-5520**		60	79	—	—
FJ-5524		**MFJ-5524**		72	90	—	—
	FJL-5530L		**MFJL-5530L**	155	180	—	—
	FJL-5540L		**MFJL-5540L**	195	220	—	—

Sealed Type With Cage

FJT (**Open Type • One-Side Sealed Type**)
FJHT
FJLT
FJTT (**Open Type • Both-Side Sealed Type**)
FJHTT
FJLTT
MFJT (Closed Type • Sealed Type)
MFJLT
Inscribed Circle
Diameter 8 — 22 mm

Boundary Dimensions (mm)											
F_w	D	C_3	C_4	C_2							
8	12	12	14	0.8	2 840	289	1 270	130	22 000	**FJT-812**	**FJTT-814**
	15	12	14	1.0	4 400	450	1 770	181	22 000		
10	14	12	14	0.8	3 500	360	1 760	179	19 000	**FJT-1012**	**FJTT-1014**
	17	12	14	1.0	4 900	500	1 990	203	19 000		
12	16	12	14	0.8	4 150	420	2 210	225	15 000	**FJT-1212**	**FJTT-1214**
	18	14	16	1.0	6 450	655	3 050	310	15 000	**FJHT-1214**	**FJHTT-1216**
	19	14	16	1.0	6 650	675	2 950	300	15 000		
14	20	14	16	1.0	6 500	665	3 250	335	13 000	**FJT-1414**	**FJTT-1416**
	22	19	22	1.1	11 600	1 180	5 700	580	13 000		
15	21	14	16	1.0	7 650	780	3 900	400	12 000	**FJT-1514**	**FJTT-1516**
	22	13	16	1.0	6 450	655	2 880	294	12 000		
	22	18	21	1.0	10 300	1 050	5 300	540	12 000		
16	22	14	16	1.0	7 100	725	3 750	380	11 000	**FJT-1614**	**FJTT-1616**
	22	18	20	1.0	10 400	1 060	6 050	620	11 000	**FJT-1618**	**FJTT-1620**
	24	23	26	1.1	17 100	1 740	9 500	970	11 000		
17	24	18	21	1.0	10 800	1 110	5 700	580	11 000		
18	24	14	16	1.0	7 650	780	4 200	430	10 000	**FJT-1814**	**FJTT-1816**
	25	18	21	1.0	11 400	1 160	6 100	620	10 000		
	25	20	23	1.0	13 300	1 360	7 500	765	10 000		
20	26	14	16	1.0	8 150	835	4 650	475	9 500	**FJT-2014**	**FJTT-2016**
	26	18	20	1.0	11 900	1 210	7 550	770	9 500	**FJT-2018**	**FJTT-2020**
	27	18	21	1.0	12 300	1 260	6 900	705	9 500		
	27	23	26	1.0	17 500	1 790	10 900	1 110	9 500		
22	28	14	16	1.0	8 650	880	5 150	525	8 500	**FJT-2214**	**FJTT-2216**
	28	18	20	1.0	12 600	1 290	8 350	850	8 500	**FJT-2218**	**FJTT-2220**
	29	18	21	1.0	12 700	1 300	7 300	745	8 500		
	29	23	26	1.0	18 100	1 840	11 500	1 170	8 500		

MFJT-812				3.1	3.5	3.6
	FJLT-812	**FJLTT-814**	**MFJLT-812**	6.4	6.8	7.0
MFJT-1012				4.1	4.6	4.6
	FJLT-1012	**FJLTT-1014**	**MFJLT-1012**	7.5	8.0	8.3
MFJT-1212				5.1	6.1	5.5
MFJHT-1214				8.7	9.7	9.2
	FJLT-1214	**FJLTT-1216**	**MFJLT-1214**	11	12	12
MFJT-1414				11	13	12
	FJLT-1419	**FJLTT-1422**	**MFJLT-1419**	18	19	20
MFJT-1514				11	12	12
	FJLT-1513	**FJLTT-1516**	**MFJLT-1513**	11	12	12
	FJLT-1518	**FJLTT-1521**	**MFJLT-1518**	15	16	17
MFJT-1614				12	13	13
MFJT-1618				15	16	16
	FJLT-1623	**FJLTT-1626**	**MFJLT-1623**	25	16	28
	FJLT-1718	**FJLTT-1721**	**MFJLT-1718**	17	18	19
MFJT-1814				13	15	15
	FJLT-1818	**FJLTT-1821**	**MFJLT-1818**	18	19	20
	FJLT-1820	**FJLTT-1823**	**MFJLT-1820**	21	22	22
MFJT-2014				14	17	16
MFJT-2018				18	21	20
	FJLT-2018	**FJLTT-2021**	**MFJLT-2018**	20	22	22
	FJLT-2023	**FJLTT-2026**	**MFJLT-2023**	25	27	28
MFJT-2214				16	18	19
MFJT-2218				21	23	24
	FJLT-2218	**FJLTT-2221**	**MFJLT-2218**	22	24	24
	FJLT-2223	**FJLTT-2226**	**MFJLT-2223**	29	30	32

Sealed Type With Cage

FJT (Open Type • One-Side Sealed Type)

FJLT

FJTT (Open Type • Both-Side Sealed Type)

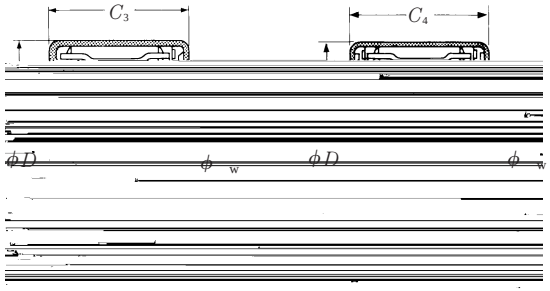
FJLTT

MFJT (Closed Type • Sealed Type)

MFJLT

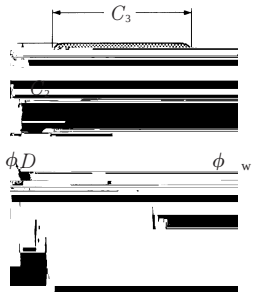
Inscribed Circle

Diameter 25 — 50 mm



Open Type

FJT, FJLT FJTT, FJLTT



Closed Type

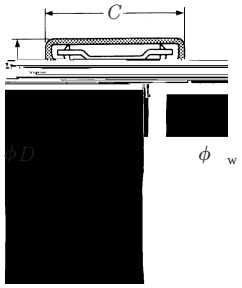
32	18	20	1.0	15 200	1 550	9 350	7 500	
33	18	21	1.1	15 400	1 570	8 800	7 500	
33	23	26	1.1	21 900	2 240	13 900	7 50015 300	
35	18	20	1.0	15 600	1 590	9 950		
37	23	26	1.0	25 400	2 590	15 500		
37	22	24	1.0	19 400	1 970	13 300		
40	23	26	1.3	25 800	2 630	15 300		
40	28	31	1.3	33 500	3 450	21 600		
42	22	24	1.0	23 600	2 410	17 900		
45	18	21	1.3	18 200	1 860	10 100		
45	28	31	1.3	36 000	3 650	24 000		
47	22	24	1.0	23 500	2 400	18 500		
50	18	21	1.3	19 900	2 030	11 600		
50	28	31	1.3	39 000	3 950	27 600		
52	22	24	1.0	25 500	2 600	21 200		
55	23	26	1.3	31 000	3 200	21 300		
62	28	31	1.3	48 500	4 950	33 500		

With Cage

Thin Type

DB

Inscribed Circle Diameter 18 — 82 mm



Boundary Dimensions (mm)			Basic Dynamic Load Ratings (N)	{kgf}	Limiting Loads (N)	{kgf}	Limiting Speeds (min^{-1})	Bearing Numbers	Mass (g)
F_w	D	C $^{0}_{-0.25}$	C_r		P_{max}		Oil		approx
18	23	9.5	5 050	515	2 820	288	18 000	**DB501801**	7.5
33	39	26	22 500	2 300	19 500	1 980	9 500	**DB503303A**	44.4
39	45	12	6 500	665	4 200	430	8 000	**DB503901**	23
55	61	12	9 900	1 010	8 050	820	5 600	**DB505501**	35
82	88	12	9 400	955	8 400	855	3 600	**DB508201**	52

Full Complement Type

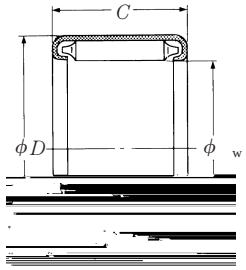
F • FH (Open Type)

NF

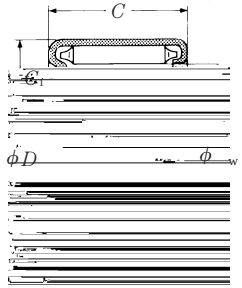
MF • MFH (Closed Type)

MNF

Inscribed Circle Diameter 8 — 20 mm



Open Type



Closed Type

Boundary Dimensions (mm)				Basic Dynamic Load Ratings (N)	{kgf}	Limiting Loads (N)	{kgf}	Limiting Speeds (min^{-1})	Bearing Numbers		Mass (g)		Matching Inner Rings	
F_w	D	C $^{0}_{-0.25}$	C_1 max	C_r		P_{max}		Oil	Open F, FH NF	Closed MF, MFH MNF	approx Open	Closed		
8	14	10	1.9	5 550	565	2 980	305	10 000	**FH-810**	**MFH-810**	6.0	6.3	—	—
9	15	10	1.8	6 100	625	3 350	340	10 000	**FH-910**	**MFH-910**	6.4	6.8	—	—
10	14	10	1.6	5 800	595	4 050	415	5 600	**F-1010**	**MF-1010**	4.7	5.0	**FIR-071010**	—
	16	10	1.9	6 650	680	3 700	375	9 000	**FH-1010**	**MFH-1010**	6.9	7.3	**FIR-071010**	—
12	16	10	1.6	6 450	660	4 700	480	5 000	**F-1210**	**MF-1210**	5.5	5.4	**FIR-081210**	—
	16	12	1.6	7 950	810	6 200	630	5 000	**F-1212**	**MF-1212**	6.6	6.8	**FIR-081212**	—
	18	12	1.9	9 000	920	5 700	580	7 500	**FH-1212**	**MFH-1212**	10	11	**FIR-081212**	—
13	19	12	1.9	9 550	975	6 100	625	7 100	**F-1312**	**MF-1312**	11	12	**FIR-101312**	—
14	20	12	2.2	9 450	965	6 350	645	6 000	**F-1412**	**MF-1412**	12	14	**FIR-101412**	—
	20	13	2.2	10 400	1 060	7 200	735	6 000	**F-1413**	**MF-1413**	13	15	**FIR-101413**	—
	20	16	2.2	13 300	1 360	9 850	1 000	6 000	**F-1416**	**MF-1416**	18	19	—	—
	19	16	1.6	12 900	1 310	10 400	1 060	5 300	**NF-1416**	**MNF-1416**	12	13	**FIR-101416**	—
	19	20	1.6	16 100	1 640	13 800	1 410	5 300	**NF-1420**	**MNF-1420**	16	17	**FIR-101420**	—
15	21	10	1.8	8 050	820	5 000	510	6 000	**F-1510**	**MF-1510**	10	12	**FIR-101510**	—
	21	12	1.8	10 300	1 050	6 900	705	6 000	**F-1512**	**MF-1512**	12	14	**FIR-101512**	**FIR-121512**
	21	14	1.8	12 400	1 270	8 800	895	6 000	**F-1514**	**MF-1514**	15	16	—	—
	21	16	1.8	14 500	1 480	10 700	1 090	6 000	**F-1516**	**MF-1516**	17	18	**FIR-121516**	—
16	22	12	2.2	10 200	1 040	7 100	725	5 300	**F-1612**	**MF-1612**	14	15	**FIR-121612**	—
	22	16	2.2	14 400	1 460	11 100	1 130	5 300	**F-1616**	**MF-1616**	18	20	**FIR-121616**	—
17	23	12	1.8	11 300	1 150	7 750	790	5 600	**F-1712**	**MF-1712**	14	15	—	—
	23	16	1.8	15 800	1 610	12 000	1 220	5 600	**F-1716**	**MF-1716**	18	20	—	—
	23	20	1.8	20 200	2 060	16 300	1 670	5 600	**F-1720**	**MF-1720**	23	24	**FIR-121720**	—
18	24	12	2.2	10 900	1 110	7 900	805	5 000	**F-1812**	**MF-1812**	14	16	**FIR-151812**	—
	24	16	2.2	15 300	1 560	12 300	1 250	5 000	**F-1816**	**MF-1816**	19	22	**FIR-151816**	—
20	26	12	2.2	11 500	1 170	8 700	885	4 500	**F-2012**	**MF-2012**	17	19	**FIR-172012**	—
	26	16	2.2	16 200	1 650	13 500	1 380	4 500	**F-2016**	**MF-2016**	22	25	**FIR-172016**	—
	26	20	2.2	20 500	2 090	18 300	1 870	4 500	**F-2020**	**MF-2020**	28	30	**FIR-152020**	**FIR-172020**

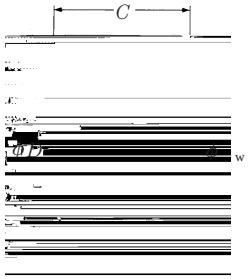
Full Complement Type

F (Open Type)

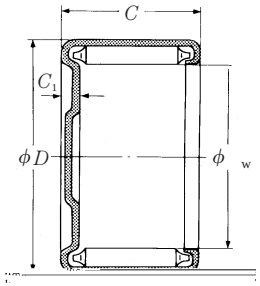
NFH

MF (Closed Type)

Inscribed Circle Diameter 22 — 55 mm



Open Type



Closed Type

Boundary Dimensions (mm)				Basic Dynamic Load Ratings (N)	{kgf}	Limiting Loads (N)	{kgf}	Limiting Speeds (min^{-1})
F_w	D	C $^{0}_{-0.25}$	C_1 max	C_r		P_{max}		Oil
22	28	10	2.2	9 400	960	6 850	700	4 000
	28	12	2.2	12 100	1 230	9 500	970	4 000
	28	16	2.2	17 100	1 740	14 800	1 510	4 800
	28	20	2.2	21 600	2 200	20 T (52)T 0 -1.25(T	2570 T 1 700	
						16 200		4 500
24	31	25	—	31 500	3 250	22 200	2 930	4 500
						31 500		4 500
25	32	16	2.5	20 200	2 060		1 650	
	32	20	2.5	25 900	2 640	11 200	2 260	4 000
	32	26	2.5	34 000	3 450	17 900	3 200	4 000
						24 600		4 000
28	35	12	2.5	14 800	1 510	34 500	1 150	4 000
	35	16	2.5	21 300	2 170		1 820	
	35	20	2.5	27 300	2 780	15 500	2 510	3 800
	35	26	2.5	35 500	3 650	18 900	3 550	3 800
						26 200		3 800
30	37	14	2.5	18 900	1 930	37 000	1 590	3 800
	37	16	2.5	22 100	2 250		1 930	
	37	20	2.5	28 400	2 900	14 000	2 670	3 400
	37	26	2.5	37 000	3 800	22 000	3 750	3 400
						30 000		3 400
35	42	12	2.5	16 900	1 720	42 500	1 420	3 400
	42	16	2.5	24 000	2 450		2 240	
	42	20	2.5	31 000	3 150	24 900	3 100	3 000
	42	26	2.5	40 000	4 100	34 000	4 350	3 000
						48 000		3 000
40	47	16	2.5	25 700	2 620		2 540	
	47	20	2.5	32 500	3 350	27 800	3 450	2 600
	47	26	2.5	43 000	4 350	38 500	4 900	2 600
						54 000		2 600
45	52	16	2.5	27 300	2 790		2 840	
	52	20	2.5	35 000	3 550	41 500	3 900	2 800
	52	26	2.5	45 500	4 650	53 000	5 500	2 800
50	58	20	2.8	39 500	4 050	45 500	4 250	2 400
	58	24	2.8	48 000	4 900	58 000	5 400	2 400
55	63	20	2.8	41 500	4 250		4 650	
	63	24	2.8	50 500	5 150		5 950	

Bearing Numbers		Mass (g)		Matching Inner Rings	
Open	Closed	approx			
		Open	Closed		
F-2210	**MF-2210**			**FIR-172210**	—
F-2212	**MF-2212**			**FIR-172212**	—
F-2216	**MF-2216**	14	17	**FIR-172216**	—
F-2220	**MF-2220**	18	21	**FIR-172220**	—
NFH-222A	—	24	27	—	—
		30	33		
F-2516	**MF-2516**			**FIR-202516**	—
F-2520	**MF-2520**	45	—	**FIR-202520**	—
F-2526	**MF-2526**			**FIR-202526**	—
		31	35		
F-2812	**MF-2812**	40	43	—	—
F-2816	**MF-2816**	52	55	**FIR-222816**	—
F-2820	**MF-2820**			**FIR-222820**	—
F-2826	**MF-2826**	26	32	**FIR-222826**	—
		35	40		
F-3014	**MF-3014**	44	48	—	—
F-3016	**MF-3016**	57	62	—	—
F-3020	**MF-3020**			**FIR-253020**	—
F-3026	**MF-3026**	30	34	**FIR-253026**	—
		35	40		
F-3512	**MF-3512**	46	51	**FIR-303512**	—
F-3516	**MF-3516**	61	66	—	—
F-3520	**MF-3520**			**FIR-303520**	—
F-3526	**MF-3526**	31	38	**FIR-303526**	—
		42	49		
F-4016	**MF-4016**	53	60	—	—
F-4020	**MF-4020**	70	76	**FIR-354020**	—
F-4026	**MF-4026**			**FIR-354026**	—
		48	56		
F-4516	**MF-4516**	60	69	—	—
F-4520	**MF-4520**	79	88	**FIR-404520**	—
F-4526	**MF-4526**			**FIR-404526**	—
		53	64		
F-5020	**MF-5020**	67	78	—	—
F-5024	**MF-5024**	88	99	—	—
F-5520	**MF-5520**	81	95	—	—
F-5524	**MF-5524**	98	110	—	—
		88	105		
		105	125		

DRAWN CUP NEEDLE ROLLER BEARINGS (INCH DESIGN)

With Cage

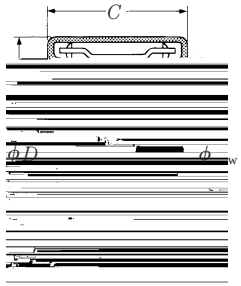
J (Open Type)

JH

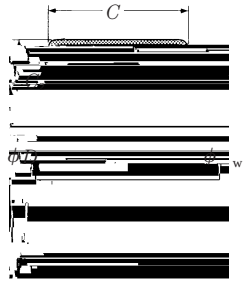
MJ (Closed Type)

MJH

Inscribed Circle Diameter 20.638 — 50.800 mm



Open Type



Closed Type

20.638	0.8125	26.988	1.0625	22.22	0.8750	—	19 400	1 980	12 900	1 320
		28.575	1.1250	19.05	0.7500	1.3	18 900	1 930	11 100	1 130
22.225	0.8750	28.575	1.1250	9.52	0.3750	—	6 600	675	3 300	335
		28.575	1.1250	12.70	0.5000	—	11 000	1 120	6 350	645
		28.575	1.1250	19.05	0.7500	—	17 900	1 830	11 900	1 210
		28.575	1.1250	25.40	1.0000	1.0	23 800	2 420	17 000	1 730
		30.162	1.1875	19.05	0.7500	1.3	18 400	1 880	11 000	1 120
		30.162	1.1875	25.40	1.0000	1.3	25 500	2 600	16 700	1 700
25.400	1.0000	31.750	1.2500	19.05	0.7500	—	18 200	1 860	12 400	1 270
		31.750	1.2500	25.40	1.0000	1.0	25 000	2 550	18 700	1 910
		33.338	1.3125	19.05	0.7500	1.3	20 800	2 120	13 000	1 330
		33.338	1.3125	25.40	1.0000	1.3	27 700	2 830	18 900	1 930
28.575	1.1250	34.925	1.3750	12.70	0.5000	1.0	11 700	1 200	7 250	740
		34.925	1.3750	19.05	0.7500	1.0	19 100	1 950	13 600	1 380
		34.925	1.3750	25.40	1.0000	1.0	26 200	2 670	20 400	2 080
		38.100	1.5000	19.05	0.7500	1.3	23 500	2 390	14 000	1 420
		38.100	1.5000	25.40	1.0000	1.3	32 000	3 250	20 700	2 110
		38.100	1.5000	28.58	1.1250	1.3	36 500	3 700	24 600	2 510
31.750	1.2500	38.100	1.5000	19.05	0.7500	1.0	19 900	2 030	14 700	1 500
		38.100	1.5000	25.40	1.0000	1.0	27 400	2 790	22 100	2 250
		41.275	1.6250	19.05	0.7500	—	24 200	2 470	14 900	1 520
		41.275	1.6250	25.40	1.0000	1.3	34 000	3 500	23 200	2 360
		41.275	1.6250	31.75	1.2500	—	42 500	4 350	31 000	3 150
34.925	1.3750	41.275	1.6250	12.70	0.5000	1.0	12 400	1 260	8 150	830
		44.450	1.7500	19.05	0.7500	1.3	26 400	2 690	16 800	1 710
		44.450	1.7500	25.40	1.0000	1.3	36 500	3 750	25 600	2 610
38.100	1.5000	47.625	1.8750	19.05	0.7500	1.3	28 500	2 900	19 000	1 930
		47.625	1.8750	25.40	1.0000	1.3	39 500	4 000	28 900	2 950
		47.625	1.8750	31.75	1.2500	1.3	49 500	5 050	39 000	3 950
41.275	1.6250	50.800	2.0000	25.40	1.0000	1.3	39 500	4 000	29 500	3 000
44.450	1.7500	53.975	2.1250	19.05	0.7500	1.3	29 700	3 050	21 000	2 140
		53.975	2.1250	25.40	1.0000	1.3	40 000	4 100	31 000	3 150
		53.975	2.1250	38.10	1.5000	1.3	60 000	6 100	52 000	5 300
47.625	1.8750	57.150	2.2500	25.40	1.0000	1.3	41 500	4 200	32 000	3 300
50.800	2.0000	60.325	2.3750	25.40	1.0000	1.3	42 500	4 350	34 500	3 500

Bearing Numbers2r(2206 r1a5<542 4500.5earing 22 500.08 49>2)Tj/F10 1 Tf7.82 0 0 7.82 281.01

16 000	**J-1314**		—		25	—	—	—
16 000		**JH-1312**		**MJH-13121**	29	31	—	—
14 000	**J-146**		—		11	—	—	—
14 000	**J-148**		—		16	—	—	—
14 000	**J-1412**		—		25	—	**IR-1012**	—
14 000	**J-1416**		**MJ-14161**		33	36	**IR-1016**	—
15 000		**JH-1412**		**MJH-14121**	31	36	**IR-1012**	—
15 000		**JH-1416**		**MJH-14161**	42	47	**IR-1016**	—
12 000	**J-1612**		—		28	—	**IR-1212**	**IR-1312**
12 000	**J-1616**		**MJ-16161**		36	40	**IR-1216**	**IR-1316**
13 000		**JH-1612**		**MJH-16121**	34	40	**IR-1212**	**IR-1312**
13 000		**JH-1616**		**MJH-16161**	46	51	**IR-1216**	**IR-1316**
11 000	**J-188**		**MJ-1881**		27	30	—	—
11 000	**J-1812**		**MJ-18121**		30	35	—	—
11 000	**J-1816**		**MJ-18161**		47	51	**IR-1416**	**IR-1516**
11 000		**JH-1812**		**MJH-18121**	45	52	—	—
11 000		**JH-1816**		**MJH-18161**	62	69	**IR-1416**	**IR-1516**
11 000		**JH-1818**		**MJH-18181**	71	78	—	—
10 000	**J-2012**		**MJ-20121**		43	46	**IR-1612**	—
10 000	**J-2016**		**MJ-20161**		61	65	**IR-1616**	—
10 000		**JH-2012**		—	66	—	—	—
10 000		**JH-2016**		**MJH-20161**	70	76	**IR-1616**	—
10 000		**JH-2020**		—	75	—	—	—
9 000	**J-228**		**MJ-2281**		68	77	—	—
9 000		**JH-2212**		**MJH-22121**	53	61	**IR-1812**	—
9 000		**JH-2216**		**MJH-22161**	73	81	**IR-1816**	—
8 500	**J-2412**		**MJ-24121**		58	68	—	—
8 500	**J-2416**		**MJ-24161**		81	90	**IR-1916**	**IR-2016**
8 500	**J-2420**		**MJ-24201**		105	115	**IR-1920**	**IR-2020**
7 500	**J-2616**		**MJ-26161**		89	96	—	—
7 100	**J-2812**		**MJ-28121**		91	105	—	—
7 100	**J-2816**		**MJ-28161**		92	105	**IR-2316**	**IR-2426**
7 100	**J-2824**		**MJ-28241**		140	155	**IR-2324**	**IR-2424**
6 700	**J-3016**		**MJ-30161**		96	135	—	—
6 300	**J-3216**		**MJ-32161**		99	165	—	—

DRAWN CUP NEEDLE ROLLER BEARINGS (INCH DESIGN)

Full Complement Type

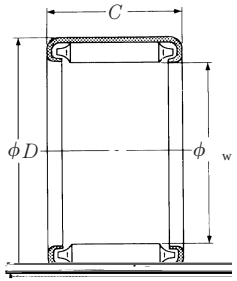
B (Open Type)

BH

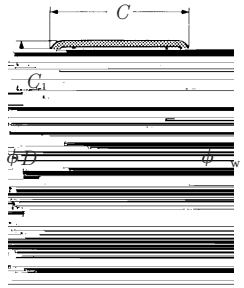
M (Closed Type)

MH

Inscribed Circle Diameter 11.112 — 15.875 mm



Open Type



Closed Type

Boundary Dimensions (mm, inch) F_w		D		C $^{0}_{-0.25}$		C_1 max	Basic Dynamic Load Ratings (N) C_r	{kgf}	Limiting Loads (N) P_{max}	{kgf}
11.112	0.4375	15.875	0.6250	9.52	0.3750	—	6 050	620	3 900	400
		15.875	0.6250	11.13	—	—	7 350	750	5 000	510
		15.875	0.6250	12.70	0.5000	2.0	8 600	875	6 100	625
		15.875	0.6250	15.88	0.6250	—	10 900	1 110	8 300	850
		17.462	0.6875	12.70	0.5000	2.3	9 850	1 000	6 000	610
12.700	0.5000	17.462	0.6875	7.92	—	2.0	5 100	520	3 200	325
		17.462	0.6875	9.52	0.3750	2.0	6 550	665	4 400	450
		17.462	0.6875	11.13	—	2.0	7 950	810	5 650	575
		17.462	0.6875	12.70	0.5000	2.0	9 250	945	6 900	700
		17.462	0.6875	15.88	0.6250	2.0	11 800	1 200	9 350	955
		17.462	0.6875	19.05	0.7500	2.0	14 100	1 440	11 800	1 210
		19.050	0.7500	11.13	—	—	9 000	920	5 400	550
		19.050	0.7500	12.70	0.5000	2.3	10 700	1 090	6 700	685
		19.050	0.7500	15.88	0.6250	2.3	13 800	1 400	9 350	950
		19.050	0.7500	19.05	0.7500	2.3	16 700	1 700	11 900	1 220
14.288	0.5625	19.050	0.7500	7.92	—	2.0	5 400	550	3 550	360
		19.050	0.7500	9.52	0.3750	2.0	7 000	710	4 900	500
		19.050	0.7500	11.13	—	2.0	8 500	865	6 300	640
		19.050	0.7500	12.70	0.5000	2.0	9 900	1 010	7 650	780
		19.050	0.7500	15.88	0.6250	2.0	12 500	1 280	10 400	1 060
		19.050	0.7500	19.05	0.7500	2.0	15 100	1 540	13 200	1 340
		20.638	0.8125	12.70	0.5000	—	11 400	1 170	7 400	755
		20.638	0.8125	15.88	0.6250	—	14 800	1 510	10 300	1 050
		20.638	0.8125	19.05	0.7500	2.3	17 900	1 830	13 200	1 350
15.875	0.6250	20.638	0.8125	7.92	—	2.0	5 750	585	3 900	395
		20.638	0.8125	11.13	—	2.0	8 950	915	6 900	705
		20.638	0.8125	12.70	0.5000	2.0	10 500	1 070	8 400	860
		20.638	0.8125	15.88	0.6250	2.0	13 300	1 350	11 400	1 170
		20.638	0.8125	19.05	0.7500	2.0	16 000	1 630	14 500	1 480
		22.225	0.8750	12.70	0.5000	2.3	12 200	1 240	8 150	830
		22.225	0.8750	15.88	0.6250	—	15 700	1 600	11 300	1 150
		22.225	0.8750	19.05	0.7500	2.3	19 000	1 940	14 500	1 470
		22.225	0.8750	25.40	1.0000	—	25 200	2 570	20 800	2 120

Limiting Speeds (min^{-1}) Oil	Bearing Numbers Open B	Open BH	Closed M	Closed MH	Mass (g) approx Open	Mass (g) approx Closed	Matching Inner Rings	
6 000	**B-76**		—		5.4	—	—	—
6 000	**B-77**		—		6.4	—	—	—
6 000	**B-78**		**M-781**		7.3	8.2	—	—
6 000	**B-710**		—		9.5	—	—	—
8 500		**BH-78**		**MH-781**	10	11	—	—
5 300	**B-85**		**M-851**		5.4	6.4	—	—
5 300	**B-86**		**M-861**		6.4	7.3	—	—
5 300	**B-87**		**M-871**		7.3	8.2	—	—
5 300	**B-88**		**M-881**		8.2	9.1	—	—
5 300	**B-810**		**M-8101**		11	12	—	—
5 300	**B-812**		**M-8121**		13	14	—	—
7 500		**BH-87**		—	7.3	—	—	—
7 500		**BH-88**		**MH-881**	11	13	—	—
7 500		**BH-810**		**MH-8101**	14	16	—	—
7 500		**BH-812**		**MH-8121**	18	19	—	—
5 000	**B-95**		**M-951**		5.7	7.1	—	—
5 000	**B-96**		**M-961**		6.4	7.7	—	—
5 000	**B-97**		**M-971**		7.7	9.1	—	—
5 000	**B-98**		**M-981**		9.1	10	**IR-68**	—
5 000	**B-910**		**M-9101**		12	13	—	—
5 000	**B-912**		**M-9121**		14	16	**IR-612**	—
7 100		**BH-98**		—	12	—	**IR-68**	—
7 100		**BH-910**		—	16	—	—	—
7 100		**BH-912**		**MH-9121**	20	21	**IR-612**	—
4 500	**B-105**		**M-1051**		5.9	7.7	—	—
4 500	**B-107**		**M-1071**		8.6	11	—	—
4 500	**B-108**		**M-1081**		10	12	**IR-68-1**	—
4 500	**B-1010**		**M-10101**		13	15	—	—
4 500	**B-1012**		**M-10121**		16	18	**IR-612-1**	—
6 300		**BH-108**		**MH-1081**	13	15	**IR-68-1**	—
6 300		**BH-1010**		—	17	—	—	—
6 300		**BH-1012**		**MH-10121**	21	23	**IR-612-1**	—
6 300		**BH-1016**		—	30	—	—	—

Full Complement Type

B (Open Type)

BH

M (Closed Type)

MH

Inscribed Circle
Diameter 17.462 — 23.812 mm

	0.6875	22.225	0.8750	9.52	0.3750	2.0	7 800	795	5 850	600	4 000	**B-116**		**M-1161**		10	12	—	—
		22.225	0.8750	12.70	0.5000	2.0	11 000	1 120	9 200	935	4 000	**B-118**		**M-1181**		11	14	—	—
		22.225	0.8750	15.88	0.6250	2.0	14 000	1 430	12 500	1 270	4 000	**B-1110**		**M-11101**		14	17	—	—
		22.225	0.8750	19.05	0.7500	2.0	16 800	1 710	15 800	1 610	4 000	**B-1112**		**M-11121**		17	20	—	—
		23.812	0.9375	11.13	—	—	10 800	1 100	7 100	725	6 000		**BH-117**		—	13	—	—	—
		23.812	0.9375	12.70	0.5000	—	12 800	1 310	8 850	900	6 000		**BH-118**		—	17	—	—	—
		23.812	0.9375	15.88	0.6250	2.3	16 600	1 690	12 300	1 250	6 000		**BH-1110**		**MH-11101**	20	23	—	—
		23.812	0.9375	19.05	0.7500	—	20 100	2 050	15 700	1 600	6 000		**BH-1112**		—	25	—	—	—
	0.7500	25.400	1.0000	9.52	0.3750	2.3	9 150	935	5 800	595	5	**B-126**		**M-1261**		10	13	—	—
		25.400	1.0000	12.70	0.5000	2.3	13 500	1 370	9 550	975		**B-128**		**M-1281**		15	18	**IR-88**	—
		25.400	1.0000	15.88	0.6250	2.3	17 400	1 770	13 300	1 350	6 0006 02 T	**B-1210**		**M-12101**		20	23	—	—
		25.400	1.0000	19.05	0.7500	2.3	21 100	2 150	17 000	1 730	935	**B-1212**		**M-12121**		25	28	**IR-812**	—
	0.8125	26.988	1.0625	9.52	0.3750	—	9 600	975	6 250	635	4 000	**B-136**		—		12	—	—	—
		26.988	1.0625	12.70	0.5000	2.3	14 100	1 440	10 200	1 050	6 000	**B-138**		**M-1381**		17	20	—	—
		26.988	1.0625	22.22	0.8750	2.3	25 700	2 620	22 200	2 270	6 000	**B-1314**		**M-13141**		32	36	—	—
		26.988	1.0625	25.40	1.0000	2.3	29 200	2 980	26 200	2 670	6 000	**B-1316**		**M-13161**		37	40	—	—
		28.575	1.1250	12.70	0.5000	2.8	14 100	1 440	9 100	930	16 800		**BH-138**		**MH-1381**	22	24	—	—
		28.575	1.1250	15.88	0.6250	2.8	18 800	1 920	13 200	1 350			**BH-1310**		**MH-13101**	26	29	—	—
		28.575	1.1250	19.05	0.7500	2.8	23 200	2 360	17 300	1 760			**BH-1312**		**MH-13121**	35	37	—	—
	0.8750	28.575	1.1250	9.52	0.3750	2.3	10 000	1 020	6 700	680		**B-146**		**M-1461**		13	17	—	—
		28.575	1.1250	12.70	0.5000	2.3	14 700	1 490	11 000	1 120		**B-148**		**M-1481**		18	22	—	—
		28.575	1.1250	19.05	0.7500	2.3	22 900	2 340	19 500	1 990		**B-1412**		**M-14121**		29	33	**IR-1012**	—
		28.575	1.1250	25.40	1.0000	2.3	30 500	3 100	28 000	2 860		**B-1416**		**M-14161**		40	43	**IR-1016**	—
		28.575	1.1250	28.58	1.1250	—	34 000	3 450	32 500	3 300		**B-1418**		—		50	—	—	—
		30.162	1.1875	15.88	0.6250	2.8	19 400	1 980	14 100	1 430			**BH-1410**		**MH-14101**	30	35	—	—
		30.162	1.1875	19.05	0.7500	2.8	24 000	2 440	18 400	1 880			**BH-1412**		**MH-14121**	36	41	**IR-1012**	—
		30.162	1.1875	25.40	1.0000	2.8	32 500	3 300	27 100	2 770			**BH-1416**		**MH-14161**	40	43	—	—
	0.9375	30.162	1.1875	12.70	0.5000	—	15 200	1 550	11 700	1 190		**B-158**		—		20	—	—	—
		30.162	1.1875	25.40	1.0000	2.3	31 500	3 200	29 800	3 050		**B-1516**		**M-15161**		41	46	—	—

Full Complement Type

B (Open Type)

BH

M (Closed Type)

MH

Inscribed Circle
Diameter 33.338 — 50.800 mm

B-218		M-2181			—
B-2110		M-21101			—
B-228		M-2281			—
B-2212		M-22121			IR-1812
B-2216		M-22161			IR-1816
B-2220		M-22201			IR-1820
	BH-228		—		—
	BH-2210		—		—
	BH-2212		MH-22121		IR-1812
	BH-2216		MH-22161		IR-1816
	BH-2220		—		IR-1820
B-248		M-2481			—
B-2410		M-24101			—
B-2412		M-24121			—
B-2414		M-24141			—
B-2416		M-24161			IR-1916
B-2420		M-24201			IR-1920
B-268		—			—
B-2610		M-26101			—
B-2616		—			—
B-2620		M-26201			IR-.057 TD<0295>Tj.8622 T257
B-2812		M-28121			
B-2816		M-28161			
B-2820		—			
B-2824		M-28241			
B-308		M-3081			
B-3012		—			
B-3016		M-30161			
B-328		M-3281			
B-3216		M-32161			
B-3220		M-32201			
B-3224		M-32241			
B-3228		M-32281			

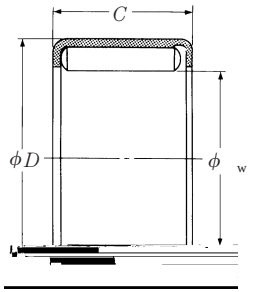
DRAWN CUP NEEDLE ROLLER BEARINGS (INCH DESIGN)

Full Complement Type (Grease-Retained Roller Type)

Y

YH

Inscribed Circle Diameter 3.969 — 20.638 mm



Boundary Dimensions (mm, inch) F_w		D		C $^{0}_{-0.25}$		Basic Dynamic Load Ratings (N) C_r	{kgf}	Limiting Loads (N) P_{max}	{kgf}	Limiting Speeds (min^{-1}) Oil	Bearing Numbers	Mass (g) approx
3.969	—	7.144	—	3.96	—	1 260	129	580	59	10 000	**Y-2** 1/2 **2** 1/2	0.4
		7.144	—	6.35	0.2500	2 300	235	1 260	128	10 000	**Y-2** 1/2 **4**	1.4
4.762	0.1875	8.731	—	6.35	0.2500	2 560	261	1 350	137	10 000	**Y-34**	2.3
6.350	0.2500	11.112	0.4375	7.92	—	4 150	420	2 300	234	10 000	**Y-45**	3.2
		11.112	0.4375	11.13	—	5 950	605	3 700	375	10 000	**Y-47**	4.5
7.938	0.3125	12.700	0.5000	7.92	—	4 750	485	2 760	281	8 000	**Y-55**	4.1
9.525	0.3750	14.288	0.5625	6.35	0.2500	4 000	410	2 250	229	7 100	**Y-64**	3.2
		14.288	0.5625	9.52	0.3750	6 500	660	4 200	425	7 100	**Y-66**	5.5
		14.288	0.5625	12.70	0.5000	8 750	890	6 100	625	7 100	**Y-68**	7.3
		14.288	0.5625	15.88	0.6250	10 800	1 100	8 050	820	7 100	**Y-610**	9.1
11.112	0.4375	15.875	0.6250	12.70	0.5000	9 550	975	7 000	715	6 000	**Y-78**	8.2
		17.462	0.6875	12.70	0.5000	11 400	1 160	7 250	740	8 500	**YH-78**	11
12.700	0.5000	17.462	0.6875	6.35	0.2500	4 700	480	2 890	295	5 300	**Y-84**	5.4
		17.462	0.6875	9.52	0.3750	7 650	780	5 350	550	5 300	**Y-86**	7.3
		17.462	0.6875	11.13	—	9 000	915	6 600	675	5 300	**Y-87**	8.2
		17.462	0.6875	12.70	0.5000	10 300	1 050	7 850	800	5 300	**Y-88**	9.1
		17.462	0.6875	15.88	0.6250	12 700	1 300	10 300	1 050	5 300	**Y-810**	11
		17.462	0.6875	19.05	0.7500	15 000	1 530	12 800	1 310	5 300	**Y-812**	14
		19.050	0.7500	15.88	0.6250	14 600	1 480	10 300	1 050	7 500	**YH-810**	16
14.288	0.5625	19.050	0.7500	12.70	0.5000	11 000	1 120	8 750	890	5 000	**Y-98**	9.5
		19.050	0.7500	15.88	0.6250	13 600	1 380	11 500	1 170	5 000	**Y-910**	12
		19.050	0.7500	19.05	0.7500	16 000	1 640	14 200	1 450	5 000	**Y-912**	15
15.875	0.6250	20.638	0.8125	7.92	—	7 050	720	5 050	515	4 500	**Y-105**	6.4
		20.638	0.8125	12.70	0.5000	11 600	1 180	9 600	980	4 500	**Y-108**	11
		20.638	0.8125	19.05	0.7500	17 000	1 730	15 700	1 600	4 500	**Y-1012**	17
		22.225	0.8750	12.70	0.5000	13 300	1 360	9 350	955	6 000	**YH-108**	15
17.462	0.6875	22.225	0.8750	19.05	0.7500	17 900	1 820	17 100	1 740	4 000	**Y-1112**	24
19.050	0.7500	25.400	1.0000	6.35	0.2500	6 250	640	3 650	370	5 300	**Y-124**	8.2
		25.400	1.0000	12.70	0.5000	10 800	1 100	7 350	750	5 300	**Y-128**	17
		25.400	1.0000	15.88	0.6250	18 600	1 890	14 700	1 500	5 300	**Y-1210**	22
		25.400	1.0000	19.05	0.7500	22 100	2 250	18 400	1 880	5 300	**Y-1212**	27
20.638	0.8125	26.988	1.0625	9.52	0.3750	11 300	1 150	7 900	805	5 000	**Y-136**	13
		26.988	1.0625	12.70	0.5000	15 500	1 580	11 900	1 210	5 000	**Y-138**	19
		28.575	1.1250	15.88	0.6250	21 300	2 170	15 500	1 580	6 000	**YH-1310**	28
		28.575	1.1250	19.05	0.7500	25 600	2 610	19 600	2 000	6 000	**YH-1312**	37

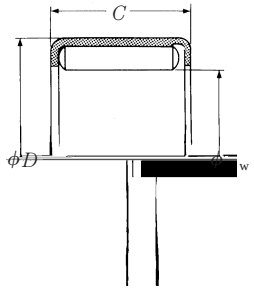
Remarks 1. In this type of bearing, a special grease holds the rollers in place until mounting.
2. Metric series bearings are available. Please consult NSK.

Full Complement Type (Grease-Retained Roller Type)

Y

YH

Inscribed Circle
Diameter 22.225 — 47.625 mm



Boundary Dimensions (mm, inch) F_w		D		C $^{0}_{-0.25}$		Basic Dynamic Load Ratings (N) C_r	{kgf}	Limiting Loads (N) P_{max}	{kgf}	Limiting Speeds (min^{-1}) Oil	Bearing Numbers	Mass (g) approx
22.225	0.8750	28.575	1.1250	12.70	0.5000	15 900	1 620	12 700	1 290	4 500	**Y-148**	20
		28.575	1.1250	19.05	0.7500	23 700	2 410	21 100	2 150	4 500	**Y-1412**	31
		28.575	1.1250	25.40	1.0000	31 000	3 150	29 600	3 000	4 500	**Y-1416**	42
		30.162	1.1875	19.05	0.7500	25 500	2 600	20 500	2 090	5 300	**YH-1412**	38
25.400	1.0000	31.750	1.2500	12.70	0.5000	17 200	1 750	14 300	1 460	4 000	**Y-168**	23
		31.750	1.2500	19.05	0.7500	25 500	2 600	23 900	2 430	4 000	**Y-1612**	35
		31.750	1.2500	25.40	1.0000	33 000	3 400	33 500	3 400	4 000	**Y-1616**	47
		33.338	1.3125	12.70	0.5000	18 800	1 920	13 800	1 400	5 000	**YH-168**	30
		33.338	1.3125	19.05	0.7500	28 600	2 920	23 600	2 410	5 000	**YH-1612**	43
		33.338	1.3125	25.40	1.0000	37 500	3 850	33 500	3 400	5 000	**YH-1616**	58
28.575	1.1250	34.925	1.3750	12.70	0.5000	18 300	1 870	16 000	1 630	3 600	**Y-188**	26
		34.925	1.3750	19.05	0.7500	27 200	2 780	26 600	2 710	3 600	**Y-1812**	38
		34.925	1.3750	25.40	1.0000	35 500	3 600	37 500	3 800	3 600	**Y-1816**	52
30.162	1.1875	38.100	1.5000	15.88	0.6250	26 500	2 700	22 200	2 260	4 300	**Y-1910**	43
31.750	1.2500	38.100	1.5000	15.88	0.6250	24 300	2 480	23 500	2 400	3 200	**Y-2010**	34
		38.100	1.5000	19.05	0.7500	28 900	2 940	29 300	2 990	3 200	**Y-2012**	42
		38.100	1.5000	25.40	1.0000	37 500	3 850	41 000	4 200	3 200	**Y-2016**	57
		38.100	1.5000	28.58	1.1250	41 500	4 250	47 000	4 800	3 200	**Y-2018**	64
		38.100	1.5000	31.75	1.2500	45 500	4 650	53 000	5 400	3 200	**Y-2020**	72
34.925	1.3750	41.275	1.6250	12.70	0.5000	20 000	2 040	19 300	1 960	2 800	**Y-228**	36
		41.275	1.6250	19.05	0.7500	29 700	3 050	32 000	3 250	2 800	**Y-2212**	47
		41.275	1.6250	31.75	1.2500	47 000	4 800	58 000	5 900	2 800	**Y-2220**	76
38.100	1.5000	47.625	1.8750	9.52	0.3750	16 900	1 730	11 600	1 190	4 000	**Y-246**	34
		47.625	1.8750	12.70	0.5000	24 700	2 520	18 900	1 930	4 000	**Y-248**	48
		47.625	1.8750	22.22	0.8750	44 500	4 550	40 500	4 150	4 000	**Y-2414**	89
		47.625	1.8750	25.40	1.0000	51 000	5 200	48 000	4 850	4 000	**Y-2416**	100
		47.625	1.8750	31.75	1.2500	62 500	6 350	62 000	6 350	4 000	**Y-2420**	125
41.275	1.6250	50.800	2.0000	15.88	0.6250	33 000	3 350	27 900	2 840	3 800	**Y-2610**	73
44.450	1.7500	53.975	2.1250	25.40	1.0000	54 500	5 550	55 000	5 600	3 600	**Y-2816**	120
47.625	1.8750	57.150	2.2500	19.05	0.7500	43 000	4 400	41 000	4 200	3 400	**Y-3012**	115

Remarks 1. In this type of bearing, a special grease holds the rollers in place until mounting.
2. Metric series bearings are available. Please consult NSK.

Miniature Bearings with Cages

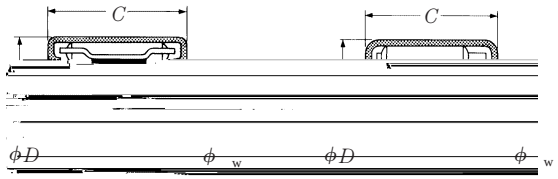
FJ • FJH • FJL (Open Type)

FJP

MFJ • MFJH (Closed Type)

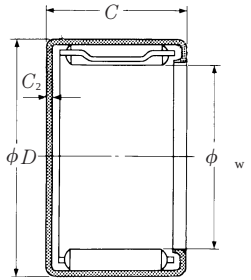
MFJL

Inscribed Circle Diameter 3 — 9 mm



Open Type

FJ, FJH, FJL FJP



Closed Type

Boundary Dimensions (mm)				Basic Dynamic Load Ratings		Limiting Loads		Limiting Speeds
				(N)	{kgf}	(N)	{kgf}	(min^{-1})
F_w	D	C $^{0}_{-0.25}$	C_2 max	C_r		P_{max}		Oil
3	6.5	6	—	1 230	125	465	47	100 000
4	8	8	—	1 720	175	670	69	75 000
5	9	8	—	1 550	158	585	60	71 000
	9	9	0.8	1 860	190	745	76	71 000
6	10	9	0.8	2 320	237	985	101	56 000
7	11	9	0.8	2 550	260	1 110	113	48 000
8	12	8	—	2 580	263	1 150	118	40 000
	12	10	0.8	2 840	289	1 270	130	43 000
	14	10	1	4 300	435	1 770	180	45 000
	15	10	1	4 400	450	1 770	181	45 000
	15	15	1	7 100	720	3 250	330	45 000
	15	20	1	10 100	1 020	5 100	520	45 000
9	13	10	0.8	3 300	335	1 600	163	36 000
	15	10	1	4 550	465	1 910	194	40 000
	16	12	1	5 150	525	2 140	219	40 000
	16	16	1	7 800	795	3 650	370	40 000

Bearing Numbers				Mass (g)	
Open		Closed			
FJP, FJ FJH	FJL	MFJ MFJH	MFJL	approx Open	Closed
***FJP-36**		—		0.9	—
***FJP-48**		—		1.3	—
FJ-58L		—		1.6	—
FJ-59		**MFJ-59**		1.7	1.9
FJ-69		**MFJ-69**		2.2	2.4
FJ-79		**MFJ-79**		2.3	2.7
FJ-88-2		—		2.3	—
FJ-810		**MFJ-810**		2.7	3.2
FJH-810		**MFJH-810**		5.2	5.5
	FJL-810		**MFJL-810L**	6.0	6.6
	FJL-815		**MFJL-815L**	8.9	9.9
	FJL-820		**MFJL-820L**	15	13
FJ-910		**MFJ-910**		3.2	3.6
FJH-910		**MFJH-910**		5.7	6.1
	FJL-912L		**MFJL-912L**	7.7	8.5
	FJL-916		**MFJL-916L**	11	12

* These bearings have polyamide cages. The maximum permissible operating temperature for these bearings is 100˚C for continued operation and 120˚C for short periods.

Full Complement Miniature Bearings

F (Open Type)

MF (Closed Type)

MFY

DD (Open Type • Closed Type)

Inscribed Circle Diameter 3.036 — 9 mm

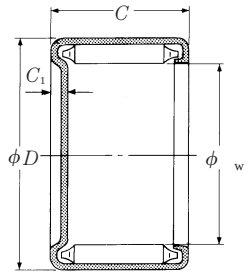
Boundary Dimensions (mm)								Bearing Numbers		Mass (g)	
								Open	Closed	approx	
								F, DD	MF, MFY, DD	Open	Closed
3.036	7.035	6.65	—	1 630	167	855	87	12 000	**DD500302**	—	1.4	—
	7.035	9.2	—	2 330	238	1 360	138	12 000	**DD500304**	—	2.0	—
4	8	6	0.8	2 240	229	1 150	117	12 000	—	**DD500401**	—	1.5
	8	8	1.7	2 470	252	1 300	132	12 000	**F-48**	**MF-48**	1.4	1.8
5	9	8	1.7	2 790	285	1 520	155	10 000	**F-58**	**MF-58**	1.8	2.2
	9	7	0.8	3 000	305	1 670	170	10 000	—	**MFY-57**	—	2.1
	9	9	1.7	3 250	335	1 860	190	10 000	**F-59**	**MF-59**	2.0	2.3
6	10	8	1.7	3 150	325	1 780	181	8 500	**F-68**	**MF-68**	2.1	2.7
	10	9	1.7	3 700	380	2 170	221	8 500	**F-69**	**MF-69**	2.3	2.8
7	11	7.5	0.8	4 100	420	2 480	253	7 500	—	**DD500701**	—	2.8
	11	9	1.7	4 100	420	2 480	253	7 500	**F-79**	**MF-79**	2.7	3.2
8	12	8	1.7	3 850	390	2 280	233	7 100	**F-88**	**MF-88**	2.7	3.2
	12	8	0.8	4 750	485	2 990	305	7 100	—	**MFY-88**	—	3.3
	12	10	1.7	5 000	510	3 200	325	7 100	**F-810**	**MF-810**	3.6	4.1
	12	12	1.7	6 200	635	4 200	430	7 100	**F-812**	**MF-812**	3.8	4.7
9	13	9	0.8	5 650	575	3 850	395	6 000	—	**MFY-99**	—	4.1
	13	10	1.7	5 400	550	3 650	370	6 000	**F-910**	**MF-910**	4.1	4.5

Full Complement Miniature Bearings

B • BH (Open Type)

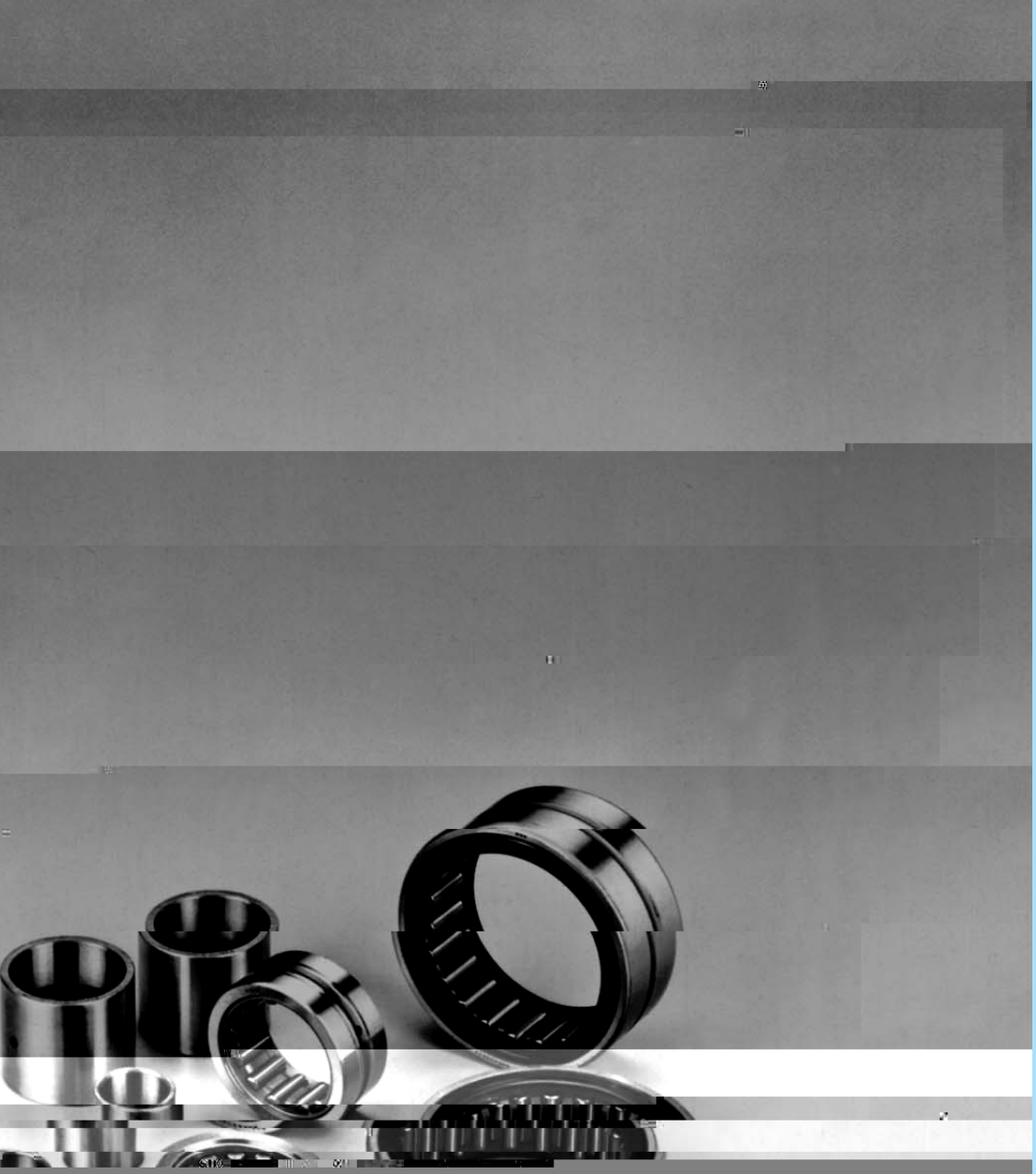
M • MH (Closed Type)

Inscribed Circle
Diameter 3.175 — 9.525 mm



0.1250	6.350	0.2500	6.35	0.2500	1.3	1 640	167	835
—	7.144	—	6.35	0.2500	1.3	1 930	197	1 000
	7.144	—	7.92	—	1.3	2 520	257	1 420
0.1875	8.731	—	6.35	0.2500	1.8	2 100	214	1 040
	8.731	—	9.52	0.3750	1.8	3 600	365	2 090
0.2500	11.112	0.4375	6.35	0.2500	2.0	2 490	254	1 200
	11.112	0.4375	7.92	—	2.0	3 350	345	1 760
	11.112	0.4375	9.52	0.3750	2.0	4 350	440	2 440
	11.112	0.4375	11.13	—	2.0	5 250	535	
0.3125	12.700	0.5000	7.92	—	2.0	3 850	395	
	12.700	0.5000	9.52	0.3750	2.0	5 000	510	
	12.700	0.5000	11.13	—	2.0	6 050	615	
	12.700	0.5000	14.27	—	2.0	8 050	820	
	14.288	0.5625	11.13	—	2.3	6 650	680	
0.3750	14.288	0.5625	7.92	—	2.0	4 300	440	
	14.288	0.5625	9.52	0.3750	2.0	5 550	565	
	14.288	0.5625	11.13	—	—	6 750	690	
	14.288	0.5625	12.70	0.5000	2.0	7 850	800	
	14.288	0.5625	14.27	—	—	8 950	915	
	14.288	0.5625	15.88	0.6250	2.0	10 000	1 020	
	15.875	0.6250	12.70	0.5000	2.3	8 950	910	

Bearing Numbers				Mass (g)	
Open		Closed			
B	BH	M	MH	Open	Closed
B-24		**M-241**		0.9	1.4
B-2 1/2 **4**		**M-2** 1/2 **41**		0.9	1.4
B-2 1/2 **5**		**M-2** 1/2 **51**		1.4	1.8
B-34		**M-341**		1.8	2.3
B-36		**M-361**		2.3	2.7
B-44		**M-441**		2.3	2.7
B-45		**M-451**		2.7	3.2
B-46		**MC-461**		3.4	3.9
B-47		**M-471**		4.1	4.5
B-55		**M-551**		3.6	4.1
B-56		**M-561**		4.5	4.8
B-57		**M-571**		5.0	5.4
B-59		**M-591**		6.4	6.8
	BH-57		**MH-571**	6.4	6.8
B-65		**M-651**		4.1	4.5
B-66		**M-661**		5.0	5.4
B-67		—		5.9	—
B-68		**M-681**		6.8	7.3
B-69		—		7.7	—
B-610		**M-6101**		8.6	9.1
	BH-68		**MH-681**	9.1	9.5



SOLID NEEDLE ROLLER BEARINGS

METRIC DESIGN

		Pages
RLM · LM, RNA · NA	Inscribed Circle Diameter 8–115 mm	B 96–B109
RNA · NA	Inscribed Circle Diameter 120–490 mm	B110–B113
RNAF · NAF, RNAFW · NAFW	Inscribed Circle Diameter 10–100 mm	B114–B117
RNA···TT, NA···TT	Inscribed Circle Diameter 14–125 mm	B118–B121

INCH DESIGN

HJ, HJ+IR	Inscribed Circle Diameter 15.875–234.950 mm	B122–B127

Solid needle roller bearings are high-accuracy bearings with maximum load capacity within a limited space for various operating conditions.

Made of carefully selected vacuum-degassed bearing steel or carburizing steel, the raceway rings are finished with accurate grinding after heat treatment. The outer rings have strong integrated ribs and contain high-accuracy rollers that have the proper crowning finish. Lightweight and extremely strong, the cage guides the rollers accurately and smoothly.

DESIGN AND TYPES

Solid needle roller bearings come in various types ranging from the light to heavy load use of the metric bearings to heavy load use of inch bearings. Each type is available in series with and without an inner ring, and both series are shown in the same bearing table. Types of solid needle roller bearings are shown in **Table 1**, while the composition of bearing numbers is shown in **Table 2**.

Among NSK solid needle roller bearings, the RNA, NA49, 59, 69 and 48 series follow the international dimension system that conforms to ISO standards.

HJ, HJ + IR series of inch bearings are widely used globally and conform to the MIL standards of the U.S.A.

RLM and LM types are bearings whose section height is close to that of drawn cup needle bearings.

Nominal Bore Diameter, d, or Nominal Outside Diameter, D (mm)		Single Plane Mean Bore Diameter Deviation, Δ_{dmp}		Single Plane Mean Outside Diameter Deviation, Δ_{Dmp}		Inner Ring Width Deviation, Δ_{Bs}		Outer Ring Width Deviation, Δ_{Cs}		Radial Runout of Assembled Inner Ring, K_{ia}	Radial Runout of Assembled Outer Ring, K_{ea}
over	incl	high	low	high	low	high	low	high	low	max	max
7.938 (5											

Table 7 Shaft Inclination

Bearing Width (mm)		Permissible Inclination (mm/mm)
over	incl	With cage
—	25	0.0015
25	50	0.0010
50	—	0.0005

Fitting

Depending on the application, the outer ring of NSK solid needle roller bearings is used with either a transitional fit or a tight fit.

Recommended fittings for solid needle roller bearings are shown in **Table 8**.Table 80 Tmari -0.0009 Tc(mm)Tj/F2 1 T0xolerw D(3.6)Tjcbe2 TDyu 9 Abutor1beari2mec(8)Tj7a NSK e1elid needle rlm443Q6e 8Fs fid needer bearined whe NAFownouter r, v beous radiionv

Table 8 Recommended Fittings for Solid Needle Roller Bearings

Units: mm

Code		Fitting Tolerance			
		Shaft or Inner Ring Rotation		Outer Ring Rotation	
		Shaft	Housing Bore	Shaft	Housing Bore
RLM, RNA RNAF HJ	Without Inner Ring	h5 ($F_w \leqq 80$) g6 ($180 \geqq F_w > 80$) f6 ($F_w > 180$)	H7	g5 ($F_w \leqq 80$) f6 ($180 \geqq F_w > 80$) e6 ($F_w > 180$)	N7
LM, NA NAF HJ+IR	With Inner Ring	k5 ($d \leqq 50$) m5 ($d > 50$)	H7	g6	N7

Remarks For metric needle bearings with an inner ring, if the inner and outer rings are fitted tighter than class k and K, respectively, a bearing with an internal clearance greater than CN clearance should be selected.

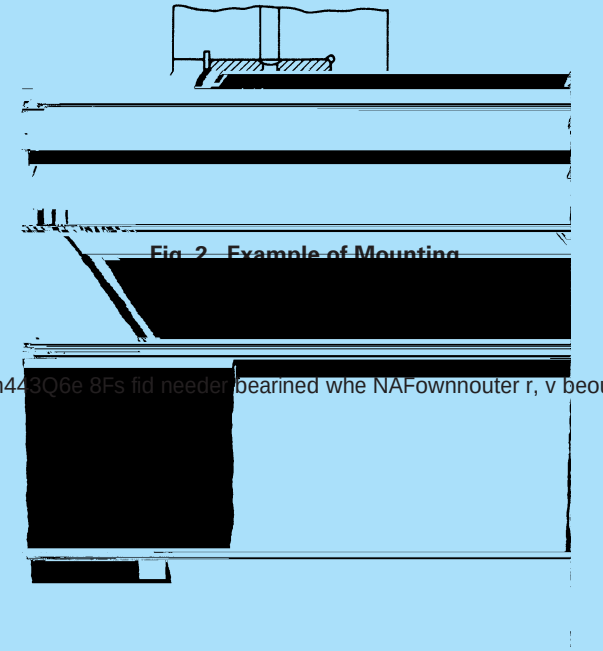


Fig. 3 Example of Mounting for RNAF and NAF

Table 9 Abutment and Fillet Dimensions for RNAF and NAF

Units: mm

Nominal Inscribed Circle Diameter, F_w		Category of D/F_w	c	h
over	incl			
8	12	$D/F_w < 2.0$ $D/F_w \geqq 2.0$	0.15 0.3	1.35 2.8
12	22	$D/F_w < 1.59$ $D/F_w \geqq 1.59$	0.2 0.3	1.8 2.8
22	30	$D/F_w < 1.48$ $D/F_w \geqq 1.48$	0.3 0.4	2.2 3.2
30	55	$D/F_w < 1.34$ $D/F_w \geqq 1.34$	0.3 0.5	2.2 3.6
55	100	—	0.5	3.6

RLM • LM
RNA • NA
Inscribed Circle
Diameter 8 — 15 mm

Boundary Dimensions (mm)				Basic Load Ratings (N)		{kgf}		Limiting Speeds (min^{-1})	Bearing Numbers		Boundary Dimensions (mm)		Mass (kg) approx	
F_w	D	C	r min	C_r	C_{or}	C_r	C_{or}	Oil	Without Inner Ring	With Inner Ring	d	B	Without Inner Ring	With Inner Ring
8	15	10	0.15	4 300	3 800	440	390	60 000	**RNA496**	—	—	—	0.0070	—
	15	12	0.15	5 500	4 600	560	470	45 000	**RLM81512-1**	**LM81512-1**	5	12	0.0083	0.011
	15	15	0.3	6 550	5 800	670	590	45 000	**RLM815**	—	—	—	0.010	—
	15	16	0.15	7 100	6 350	720	650	45 000	**RLM81516-1**	**LM81516-1**	5	16	0.011	0.015
9	16	12	0.3	6 150	5 400	625	550	40 000	**RLM912**	**LM91612-1**	6	12	0.0092	0.013
	16	16	0.3	7 900	7 450	805	760	40 000	**RLM916**	—	—	—	0.011	—
	17	10	0.15	4 700	4 350	470	445	50 000	**RNA497**	—	—	—	0.0091	—
10	15	10	0.3	4 500	4 900	460	500	36 000	**RLM1010**	—	—	—	0.0055	—
	17	10	0.3	5 350	4 650	545	470	36 000	**RLM101710**	—	—	—	0.0082	—
	17	12	0.15	6 750	6 200	685	635	36 000	**RLM101712-1**	**LM101712-1**	7	12	0.0097	0.014
	17	15	0.3	8 050	7 800	820	795	36 000	**RLM101715**	—	—	—	0.012	—
	17	16	0.15	8 650	8 600	885	875	36 000	**RLM101716-1**	**LM101716-1**	7	16	0.013	0.018
	19	11	0.2	6 550	6 000	670	615	48 000	**RNA498**	**NA498**	8	11	0.012	0.015
12	17	12	0.3	6 150	7 650	625	780	30 000	**RLM1212**	**LM1212**	8	12.2	0.0076	0.013
	19	12	0.3	7 300	7 150	745	730	30 000	**RLM121912**	**LM121912**	8	12.2	0.011	0.017
	19	15	0.3	8 700	8 950	885	915	30 000	**RLM121915**	**LM121915**	8	15.2	0.014	0.021
	19	16	0.3	9 400	9 850	955	1 010	30 000	**RLM121916-1**	**LM121916-1**	9	16	0.014	0.022
	19	20	0.3	12 000	13 500	1 220	1 380	30 000	**RLM121920-1**	—	—	—	0.018	—
	20	11	0.3	7 050	6 850	720	700	38 000	**RNA499**	**NA499**	9	11	0.013	0.017
14	22	12	0.3	9 350	9 150	955	935	24 000	**RLM1412**	—	—	—	0.014	—
	22	13	0.3	9 150	9 950	930	1 010	32 000	**RNA4900**	**NA4900**	10	13	0.016	0.024
	22	16	0.3	12 100	12 700	1 230	1 300	24 000	**RLM1416**	**LM1416**	10	16.2	0.019	0.028
	22	16	0.3	11 600	13 600	1 190	1 390	32 000	**RNA5900**	**NA5900**	10	16	0.022	0.031
	22	20	0.3	15 500	17 500	1 580	1 790	24 000	**RLM1420**	**LM1420**	10	20.2	0.024	0.036
	22	22	0.3	16 300	20 900	1 660	2 130	32 000	**RNA6900**	**NA6900**	10	22	0.027	0.040
15	20	8	0.3	4 050	4 800	415	490	24 000	**RLM158**	**LM158**	10	8.2	0.0061	0.012
	20	15	0.3	8 100	11 700	825	1 190	24 000	**RLM1515**	**LM1515**	10	15.2	0.011	0.022
	20	20	0.3	11 100	17 400	1 130	1 770	24 000	**RLM1520**	**LM1520**	10	20.2	0.015	0.030
	22	12	0.3	8 300	8 900	845	905	24 000	**RLM152212**	**LM152212**	10	12.2	0.013	0.022
	22	15	0.3	9 900	11 100	1 010	1 140	24 000	**RLM152215**	**LM152215**	10	15.2	0.016	0.027
	22	20	0.3	13 600	16 800	1 390	1 710	24 000	**RLM152220**	**LM152220**	10	20.2	0.021	0.036
	23	16	0.3	12 300	14 800	1 250	1 510	24 000	**RLM152316-1**	—	—	—	0.021	—
	23	20	0.3	15 500	20 100	1 590	2 050	24 000	**RLM152320-1**	—	—	—	0.026	—

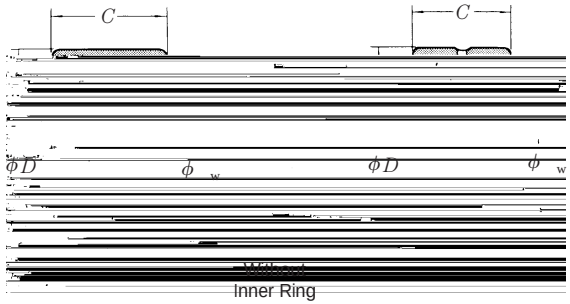
24	13	10 100	11 700	28 000
24	16	12 900	14 200	22 000
24	16	12 800	16 000	28 000
24	20	16 500	19 500	22 000
24	22	17 900	24 500	28 000
22	10	5 850	7 950	20 000
22	20	11 800	19 500	20 000
24	15	11 000	13 200	20 000
24	25	18 200	25 300	20 000
25	16	13 600	15 500	20 000
25	20	16 200	21 900	20 000
25	15	11 500	14 300	20 000
25	17	13 300	17 200	20 000
25	20	15 800	21 500	20 000
25	25	19 000	27 300	20 000
26	13	10 500	12 700	24 000
26	16	12 700	16 200	20 000
26	20	16 100	22 000	20 000
27	16	14 300	17 000	18 000
27	20	18 300	23 400	18 000
27	10	7 950	9 150	18 000
27	15	11 900	15 400	18 000
27	20	16 400	23 200	18 000
27	20	16 400	23 200	18 000
27	25	19 800	29 500	18 000
28	13	10 800	13 600	22 000
28	16	14 400	19 700	18 000
28	18	15 700	21 900	22 000
28	20	18 200	23 500	18 000
28	23	19 300	28 600	22 000
29	16	14 900	18 500	17 000
29	20	19 100	25 400	17 000

12	13	
12	16.2	
12	16	
12	10(17)T(15)T0 -1.868 60 -1.0/ 1 1 T	
12	21 9 T -1.0 T 6.2	
12		
12		
12	216.2	
12		
—		
—		
15		
15		
15		
15		
—		
—		
—		
15		
15		
15		
15		
15		
15		
15		
15		
15		
15		
15		
17		
17		

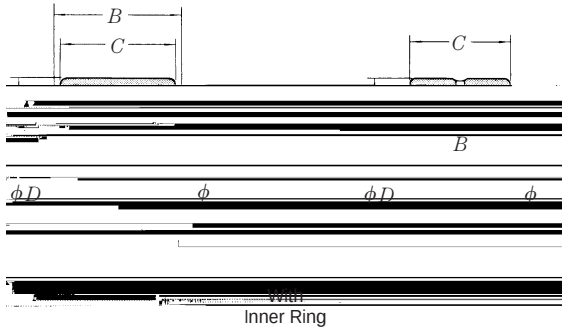
RLM • LM

RNA • NA

Inscribed Circle
Diameter 30 — 38 mm



RLM RNA



LM NA

Boundary Dimensions (mm)				Basic Load Ratings (N)		{kgf}		Limiting Speeds (min^{-1})
F_w	D	C	r min	C_r	C_{or}	C_r	C_{or}	Oil
30	37	15	0.5	14 800	23 000	1 500	2 340	12 000
	37	20	0.5	20 300	34 500	2 070	3 550	12 000
	37	25	0.5	24 500	44 000	2 490	4 500	12 000
	40	20	0.5	25 000	36 000	2 550	3 650	12 000
	40	25	0.5	30 000	46 000	3 100	4 650	12 000
	40	30	0.5	35 000	56 000	3 600	5 700	12 000
	42	17	0.3	21 400	26 800	2 180	2 740	14 000
	42	23	0.3	30 000	41 500	3 100	4 250	14 000
	42	30	0.3	39 500	59 000	4 050	6 050	14 000
32	42	20	0.5	25 800	38 000	2 630	3 900	11 000
	42	30	0.5	36 500	59 000	3 700	6 050	11 000
	45	17	0.3	22 200	28 700	2 270	2 930	13 000
	45	23	0.3	31 500	44 500	3 200	4 550	13 000
	45	30	0.3	41 000	63 500	4 200	6 450	13 000
35	42	20	0.5	22 300	41 000	2 270	4 200	10 000
	42	30	0.5	31 000	63 500	3 200	6 450	10 000
	45	20	0.5	27 500	42 500	2 800	4 350	10 000
	45	25	0.5	33 000	54 500	3 400	5 550	10 000
	45	30	0.5	38 500	66 000	3 950	6 750	10 000
	47	17	0.3	23 900	32 500	2 430	3 300	12 000
	47	23	0.3	33 500	50 500	3 450	5 150	12 000
	47	30	0.3	44 000	71 500	4 500	7 300	12 000
37	47	20	0.6	28 200	45 000	2 880	4 550	9 500
	47	30	0.6	39 500	69 500	4 050	7 100	9 500
	47	30	0.6	39 500	69 500	4 050	7 100	9 500
38	48	15	0.6	20 900	30 500	2 130	3 150	9 000
	48	20	0.6	29 000	47 000	2 960	4 800	9 000
	48	25	0.6	35 000	60 000	3 600	6 100	9 000
	48	30	0.6	41 000	73 000	4 150	7 450	9 000

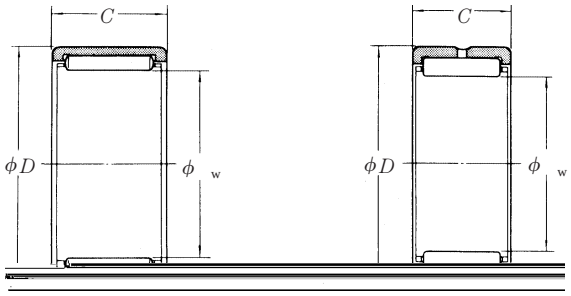
Bearing Numbers					Boundary Dimensions (mm)		Mass (kg) approx	
Without Inner Ring				With Inner Ring				
RLM	RNA49	RNA59	RNA69	LM · NA	d	B	Without Inner Ring	With Inner Ring
RLM3015				**LM3015**	25	15.2	0.030	0.055
RLM3020				**LM3020**	25	20.2	0.040	0.073
RLM3025				**LM3025**	25	25.2	0.050	0.092
RLM304020				**LM304020**	25	20.2	0.060	0.093
RLM304025				**LM304025**	25	25.2	0.075	0.12
RLM304030				**LM304030**	25	30.2	0.090	0.14
	RNA4905			**NA4905**	25	17	0.063	0.091
		RNA5905		**NA5905**	25	23	0.10	0.14
			RNA6905	**NA6905**	25	30	0.11	0.16
RLM3220				**LM3220**	28	20.2	0.064	0.090
RLM3230				**LM3230**	28	30.2	0.096	0.14
	RNA49/28			**NA49/28**	28	17	0.076	0.099
		RNA59/28		**NA59/28**	28	23	0.11	0.145
			RNA69/28	**NA69/28**	28	30	0.13	0.175
RLM3520				**LM3520**	30	20.2	0.046	0.085
RLM3530				**LM3530**	30	30.2	0.070	0.13
RLM354520				**LM354520**	30	20.2	0.069	0.11
RLM354525				**LM354525**	30	25.2	0.086	0.135
RLM354530				**LM354530**	30	30.2	0.10	0.16
	RNA4906			**NA4906**	30	17	0.072	0.105
		RNA5906		**NA5906**	30	23	0.11	0.15
			RNA6906	**NA6906**	30	30	0.13	0.19
RLM3720				**LM3720**	32	20.3	0.072	0.115
RLM3730				**LM3730**	32	30.3	0.11	0.175
RLM374730-1				**LM374730-1**	32	30	0.11	0.17
RLM3815				**LM3815**	32	15.3	0.056	0.094
RLM3820				**LM3820**	32	20.3	0.074	0.125
RLM3825				**LM3825**	32	25.3	0.093	0.16
RLM3830				**LM3830**	32	30.3	0.11	0.195

Remarks 1. For information on inner rings, refer to page B129.
2. If a full complement roller bearing is required, please contact NSK.

RLM • LM

RNA • NA

Inscribed Circle
Diameter 75 — 115 mm



92	25	64 000	118 000	4 800
92	35	88 000	177 000	4 800
95	30	83 500	148 000	5 600
95	25	62 500	125 000	4 500
95	35	86 000	189 000	4 500
100	30	80 500	143 000	5 300
100	40	107 000	206 000	5 300
100	54	143 000	298 000	5 300
105	25	79 000	143 000	4 000
105	30	84 000	155 000	5 000
105	35	109 000	215 000	4 000
105	40	112 000	222 000	5 000
105	54	149 000	325 000	5 000
110	25	82 500	154 000	4 000
110	30	87 500	166 000	4 500
110	40	116 000	239 000	4 500
110	54	155 000	345 000	4 500
115	26	85 500	164 000	3 600
115	30	95 500	189 000	4 300
120	26	86 000	168 000	3 600
120	35	104 000	214 000	4 000
120	46	138 000	310 000	4 000
120	63	174 000	415 000	4 000
125	35	108 000	228 000	4 000
125	46	143 000	330 000	4 000
125	63	181 000	445 000	4 000
130	30	101 000	213 000	3 200
130	35	111 000	242 000	3 800
130	40	134 000	305 000	3 200
130	46	148 000	350 000	3 800
130	63	187 000	470 000	3 800
140	40	144 000	295 000	3 600
140	54	193 000	430 000	3 600

—	—		0.315
—	—		0.44
—	—		0.46
70	25		0.29
70	35		0.405
70	30		0.47
70	40		0.69
70	54		0.89
75	25		0.42
75	30		0.54391 T
75	35		0I0004 T(0.39(0.54391 T)T6
75	40		0.46
75	54		
80	25		
80	30		
80	40		
80	54		
85	26		
—	—		
90	26		
85	35		
85	46		
85	63		
90	35		
90	46		
90	63		
—	—		
95	35		
—	—		
95	46		
95	63		
100	40		
100	54		

RNA • NA

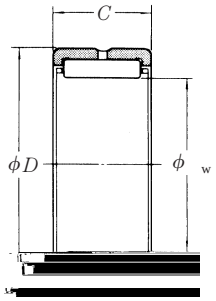
Inscribed Circle Diameter 120 — 265 mm

Boundary Dimensions (mm)				Basic Load Ratings (N)		{kgf}		
F_w	D	B, C	r min	C_r	C_{or}	C_r	C_{or}	
120	140	30	1	99 500	214 000	10 100	21 900	3 400
125	150	40	1.1	149 000	315 000	15 200	32 500	3 200
	150	54	1.1	200 000	460 000	20 300	47 000	3 200
130	150	30	1	105 000	238 000	10 700	24 300	3 200
135	165	45	1.1	192 000	395 000	19 600	40 500	3 000
	165	60	1.1	253 000	565 000	25 800	58 000	3 000
145	165	35	1.1	127 000	315 000	12 900	32 000	2 800
150	180	50	1.5	228 000	515 000	23 200	52 500	2 800
	180	67	1.5	299 000	725 000	30 500	74 000	2 800
155	175	35	1.1	133 000	340 000	13 600	35 000	2 600
160	190	50	1.5	235 000	545 000	24 000	55 500	2 600
	190	67	1.5	310 000	775 000	31 500	79 000	2 600
165	190	40	1.1	180 000	440 000	18 300	45 000	2 400
170	210	60	2	315 000	645 000	32 000	66 000	2 400
175	200	40	1.1	184 000	465 000	18 700	47 000	2 200
180	220	60	2	325 000	695 000	33 500	71 000	2 200
185	215	45	1.1	224 000	540 000	22 900	55 000	2 200
190	230	60	2	340 000	745 000	34 500	76 000	2 200
195	225	45	1.1	230 000	565 000	23 500	58 000	2 000
205	250	69	2	400 000	940 000	41 000	96 000	2 000
210	240	50	1.5	268 000	705 000	27 300	72 000	1 900
215	260	69	2	415 000	1 000 000	42 000	102 000	1 900
220	250	50	1.5	274 000	740 000	27 900	75 500	1 800
225	280	80	2.1	525 000	1 140 000	53 500	116 000	1 900
240	270	50	1.5	286 000	805 000	29 100	82 000	1 700
245	300	80	2.1	545 000	1 230 000	55 500	125 000	1 700
265	300	60	2	375 000	1 070 000	38 500	109 000	1 500
	320	80	2.1	590 000	1 400 000	60 500	142 000	1 600

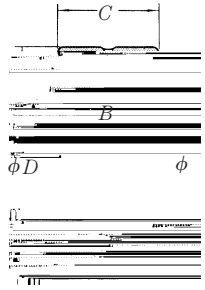
				Boundary Dimensions (mm)	Mass (kg)	
				d	approx	
RNA4822			**NA4822**	110	0.67	1.1
	RNA4922		**NA4922**	110	1.25	2.1
		RNA5922	**NA5922**	110	1.95	3.05
RNA4824			**NA4824**	120	0.71	1.15
	RNA4924		**NA4924**	120	1.9	2.9
		RNA5924	**NA5924**	120	2.7	4.05
RNA4826			**NA4826**	130	0.92	1.8
	RNA4926		**NA4926**	130	2.3	4.0
		RNA5926	**NA5926**	130	3.3	5.55
RNA4828			**NA4828**	140	0.98	1.9
	RNA4928		**NA4928**	140	2.45	4.25
		RNA5928	**NA5928**	140	3.55	6.0
RNA4830			**NA4830**	150	1.6	2.75
	RNA4930		**NA4930**	150	3.9	6.25
RNA4832			**NA4832**	160	1.75	2.95
	RNA4932		**NA4932**	160	4.1	6.6
RNA4834			**NA4834**	170	2.55	4.0
	RNA4934		**NA4934**	170	4.3	6.95
RNA4836			**NA4836**	180	2.65	4.2
	RNA4936		**NA4936**	180	6.2	10
RNA4838			**NA4838**	190	3.2	5.6
	RNA4938		**NA4938**	190	6.45	10.5
RNA4840			**NA4840**	200	3.35	5.9
	RNA4940		**NA4940**	200	9.7	15
RNA4844			**NA4844**	220	3.65	6.45
	RNA4944		**NA4944**	220	10	15.5
RNA4848			**NA4848**	240	5.45	10
	RNA4948		**NA4948**	240	11.5	17.5

RNA • NA

Inscribed Circle Diameter 285 — 490 mm



RNA



NA

Boundary Dimensions (mm)				Basic Load Ratings (N)		{kgf}		Limiting Speeds (min^{-1})
F_w	D	B, C	r min	C_r	C_{or}	C_r	C_{or}	Oil
285	320	60	2	395 000	1 160 000	40 000	118 000	1 400
290	360	100	2.1	870 000	1 910 000	88 500	194 000	1 400
305	350	69	2	510 000	1 390 000	52 000	142 000	1 300
310	380	100	2.1	905 000	2 050 000	92 500	209 000	1 300
330	380	80	2.1	660 000	1 810 000	67 500	185 000	1 200
340	420	118	3	1 150 000	2 630 000	117 000	269 000	1 200
350	400	80	2.1	675 000	1 900 000	69 000	194 000	1 100
360	440	118	3	1 190 000	2 820 000	122 000	288 000	1 100
370	420	80	2.1	690 000	1 990 000	70 500	203 000	1 100
380	460	118	3	1 240 000	3 000 000	126 000	305 000	1 100
390	440	80	2.1	705 000	2 080 000	72 000	212 000	1 000
400	480	118	3	1 280 000	3 200 000	130 000	325 000	1 000
415	480	100	2.1	1 030 000	2 940 000	105 000	299 000	1 000
430	520	140	4	1 550 000	3 750 000	158 000	385 000	950
450	540	140	4	1 600 000	4 000 000	164 000	410 000	900
470	560	140	4	1 660 000	4 250 000	170 000	435 000	900
490	600	160	4	1 980 000	4 750 000	202 000	485 000	850

Bearing Numbers				Boundary Dimensions (mm)	Mass (kg) approx	
Without Inner Ring			With Inner Ring			
RNA48	RNA49	RNA59	NA	d	Without Inner Ring	With Inner Ring
RNA4852			**NA4852**	260	5.9	11
	RNA4952		**NA4952**	260	19.5	29.5
RNA4856			**NA4856**	280	9.5	15.5
	RNA4956		**NA4956**	280	20.5	31
RNA4860			**NA4860**	300	13	22
	RNA4960		**NA4960**	300	30	48.5
RNA4864			**NA4864**	320	13.5	23.5
	RNA4964		**NA4964**	320	32	51.5
RNA4868			**NA4868**	340	14	24.5
	RNA4968		**NA4968**	340	33.5	54
RNA4872			**NA4872**	360	15	26
	RNA4972		**NA4972**	360	35.5	57
RNA4876			**NA4876**	380	25.5	42.5
	RNA4976		**NA4976**	380	50.5	85.5
	RNA4980		**NA4980**	400	52.5	89
	RNA4984		**NA4984**	420	54.5	92.5
	RNA4988		**NA4988**	440	81.5	125

Remarks 1. For information on inner rings, refer to page B129.
2. If a full complement roller bearing is required, please contact NSK.

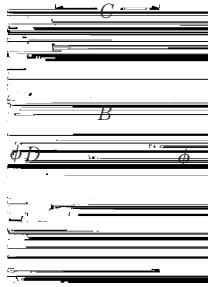
RNA···TT (Sealed, Without Inner Ring)

NA···TT (Sealed, With Inner Ring)

Inscribed Circle Diameter 14 — 52 mm

RNA···TT Sealed, Without Inner Ring

NA Sealed, With



NA···TT

55	70	22	0.6	38 500	63 500	3 900	6 450	3 400	**RNA49/48TT**
58	72	22	0.6	38 000	63 500	3 850	6 500	3 200	**RNA4910TT**
	72	40	0.6	73 000	148 000	7 450	15 100	3 200	**RNA6910TT**
63	80	25	1	47 500	76 000	4 850	7 750	3 000	**RNA4911TT**
	80	45	1	90 000	172 000	9 200	17 500	3 000	**RNA6911TT**
68	85	25	1	50 000	82 500	5 100	8 450	2 800	**RNA4912TT**
	85	45	1	94 500	187 000	9 600	19 100	2 800	**RNA6912TT**
72	90	25	1	52 500	89 500	5 350	9 100	2 600	**RNA4913TT**
	90	45	1	99 000	203 000	10 100	20 700	2 600	**RNA6913TT**
80	100	30	1	70 000	120 000	7 150	12 200	2 200	**RNA4914TT**
	100	54	1	130 000	264 000	13 200	26 900	2 200	**RNA6914TT**
85	105	30	1	77 000	139 000	7 850	14 100	2 200	**RNA4915TT**
	105	54	1	136 000	286 000	13 800	29 100	2 200	**RNA6915TT**
90	110	30	1	76 500	139 000	7 800	14 200	2 000	**RNA4916TT**
	110	54	1	141 000	305 000	14 400	31 500	2 000	**RNA6916TT**
100	120	35	1.1	94 500	189 000	9 600	19 300	1 900	**RNA4917TT**
	120	63	1.1	167 000	395 000	17 100	40 000	1 900	**RNA6917TT**
105	125	35	1.1	98 000	201 000	10 000	20 500	1 800	**RNA4918TT**
	125	63	1.1	173 000	420 000	17 700	43 000	1 800	**RNA6918TT**
110	130	35	1.1	101 000	214 000	10 300	21 800	1 700	**RNA4919TT**
	130	63	1.1	181 000	450 000	18 500	46 000	1 700	**RNA6919TT**
115	140	40	1.1	131 000	261 000	13 400	26 600	1 600	**RNA4920TT**
125	150	40	1.1	136 000	279 000	13 800	28 500	1 500	**RNA4922TT**

—	—	—	0.18	—
NA4910TT	50	23	0.18	0.30
NA6910TT	50	41	0.32	0.535
NA4911TT	55	26	0.26	0.405
NA6911TT	55	46	0.475	0.735
NA4912TT	60	26	0.28	0.44
NA6912TT	60	46	0.485	0.765
NA4913TT	65	26	0.32	0.47
NA6913TT	65	46	0.53	0.795
NA4914TT	70	31	0.47	0.75
NA6914TT	70	55	0.89	1.4
NA4915TT	75	31	0.50	0.80
NA6915TT	75	55	0.96	1.5
NA4916TT	80	31	0.53	0.845
NA6916TT	80	55	0.99	1.55
NA4917TT	85	36	0.68	1.25
NA6917TT	85	64	1.2	2.25
NA4918TT	90	36	0.72	1.35
NA6918TT	90	64	1.35	2.45
NA4919TT	95	36	0.74	1.4
NA6919TT	95	64	1.5	2.65
NA4920TT	100	41	1.15	1.95
NA4922TT	110	41	1.25	2.1

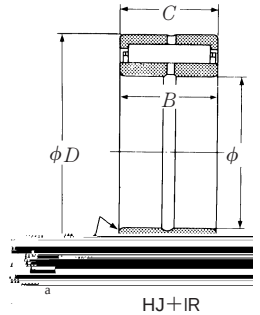
HJ (Single-Row, Without Inner Ring)

HJ + IR (Single-Row, With Inner Ring)

Inscribed Circle Diameter 15.875 — 44.450 mm



HJ



HJ+IR

* Fillet Radius of Shaft, Housing

Bearing Numbers (Without Inner Ring)	Boundary Dimensions (mm, inch) F_w		D		C		Basic Load Ratings (N) C_r	C_{or}	{kgf} C_r	C_{or}	Limiting Speeds (min^{-1}) Oil
15.875	0.6250	28.575	1.1250	19.05	0.7500		18 600	19 400	1 890	1 980	30 000
19.050	0.7500	31.750	1.2500	19.05	0.7500		19 800	21 900	2 020	2 230	24 000
		31.750	1.2500	25.40	1.0000		26 800	32 000	2 730	3 300	24 000
22.225	0.8750	34.925	1.3750	19.05	0.7500		22 100	26 200	2 260	2 670	20 000
		34.925	1.3750	25.40	1.0000		29 900	38 500	3 050	3 950	20 000
25.400	1.0000	38.100	1.5000	19.05	0.7500		24 200	30 500	2 470	3 100	17 000
		38.100	1.5000	25.40	1.0000		32 500	45 000	3 350	4 600	17 000
28.575	1.1250	41.275	1.6250	25.40	1.0000		35 500	51 500	3 600	5 250	15 000
		41.275	1.6250	31.75	1.2500		44 000	68 000	4 500	6 950	15 000
31.750	1.2500	44.450	1.7500	25.40	1.0000		36 500	55 000	3 700	5 600	13 000
		44.450	1.7500	31.75	1.2500		45 500	72 500	4 600	7 400	13 000
34.925	1.3750	47.625	1.8750	25.40	1.0000		38 500	61 000	3 950	6 250	12 000
		47.625	1.8750	31.75	1.2500		48 000	81 000	4 900	8 250	12 000
38.100	1.5000	52.388	2.0625	25.40	1.0000		46 000	68 500	4 650	7 000	11 000
		52.388	2.0625	31.75	1.2500		57 000	91 000	5 850	9 300	11 000
41.275	1.6250	55.562	2.1875	25.40	1.0000		47 000	72 500	4 800	7 400	10 000
		55.562	2.1875	31.75	1.2500		58 500	96 500	6 000	9 850	10 000
44.450	1.7500	58.738	2.3125	25.40	1.0000		48 000	76 500	4 900	7 800	9 500
		58.738	2.3125	31.75	1.2500		60 000	102 000	6 150	10 400	9 500

Bearing Numbers (Without Inner Ring)	Boundary Dimensions (mm, inch) d		B		Matching Inner Rings	* (mm) r_a max	Mass (kg) approx Without Inner Ring	With Inner Ring
HJ-101812	9.525	0.3750	19.05	0.7500	**IR-061012**	0.6	0.050	0.068
HJ-122012	12.700	0.5000	19.05	0.7500	**IR-081212**	1	0.054	0.081
HJ-122016	12.700	0.5000	25.40	1.0000	**IR-081216**	1	0.073	0.11
HJ-142212	15.875	0.6250	19.05	0.7500	**IR-101412**	1	0.064	0.090
	17.462	0.6875	19.05	0.7500	**IR-111412**	1	0.064	0.087
HJ-142216	15.875	0.6250	25.40	1.0000	**IR-101416**	1	0.082	0.115
HJ-162412	19.050	0.7500	19.05	0.7500	**IR-121612**	1	0.068	0.10
HJ-162416	19.050	0.7500	25.40	1.0000	**IR-121616**	1	0.091	0.135
	20.638	0.8125	25.40	1.0000	**IR-131616**	1	0.091	0.125
HJ-182616	22.225	0.8750	25.40	1.0000	**IR-141816**	1	0.10	0.15
	23.812	0.9375	25.40	1.0000	**IR-151816**	1	0.10	0.14
HJ-182620	22.225	0.8750	31.75	1.2500	**IR-141820**	1	0.13	0.195
	23.812	0.9375	31.75	1.2500	**IR-151820**	1	0.13	0.18
HJ-202816	25.400	1.0000	25.40	1.0000	**IR-162016**	1	0.11	0.17
HJ-202820	25.400	1.0000	31.75	1.2500	**IR-162020**	1	0.14	0.215
HJ-223016	28.575	1.1250	25.40	1.0000	**IR-182216**	1	0.12	0.185
HJ-223020	28.575	1.1250	31.75	1.2500	**IR-182220**	1	0.155	0.23
HJ-243316	31.750	1.2500	25.40	1.0000	**IR-202416**	1.5	0.155	0.23
HJ-243320	30.162	1.1875	31.75	1.2500	**IR-192420**	1.5	0.195	0.30
	31.750	1.2500	31.75	1.2500	**IR-202420**	1.5	0.195	0.285
HJ-263516	33.338	1.3125	25.40	1.0000	**IR-212616**	1.5	0.16	0.255
HJ-263520	33.338	1.3125	31.75	1.2500	**IR-212620**	1.5	0.20	0.32
	34.925	1.3750	31.75	1.2500	**IR-222620**	1.5	0.20	0.30
HJ-283716	36.512	1.4375	25.40	1.0000	**IR-232816**	1.5	0.17	0.27
	38.100	1.5000	25.40	1.0000	**IR-242816**	1.5	0.17	0.265
HJ-283720	34.925	1.3750	31.75	1.2500	**IR-222820**	1.5	0.215	0.36
	36.512	1.4375	31.75	1.2500	**IR-232820**	1.5	0.215	0.34
	38.100	1.5000	31.75	1.2500	**IR-242820**	1.5	0.215	0.315

Remarks 1. For bearings with inner rings, the inner ring number is written separately from the Bearing number.
Example: HJ-202816 + IR-162016
2. If a full complement roller bearing is required, please contact NSK.

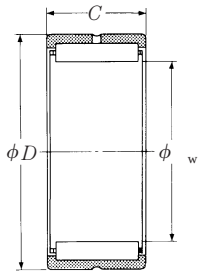
HJ (Single-Row, Without Inner Ring)

HJ + IR (Single-Row

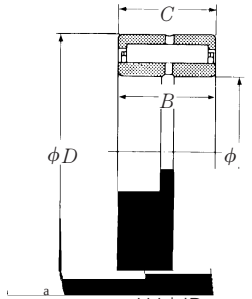
HJ (Single-Row, Without Inner Ring)

HJ + IR (Single-Row, With Inner Ring)

Inscribed Circle Diameter 107.950 — 234.950 mm



HJ



HJ+IR

* Fillet Radius of Shaft, Housing

Bearing Numbers Without Inner Ring	Boundary Dimensions (mm, inch) F_w		D		C		Basic Load Ratings (N) C_r	C_{or}	{kgf} C_r	C_{or}	Limiting Speeds (min^{-1}) Oil
107.950	4.2500	133.350	5.2500	50.80	2.0000		205 000	445 000	20 900	45 500	3 800
114.300	4.5000	152.400	6.0000	57.15	2.2500		290 000	525 000	29 600	53 500	3 800
		152.400	6.0000	63.50	2.5000		325 000	600 000	33 000	61 500	3 800
127.000	5.0000	165.100	6.5000	50.80	2.0000		279 000	515 000	28 400	52 500	3 400
		165.100	6.5000	57.15	2.2500		315 000	600 000	32 000	61 000	3 400
		165.100	6.5000	63.50	2.5000		350 000	685 000	35 500	70 000	3 400
139.700	5.5000	177.800	7.0000	63.50	2.5000		350 000	715 000	36 000	73 000	3 000
		177.800	7.0000	76.20	3.0000		415 000	890 000	42 500	91 000	3 000
146.050	5.7500	184.150	7.2500	76.20	3.0000		425 000	925 000	43 500	94 500	2 800
152.400	6.0000	190.500	7.5000	63.50	2.5000		375 000	795 000	38 000	81 500	2 800
		190.500	7.5000	76.20	3.0000		445 000	995 000	45 000	101 000	2 800
165.100	6.5000	203.200	8.0000	63.50	2.5000		385 000	855 000	39 500	87 000	2 400
		203.200	8.0000	76.20	3.0000		460 000	1 060 000	46 500	109 000	2 400
184.150	7.2500	231.775	9.1250	76.20	3.0000		535 000	1 140 000	54 500	117 000	2 200
196.850	7.7500	244.475	9.6250	76.20	3.0000		555 000	1 230 000	56 500	125 000	2 000
209.550	8.2500	257.175	10.1250	76.20	3.0000		575 000	1 310 000	58 500	133 000	2 000
222.250	8.7500	269.875	10.6250	76.20	3.0000		590 000	1 390 000	60 500	142 000	1 900
234.950	9.2500	282.575	11.1250	76.20	3.0000		610 000	1 470 000	62 000	150 000	1 800

Remarks 1. For bearings with inner rings, the inner ring number is written separately from the Bearing number.
Example: HJ-202816 + IR-162016
2. If a full complement roller bearing is required, please contact NSK.

Bearing Numbers Without Inner Ring	Boundary Dimensions (mm, inch) d		B		Matching Inner Rings	* (mm) r_a max	Mass (kg) approx Without Inner Ring	With Inner Ring
HJ-688432	88.900	3.5000	50.80	2.0000	**IR-566832**	2.5	1.5	2.65
	95.250	3.7500	50.80	2.0000	**IR-606832**	2.5	1.5	2.5
HJ-729636	95.250	3.7500	57.15	2.2500	**IR-607236**	2.5	2.75	4.15
HJ-729640	95.250	3.7500	63.50	2.5000	**IR-607240**	2.5	3.05	4.6
HJ-8010432	—	—	—	—	—	2.5	2.4	—
HJ-8010436	101.600	4.0000	57.15	2.2500	**IR-648036**	2.5	2.9	4.95
	107.950	4.2500	57.15	2.2500	**IR-688036**	2.5	2.9	4.45
HJ-8010440	101.600	4.0000	63.50	2.5000	**IR-648040**	2.5	3.3	5.55
HJ-8811240	114.300	4.5000	63.50	2.5000	**IR-728840**	2.5	3.6	6.1
HJ-8811248	114.300	4.5000	76.20	3.0000	**IR-728848**	2.5	4.25	7.2
HJ-9211648	120.650	4.7500	76.20	3.0000	**IR-769248**	3	4.55	7.7
HJ-9612040	127.000	5.0000	63.50	2.5000	**IR-809640**	3	3.9	6.65
HJ-9612048	127.000	5.0000	76.20	3.0000	**IR-809648**	3	4.75	8.1
HJ-10412840	139.700	5.5000	63.50	2.5000	**IR-8810440**	3	4.15	7.2
HJ-10412848	139.700	5.5000	76.20	3.0000	**IR-8810448**	3	4.75	8.4
HJ-11614648	152.400	6.0000	76.20	3.0000	**IR-9611648**	3	7.1	12
HJ-12415448	165.100	6.5000	76.20	3.0000	**IR-10412448**	3	7.5	13
HJ-13216248	177.800	7.0000	76.20	3.0000	**IR-11213248**	3	7.95	13.5
HJ-14017048	190.500	7.5000	76.20	3.0000	**IR-12014048**	4	8.35	14.5
HJ-14817848	203.200	8.0000	76.20	3.0000	**IR-12814048**	4	8.6	15

INNER RINGS FOR NEEDLE ROLLER BEARINGS

DRAWN CUP TYPE

Metric Design (FIR)	Bore Diameter	7−45 mm	B130−B135
Inch Design (IR)	Bore Diameter	9.525−38.100 mm	B136−B137

SOLID TYPE

Metric Design (FIR)	Bore Diameter	5−220 mm	B138−B151
Metric Design (FIR)	Bore Diameter	8−50 mm	B152−B155
Inch Design (IR)	Bore Diameter	9.525−203.200 mm	B156−B161

For use when shafts cannot be finished with proper accuracy and hardness, NSK produces inner rings that are made from carefully selected bearing steel and finished with heat treatment and grinding work.

TYPE

The various types of inner rings for needle roller bearings are shown in **Table 1**.

ACCURACY

Dimensional accuracy of the inner rings of NSK needle roller bearings conforms with ISO (refer to pages A26 and A27). Tolerances for inch inner rings are shown in the dimensional table for drawn cup bearings, and in **Table 3** on page B92 for solid bearings.

Table 1 Types of Inner Ring

Code	Details
FIR	Metric needle bearing combination
IR	Inch needle bearing combination

MOUNTING

The inner ring is mounted with the unmarked side placed onto the shaft shou614 -1.ilNG4.9.....itthe it A27). n pag showable for gs of Ned

FIR

Bore Diameter 7 — 15 mm

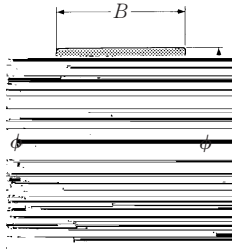
Matching Drawn Cup Needle Roller Bearings

F	FJ	FJL
—	—	FJL-1012L
—	FJ-1015	FJL-1015
—	FJ-1210	—
FJ-1212	FJH-1212	FJL-1212L
—	—	FJL-1215
F-1312	FJ-1312	—
F-1412	FJ-1412	—
F-1413	—	—
—	—	FJL-1416L
—	—	FJL-1420L
—	—	FJL-1510L
F-1512	FJ-1512	FJL-1512L
—	—	FJL-1515
—	—	FJL-1520
—	—	FJL-1525L
F-1512	FJ-1512	FJL-1512L
F-1516	FJ-1516	—
F-1612	FJ-1612	—
F-1616	FJ-1616	FJL-1616L
—	—	FJL-1620L
—	—	FJL-1715
—	—	FJL-1720L
—	—	FJL-1725L
F-1812	FJ-1812	—
—	—	FJL-1815
F-1816	FJ-1816	—
—	—	FJL-1820L
—	—	FJL-1825
—	—	FJL-2015
F-2020	FJ-2020	FJL-2020
—	—	FJL-2025L
—	—	FJL-2030L

INNER RINGS FOR DRAWN CUP NEEDLE ROLLER BEARINGS

FIR

Bore Diameter 17 — 30 mm

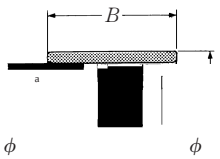


Boundary Dimensions (mm)				Inner Ring Numbers	Mass (g)	Matching Drawn Cup Needle Roller Bearings		
d	F h5	B	r min		approx	F	FJ	FJL
17	20	12.5	0.3	**FIR-172012**	8.5	F-2012	FJ-2012	—
	20	16.5	0.3	**FIR-172016**	11	F-2016	FJ-2016	—
	20	20.5	0.3	**FIR-172020**	14	F-2020	FJ-2020	FJL-2020
	22	10.5	0.3	**FIR-172210**	12	F-2210	—	FJL-2210L
	22	12.5	0.3	**FIR-172212**	15	F-2212	FJ-2212	—
	22	15.5	0.3	**FIR-172215**	18	—	—	FJL-2215L
	22	16.5	0.3	**FIR-172216**	20	F-2216	FJ-2216	—
	22	20.5	0.3	**FIR-172220**	24	F-2220	FJ-2220	FJL-2220L
	22	25.5	0.3	**FIR-172225**	30	—	—	FJL-2225L
	22	30.5	0.3	**FIR-172230**	36	—	—	FJL-2230L
20	25	10.5	0.3	**FIR-202510**	14	—	—	FJL-2510
	25	15.5	0.3	**FIR-202515**	21	—	—	FJL-2515L
	25	16.5	0.3	**FIR-202516**	23	F-2516	FJ-2516	—
	25	20.5	0.3	**FIR-202520**	28	F-2520	FJ-2520	FJL-2520
	25	25.5	0.3	**FIR-202525**	35	—	—	FJL-2525L
	25	26.5	0.3	**FIR-202526**	36	F-2526	FJ-2526	—
	25	30.5	0.3	**FIR-202530**	42	—	—	FJL-2530
22	28	16.5	0.3	**FIR-222816**	30	F-2816	FJ-2816	—
	28	20.5	0.3	**FIR-222820**	38	F-2820	FJ-2820	FJL-2820L
	28	26.5	0.3	**FIR-222826**	49	F-2826	FJ-2826	—
	28	30.5	0.3	**FIR-222830**	56	—	—	FJL-2830L
25	30	15.5	0.3	**FIR-253015**	26	—	—	FJL-3015L
	30	20.5	0.3	**FIR-253020**	34	F-3020	FJ-3020	FJL-3020L
	30	25.5	0.3	**FIR-253026**	43	—	—	FJL-3025L
	30	26.5	0.3	**FIR-253026**	44	F-3026	FJ-3026	—
	30	30.5	0.3	**FIR-253030**	51	—	—	FJL-3030L
28	32	20.5	0.3	**FIR-283220**	30	—	—	FJL-3220
	32	30.5	0.3	**FIR-283230**	45	—	—	FJL-3230
30	35	12.5	0.6	**FIR-303512**	25	F-3512	FJ-3512	FJL-3512
	35	15.5	0.6	**FIR-303515**	31	—	—	FJL-3515
	35	20.5	0.6	**FIR-303520**	41	F-3520	FJ-3520	FJL-3520L
	35	25.5	0.6	**FIR-303525**	51	—	—	FJL-3525L
	35	26.5	0.6	**FIR-303526**	53	F-3526	FJ-3526	—
	35	30.5	0.6	**FIR-303530**	61	—	—	FJL-3530L

INNER RINGS FOR DRAWN CUP NEEDLE ROLLER BEARINGS (INCH DESIGN)

IR

Bore Diameter 9.525 — 38.100 mm



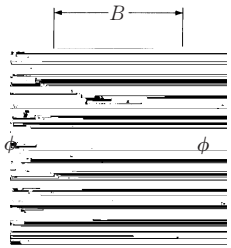
Boundary Dimensions (mm, inch) d $^{0}_{-0.013}$		F $^{0}_{-0.013}$		B $^{0}_{-0.25}$	Inner Ring Numbers	Mass (g) approx	Fillet Radius of Shaft (mm) r_a max
9.525	0.3750	14.288	0.5625	13.08	**IR-68**	9.1	0.6
		15.875	0.6250	13.08	**IR-68-1**	13	0.6
		14.288	0.5625	19.43	**IR-612**	13	0.6
		15.875	0.6250	19.43	**IR-612-1**	19	0.6
12.700	0.5000	19.050	0.7500	13.08	**IR-88**	16	1.0
		19.050	0.7500	19.43	**IR-812**	24	1.0
15.875	0.6250	22.225	0.8750	19.43	**IR-1012**	29	1.0
		22.225	0.8750	25.78	**IR-1016**	38	1.0
19.050	0.7500	25.400	1.0000	13.08	**IR-128**	23	1.0
		25.400	1.0000	19.43	**IR-1212**	34	1.0
		25.400	1.0000	25.78	**IR-1216**	44	1.0
		25.400	1.0000	32.13	**IR-1220**	55	1.0
		25.400	1.0000	38.48	**IR-1224**	66	1.0
20.638	0.8125	25.400	1.0000	19.43	**IR-1312**	26	1.0
		25.400	1.0000	25.78	**IR-1316**	35	1.0
22.225	0.8750	28.575	1.1250	25.78	**IR-1416**	51	1.0
23.812	0.9375	28.575	1.1250	25.78	**IR-1516**	39	1.0
25.400	1.0000	31.750	1.1250	19.42	**IR-1612**	43	1.0
		31.750	1.1250	25.78	**IR-1616**	57	1.0
28.575	1.1250	34.925	1.3750	19.43	**IR-1812**	48	1.0
		34.925	1.3750	25.78	**IR-1816**	64	1.0
		34.925	1.3750	32.13	**IR-1820**	79	1.0
30.162	1.1875	38.100	1.5000	25.78	**IR-1916**	85	1.0
		38.100	1.5000	32.13	**IR-1920**	105	1.0
31.750	1.2500	38.100	1.5000	25.78	**IR-2016**	70	1.5
		38.100	1.5000	32.13	**IR-2020**	87	1.5
34.925	1.3750	41.275	1.6250	32.13	**IR-2220**	95	1.5
36.512	1.4375	44.450	1.7500	25.78	**IR-2316**	100	1.5
		44.450	1.7500	38.48	**IR-2324**	150	1.5
38.100	1.5000	44.450	1.7500	25.78	**IR-2416**	83	1.5
		44.450	1.7500	38.48	**IR-2424**	125	1.5

Matching Drawn Cup Needle Roller Bearings			
B	BH	J	JH
B-98	BH-98	J-98	JH-98
B-108	BH-108	J-108	—
B-912	BH-912	—	—
B-1012	BH-1012	J-1012	—
B-128	—	J-128	—
B-1212	—	J-1212	JH-1212
B-1412	BH-1412	J-1412	JH-1412
B-1416	—	J-1416	JH-1416
B-168	BH-168	—	—
B-1612	BH-1612	J-1612	JH-1612
B-1616	BH-1616	J-1616	JH-1616
—	BH-1620	—	—
—	BH-1624	—	—
B-1612	BH-1612	J-1612	JH-1612
B-1616	BH-1616	J-1616	JH-1616
B-1816	BH-1816	J-1816	JH-1816
B-1816	BH-1816	J-1816	JH-1816
B-2012	BH-2012	J-2012	—
B-2016	BH-2016	J-2016	JH-2016
B-2212	BH-2212	—	JH-2212
B-2216	BH-2216	—	JH-2216
B-2220	BH-2220	—	—
B-2416	—	J-2416	—
B-2420	—	J-2420	—
B-2416	—	J-2416	—
B-2420	—	J-2420	—
B-2620	—	—	—
B-2816	—	J-2816	—
B-2824	—	J-2824	—
B-2816	—	J-2816	—
B-2824	—	J-2824	—

Remarks Inner rings can be used with Y and YH types (pages B76~B79).

FIR

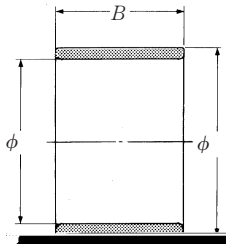
Bore Diameter 5 — 15 mm



Boundary Dimensions (mm)				Inner Ring Numbers	Mass (kg)	Matching Solid Needle Roller Bearings			
d	F	B	r min		approx	RLM	RNA	RNAF	RNAFW
5	8	12	0.15	**FIR-5812-1**	0.003	RLM81512-1			
	8	16	0.15	**FIR-5816-1**	0.004	RLM81516-1			
7	10	12	0.15	**FIR-71012-1**	0.004	RLM101712-1			
	10	16	0.15	**FIR-71016-1**	0.005	RLM101716-1			
9	12	16	0.3	**FIR-91216-1**	0.006	RLM121916-1			
10	14	12	0.3	**FIR-101412-1**	0.007			RNAF142612	
	14	13	0.3	**FIR-101413-1**	0.008		RNA4900	RNAF142213	
	14	14	0.3	**FIR-101414-1**	0.008		RNA4900TT		
	14	16	0.3	**FIR-101416-1**	0.009		RNA5900		
	14	20	0.3	**FIR-101420-1**	0.012				RNAFW142220
	14	22	0.3	**FIR-101422-1**	0.013		RNA6900		
12	16	12	0.3	**FIR-121612-1**	0.008			RNAF162812	
	16	13	0.3	**FIR-121613-1**	0.009		RNA4901	RNAF162413	
	16	14	0.3	**FIR-121614-1**	0.010		RNA4901TT		
	16	16	0.3	**FIR-121616-1**	0.011		RNA5901		
	16	20	0.3	**FIR-121620-1**	0.014				RNAFW162420
	16	22	0.3	**FIR-121622-1**	0.015		RNA6901		
	16	23	0.3	**FIR-121623-1**	0.016		RNA6901TT		
15	20	12	0.3	**FIR-152012-1**	0.013			RNAF203212	
	20	13	0.3	**FIR-152013-1**	0.014		RNA4902	RNAF202813	
	20	14	0.3	**FIR-152014-1**	0.015		RNA4902TT		
	20	18	0.3	**FIR-152018-1**	0.019		RNA5902		
	20	23	0.3	**FIR-152023-1**	0.025		RNA5902		
	20	24	0.3	**FIR-152024-1**	0.026		RNA6902TT		
	20	26	0.3	**FIR-152026-1**	0.028				RNAFW202826

FIR

Bore Diameter 28 — 38 mm

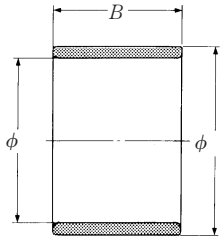


Boundary Dimensions (mm)				Inner Ring Numbers	Mass (kg)	Matching Solid Needle Roller Bearings			
d	*F*	*B*	*r* min		approx	RLM	RNA	RNAF	RNAFW
28	32	17	0.3	**FIR-283217-1**	0.025		RNA49/28		
	32	18	0.3	**FIR-283218-1**	0.026		RNA49/28TT		
	32	23	0.3	**FIR-283223-1**	0.034		RNA59/28		
	32	30	0.3	**FIR-283230-1**	0.044		RNA69/28		
	32	31	0.3	**FIR-283231-1**	0.046		RNA69/28TT		
30	35	13	0.3	**FIR-303513-1**	0.026			RNAF354513	
	35	16	0.3	**FIR-303516-1**	0.032			RNAF354716	
	35	17	0.3	**FIR-303517-1**	0.034		RNA4906	RNAF354517	
	35	18	0.3	**FIR-303518-1**	0.036		RNA4906TT		
	35	23	0.3	**FIR-303523-1**	0.046		RNA5906		
	35	26	0.3	**FIR-303526-1**	0.052				RNAFW354526
	35	30	0.3	**FIR-303530-1**	0.060		RNA6906		
	35	31	0.3	**FIR-303531-1**	0.062		RNA6906TT		
	35	32	0.3	**FIR-303532-1**	0.064				RNAFW354732
32	37	30	0.3	**FIR-323730-1**	0.063	RLM374730-1			
	40	20	0.6	**FIR-324020-1**	0.071		RNA49/32		
	40	21	0.6	**FIR-324021-1**	0.074		RNA49/32TT		
	40	27	0.6	**FIR-324027-1**	0.095		RNA59/32		
	40	36	0.6	**FIR-324036-1**	0.127		RNA69/32		
	40	37	0.6	**FIR-324037-1**	0.131		RNA69/32TT		
35	40	17	0.3	**FIR-354017-1**	0.039			RNAF405017	
	40	20	0.3	**FIR-354020-1**	0.046			RNAF405520	
	40	34	0.3	**FIR-354034-1**	0.078				RNAFW405034
	40	40	0.3	**FIR-354040-1**	0.092				RNAFW405540
	42	20	0.6	**FIR-354220-1**	0.066		RNA4907		
	42	21	0.6	**FIR-354221-1**	0.069		RNA4907TT		
	42	27	0.6	**FIR-354227-1**	0.089		RNA5907		
	42	36	0.6	**FIR-354236-1**	0.119		RNA6907		
	42	37	0.6	**FIR-354237-1**	0.122		RNA6907TT		
38	43	20	0.3	**FIR-384320-1**	0.050	RLM435320-1			
	43	30	0.3	**FIR-384330-1**	0.074	RLM435330-1			

RLM8510525-1

FIR

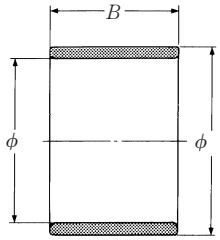
Bore Diameter 8 — 20 mm



Boundary Dimensions (mm)				Inner Ring Numbers	Mass (g)	Matching Solid Needle Roller Bearings	
						RLM	
d	*F*	*B*	*r* min		approx		
8	12	12.2	0.3	**FIR-81212-2**	5.9	RLM1212	RLM121912
	12	15.2	0.3	**FIR-81215-2**	7.4		RLM121915
10	14	16.2	0.3	**FIR-101416-2**	9.5	RLM1416	
	14	20.2	0.3	**FIR-101420-2**	11.9	RLM1420	
	15	8.2	0.3	**FIR-10158-2**	6.2	RLM158	
	15	12.2	0.3	**FIR-101512-2**	9.3		RLM152212
	15	15.2	0.3	**FIR-101515-2**	11.6	RLM1515	RLM152215
	15	20.2	0.3	**FIR-101520-2**	15.5	RLM1520	RLM152220
12	16	16.2	0.3	**FIR-121616-2**	11.1	RLM1616	
	16	20.2	0.3	**FIR-121620-2**	13.9	RLM1620	
	17	10.2	0.3	**FIR-121710-2**	9.0	RLM1710	
	17	15.2	0.5	**FIR-121715-2**	13.5		RLM172415
	17	20.2	0.5	**FIR-121720-2**	17.9	RLM1720	
	17	25.2	0.5	**FIR-121725-2**	22.4		RLM172425
15	18	15.2	0.5	**FIR-151815-2**	9.2	RLM1815	
	18	17.2	0.5	**FIR-151817-2**	10.4	RLM1817	
	18	20.2	0.5	**FIR-151820-2**	12.3	RLM1820	
	18	25.2	0.5	**FIR-151825-2**	15.3	RLM1825	
	19	16.2	0.5	**FIR-151916-2**	13.5	RLM1916	
	19	20.2	0.5	**FIR-151920-2**	16.8	RLM1920	
	20	10.2	0.5	**FIR-152010-2**	10.9	RLM2010	
	20	15.2	0.5	**FIR-152015-2**	16.3	RLM2015	
	20	20.2	0.5	**FIR-152020-2**	21.7	RLM2020	RLM202820
	20	25.2	0.5	**FIR-152025-2**	27	RLM2025	
17	21	16.2	0.5	**FIR-172116-2**	15.1	RLM2116	
	21	20.2	0.5	**FIR-172120-2**	18.8	RLM2120	
	22	25.2	0.5	**FIR-172215-2**	18.2	RLM2215	
	22	16.2	0.5	**FIR-172216-2**	19.4		RLM223016
	22	20.2	0.5	**FIR-172220-2**	24.1	RLM2220	RLM223020
	22	25.2	0.5	**FIR-172225-2**	30.1	RLM2225	
20	24	16.2	0.5	**FIR-202416-2**	17.5		RLM243216
	24	20.2	0.5	**FIR-202420-2**	21.8	RLM2420	
	24	28.2	0.5	**FIR-202428-2**	30.4	RLM2428	
	25	12.2	0.5	**FIR-202512-2**	16.8	RLM2512	
	25	20.2	0.5	**FIR-202520-2**	27.8	RLM2520	RLM253320
	25	25.2	0.5	**FIR-202525-2**	34.7	RLM2525	RLM253325

FIR

Bore Diameter 22 — 50 mm



Boundary Dimensions (mm)				Inner Ring Numbers	Mass (g)	Matching Solid Needle Roller Bearings	
						RLM	
d	*F*	*B*	*r* min		approx		
22	26	20.2	0.5	**FIR-222620-2**	23.8	RLM2620	
	28	20.2	0.5	**FIR-222820-2**	37.1	RLM2820	RLM283720
	28	25.2	0.5	**FIR-222825-2**	46.3	RLM2825	
	28	30.2	0.5	**FIR-222830-2**	55.5		RLM283730
25	29	20.2	0.5	**FIR-252920-2**	26.7	RLM2920	
	29	30.2	0.5	**FIR-252930-2**	40	RLM2930	
	30	15.2	0.5	**FIR-253015-2**	25.6	RLM3015	
	30	20.2	0.5	**FIR-253020-2**	34	RLM3020	RLM304020
	30	25.2	0.5	**FIR-253025-2**	42.5	RLM3025	RLM304025
28	32	20.2	0.5	**FIR-283220-2**	29.7	RLM3220	
	32	30.2	0.5	**FIR-283230-2**	44.4	RLM3230	
30	35	20.2	0.5	**FIR-303520-2**	40.2	RLM3520	RLM354520
	35	25.2	0.5	**FIR-303525-2**	50.2		RLM354525
	35	30.2	0.5	**FIR-303530-2**	60.1	RLM3530	RLM354530
32	37	20.3	0.6	**FIR-323720-2**	42.9	RLM3720	
	37	30.3	0.6	**FIR-323730-2**	64	RLM3730	
	38	15.3	0.6	**FIR-323815-2**	39.4	RLM3815	
	38	20.3	0.6	**FIR-323820-2**	52.2	RLM3820	
	38	25.3	0.6	**FIR-323825-2**	65.1	RLM3825	
	38	30.3	0.6	**FIR-323830-2**	78	RLM3830	
35	40	15.3	0.6	**FIR-354015-2**	35.1	RLM4015	
	40	20.3	0.6	**FIR-354020-2**	46.6	RLM4020	
	40	25.3	0.6	**FIR-354025-2**	58.1	RLM4025	
	40	30.3	0.6	**FIR-354030-2**	69.6	RLM4030	
40	45	20.3	0.6	**FIR-404520-2**	52.9	RLM4520	
	45	25.3	0.6	**FIR-404525-2**	65.9	RLM4525	
	45	30.3	0.6	**FIR-404530-2**	78.9	RLM4530	
42	50	20.3	0.6	**FIR-425020-2**	91.5	RLM5020	RLM506220
	50	25.3	0.6	**FIR-425025-2**	114		RLM506225
	50	30.3	0.6	**FIR-425030-2**	137	RLM5030	RLM506230
45	55	30.3	0.6	**FIR-455530-2**	186	RLM5530	
	55	40.3	0.6	**FIR-455540-2**	247	RLM5540	
50	60	30.3	0.6	**FIR-506030-2**	204		RLM607230
	60	40.3	0.6	**FIR-506040-2**	272	RLM6040	RLM607240

0.17	HJ-324120
0.12	HJ-324116
0.145	HJ-324120
0.305	HJ-364824
0.355	HJ-364828
0.375	HJ-405224
0.425	HJ-405228
0.34	HJ-405224
0.40	HJ-405228
0.50	HJ-445628
0.375	HJ-445624
0.45	HJ-445628
0.57	HJ-486028
0.44	HJ-486024
0.47	HJ-486028
0.50	
0.60	
0.75	
0.70	
0.90	
0.70	
1.1	
0.90	
0.75	
1.15	
1.0	
1.4	
1.55	
2.05	
2.25	
1.55	

IR

Bore Diameter 114.300 — 203.200 mm

114.300	4.5000	5.5000				
		5.5000				
120.650	4.7500	5.7500				
127.000	5.0000	6.0000				
		6.0000				
139.700	5.5000	6.5000				
		6.5000				
152.400	6.0000	7.2500				
165.100	6.5000	7.7500				
177.800	7.0000	8.2500				
		3.07 2.52 243.01 15T21.2 0 0 7.04 417 0.12				
190.500	7.5000					
203.200	8.0000					

Mass (kg) approx	Fillet Radius of Shaft (mm) r_a max	Matching Solid Needle Roller Bearings HJ
2.5	2.5	HJ-8811240
2.95	2.5	HJ-8811248
3.15	3	HJ-9211648
2.75	3	HJ-9612040
3.35	3	HJ-9612048
3.05	3	HJ-10412840
3.65	3	HJ-10412848
4.9	3	HJ-11614648
5.5	3	HJ-12415448
5.55	3	HJ-13216248
6.15	4	HJ-14017048
6.4	4	HJ-14817848

Table 1 Bearing Types

Code		Description
Metric	FNTA	Cage & Needle roller assemblies for thrust needle bearings
	FB, FG, FH	Thrust needle bearings with integrated raceway washers
Inch	NTA, NTC	Cage & Needle roller assemblies for thrust needle bearings

The composition of bearing numbers is as follows:

(Example) FNTA-2035

- Outside Diameter (mm)
- Bore Diameter (mm)
- Type Code

Table 2 Raceway Washers of Thrust Needle Bearings

Units: mm

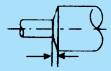
Application

Thrust Needle Bearings

When using FNTA and NTA cage & Needle roller assemblies, using the gear side as a raceway ring saves bearing space (refer to **Fig. 2**).

In general, the accuracy, surface roughness, and hardness of the raceway components should satisfy the specifications shown in **Table 3**.

Table 3 Specifications of Thrust Bearing Raceway Surface

Squareness A	0.5/1000 (mm/mm)	
Squareness B	1.0/1000 (mm/mm)	
Roughness, (1) Ra	0.4	—
Hardness, (2)	HRC 58 to 64 (HRC60 to 64 is favorable)	—

Notes (1) Refer to Section **5.2** on page A34 for details.
(2) Refer to Section **5.3** on page A35 for details.

When a cage & Needle roller assembly cannot be used by itself, a thrust raceway washer should be employed. The raceway washer should be selected after considering washer support face and the volume of the load. The thrust raceway washer should be set to prevent sliding between the contact surfaces.

When the area supporting the raceway washer is sufficiently large, a thin raceway washer, such as the FTRA and TRA types, can be used. It should be noted that even if the washers of the FTRA and TRA types are warped, an axial load of more than approximately 196 N {20 kgf} will flatten them.

When the support face of the shaft or housing is small (refer to **Fig. 3**). FTRE and TRD types, which are thick-wall raceway washers, or any of the other thicker types should be used. In any case, to bring out the full performance of the bearing, the squareness of the support face should be ensured and sufficient space is needed in the support face.

For squareness of the raceway washer support face, the values shown in **Table 3** are applied. Please consult NSK regarding shape and accuracy.

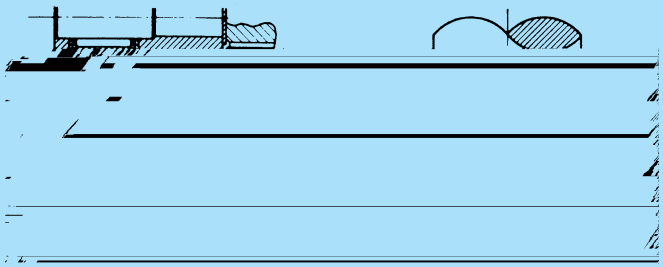


Fig. 2

Fig. 3

Bearing Guide

The cages used in FNTA and NTA cage & Needle roller assemblies are guided by the shaft along their extended cage bore.

Bore diameter tolerance is smaller than that for the outside diameter, and as relative speed at the guide face is slow, the bore guiding method is effective. When the outside of the cage is guided, it is necessary for the housing guide surface to be hardened, at least on its surface, to protect it from wear.

Fitting

Recommended fittings for thrust needle bearings is shown in **Table 4**.

Table 4 Recommended Fitting for Thrust Bearing

Units: mm

Classification	Type	Cage or Raceway Washer Guide	Fitting Class or Tolerance	
			Shaft	Housing Bore
Thrust Needle Bearing Cage & Needle Roller Assembly	FNTA	Bore	h8	D_c+over 1.0
		Outside	—	H10
	NTA NTC	Bore	$^{0}_{-0.075}$	D_c+over 1.0
		Outside	—	H10
Thrust Needle Bearing Raceway Washer	FTRA — FTRE	Bore	h8	D_c+over 1.0
		Outside	—	H10
	TRA — TRF	Bore	$^{0}_{-0.075}$	D_c+over 1.0
		Outside	—	H10

Remarks D_c in the table to the bore and outside surface of the cage.
Please consult NSK regarding fitting of bearing types other than those shown in **Table 4**.

Thrust Needle Bearings

FNTA (Thrust Cage & Needle Roller Assemblies)

FTRA (Thrust Bearing Rings s = 1.0)

FTRB (s = 1.5)

FTRC (s = 2.0)

FTRD (s = 2.5)

FTRE (s = 3.0)

Bore Diameter 10 — 100 mm

24			

Thrust Needle Bearings

NTA (Thrust Cage & Needle Roller Assemblies)

NTC

TRA (Thrust Bearing Rings s = 0.8)

TRB (s = 1.6)

TRC (s = 2.4)

TRD (s = 3.2)

TRE (s = 4.0)

Bore Diameter 6.350 — 104.775 mm

0.2500	17.450	—	1.984	—	4 400	9 900	1 010	24 000
—	19.050	0.7500	1.984	—	4 950	12 100	1 230	22 000
0.3750	20.625	—	1.984	—	5 200	13 200	1 350	20 000
0.5000	23.800	—	1.984	—	6 150	17 600	1 790	18 000
—	25.400	1.0000	1.984	—	6 600	19 800	2 020	17 000
0.6250	28.575	1.1250	1.984	—	8 100	26 600	2 720	15 000
0.7500	31.750	1.2500	1.984	—	9 000	32 000	3 250	13 000
0.8750	36.500	—	1.984	—	11 600	46 500	4 750	11 000
	42.850	—	1.984	—	16 300	74 500	7 600	9 500
1.0000	39.675	—	1.984	—	12 000	50 000	5 100	10 000
1.1250	44.450	1.7500	1.984	—	14 800	68 000	6 950	9 000
1.2500	49.200	—	1.984	—	17 700	88 500	9 050	8 000
1.3750	52.375	—	1.984	—	18 700	98 000	10 000	7 500
1.5000	55.550	—	1.984	—	20 400	112 000	11 400	7 500
1.7500	63.500	2.5000	1.984	—	20 400	117 000	11 900	6 700
2.0000	69.850	2.7500	1.984	—	21 100	126 000	12 800	6 000
2.1250	73.025	2.8750	1.984	—	21 400	131 000	13 300	5 600
2.2500	76.200	3.0000	1.984	—	21 800	135 000	13 800	
	79.375	3.1250	3.175	0.1250	33 500	172 000	17 500	
2.5000	82.550	3.2500	1.984	—	22 400	145 000	14 700	
2.7500	92.075	3.6250	3.175	0.1250	42 500	248 000	25 300	
3.0000	95.250	3.7500	1.984	—	23 700	163 000	16 600	
3.2500	104.775	4.1250	3.175	0.1250	46 000	287 000	29 200	
3.7500	117.475	4.6250	3.175	0.1250	50 000	335 000	34 000	
4.1250	128.575	—	3.175	0.1250	57 000	405 000	41 000	

Thrust Needle Bearings

FB (With Integrated Raceway Washers)

FTRA (Thrust Bearing Rings s = 1.0)

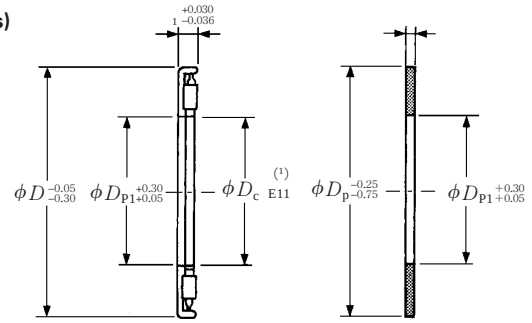
FTRB (s = 1.5)

FTRC (s = 2.0)

FTRD (s = 2.5)

FTRE (s = 3.0)

Bore Diameter 20 — 55 mm



FB FTRA



FTRB FTRC FTRD FTRE

Boundary Dimensions (mm)			Basic Load Ratings (N)		{kgf}		Limiting Speeds (min^{-1})	Bearing Numbers
D_C,D_{P1}	D_C,D_P	T_1	C_a	C_{oa}	C_a	C_{oa}	Oil	
20	35	2.8	9 450	34 500	965	3 550	13 000	**FB502002**
30	47	2.8	12 700	56 500	1 300	5 750	9 000	**FB503002**
35	53	2.8	15 600	77 000	1 590	7 850	8 000	**FB503503**
40	60	2.8	20 200	112 000	2 060	11 400	7 100	**FB504001**
45	65	2.8	20 400	117 000	2 080	11 900	6 300	**FB504501**
50	70	2.8	21 200	126 000	2 160	12 800	6 000	**FB505002**
55	75	2.8	22 500	140 000	2 290	14 300	5 600	**FB505501**

Matching Bearing Rings			
$s=1.0^{\pm 0.05}$	$s=1.5^{\ 0}_{-0.08}$	$s=2.0^{\ 0}_{-0.08}$	$s=2.5^{\ 0}_{-0.08}$
FTRA-2035	**FTRB-2035**	**FTRC-2035**	**FTRD-2035**
FTRA-3047	**FTRB-3047**	**FTRC-3047**	**FTRD-3047**
FTRA-3553	**FTRB-3553**	**FTRC-3553**	**FTRD-3553**
FTRA-4060	**FTRB-4060**	**FTRC-4060**	**FTRD-4060**
FTRA-4565	**FTRB-4565**	**FTRC-4565**	**FTRD-4565**
FTRA-5070	**FTRB-5070**	**FTRC-5070**	**FTRD-5070**
FTRA-5575	**FTRB-5575**	**FTRC-5575**	**FTRD-5575**

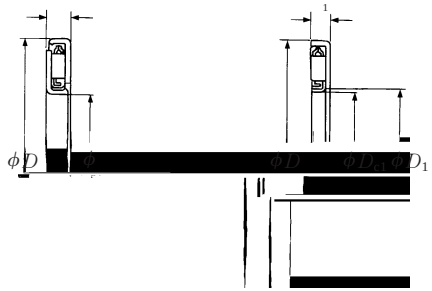
Note (1) For tolerance classes E11, please refer to pages C60.

Thrust Needle Bearings

FH (With Integrated Raceway Washers)

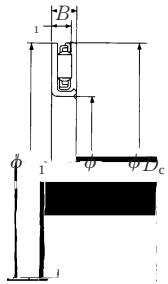
FG

Bore Diameter 22.6 — 43 mm



Example 1

Example 2



Example 3

—	38.7	—	3.894	—	10 100
—	45.9	—	3.604	—	15 300
—	53	—	3.8	—	13 700
—	54.02	—	3.604	—	7.1.8623 T 15 300 -1.8623 T08.897 07.0 T T 13 700 T 0 9 88623 T 7.10.019312300 T T.897 5
—	70	—	4	—	
—	78	—	4	—	13 700
—	78.1	—	4	—	
28.575	46.32	—	3.81	—	
30	47	—	2.824	—	
35	53	—	2.824	—	
38	57.3	—	2.81	—	
42	61.98	—	3.81	—	
45	64	—	2.8	—	
48.4	68.48	—	3.81	—	
52	72.1	—	2.81	—	
58	78	—	2.8	—	
—	45	45	2.794	3.43	
—	52.5	52	2.81	3.43	
—	48	48	2.794	3.43	
—	47.8	48	2.794	3.43	
—	60	60.05	2.8	3.43	

Accessories

NSK cam followers include a sealing plug but the nut, washer and grease nipple are available as accessories. When ordering, please add the part code shown in **Table 5** after the bearing number.

Applications

Fitting

The recommended fittings for the mounting area of cam follower studs are shown in **Table 6**. Since cam followers use cantilever mounting, the fitting for the stud and mounting hole should be assembled with as little play as possible. In case there is interference in the fitting of the stud and mounting hole, the center of the stud end should be inserted with a press. The side plate should be securely fixed onto the plane surface square to the center axis, without play. In order to get a sufficient support face for the side plate, the dimension of the shoulder should be larger than the value of F shown in the bearing table. Play in the mounting part should be avoided because it would not only cause inclination to the stud but also create considerable deflection when a load is imposed. The load would also be unevenly imposed on the rollers due to edge contact between the outer ring and track (on which the outer ring runs).

Maximum Permissible Load

Permissible Track Load

The maximum radial load that the cam follower can carry is determined by the bearing strength and shear strength of the stud rather than the load rating for needle bearings. This value is given in the bearing table as the maximum permissible load.

The cam follower can deliver a performance of the maximum strength of stud by mounting securely to the side plate so as to minimize overhang. It is necessary, therefore, to minimize chamfering at the corner of the stud mounting hole and avoid burrs.

Permissible Track Load

The permissible load of the track is determined by compression strength or hardness. The permissible load of the track shown in the bearing table is the value of a track made of steel with a hardness of HRC40.

Table 7 indicates the permissible load coefficient of the track for each hardness.

The permissible load of the track for each hardness can be obtained by multiplying the permissible load of the track shown in the bearing table by the permissible load coefficient of the track corresponding to each hardness.

Maximum Clamp Torque

Since the stud of the cam follower receives bending stress and tensile

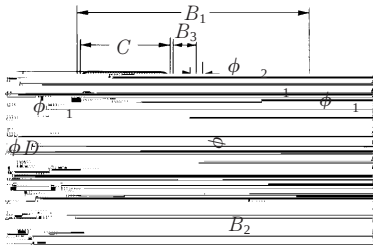
FCR (Full Complement)

FCRS (Full Complement, Sealed, With Thrust Washer)

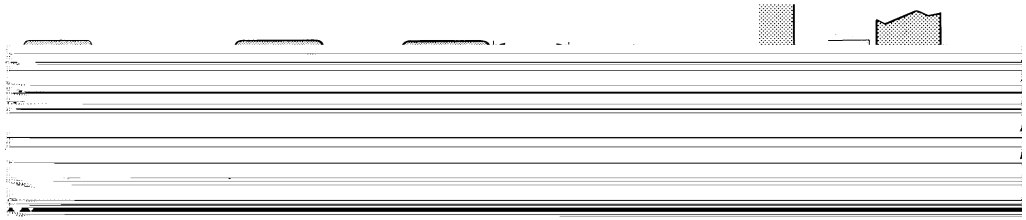
FCJ (With Cage)

FCJS (Sealed, With Cage and Thrust Washer)

Outside Diameter 72 — 90 mm



FCR



29	24	M24X1.5	25	11
29	24	M24X1.5	25	11
35	30	M30X1.5	32	15
35	30	M30X1.5	32	15
35	30	M30X1.5	32	15
35	30	M30X1.5	32	15
35	30	M30X1.5	32	TD(15)Tj0 -1.0569 TD(15730X1.5)Tj0 -1.057 TD(M30X1.5)Tj0 j0 -1.0569 TD4 1 Tf-15.0 T7 Tt5
35	30	M30X1.5	32	TD j 0 -180 T7 Tt5

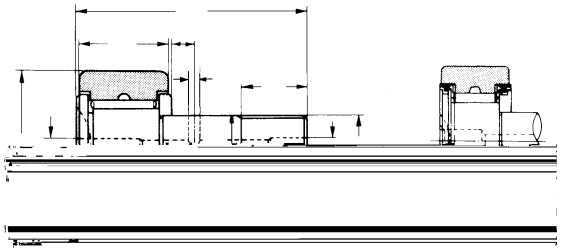
3261.0569 TD (M30X8 0 -1.057 TD (30)Tj8 0 -1-14 061622 TD (15)Tj 0 0 -1.057 TD (30)Tj 0 0 -1.057 TD (15)Tj 0 0 -1.057 TD (30)Tj 0 0 -1.057 TD (15)Tj 0 0 -1.057 TD715)Tj 0 0 -18 r 92.126 263

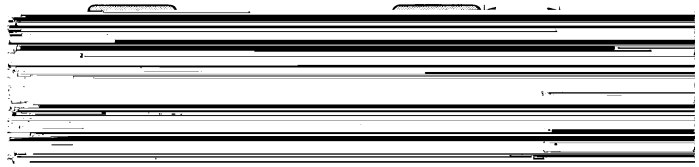
CAM FOLLOWERS (INCH DESIGN)

CR (Full Complement)

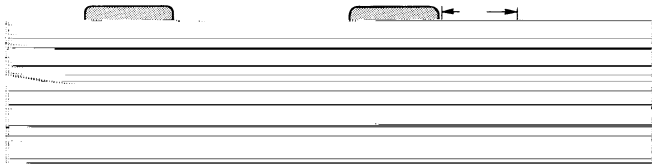
CRS (Full Complement, Sealed, With Thrust Washer)

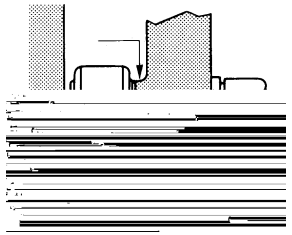
Outside Diameter 12.700 — 152.4 mm





0.5000	8.74	4.826	—	10-32
	9.52	4.826	—	10-32
0.6250	10.31	6.350	0.2500	
	11.13	6.350	0.2500	
0.7500	12.70	9.525	0.3750	
0.8750	12.70	9.525	0.3750	
1.0000	15.88	11.112	0.4375	
1.1250	15.88	11.112	0.4375	
1.2500	19.05	12.700	0.5000	
1.3750	19.05	12.700	0.5000	
1.5000	22.22	15.875	0.6250	
1.6250	22.22	15.875	0.6250	
1.7500	25.40	19.050	0.7500	
1.8750	25.40	19.050	0.7500	
2.0000	31.75	22.225	0.8750	
2.2500	31.75	22.225	0.8750	
2.5000	38.10	25.400	1.0000	
2.7500	38.10	25.400	1.0000	
3.0000	44.45	31.750	1.2500	
3.2500	44.45	31.750	1.2500	
3.5000	50.80	34.925	1.3750	
4.0000	57.15	38.100	1.5000	
5.0000	69.85	50.800	2.0000	
6.0000	82.55	63.500	2.5000	





CR-8	**CRS-8**		3.18		90
CR-8-1	**CRS-8-1**		3.18		90
CR-10	**CRS-10**		3.18		226
CR-10-1	**CRS-10-1**		3.18		226
CR-12	**CRS-12**		4.76		630
CR-14	**CRS-14**		4.76		630
CR-16	**CRS-16**		6.35		1 700
CR-18	**CRS-18**		6.35		1 700
CR-20	**CRS-20**		6.35		2 310
CR-22	**CRS-22**		6.35		2 310
CR-24	**CRS-24**		7.94		4 400
CR-26	**CRS-26**		7.94		4 400
CR-28	**CRS-28**		7.94		8 500
CR-30	**CRS-30**		7.94		8 500
CR-32	**CRS-32**		11.11		10 200
CR-36	**CRS-36**		11.11		10 200
CR-40	**CRS-40**		12.70		15 300
CR-44	**CRS-44**		12.70		15 300
CR-48	**CRS-48**		15.88		23 100
CR-52	**CRS-52**		15.88		23 100
CR-56	**CRS-56**		15.88		28 200
CR-64	**CRS-64**		19.05		
CRB-80	**CRSB-80**		22.22		
CRB-96	**CRSB-96**		25.40		

ROLLER FOLLOWERS (YOKE TYPE TRACK ROLLERS)

			Pages
Metric Design	Bore Diameter	5−50 mm	B194−B195
Inch Design	Bore Diameter	6.350−57.150 mm	B196−B197

The roller follower with a thick-wall outer ring and crowned roller has a large load capacity which enables it to carry shock loads. Handling is easy since it it non-separating and applications such as track rollers, cams and rocker arms are wide.

Types

NSK roller rollowers are available in the types shown in **Table 1**. All of the bearings in **Table 1** have a cylindrical outside. Bearings of the following specifications are available and can be manufactured upon request:

1. Outer ring with a spherical exterior

In this case, your order should be placed in the following manner:

(1) For metric bearings, **R** should be added to the end of bearing number.

Table 1 Bearing Types

Type		Details
Metric	FYCR	Full complement
	FYCRS	With seal, full complement, with thrust washer
	FYCJ	With cage
	FYCJS	With seal, with cage, with thrust washer
Inch	YCR	Full complement
	YCRS	With seal, full complement, with thrust washer

Accuracy

NSK metric roller followers are manufactured in compliance with ISOISO

Table 2 Tolerances for Inch Bearings

Units: μm

Nominal Bore Diameter, d (mm)		Single Plane Mean Bore Diameter Deviation, Δ_{dmp}		Single Plane Mean Outside Diameter Deviation, Δ_{Dmp}				Outer Ring Width Deviation, Δ_{Cs}		Overall Inner Ring Width Deviation, Δ_{Bs}	
				Cylindrical Outside Surface		Spherical Outside Surface (1)					
over	incl	high	low	high	low	high	low	high	low	high	low
—	19.05	+5	−10	0	−25	0	−50	0	−130	+130	−256
19.05	57.15	+2	−13	0	−25	0	−50	0	−130	+130	−250

Note (1) Metric bearings have the same dimension tolerance.



Table 4 Spherical Radius, R, of Metric Bearing Outside

Units: mm

Bearing Number	R
All Bearing Numbers	500

Table 5 Spherical Radius, R, of Inch Bearing Outside

Units: mm

Bearing Number (1)	R	Bearing Number (1)	R
YCRC-12	250	YCRC-32	600
YCRC-14	250	YCRC-36	600
YCRC-16	300	YCRC-40	760
YCRC-18	300	YCRC-44	760
YCRC-20	360	YCRC-48	760
YCRC-22	360	YCRC-52	760
YCRC-24	500	YCRC-56	760
YCRC-26	500	YCRC-64	760
YCRC-28	500	YCRC-80	1200
YCRC-30	500	YCRC-96	1400

Note (1) While YCRC bearing numbers are listed here, the values of R also apply to YCRSC bearings.

FYCR (Full Complement)

FYCRS (Full Complement, Sealed, With Thrust Washer)

FYCJ (With Cage)

FYCJS (Sealed, With Cage and Thrust Washer)

YCR (Full Complement)

YCRS (Full Complement, Sealed, With Thrust Washer)

Bore Diameter 6.350 — 57.150 mm

0.2500	19.050 22.225	
0.3125	25.400 28.575	
0.3750	31.750 34.925	
0.4375	38.2l.jTD(28.575)Tj0 -1.8622 TD840.5000	
0.5000	0.4.57Tw4 0 7 -17w[(YCR)-78.2R57T	
0.6250		
0.7500		
1.0000		
1.1250		
1.2500		
1.7500		
2.2500		

NEEDLE ROLLERS

			Pages
Metric Design	Roller Diameter	1−5 mm	B200
Inch Design	Roller Diameter	0.792−6.350 mm	B207

NSK needle rollers are made of carefully selected degassed bearing steel and given a precise grinding finish after heat treatment. Provided with the following characteristics, they have a wide range of applications, including gears, small engines and universal joints:

(1) Most economical when applied as a full complement bearing
(2) Very high load capacity
(3) Smaller mounting space
(4) Rollers with special crowning

Types

Needle rollers come in the types shown in **Table 1**.

End Face Shape	Type	Code	Details
	Rounded	A	General
	Flat	F	
	Conical	T	
	Trunnion	C	
	Crank Pin	P	
	Stepped	M	

Accuracy

NSK metric needle rollers are manufactured in compliance with ISO. Dimensions are shown in **Table 2** and dimension accuracy in **Table 3**, **4** and **5**.

Inch needle rollers are manufactured with a standard diameter tolerance of 0 to −5μm. Needle rollers with a diameter tolerance of 0 to −3μm and 0 to −2μm are also available and manufactured upon request. Please consult NSK for further details.

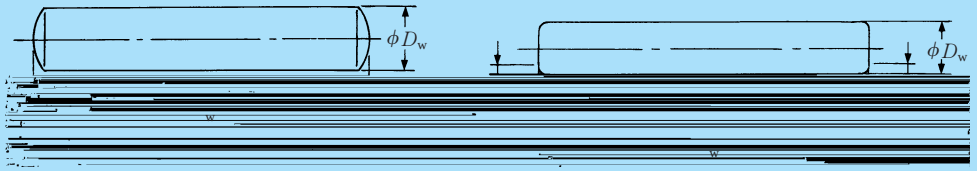


Table 2 Nominal Size and Dimension of Needle Rollers

Units: mm

Nominal Size	D_w	L_w	r (1) (min)	Mass (kg) (Reference) per 1,000 pieces
1 × 5.8	1	5.	0.1	0.035
1 × 6.8	1	.	0.1	0.042
1 × 7.8	1	.	0.1	0.04
1 × 9.8	1	.	0.1	0.0 0
1.5 × 5.8	1.5	5.	0.1	0.0 0
1.5 × 6.8	1.5	.	0.1	0.0 3
1.5 × 7.8	1.5	.	0.1	0.105
1.5 × 9.8	1.5	.	0.1	0.135
1.5 × 11.8	1.5	11.	0.1	0.1 0
1.5 × 13.8	1.5	13.	0.1	0.1 0
2 × 6.8	2	.	0.1	0.1 5
2 × 7.8	2	.	0.1	0.1 0
2 × 9.8	2	.	0.1	0.240
2 × 11.8	2	11.	0.1	0.2 0
2 × 13.8	2	13.	0.1	0.335
2 × 15.8	2	15.	0.1	0.3 5
2 × 17.8	2	1 .	0.1	0.435
2 × 19.8	2	1 .	0.1	0.4 5
2.5 × 7.8	2.5	.	0.1	0.300
2.5 × 9.8	2.5	.	0.1	0.3 5
2.5 × 11.8	2.5	11.	0.1	0.450
2.5 × 13.8	2.5	13.	0.1	0.525
2.5 × 15.8	2.5	15.	0.1	0. 05
2.5 × 17.8	2.5	1 .	0.1	0. 0
2.5 × 19.8	2.5	1 .	0.1	0. 55
2.5 × 21.8	2.5	21.	0.1	0. 35
2.5 × 23.8	2.5	23.	0.1	0. 10
3 × 9.8	3	.	0.1	0.540
3 × 11.8	3	11.	0.1	0. 50
3 × 13.8	3	13.	0.1	0. 0
3 × 15.8	3	15.	0.1	0. 0
3 × 17.8	3	1 .	0.1	0. 0
3 × 19.8	3	1 .	0.1	1.10
3 × 21.8	3	21.	0.1	1.20
3 × 23.8	3	23.	0.1	1.30
3 × 25.8	3	25.	0.1	1.40
3 × 27.8	3	2 .	0.1	1.55
3 × 29.8	3	2 .	0.1	1. 5
3.5 × 11.8	3.5	11.	0.1	0. 5
3.5 × 13.8	3.5	13.	0.1	1.05
3.5 × 15.8	3.5	15.	0.1	1.20
3.5 × 17.8	3.5	1 .	0.1	1.35

Units: mm

Nominal Size	D_w	L_w	r (1) (min)	Mass (kg) (Reference) per 1,000 pieces
3.5 × 19.8	3.5	1 .	0.1	1.50
3.5 × 21.8	3.5	21.	0.1	1. 5
3.5 × 23.8	3.5	23.	0.1	1. 0
3.5 × 25.8	3.5	25.	0.1	1. 5
3.5 × 27.8	3.5	2 .	0.1	2.10
3.5 × 29.8	3.5	2 .	0.1	2.25
3.5 × 31.8	3.5	31.	0.1	2.40
3.5 × 34.8	3.5	34.	0.1	2. 0
4 × 13.8	4	13.	0.1	1.35
4 × 15.8	4	15.	0.1	1.55
4 × 17.8	4	1 .	0.1	1. 5
4 × 19.8	4	1 .	0.1	1. 5
4 × 21.8	4	21.	0.1	2.15
4 × 23.8	4	23.	0.1	2.35
4 × 25.8	4	25.	0.1	2.55
4 × 27.8	4	2 .	0.1	2. 0
4 × 29.8	4	2 .	0.1	2. 0
4 × 31.8	4	31.	0.1	3.10
4 × 34.8	4	34.	0.1	3.40
4 × 37.8	4	3 .	0.1	3. 0
4 × 39.8	4	3 .	0.1	3. 0
4.5 × 17.8	4.5	1 .	0.1	2.20
4.5 × 19.8	4.5	1 .	0.1	2.45
4.5 × 21.8	4.5	21.	0.1	2. 0
4.5 × 23.8	4.5	23.	0.1	2. 5
4.5 × 25.8	4.5	25.	0.1	3.20
4.5 × 29.8	4.5	2 .	0.1	3. 0
4.5 × 31.8	4.5	31.	0.1	3. 5
4.5 × 34.8	4.5	34.	0.1	4.30
4.5 × 37.8	4.5	3 .	0.1	4. 0
4.5 × 39.8	4.5	3 .	0.1	4. 0
5 × 19.8	5	1 .	0.1	3.00
5 × 21.8	5	21.	0.1	3.35
5 × 23.8	5	23.	0.1	3. 5
5 × 25.8	5	25.	0.1	3. 5
5 × 27.8	5	2 .	0.1	4.25
5 × 29.8	5	2 .	0.1	4.55
5 × 31.8	5	31.	0.1	4. 5
5 × 34.8	5	34.	0.1	5.30
5 × 37.8	5	3 .	0.1	5. 5
5 × 39.8	5	3 .	0.1	.10
5 × 49.8	5	4 .	0.1	. 0

Note (1) Suitable for rollers with a flat end face.

Remarks 1. The figure shows the end faces with round and flat surfaces.

2. The minimum dimension and the maximum dimension of the fillet radius R of the end faces of the round surface are $\frac{D_w}{2}$ and $\frac{L_w}{2}$, respectively.

Table 3 Tolerances of Chamfer Dimension of Needle Rollers

Units: mm

D_w over	D_w incl	r (min)	r (max)
—	1	0.1	0.4
1	3	0.1	0.6
3	5	0.1	0.9

Remarks To be applied to the roller with a flat end face.

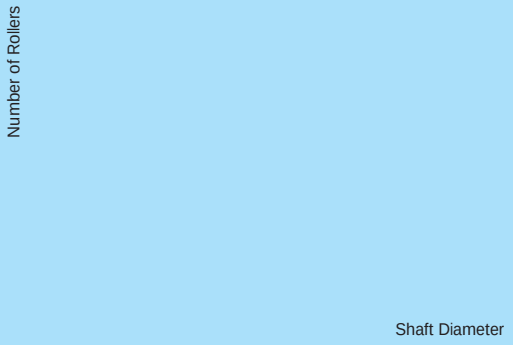


Fig. 1 Roller Number and Shaft Diameter for Standard Metric Roller Diameter

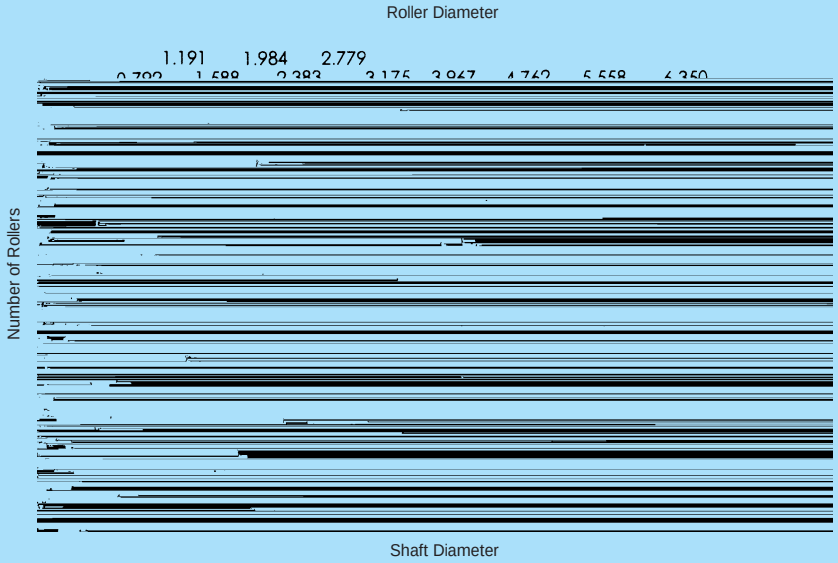


Fig. 3 Number of Rollers and Shaft Diameter for Standard Inch Roller Diameter

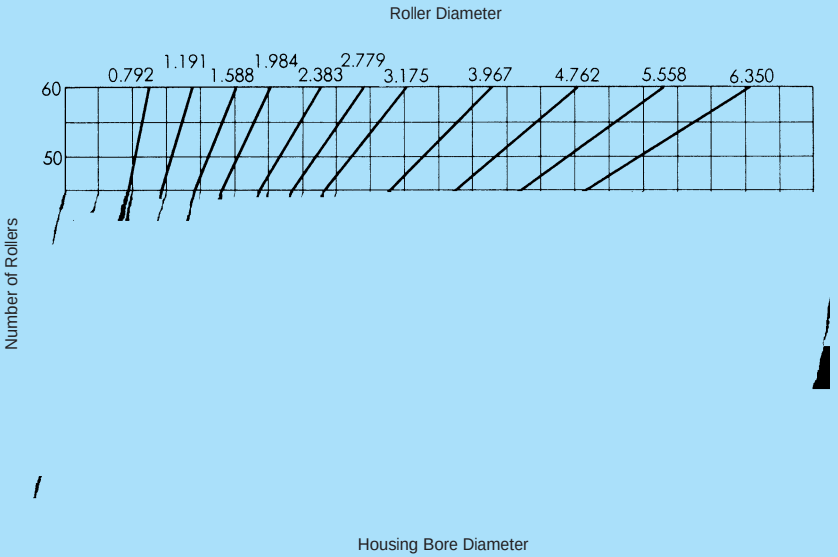


Fig. 4 Number of Rollers and Housing Bore Diameter for Standard Inch Roller Diameter

Specification (mm)		Product Number	Mass per 1,000 pieces, kg (approx)
Diameter, D_w	Length, L_w		
0.792	3.05	**Q-8266**	0.012
	4.06	**Q-8267**	0.016
	4.83	**Q-8100**	0.019
	5.59	**Q-8268**	0.021
	6.35	**Q-8101**	0.024
	7.11	**Q-8269**	0.027
	7.87	**Q-8102**	0.030
1.191	4.06	**Q-8271**	0.035
	4.83	**Q-8272**	0.042
	5.59	**Q-8273**	0.048
	6.35	**Q-8103**	0.055
	7.11	**Q-8274**	0.062
	7.87	**Q-8104**	0.068
	9.65	**Q-8105**	0.084
	11.18	**Q-8106**	0.097
1.588	6.35	**Q-8276**	0.098
	7.11	**Q-8277**	0.110
	7.87	**S-1414-Q**	0.120
	9.65	**Q-8107**	0.150
	11.18	**Q-8108**	0.170
	12.70	**Q-1821**	0.195
	14.22	**Q-8109**	0.220
	15.75	**H-368-Q**	0.245
	19.05	**Q-8284**	0.295
1.984	7.87	**Q-8286**	0.190
	9.65	**Q-8287**	0.230
	11.18	**Q-8110**	0.270
	12.70	**Q-8111**	0.305
	14.22	**Q-8112**	0.340
	15.75	**Q-8049**	0.380
	19.05	**Q-8114**	0.460
	22.35	**Q-8289**	0.540
2.283	9.65	**Q-8290**	0.335
	11.18	**Q-8291**	0.390
	12.70	**Q-8292**	0.440
	14.22	**Q-8115**	0.495
	15.75	**Q-8116**	0.545
	19.05	**H-230-Q**	0.660
	22.35	**Q-8037**	0.775
	25.40	**Q-8294**	0.880
2.779	11.18	**Q-8296**	0.530
	12.70	**Q-8297**	0.600
	14.22	**Q-8298**	0.670
	15.75	**Q-8118**	0.745
	19.05	**Q-8119**	0.900
	22.35	**Q-8120**	1.05
	25.40	**Q-8121**	1.20
	28.45	**Q-8303**	16342 -258

Specification (mm)		Product Number	Mass per 1,000 pieces, kg (approx)
Diameter, D_w	Length, L_w		

28.45

71.18

SPHERICAL PLAIN BEARINGS

			Pages
Metric Design	Bore Diameter	12−160 mm	B214−B217
Inch Design	Bore Diameter	12.700−152.400 mm	B218−B219

Spherical plain bearings are self-aligning. They are designed to carry heavy radial loads and combinations of radial and axial loads and to adjust the inclination of the inner ring and outer ring.

They are widely used in industrial and construction machinery and equipment that is characterized by low-speed oscillation and operation.

Design and Types

The simple structure consists of an inner ring with a spherical outside surface of the same diameter mounted to a single or double-cut split outer ring with a ground, spherical bore surface. Both inner and outer rings are made of high-carbon chromium bearing steel, fully hardened to HRC55 or more, and given a precise grinding finish. All the surfaces of the inner and outer rings are given phosphate surface treatment and covered with a coating of molybdenum disulfide.

The bearing codes and the details are shown in **Table 1**. Bearing numbers are formulated as follows. (Please note that inch bearings have their own bearing number formula that differs from metric bearings.)

(Example) 20 FSF 32

Although the bearing table shows FSF and SF bearings with single-cut outer ring, FSBB and SBB types with a double-cut split outer ring are also available.

Special spherical plain bearings, e.g., thrust spherical plain bearings, extended inner ring spherical plain bearings and spherical plain bearings made of special materials are also available. Please contact NSK for further details.

Table 1 Bearing Types

Code		Details
Metric	FSF	Outer ring, single-cut
	FSFTT	Outer ring, single-cut with seal
	FSBB	Outer ring, double-cut split After the inner ring is mounted, it is fitted with a snap ring.
Inch	SF	Outer ring, single-cut
	SF ... TT	Outer ring, single-cut with seal
	SBB	Outer ring, double-cut split After the inner ring is mounted, it is fitted with a snap ring.

Accuracy

The dimensional tolerances of NSK's metric spherical plain bearings are in accordance with the accuracy of ISO of radial bearings (refer to pages A26 and A27). However, dimensional tolerance values are before surface treatment and outer ring splitting. For FSBB bearings, the dimensional tolerance of the inner ring bore diameter is the value after surface treatment.

The dimensional tolerances of Inch spherical plain bearings are shown in **Table 2.1** and **Table 2.2**.

Table 2.1 Dimensional Tolerances of Inner Ring Bore Diameter and Width (Inch)

Units: μm

Nominal Bore Diameter, d (mm)		Single Plane Mean Bore Diameter Deviation, Δ_{dmp} (1)		Deviation of a single inner ring with Δ_{Bs}	
over	incl	high	low	high	low
11.112 (7/16)	50.800 (2)	0	−13	0	−130
50.800 (2)	76.200 (3)	0	−20	0	−130
76.200 (3)	120.650 (4 3/4)	0	−20	0	−130
120.650 (4 3/4)	152.400 (6)	0	−25	0	−130

Note (1) Value after surface treatment

Table 2.2 Dimensional Tolerances of Outer Ring Outside Diameter and Width (Inch)

Units: μm

Nominal Outside Diameter, D (mm)		Single Plane Mean Outside Diameter Deviation, Δ_{Dmp} (1)		Deviation of a single outer ring with Δ_{Cs}	
over	incl	high	low	high	low
20.638 (13/16)	50.800 (2)	0	−13	0	−130
50.800 (2)	80.962 (3 3/16)	0	−15	0	−130
80.962 (3 3/16)	120.650 (4 3/4)	0	−20	0	−130
120.650 (4 3/4)	177.800 (7)	0	−25	0	−130
177.800 (7)	222.250 (8 3/4)	0	−30	0	−130

Note (1) Value before surface treatment and outer ring splitting

Applications

Dynamic Load Capacity (C_d)

The dynamic load capacity shown in the Bearing Table indicates the maximum load that the bearing can carry under the following conditions:

1. Intermittent motion and load
2. Appropriate lubrication and periodic oiling
3. Appropriate fittings

Fitting

Recommended fittings for application of spherical plain bearings are shown in **Table 3**.

Design of Shaft and Housing

Shaft

In general, because oscillating and rotating motion is generated between the shaft and inner ring bore surface as the load becomes larger, it is

Table 4 Values of Coefficient K

E/D	K	E/D	K	E/D	K
1.2	1.8	1.8	2.4	3.0	3.7
1.4	2.0	2.0	2.7	4.0	4.7
1.6	2.2	2.5	3.2	5.0	5.5

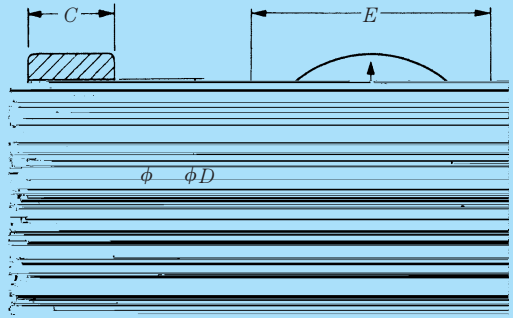


Fig. 1

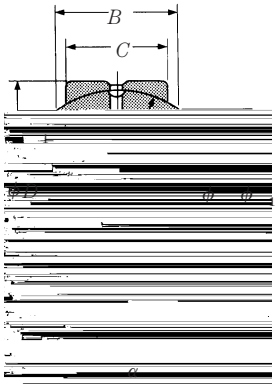
FSF

Bore Diameter 12 — 65 mm

| | | |

FSF

Bore Diameter 70 — 160 mm



Boundary Dimensions (mm)							Load Capacities Dynamic Loads (N)	{kgf}	Limiting Loads (N)	{kgf}
d	D	C	B	r min	r_1 min	U	C_d		C_s	
70	105	40	4	1	0.3	2	25 000	2 100	5 000	500
	110	50	5	0.	0.	100	2 3 000	2 00	1 110 000	113 000
75	120	55	4	0.	0.	110	345 000	35 500	1 3 0 000	140 000
80	120	45	55	1	0.3	105	330 000	33 500	1 000 000	102 000
	130	0	0	0.	0.	120	410 000	42 000	1 0 000	1 000
85	135	3	4	0.	0.	125	455 000	4 500	1 10 000	1 5 000
90	130	50	0	1.1	1	115	3 5 000	3 000	1 220 000	125 000
	140	5		0.	0.	130	500 000	51 000	1 0 000	201 000
95	150	0	2	0.	0.	140	5 5 000	5 500	2 2 0 000	230 000
100	150	55	0	1.1	1	130	510 000	52 000	1 4 0 000	14 000
	1 0	5		1	1	150	40 000	5 500	2 5 0 000	2 3 000
110	1 0	55	0	1.1	1	140	5 0 000	5 000	1 0 000	1 000
	1 0	0	3	1	1	1 0	50 000	000	2 0 000	305 000
115	1 0	5		1	1	1 5	15 000	3 500	2 0 000	2 4 000
120	1 0	0	5	1.1	1	155	45 000	000	1 0 000	201 000
	1 0	0	105	1	1	1 5	25 000	4 500	3 250 000	330 000
130	200	5	110	1	1	1 5	1 040 000	10 000	3 00 000	3 0 000
140	210	0	0	2	1	1 0	20 000	4 000	2 10 000	2 000
150	220	105	120	1	1	205	1 330 000	13 000	4 300 000	440 000
160	230	0	105	2	1	200	1 250 000	12 000	3 250 000	330 000

Bearing Numbers	Limiting Inclination Angles (°) α	Mass (kg) approx	Inner Ring Side Face Diameters (mm) d_1 approx
70FSF105	.5	1.55	
70FSF110	5.5	2.2	1
75FSF120	5.5	3.0	
80FSF120	.5	2.3	
80FSF130		4.0	
85FSF135		4.25	101
90FSF130		2.	
90FSF140		4.	105
95FSF150		.05	113
100FSF150	.5	4.4	110
100FSF160		.4	121
110FSF160		4.	121
110FSF170	5.5	.55	130
115FSF180	5.5	10.5	133
120FSF180	.5	.	130
120FSF190		12.5	140
130FSF200	5.5	14	14
140FSF210		11	15
150FSF220	5	1	1
160FSF230		14	1 0

NEEDLE ROLLER BEARINGS FOR UNIVERSAL JOINTS

			Pages
Drawn Cup Type	Inscribed Circle Diameter	10–21.3 mm	B224–B225
Solid Type	Inscribed Circle Diameter	12.170–32.600 mm	B226–B227

Needle roller bearings for universal joints are available as drawn cup and solid. The drawn cup needle bearing has a large load capacity in spite of its small cross-sectional height. Since the material for the drawn cup (outer ring) is a special alloy steel sheet developed by the bearing performs well regarding fatigue and shock resistance. If this drawn cup needle bearing is applied, an economical universal joint with a large torque capacity can be designed.

A method for fixing a drawn cup needle bearing to the yoke hole is the

Types

Needle rolling bearings for universal joints are available in the types in **Table 1**.

Table 1 Bearing Types

Code	Details
ZY	Closed end drawn cup needle bearing that is fixed to the yoke by tightening or with a rose washer.
NSA	Closed end solid needle bearing that is fixed to the yoke with a snap ring or a detent plate. The outer ring has a sealing structure that varies depending on the fixation method.

Drawn Cup Needle Roller Bearings for Universal Joints

These bearings are assembled into universal joints with their own dedicated assembly equipment.

Universal joints have the following characteristics:

(1) It is possible to give a light preload between the joint spider end face and the bearing bottom.
(2) It is possible to align the joint spider rotating center with the shaft rotating center as necessary.
(3) Smaller size, lighter weight and working energy efficiency contribute to a reduced cost.

Fitting

For each fitting tolerance of the joint spider and yoke hole, k6 and F7 are recommended respectively.

Accuracy, Roughness and Hardness of the Joint Spider and Yoke Hole

Drawn cup needle bearings form a correct raceway track for the needle rollers only after press fitting into a yoke hole of specified dimensions. It is therefore necessary to finish the yoke hole accurately according to the dimensions specified. Accuracy, roughness and hardness of the joint spider and yoke hole are the same as standard drawn cup needle bearings (please refer to page B39). However, yoke hardness is required to be HRC23 to 28.

Solid Needle Roller Bearings for Universal Joints

These bearings have proven past performance and are fixed to the yoke hole with a snap ring or detent plate. Because they are solid with a thick-wall outer ring, the bearing is well-suited for use in universal joints in medium and large vehicles on which a heavy load is imposed.

Accuracy

The dimensional tolerance of each part varies depending on each bearing. Please consult NSK for details.

Fitting

As for the fittings between the bearing outside diameter and yoke hole, a transient or tight fit is commonly applied and the shaft diameter should be determined so that the radial minimum internal clearance is maintained at about 0.005 mm. For each bearing number, please consult NSK.

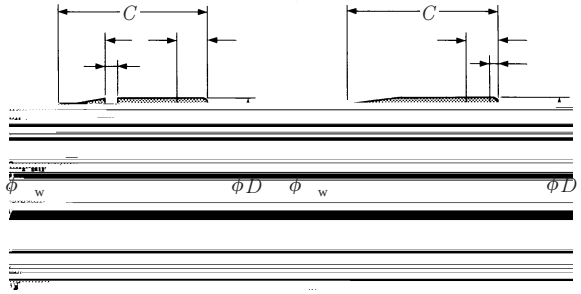
ZY

Inscribed Circle Diameter 10 —

ZY-108	6.9	16.016	10.014	10.036
ZY-109	6.6	15.016	10.011	10.026
ZY-1210	10	18.020	12.073	12.095
ZY-1411	12	20.020	14.009	14.035
ZY-1612	14	22.020	16.009	16.035
ZY-1813	17	24.620	18.009	18.035
ZY-2115	37	29.002	21.316	21.337

NSA

Inscribed Circle Diameter 12.170 — 32.600 mm



Example 3 Example 4

20.5	16	2	
26	16	4	
23.813	15	2	
25	16.8	3.3	
29	17.5	3.5	
28	18.5	3.5	
29	17.5	3.5	
33	21.2	4	
35	23	4	
40	25.5	4	
42	30	6	
46	31.5	7	
48	33.2	6	

1 200	1 870	**NSA02001**	2	24
1 240	1 770	**NSA02601**	2	40
1 360	2 040	**NSA02424**	1	28
1 140	1 860	**NSA024A**	3	38
1 730	2 530	**NSA02901**	3	54
1 490	2 760	**NSA02803**	3	49
1 520	2 860	**NSA02903**	3	54
2 180	3 950	**NSA03301**	2	80
2 430	4 800	**NSA03501**	2	90
2 920	6 400	**NSA04002**	2	135
3 600	7 500	**NSA04204**	4	165
3 900	8 500	**NSA04604**	4	205
4 450	9 100	**NSA04803**	4	225

DRAWN CUP ROLLER CLUTCHES

			Pages
FC, FLC, RC	Shaft Diameter	4−30 mm	B234−B235
FCB, FCBN, RCB	Shaft Diameter	4−30 mm	B236−B237

Drawn cup roller clutches are very compact one-way clutches with a unique drawn cup outer ring. In spite of their lightweight and small section height, torque capacity is high. Operation is accurate and the friction torque when overrunning is small. Mounting is as eazy as drawn cup needle bearings.

Design and Types

Drawn cup roller clutches are composed of an outer ring, which forms the cam face on the drawn cup bore surface by precise deep drawing, as well as rollers, a cage and a spring.

The types of drawn cup roller clutches are shown in **Table 1** and the states of engagement and overruns are shown in **Fig. 1** and **Fig. 2**.

The metric FCP series for low-torque transmissions and plastic housings are available. Please consult NSK for further details.

Table 1 Types of Drawn Cup Roller Clutches

Type	Code	Details
Metric	FC	For torque transmissions only, containing stainless steel spring
	FCL	For torque transmissions only, containing stainless steel spring
	FCB	For torque transmissions and imposing of radial load, containing stainless steel spring
	FCBN	Narrow width type. For torque transmission and imposing of radial load, containing stainless steel spring
Inch	RC	For torque transmission only, containing plastic spring
	RCB	For torque transmission and imposing of radial load, containing plastic spring
	RC-FS	For torque transmission only, containing a stainless steel spring
	RCB-FS	For torque transmission and imposing of radial load, and containing a stainless steel spring

Remarks Drawn cup metric roller clutches have a standard structure of a spring pushing multiple rollers. In addition, the K type with a structure of a spring pushing a single roller is available for low torque (K is attached to the end of the product number).



Fig. 1 Clutch in Engagement

With the force of the spring mounted inside the clutch produced by the relative rotation of the clutch and the shaft mounted to the housing, the roller contacts the wedge face and engages it. The engagement directions are opposite depending on whether the shaft or housing is driven.

Fig. 2 Clutch Overrun

By the relative rotation of the clutch and the shaft mounted to housing, the roller operates free from the wedge face and overruns. In this case, the housing and the clutch overrun in a clockwise direction and the shaft overruns in a counterclockwise direction.

Applications

Specifications of Shaft and Housing

(1) Accuracy, Roughness and Hardness

Drawn cup roller clutches do not usually use an inner ring but use the shaft as the raceway ring. Made of a thin steel plate, they perform best only with press fitting into a normal housing. Therefore, the dimensional accuracy and hardness of the shaft and housing are required to satisfy the specifications shown below (**Table 2**).

Table 2 Accuracy, Roughness and Hardness

Item	Shaft	Housing
Out-of-Roundness Tolerance	$\frac{IT3}{2}$	$\frac{IT4}{2}$ to $\frac{IT5}{2}$
Cylindrical Tolerance	$\frac{IT3}{2}$	$\frac{IT4}{2}$ to $\frac{IT5}{2}$
Roughness, Ra	0.4	1.6
Hardness	HRC58 to 64	—

Note Please refer to Section **5.2** on page A34 and Section **5.3** on page A35 for further details.

(2) Housing Rigidity

In order to obtain the best performance from drawn cup roller clutches, the housing must have sufficient thickness and be designed to avoid deformation even if torque and radial loads are imposed. Special attention should be paid material quality and wall thickness of the housing. Housing material usually consists of steel. However, if cast iron housing is used, the maximum load torque value must not exceed 70% of torque capacity. For aluminum housing, the same value must not exceed 50% of torque capacity.

Even with steel housings, the outside diameter shoud be larger than the minimum outside diameter dimension of the housing shown in the bearing table.

Fitting

Drawn cup roller clutches can perform as designed only when used with standard fittings. Therefore, the shaft and housing bore should be finished to the recommended fitting dimensions shown in **Table 3**. The recommended values shown in **Table 3** are for steel, provided that the housing outer diameter is larger than the minimum dimension shown in the bearing table.

Depending on application conditions, a fitting change may be required.

Table 3 Fittings for Drawn Cup Roller Clutches

Type		Fitting Tolerance	
		Shaft	Housing Bore
Metric	FC, FCL FCB, FCBN	h6	N7
Inch	RC (FS) RCB (FS)	h6	J7

Mounting

For press fitting of drawn cup roller clutches into the housing bore, it is necessary to prevent the outer ring from deformation and damage by using an appropriate jig as shown **Fig. 4**. Precautions for mounting are described below:

(1) Use a hand press or similar for press fitting. Avoid applying blows with a hammer or similar instrument. (**Fig. 3**)

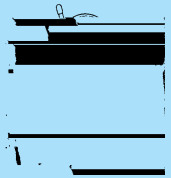


Fig. 3

(2) Place the roller clutch side face on the marked side onto the jig shoulder. For accurate press fitting, provide a stopper for the locations and guide. (**Fig. 4**)

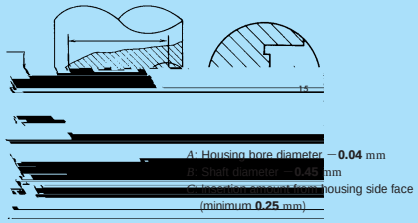


Fig. 4

(3) A snap ring and shoulder for positioning the roller clutch are not required. When press fitting the roller clutch into the housing with a shoulder or a closed and, care should be taken not to have the side face of the roller clutch contact the shoulder or the bottom. (**Fig. 5**)

(4) When assembling the shaft, keep rotating it while mounting. A large chamfer for the corner of the shaft is advisable. (**Fig. 6**)

Operating Temperature and Engagement Speed

The operating temperature of drawn cup roller clutches should be 90˚C or less for a standard plastic spring and 120˚C or less for a stainless steel spring.

When engagement speed exceeds 200 cycles per minute and when operation of the spring is impaired by low temperatures, a clutch with a stainless steel spring must be applied.

Lubrication

Oil lubrication is generally recommended and, in the conditions described below, it is required.

- Overrunning
- High engagement speed
- Very low transmitting torque
- High operating temperature

As grease lubrication is common, NSK produces bearings packed with standard grease.

Grease containing extreme pressure additives should be avoided as it may cause slippage.

Hardening of grease due to deterioration and formation of sludge impair the lock performance of the clutch. Extreme caution must be taken for deterioration of lubricant.

Please consult NSK regarding the lubricant to be applied.

Engagement Direction

Clutch engagement takes place when rotating the housing in the direction of the arrow (←LOCK) marked on the side face of the drawn cup outer ring. (Refer to **Fig. 7**)

Cautions in Application

Some machines using a one-way clutch generate inertia during operation. In such cases, it is necessary to accurately determine the load torque imposed on the clutch.

In some cases, the torque actually imposed on the clutch is a far greater value than the value calculated based on the power source such as a motor or brake. Sometimes the transient response at the instant the clutch is locked, in particular, is this excessive load torque. (This is caused by the inertia force of the whole motion system surrounding the mounted clutch and therefore can hardly be calculated beforehand.)

If such a case is anticipated, it is necessary to select a clutch after measuring the impact value and correctly grasping the torque imposed on the clutch. In any case, the torque imposed on the clutch should not exceed the torque capacity as shown in the bearing table.

If vibration is involved, the clutch function may be destroyed. Therefore, either refrain from using roller clutches when vibration is involved or attach an effective protection device. Furthermore, for those parts where an accident may cause injury or critical damage, add effective protection devices to the existing equipment.

				$^{0}_{-0.25}$			
4		8		6		0.31	0.032
6		10		12		2.45	0.250
		10		12		1.96	0.200
6.350	0.2500	11.112	0.4375	12.70	0.5000	1.96	0.200
		11.112	0.4375	12.70	0.5000	1.96	0.200
8		12		12		3.24	0.330
		14		12		4.02	0.410
9.525	0.3750	15.875	0.6250	12.70	0.5000	5.10	0.520
		15.875	0.6250	12.70	0.5000	5.10	0.520
10		14		12		4.41	0.450
		16		12		5.30	0.540
12		18		16		13.24	1.350
12.700	0.5000	19.050	0.7500	12.70	0.5000	8.34	0.850
		19.050	0.7500	12.70	0.5000	8.34	0.850
14		20		16		14.22	1.450
15.875	0.6250	22.225	0.8750	15.88	0.6250	16.18	1.650
		22.225	0.8750	15.88	0.6250	16.18	1.650
16		22		16		20.59	2.100
19.050	0.7500	25.400	1.0000	15.88	0.6250	22.06	2.250
		25.400	1.0000	15.88	0.6250	22.06	2.250
20		26		16		30.89	3.150
25		32		20		68.65	7.000
25.400	1.0000	33.338	1.3125	15.88	0.6250	46.58	4.750
		33.338	1.3125	15.88	0.6250	46.58	4.750
30		37		20		95.12	9.700

FC-4K (1)	0.90	12	F-48	—
FC-6	4.1	14	F-68	FJ-69
FC-6K (1)	2.7	14	F-68	FJ-69
—	3.6	16	B-45	J-45
—	3.6	16	B-45	J-45
FCL-8K (1)	3.3	18	F-810	FJ-810
	6.8	20	FH-810	FJH-810
	7.7	22	BH-68	JH-68
BH-108	3.9	23	F-1010	FJ-1010
	9.1	25	FH-1010	FJH-1010
	12	27	FH-1212	FJH-1212
	9.1	28	BH-88	JH-88
	9.1	28	BH-88	JH-88
	16	29	F-1412	FJ-1412
	14	30	BH-108	JH-108
	14	30	BH-108	JH-108
	18	31	F-1612	FJ-1612
	15	36	B-1210	J-1210
	15	36	B-1210	J-1210
	21	38	F-2012	FJ-2012
	34	46	F-2516	FJ-2516
	26	48	BH-168	JH-1612
	26	48	BH-168	JH-1612
	42	51	F-3020	FJ-3020

BH2016Nc(19.050)Tj0 -3.7245 TD283 TD(FCL-8K)Tj/G.0569 TD<0295>Tj/F2 1 Tf-2.0005 -1.8623 TD(FCL-8K)T

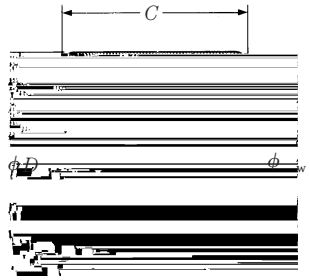
FCB • FCBN

RCB

Shaft Diameter 4 — 30 mm



FCB



RCB

F_w		D		C $^{0}_{-0.25}$		Torque Capacities (N·m)	{kgf·m}
4		10		9		0.19	0.019
6		12		10		0.56	0.057
8		14		20		4.02	0.410
9.525	0.3750	15.875	0.6250	22.22	0.8750	5.10	0.520
		15.875	0.6250	22.22	0.8750	5.10	0.520
10		16		20		5.30	0.540
12		18		26		13.24	1.350
12.700	0.5000	19.050	0.7500	22.22	0.8750	8.34	0.850
		19.050	0.7500	22.22	0.8750	8.34	0.850
15.875	0.6250	22.225	0.8750	25.40	1.0000	16.18	1.650
		22.225	0.8750	25.40	1.0000	16.18	1.650
16		22		26		20.59	2.100
19.050	0.7500	25.400	1.0000	25.40	1.0000	22.06	2.250
		25.400	1.0000	25.40	1.0000	22.06	2.250
20		26		26		30.89	3.150
25		32		30		68.65	7.000
25.400	1.0000	33.338	1.3125	27.00	—	46.58	4.750
		33.338	1.3125	27.00	—	46.58	4.750
30		37		30		95.12	9.700

Roller Clutch Numbers		Basic Dynamic Load Ratings (N) C_r	{kgf}	Limiting Loads (N) P_{max}	{kgf}	Mass (g) approx	Minimum Outside Diameters of Housing (mm)
Metric Design	Inch design						
FCBN-4K (1)	—	1 190	121	540	55	2.7	16
FCBN-6K (1)	—	1 630	166	735	75	3.8	18
FCB-8	—	2 430	248	1 200	122	11	20
—	**RCB-061014**	3 700	375	2 010	205	14	22
—	**RCB-061014-FS** (2)	3 700	375	2 010	205	14	22
FCB-10	—	2 820	288	1 450	148	13	25
FCB-12	—	3 800	390	2 240	228	18	27
—	**RCB-081214**	4 400	450	2 580	263	16	28
—	**RCB-081214-FS** (2)	4 400	450	2 580	263	16	28
—	**RCB-101416**	4 900	500	3 050	310	23	30
—	**RCB-101416-FS** (2)	4 900	500	3 050	310	23	30
FCB-16	—	4 100	420	2 670	272	24	31
—	**RCB-121616**	5 550	565	3 700	375	26	36
—	**RCB-121616-FS** (2)	5 550	565	3 700	375	26	36
FCB-20	—	5 100	520	3 550	360	28	38
FCB-25	—	6 850	700	4 700	480	48	46
—	**RCB-162117**	9 750	995	6 750	690	45	48
—	**RCB-162117-FS** (2)	9 750	995	6 750	690	45	48
FCB-30	—	7 000	715	5 250	535	54	51

Notes (1) The suffix K indicates low-torque products.
(2) Even if the suffix FS is not marked on the product, it can be distinguished from others because its cage is always red.

Remarks For stock availability, please contact NSK.
Please consult NSK when making a selection.

OIL SEALS FOR NEEDLE BEARINGS

Pages

Single-Lip Synthetic Rubber Seals B242

Double-Lip Synthetic Rubber Seals..... B242

Needle roller bearing oil seals are manufactured to meet the section height of drawn cup needle bearings. It is possible, therefore, to mount them onto the side face of a needle bearing without specially machining the housing bore.

The oil seals of VC and KC bearings serve as packing because their outside circumferences are rubber and facilitate easy mounting.

Types

The types of needle roller bearing oil seals are shown in **Table 1**.

Table 1 Types of Oil Seals

Type	Details	
VC	Synthetic rubber	Single lip
KC	Synthetic rubber	Double lip

Accuracy

The dimensional tolerance of oil seals complies with ISO6194 (JIS B 2402). The outside diameter and the width tolerances are shown in **Table 2** and **Table 3**, respectively.

Table 2 Outside Diameter Tolerance

Units: mm

Nominal Outside Diameter		Tolerance	
over	incl	high	low
—	30	+0.30	+0.10
30	120	+0.35	+0.10

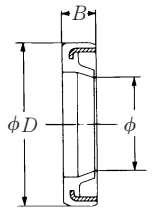
Table 3 Width Tolerance

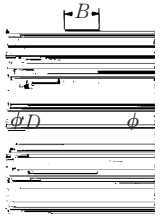
Units: mm

Nominal Width		Width Tolerance	
over	incl	high	low
–	6	+0.2	−0.2

u r u rs
s s( )
d D B

VC-4825	—
VC-5925	—
VC-61025	—
VC-71125	—
VC-81225	—
VC-8153	—
VC-91325	—
VC-9163	—
VC-101425	—
VC-10173	—
VC-121625	—
VC-12183	—
VC-12193	—
VC-13193	—
VC-14203	KC-14203
VC-14223	KC-14223
VC-15213	KC-15213
VC-15223	KC-15223
VC-16223	KC-16223
VC-16243	KC-16243
VC-17233	KC-17233
VC-17243	KC-17243
VC-18243	KC-18243
VC-18253	KC-18253
VC-20264	KC-20264
VC-20274	KC-20274
VC-22284	KC-22284
VC-22294	KC-22294
VC-25324	KC-25324
VC-25334	KC-25334





s su g s

EXAMPLE FIGURES

APPENDICES

FIGURES

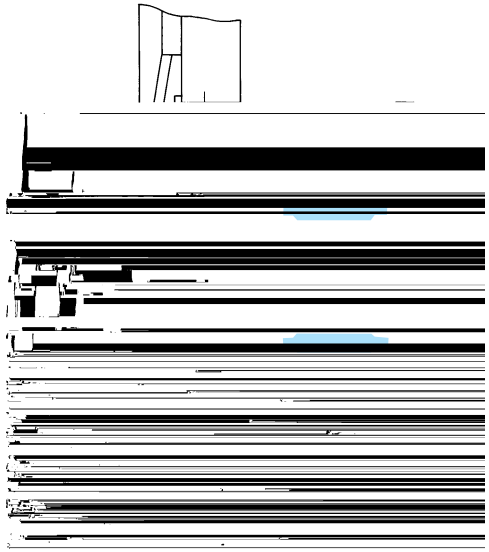
g

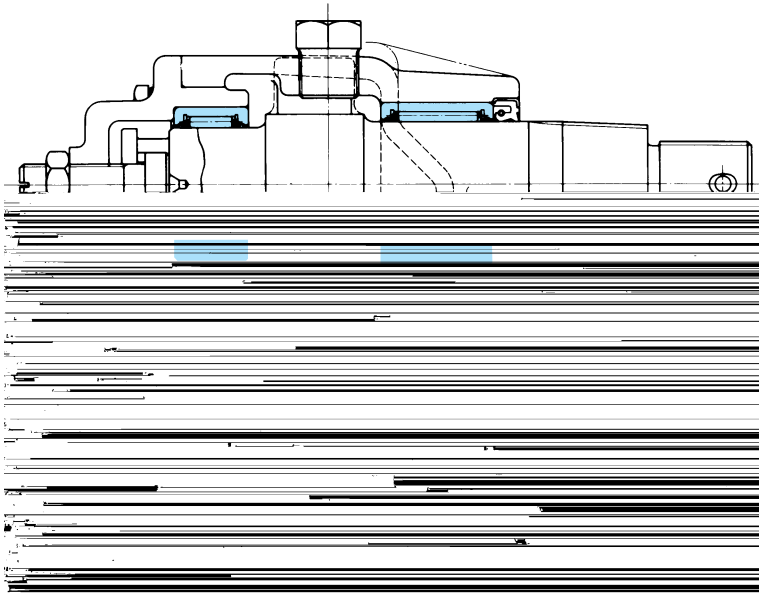
- T .....
- T T T 9
- T 19
- T 0
- .....
- T T T..... 0
- T - T 9
- 41
- T 44

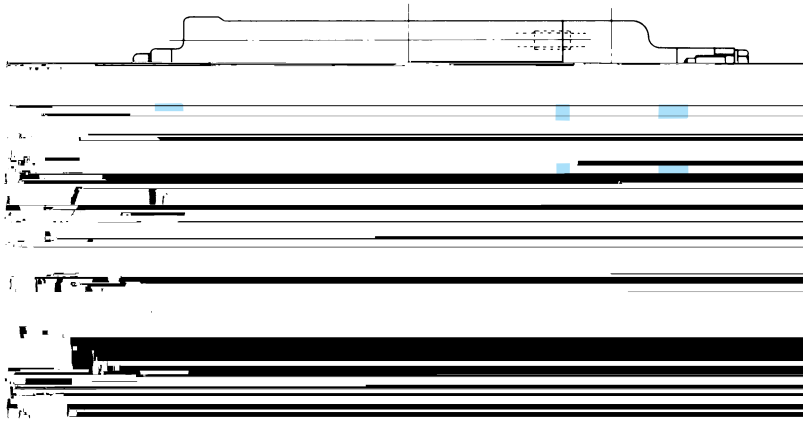
APPENDICES

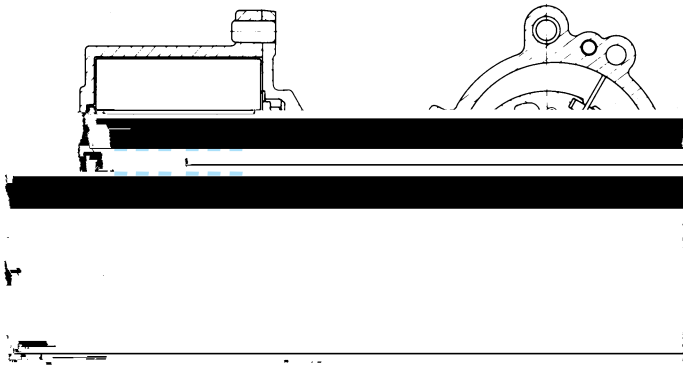
1 T SI
(T T T) T 48
N-kgf T 50
kg-lb T 51
4 °C-°F T 5
5 T T 5
inch-mm T 54
T ( )..... 5
8 T T .. 5
9 T T T 58
10 T T 0
11 T T IT .....
1 T f_n 4
1 T T f_h T $L \cdot L_h$ 5
14 .....
15 T T .....

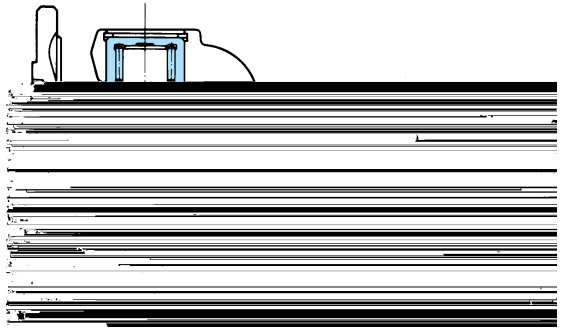
MOTOR VEHICLES

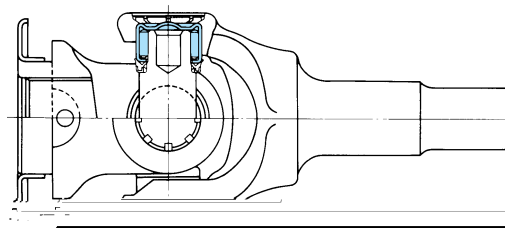




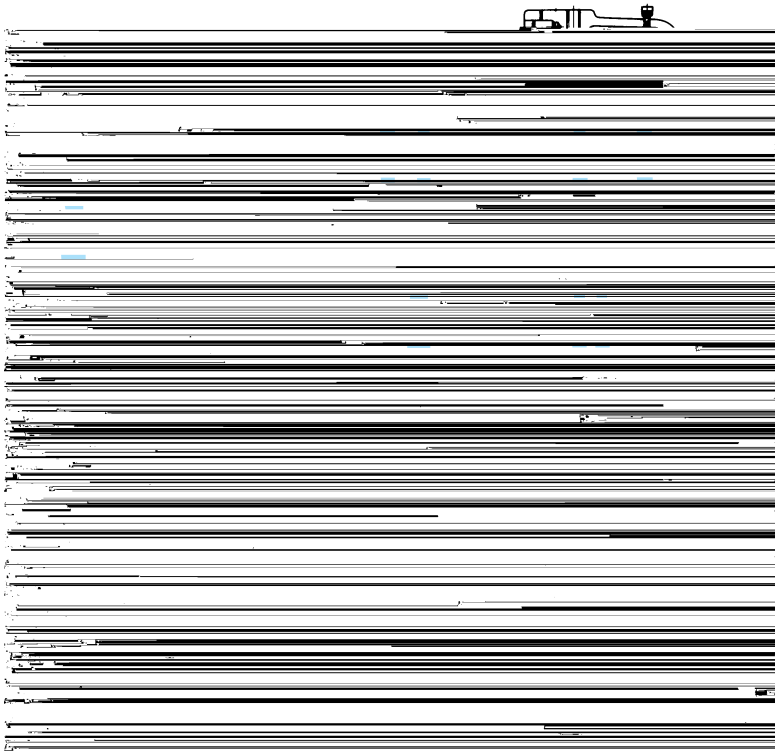


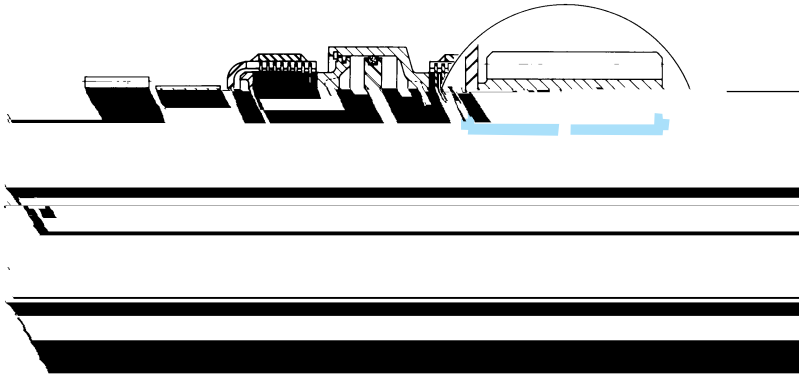


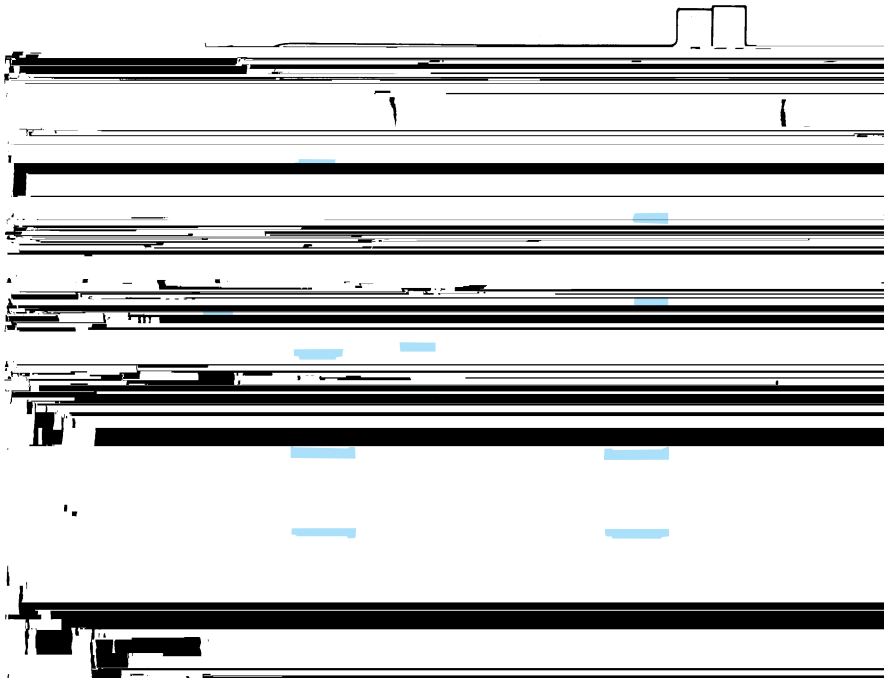





Input Shaft







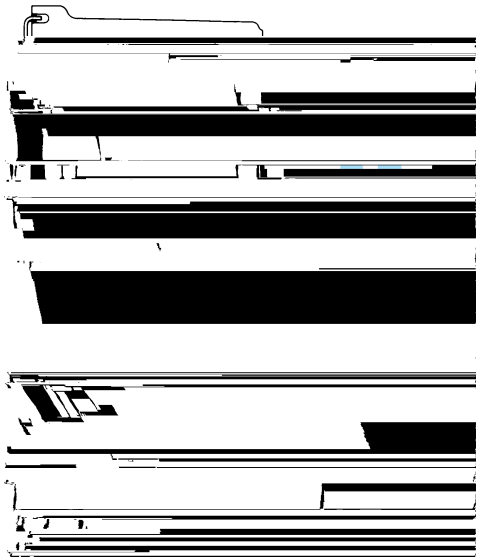


Fig. 21 Final Reduction Gear for Large Tractor

For rubber-tire tractors used in construction, a planetary final reduction gear is used as shown in the figure. In this case, since the load is large and space is limited, cage & needle roller assemblies are used in consideration of the large load capacity, compact size, assembly, and service.

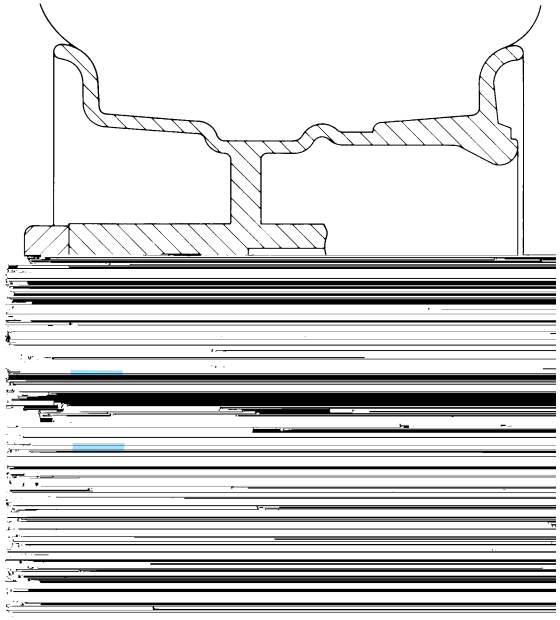


Fig. 22 Final Reduction Gear

The structure is similar to **Fig. 21**. Two rows of cage & needle roller assemblies are also applied to this device to enhance the stability of the gears. Rollers treated with a proper crowning are recommended.

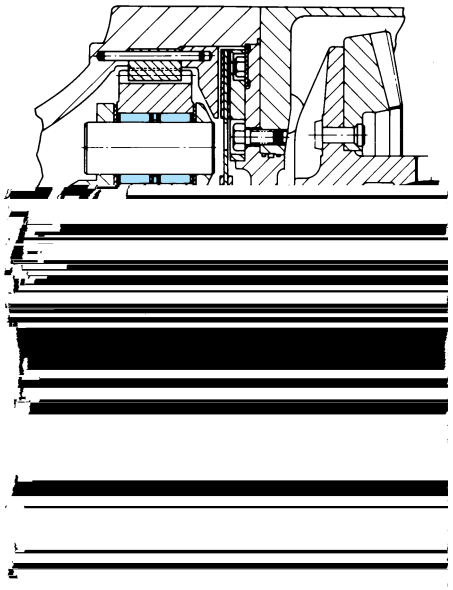


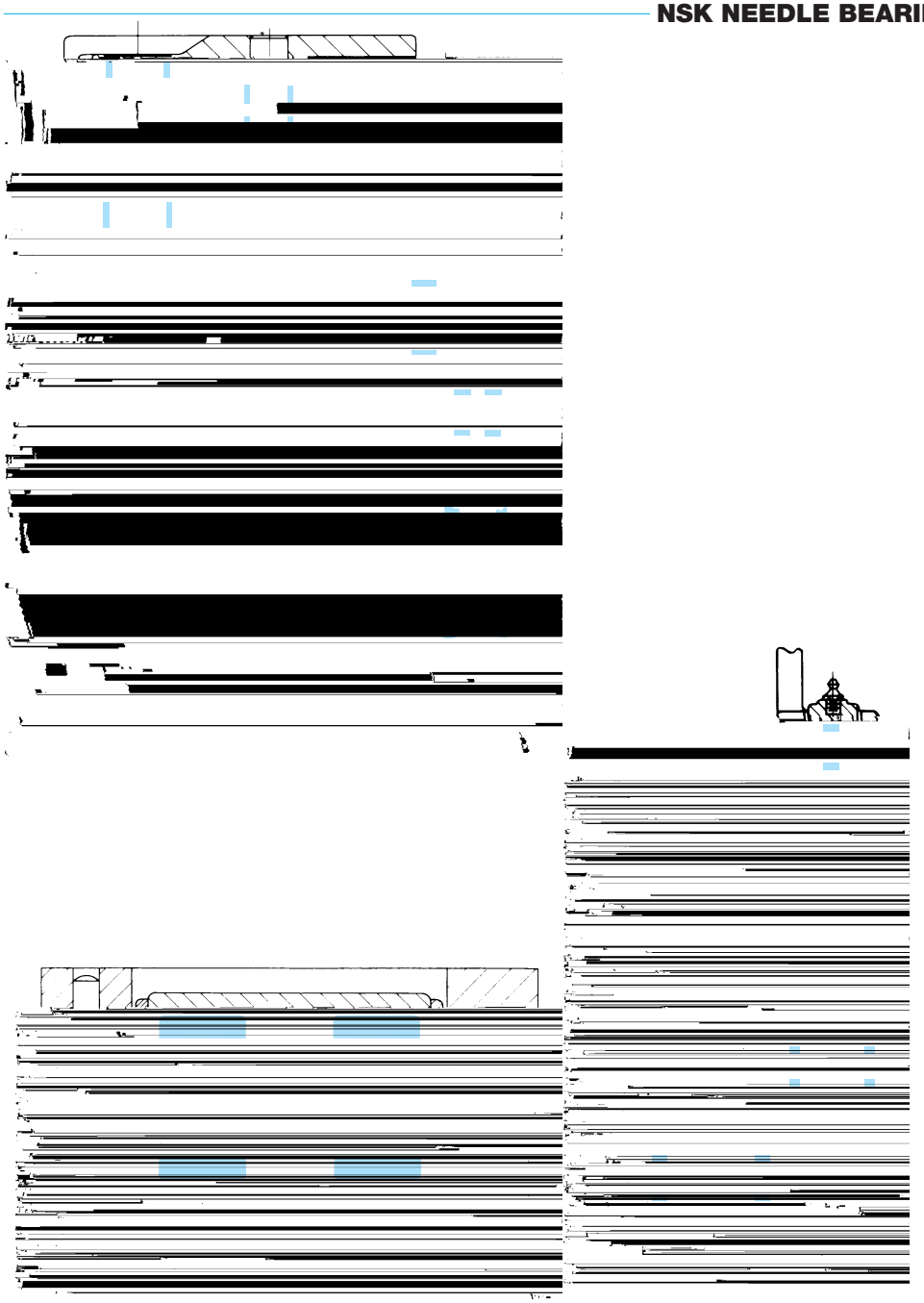
Fig. 23 Final Reduction Gear

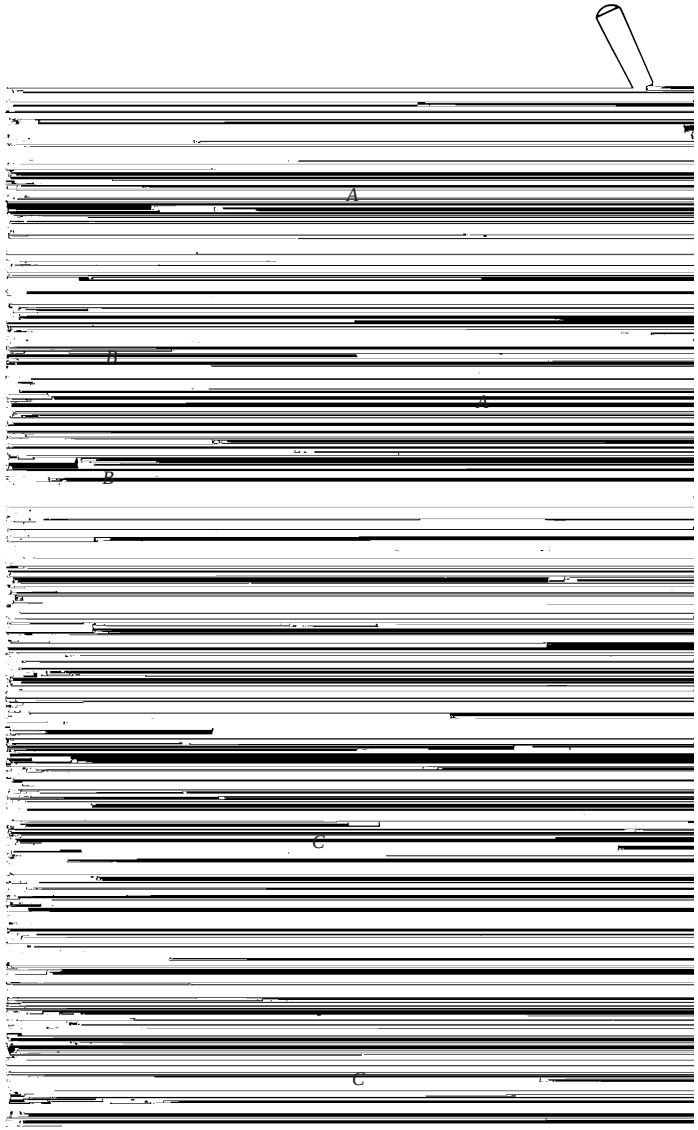
In some cases, a final reduction gear is positioned close to the differential gears as shown in this figure. Instead of cage & needle roller assemblies, a single needle roller bearing is integrated into the two rows and the rollers are kept separate by a hardened spacer. It is absolutely essential that the needle rollers have the proper crowning.



Fig. 24 Auxiliary Gearbox

This illustrates an application of cage & needle roller assemblies to the planetary gears of an auxiliary gearbox.




A
B
B
C
C

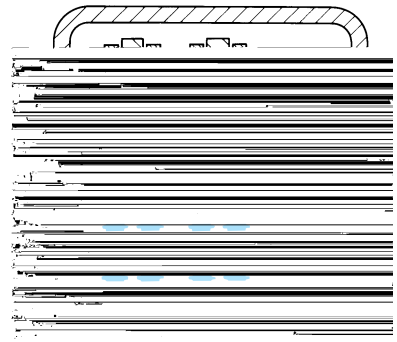




Fig. 33 Hydraulic Cylinder for Bulldozer Blade Operation

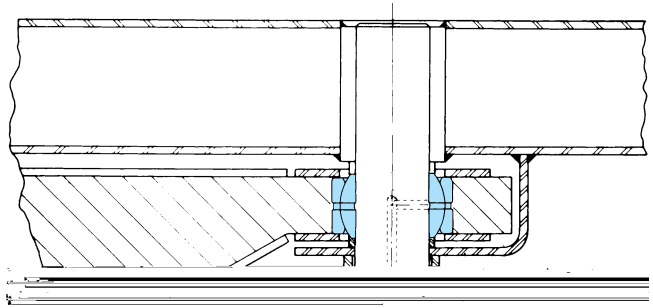


Fig. 34 Scraper Linkage



Fig. 35 Hydraulic Cylinder for Shovel Operation

AGRICULTURAL MACHINERY

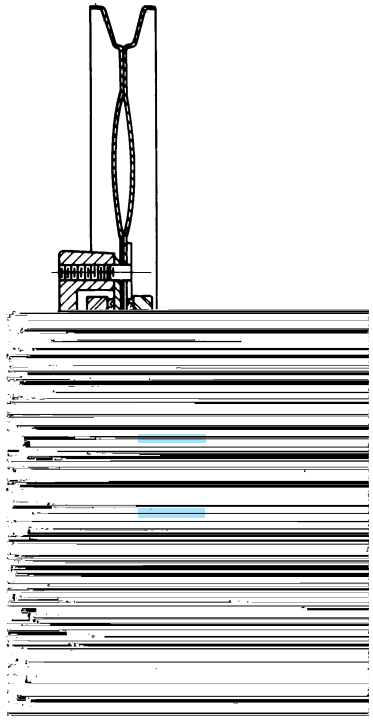


Fig. 36 Grain Reaping Machine

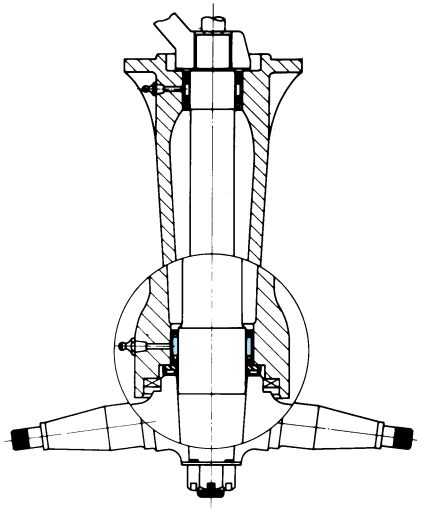


Fig. 37 Tractor Bolster

A compact thrust needle roller bearing is applied to the thrust pad of a tractor bolster. A drawn cup needle roller bearing is also used at the same time for smoother operation.

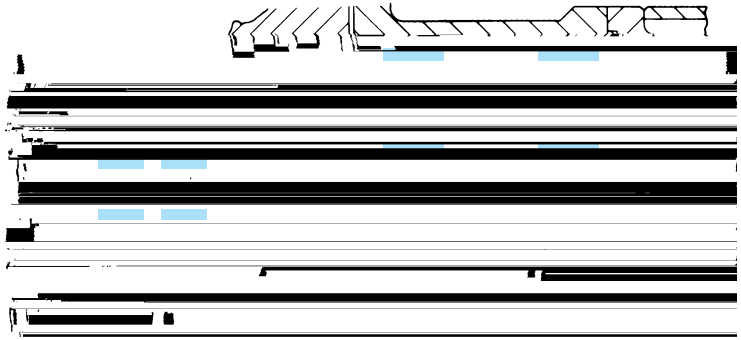


Fig. 38 Pitman

For superior wear resistance and operating efficiency, a drawn cup needle roller bearing is applied to the pitman crank and crankpin.

MACHINE TOOLS

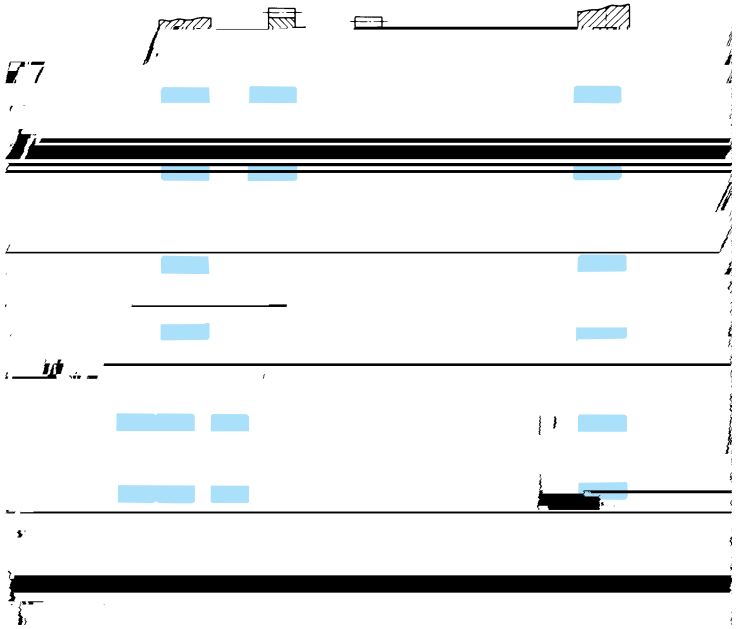


Fig. 39 Machine Tool Gearbox

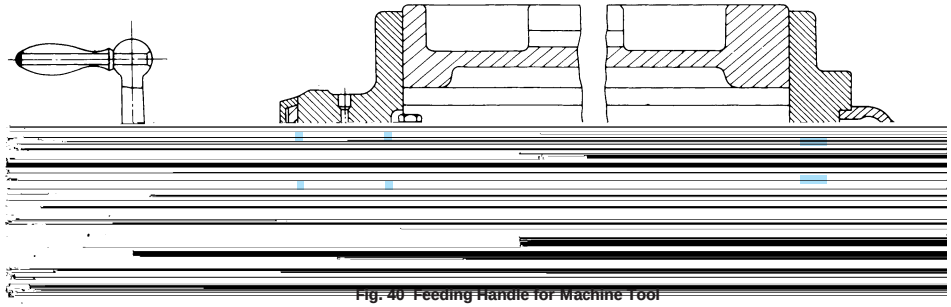


Fig. 40 Feeding Handle for Machine Tool

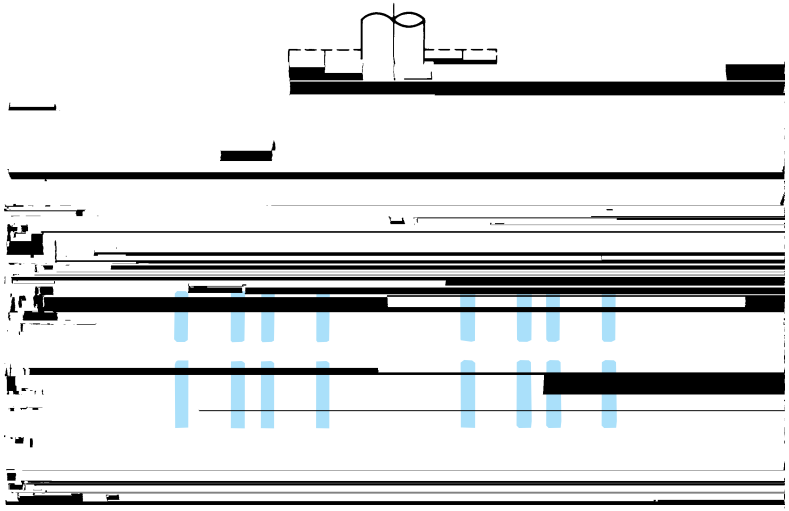


Fig. 41 Multi-Spindle Drill

In the case of multiple spindles occupying a limited space, such as a multiple spindle drilling machine, a drawn cup needle roller bearing is recommended.

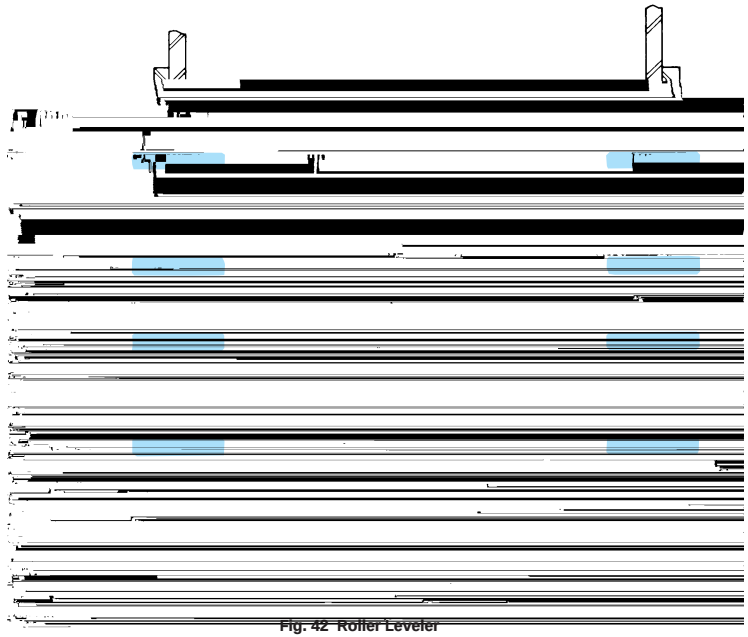


Fig. 42 Roller Leveler

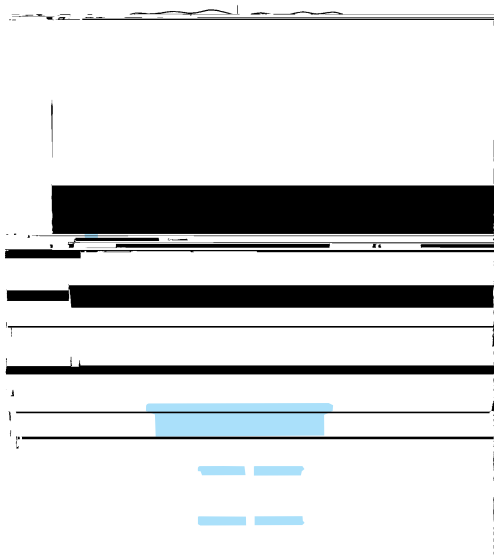


Fig. 43 Back-Up Roll and Working Roll

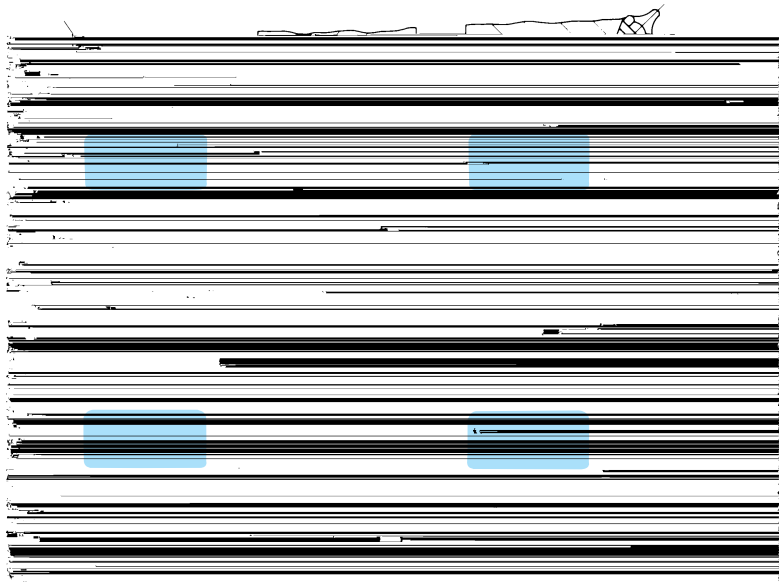


Fig. 44 Crane Wheel

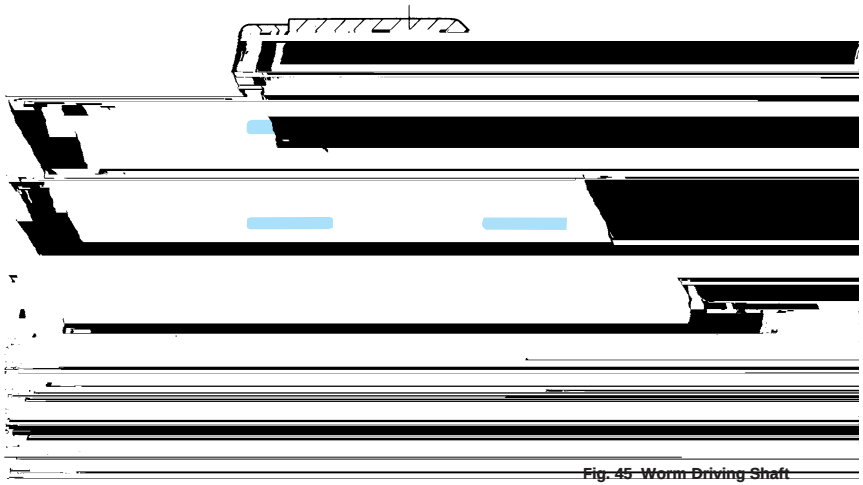


Fig. 45 Worm Driving Shaft

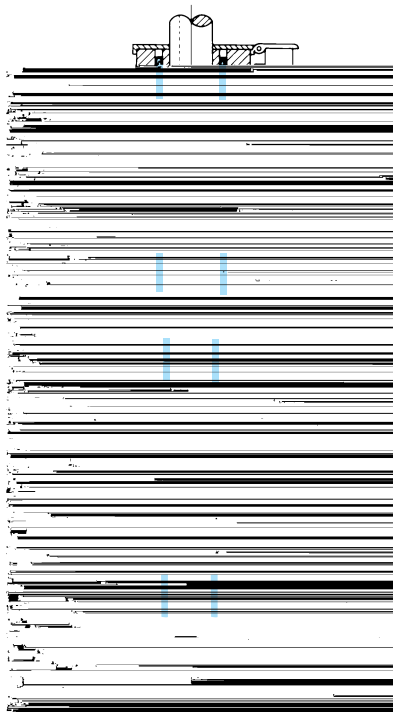


Fig. 46 Small Drill Press Spindle

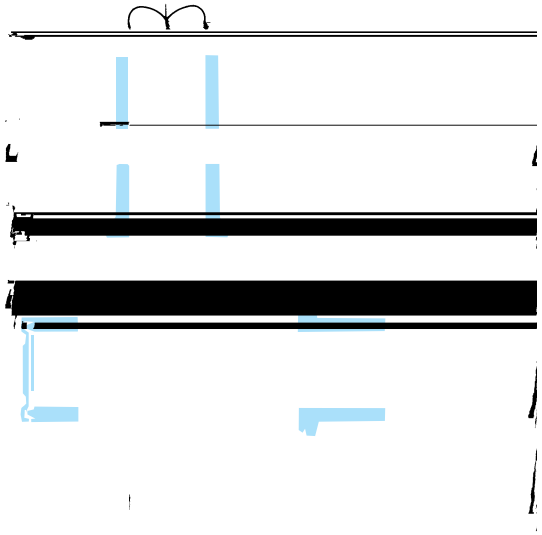


Fig. 47 Gearbox

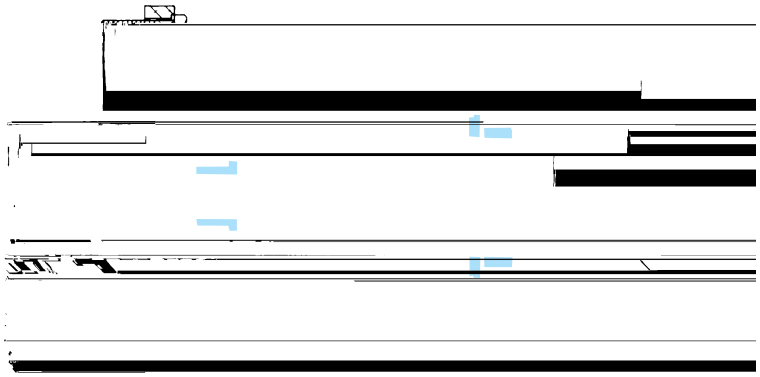


Fig. 48 Gearbox



Fig. 49 Conveyer Driving Reduction Gear

BUSINESS MACHINES

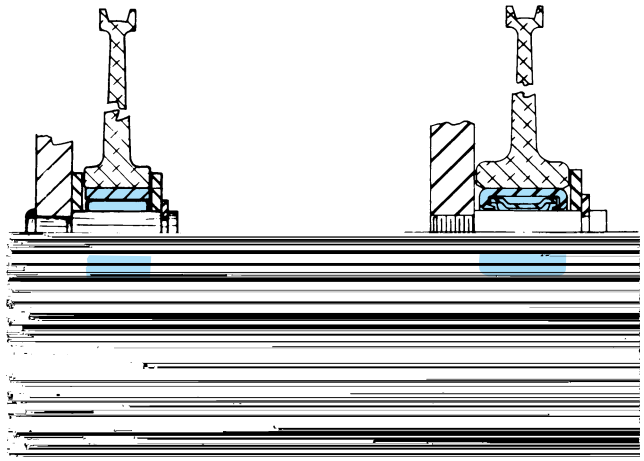


Fig. 50 Magnetic Tape Driving Pulley for Electronic Computers

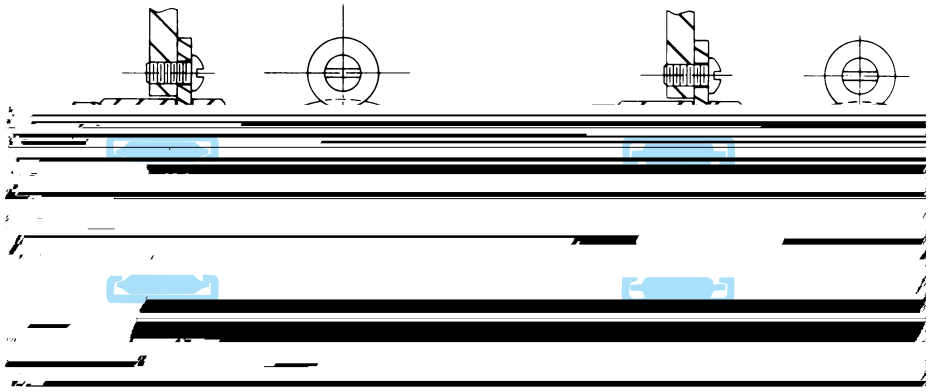


Fig. 51 Copying Machine Side Frame

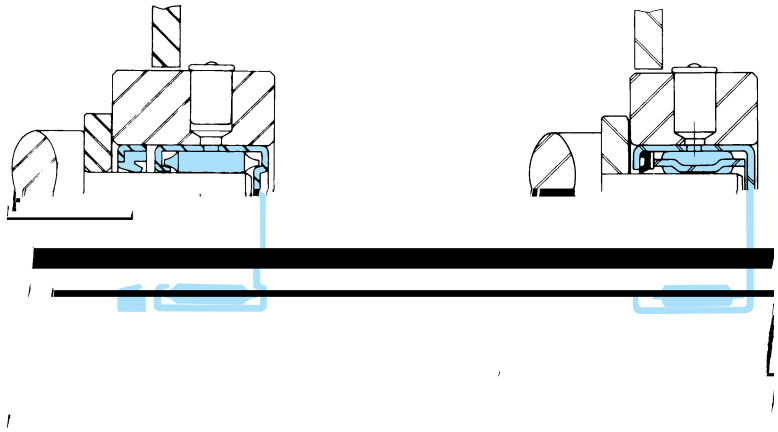


Fig. 52 Copying Machine Side Frame

The application of a closed drawn cup needle roller bearing to the shaft end contributes to cost reduction and enhancement of seal performance.

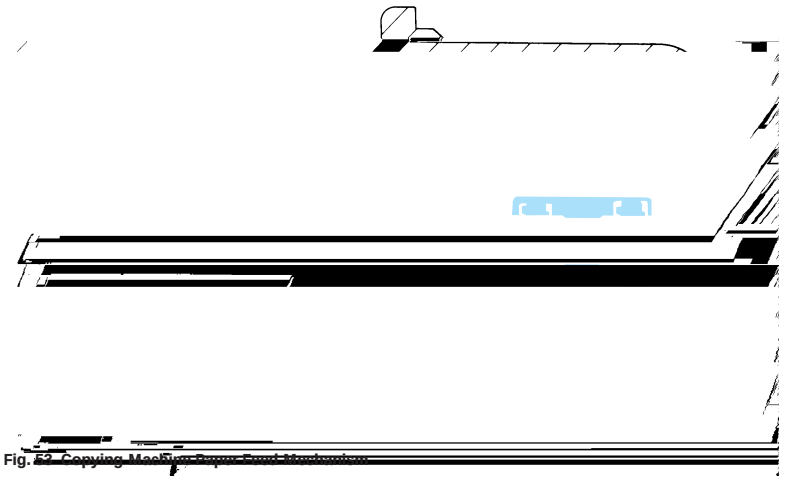
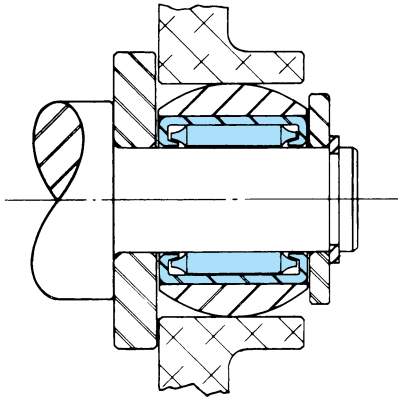


Fig. 53 Copying Machine Paper Feed Mechanism



ELECTRIC AND PNEUMATIC EQUIPMENT

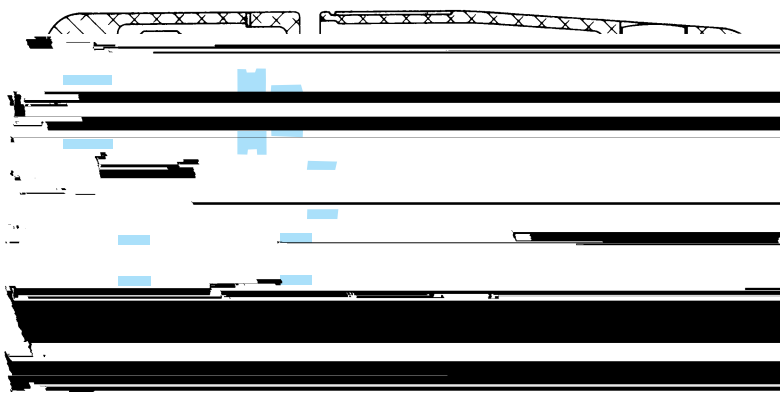


Fig. 59 Electric Drill

The application of a drawn cup needle roller bearing contributes to shortening the distance between shafts and reduces size and weight.
A needle roller bearing with a cage is applied to the motor shaft due to high-speed rotation.

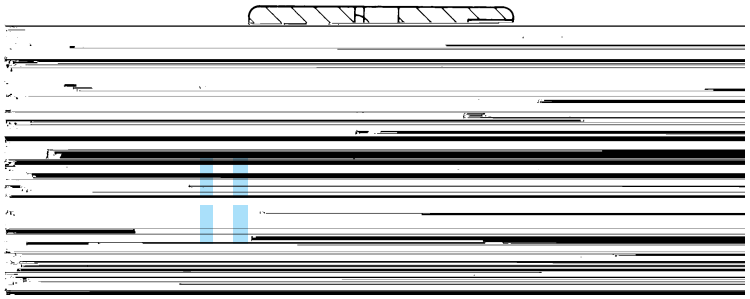


Fig. 60 Electric Polisher



Fig. 61 Hedge Trimmer

The figure shows the crankshaft of a hedge trimmer. A hardened steel ball is used as the center shaft because an axial load through worm gears is imposed there.

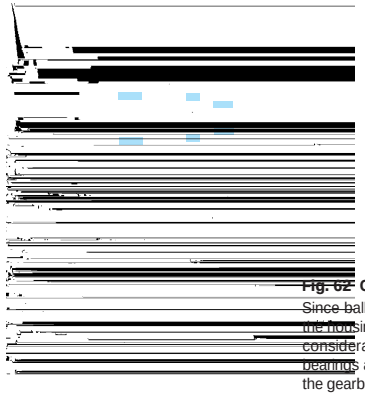


Fig. 62 Circular Saw

Since ball bearings are commonly applied to motor fan shafts, the housing space on the right-hand side of the spindle shaft is considerably limited. Accordingly, drawn cup needle roller bearings are used in many cases. In order to prevent grease in the gearbox from entering into the motor, a closed type bearing is applied.

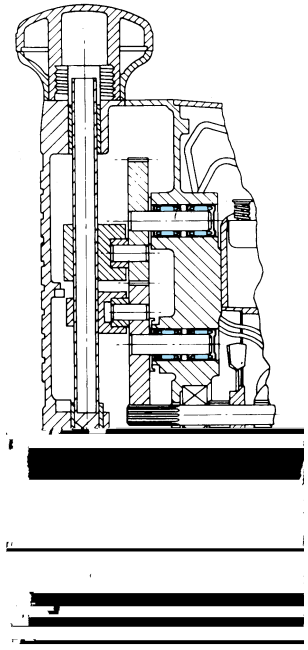


Fig. 67 Jig Saw
Two drawn cup needle roller bearings are applied to support the blade and counter balance driving gears.

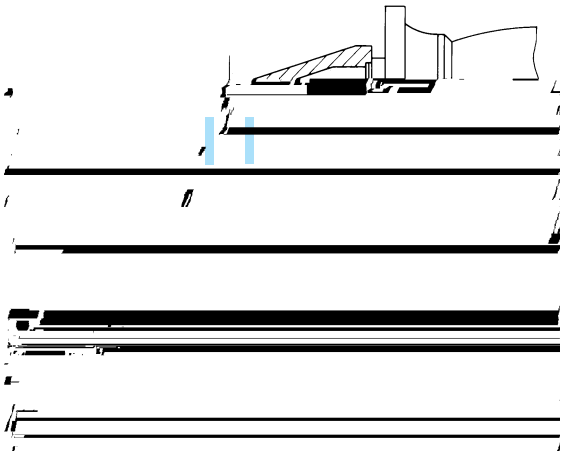


Fig. 68 Polisher
It is possible to use the housing as a through hole by changing the drawn cup needle roller bearing on the upper part of the spindle shaft to a closed type.



Fig. 69 Nut Setter

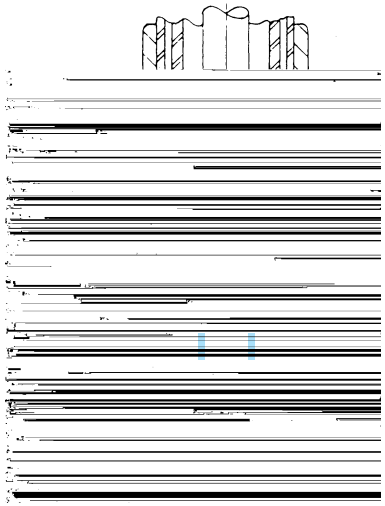


Fig. 70 Agitator Shaft

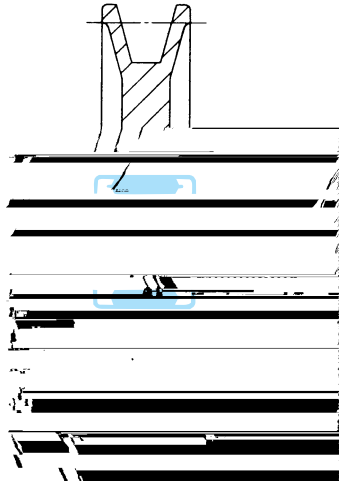


Fig. 71 Pulley Support
This is a good example of low-cost design, showing that a single drawn cup needle roller bearing with a seal can deliver stable performance without maintenance over a long period of time to facilitate long life.

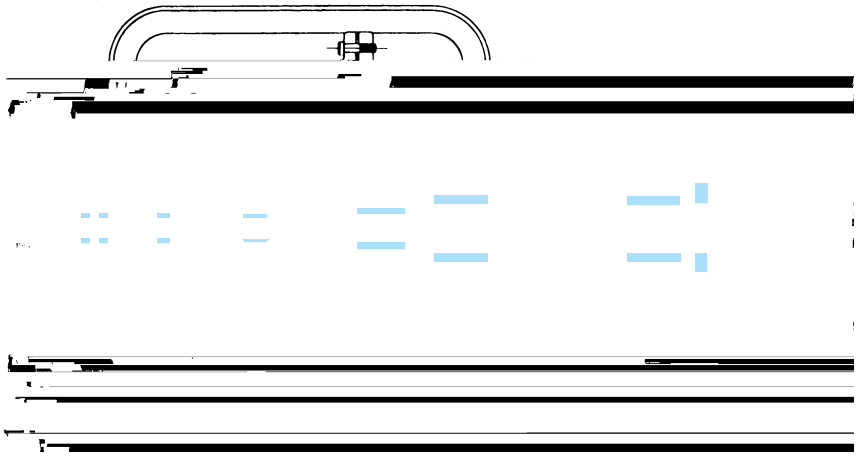


Fig. 72 Agitator Shaft

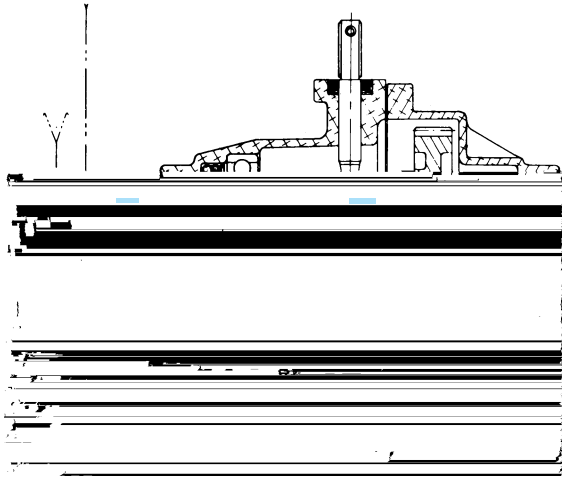


Fig. 77 Washer and Dryer Two-Speed Transmission

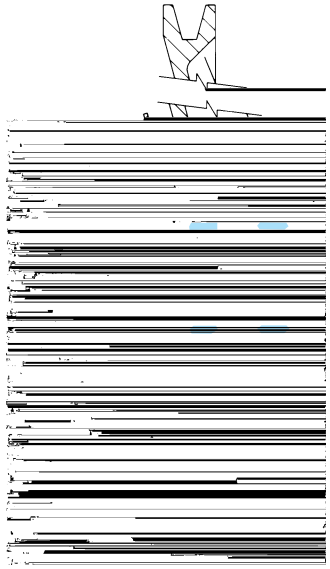


Fig. 78 Washing Machine Basket Drive Shaft

TWO-STROKE ENGINES

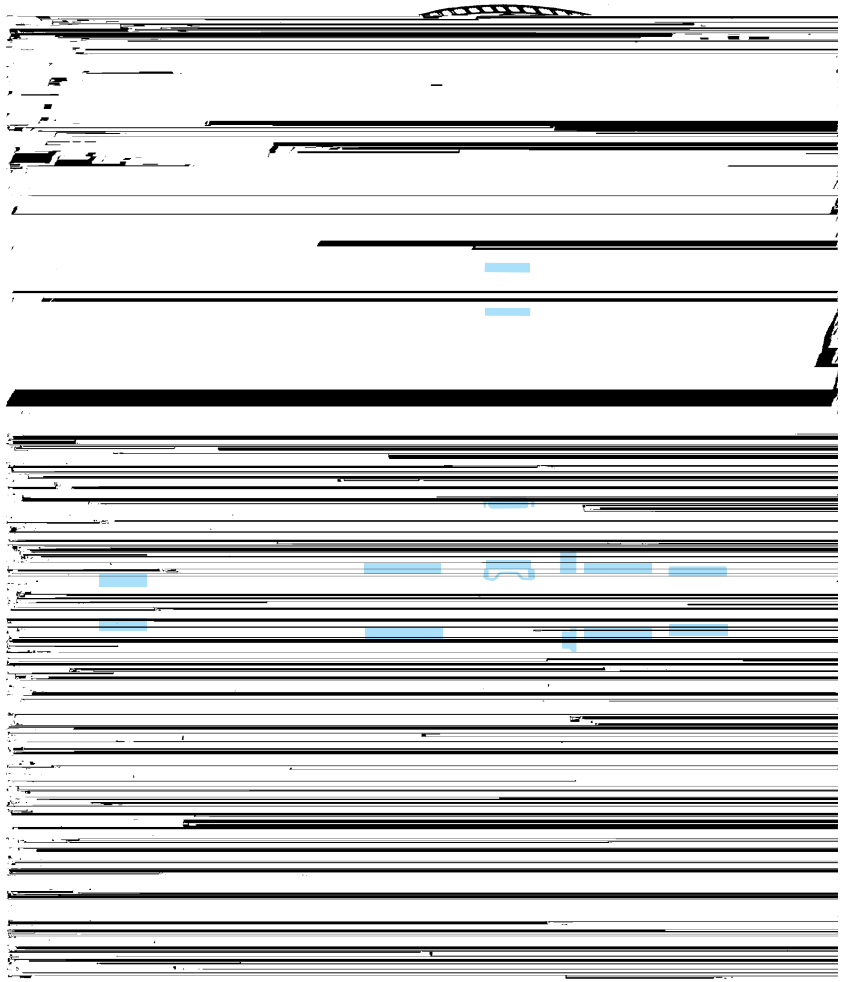


Fig. 79 Chain Saw Engine

Many drawn cup needle roller bearings are applied to the chain saw engine, contributing to its lighter weight. Application of a drawn cup roller clutch to the starter allows further simplification of operation.

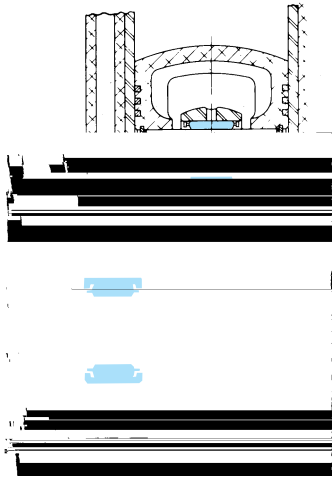


Fig. 80 Two-Stroke Engine

This illustrates the application of a solid needle roller bearing to the crankshaft, increasing load capacity and facilitating a more compact size.

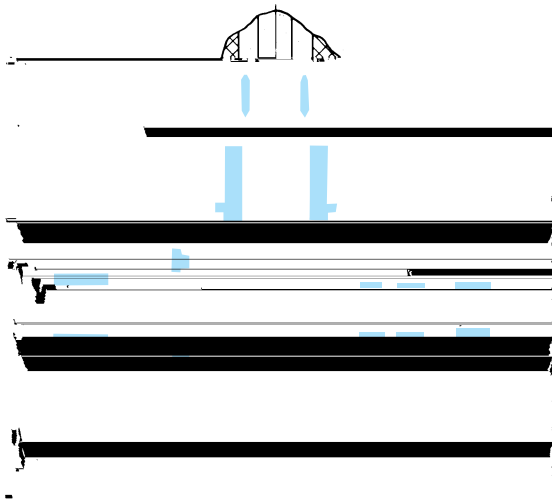


Fig. 81 Outboard Motor Lower Unit

HYDRAULIC MACHINES

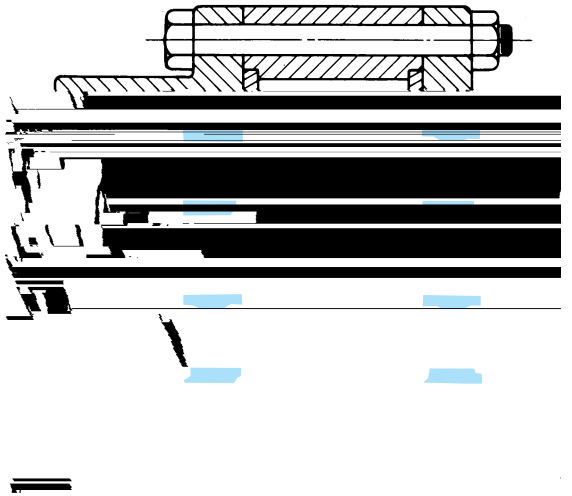


Fig. 82 Gear Pump

A solid needle roller bearing is commonly applied to high-pressure gear pumps. Since the load is large and problems such as edge load may be caused by shaft deflection, crowning should be applied to the rollers.

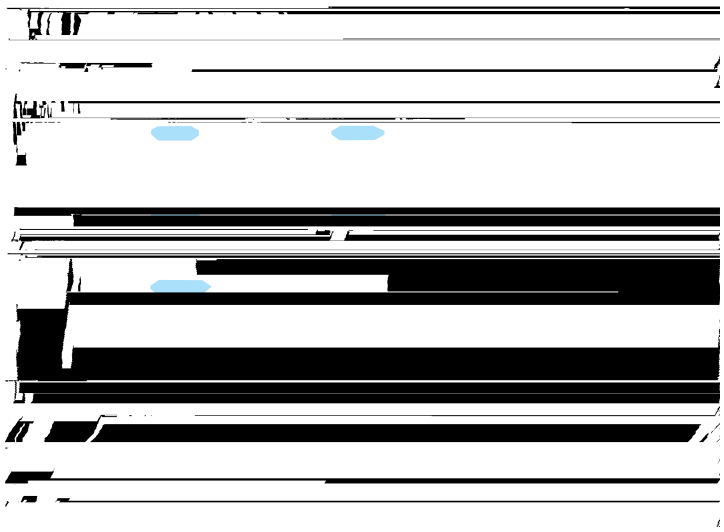


Fig. 83 Gear Pump

The comparatively low-pressure gear pump operates satisfactorily with a drawn cup needle roller bearing. It also serves to reduce cost.

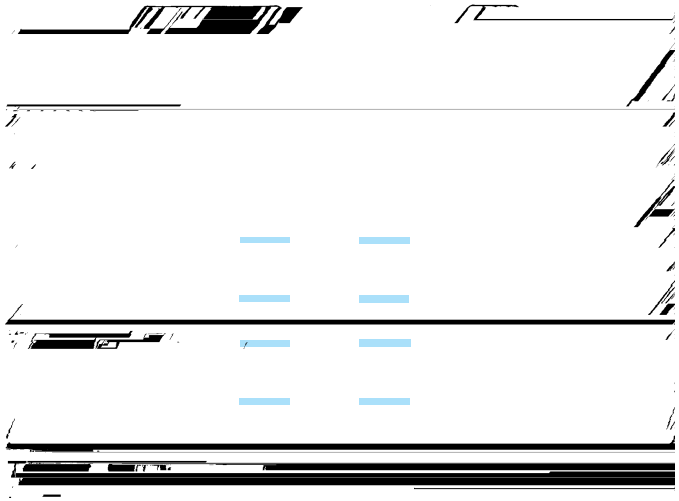


Fig. 84 Gear Pump

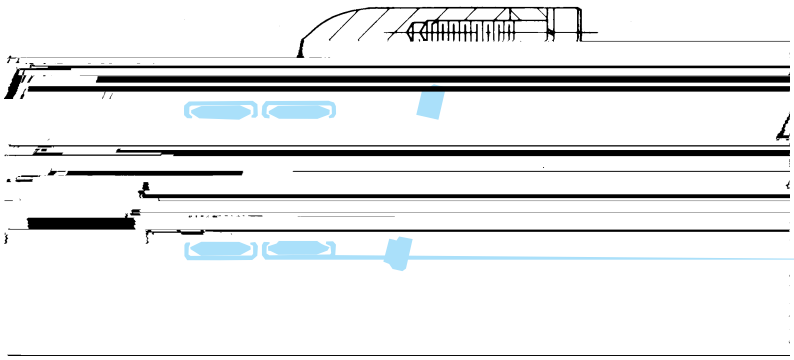


Fig. 85 Axial Piston Pump

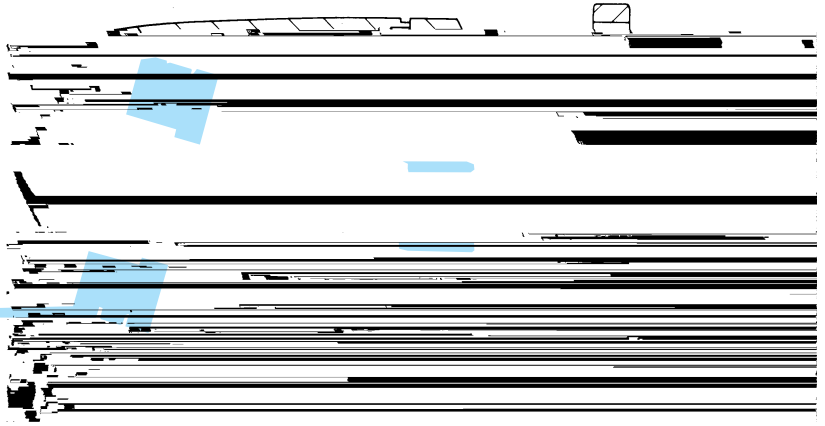
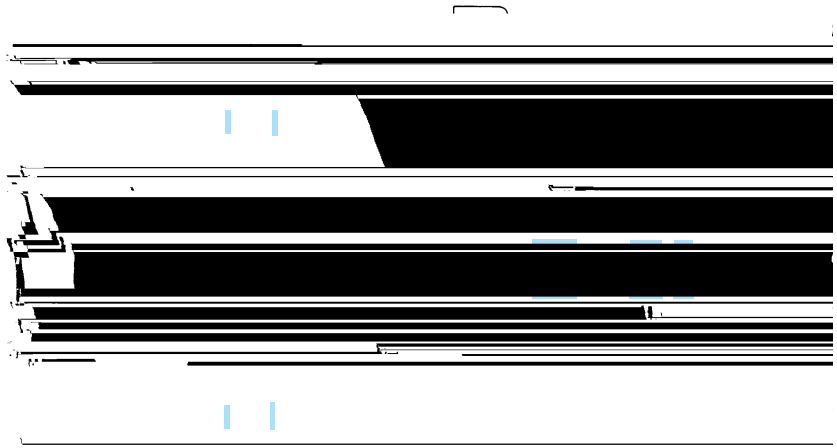
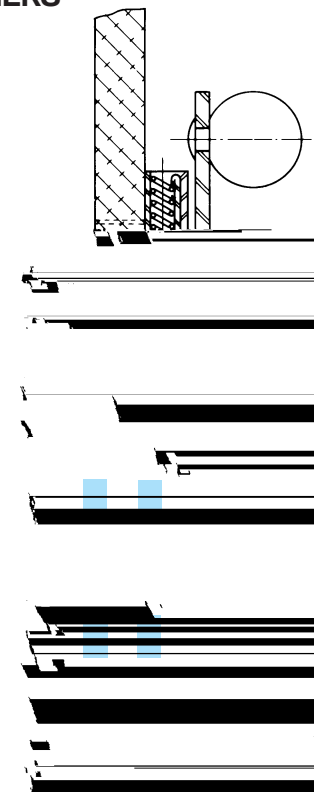
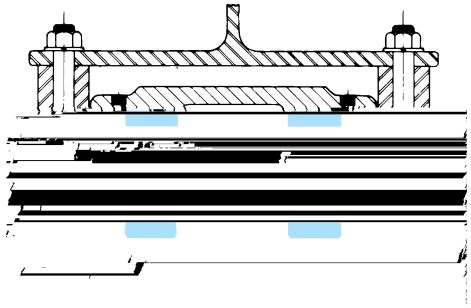


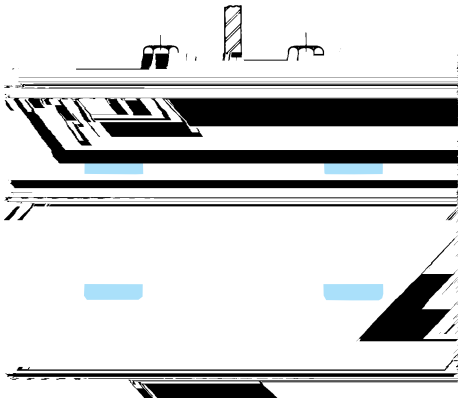
Fig. 86 Axial Piston Pump

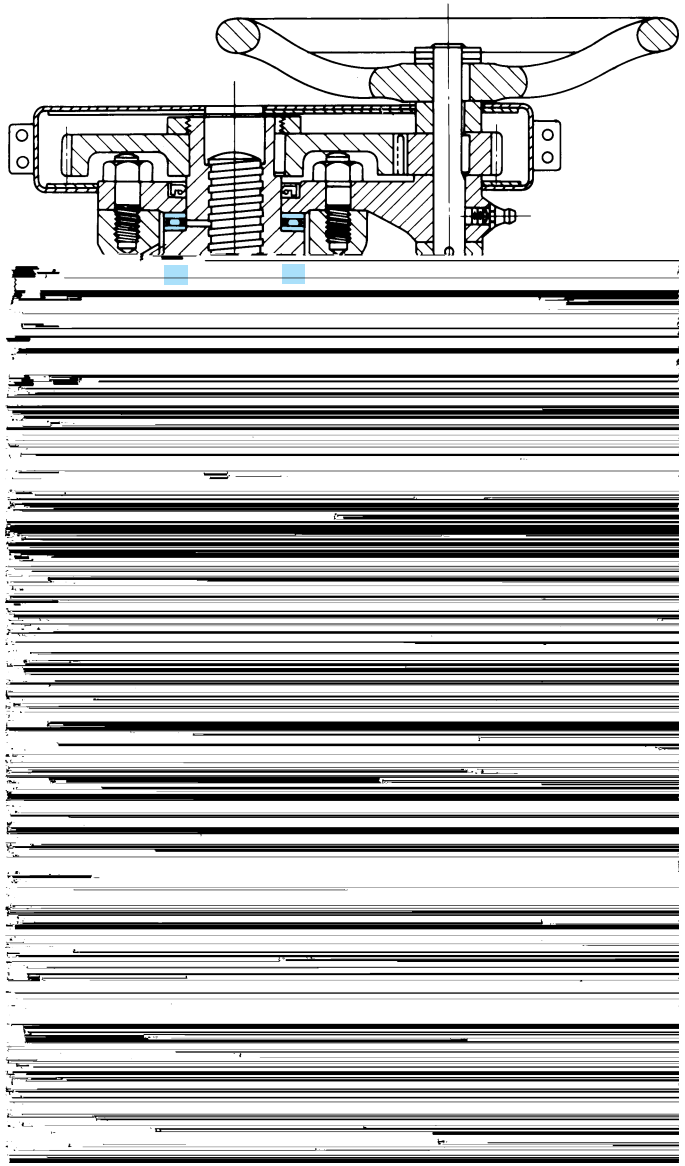


OTHERS









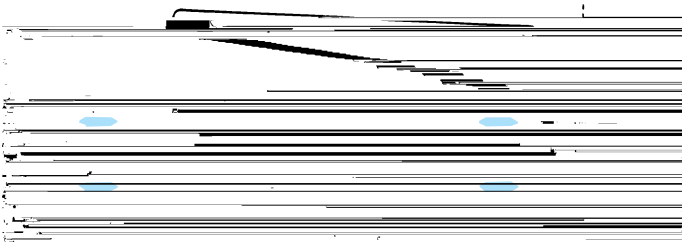


Fig. 92 Electric Guitar Tremolo

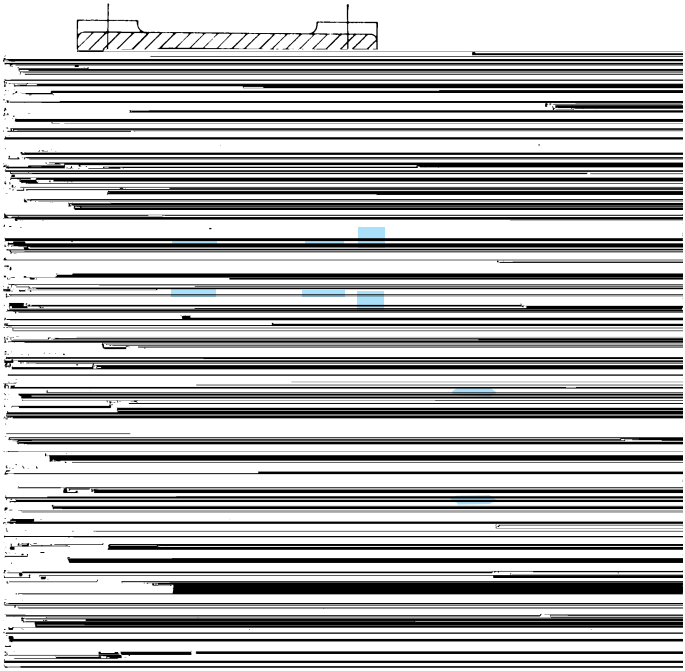


Fig. 93 Meat Saw for Hamburgers

Appendix 1 Conversion Table from SI (International Units) System

Comparison of SI, CGS, and Engineering Units

Units / Unit System	Length	Mass	Time	Temp.	Acceleration	Force	Stress	Pressure	Energy	Power
SI	m	kg	s	K, ℃	m/s^2	N	Pa	Pa	J	W
CGS System	cm	g	s	℃	Gal	dyn	dyn/cm^2	dyn/cm^2	erg	erg/s
Engineering Unit System	m	$kgf \cdot s^2/m$	s	℃	m/s^2	kgf	kgf/m^2	kgf/m^2	$kgf \cdot m$	$kgf \cdot m/s$

1 N=0.1019716 kgf
1 kgf=9.80665 N

N		kgf	N		kgf	N		kgf
9.8066	1	0.1020	333.43	34	3.4670	657.05	67	6.8321
19.613	2	0.2039	343.23	35	3.5690	666.85	68	6.9341
29.420	3	0.3059	353.04	36	3.6710	676.66	69	7.0360
39.227	4	0.4079	362.85	37	3.7729	686.47	70	7.1380
49.033	5	0.5099	372.65	38	3.8749	696.27	71	7.2400
58.840	6	0.6118	382.46	39	3.9769	706.08	72	7.3420
68.647	7	0.7138	392.27	40	4.0789	715.89	73	7.4439
78.453	8	0.8158	402.07	41	4.1808	725.69	74	7.5459
88.260	9	0.9177	411.88	42	4.2828	735.50	75	7.6479
98.066	10	1.0197	421.69	43	4.3848	745.31	76	7.7498
107.87	11	1.1217	431.49	44	4.4868	755.11	77	7.8518
117.68	12	1.2237	441.30	45	4.5887	764.92	78	7.9538
127.49	13	1.3256	451.11	46	4.6907	774.73	79	8.0558
137.29	14	1.4276	460.91	47	4.7927	784.53	80	8.1577
147.10	15	1.5296	470.72	48	4.8946	794.34	81	8.2597
156.91	16	1.6315	480.53	49	4.9966	804.15	82	8.3617
166.71	17	1.7335	490.33	50	5.0986	813.95	83	8.4636
176.52	18	1.8355	500.14	51	5.2006	823.76	84	8.5656
186.33	19	1.9375	509.95	52	5.3025	833.57	85	8.6676
196.13	20	2.0394	519.75	53	5.4045	843.37	86	8.7696
205.94	21	2.1414	529.56	54	5.5065	853.18	87	8.8715
215.75	22	2.2434	539.37	55	5.6084	862.99	88	8.9735
225.55	23	2.3453	549.17	56	5.7104	872.79	89	9.0755
235.36	24	2.4473	558.98	57	5.8124	882.60	90	9.1774
245.17	25	2.5493	568.79	58	5.9144	892.41	91	9.2794
254.97	26	2.6513	578.59	59	6.0163	902.21	92	9.3814
264.78	27	2.7532	588.40	60	6.1183	912.02	93	9.4834
274.59	28	2.8552	598.21	61	6.2203	921.83	94	9.5853
284.39	29	2.9572	608.01	62	6.3222	931.63	95	9.6873
294.20	30	3.0591	617.82	63	6.4242	941.44	96	9.7893
304.01	31	3.1611	627.63	64	6.5262	951.25	97	9.8912
313.81	32	3.2631	637.43	65	6.6282	961.05	98	9.9932
323.62	33	3.3651	647.24	66	6.7301	970.86	99	10.095

1 kg=2.2046226 lb
1 lb=0.4535923 kg

kg		lb	kg		lb	kg		lb
0.454	1	2.205	15.422	34	74.957	30.391	67	147.71
0.907	2	4.409	15.876	35	77.162	30.844	68	149.91
1.361	3	6.614	16.329	36	79.366	31.298	69	152.12
1.814	4	8.818	16.783	37	81.571	31.751	70	154.32
2.268	5	11.023	17.237	38	83.776	32.205	71	156.53
2.722	6	13.228	17.690	39	85.980	32.659	72	158.73
3.175	7	15.432	18.144	40	88.185	33.112	73	160.94
3.629	8	17.637	18.597	41	90.390	33.566	74	163.14
4.082	9	19.842	19.051	42	92.594	34.019	75	165.35
4.536	10	22.046	19.504	43	94.799	34.473	76	167.55
4.990	11	24.251	19.958	44	97.003	34.927	77	169.76
5.443	12	26.455	20.412	45	99.208	35.380	78	171.96
5.897	13	28.660	20.865	46	101.41	35.834	79	174.17
6.350	14	30.865	21.319	47	103.62	36.287	80	176.37
6.804	15	33.069	21.772	48	105.82	36.741	81	178.57
7.257	16	35.274	22.226	49	108.03	37.195	82	180.78
7.711	17	37.479	22.680	50	110.23	37.648	83	182.98
8.165	18	39.683	23.133	51	112.44	38.102	84	185.19
8.618	19	41.888	23.587	52	114.64	38.555	85	187.39
9.072	20	44.092	24.040	53	116.84	39.009	86	189.60
9.525	21	46.297	24.494	54	119.05	39.463	87	191.80
9.979	22	48.502	24.948	55	121.25	39.916	88	194.01
10.433	23	50.706	25.401	56	123.46	40.370	89	196.21
10.886	24	52.911	25.855	57	125.66	40.823	90	198.42
11.340	25	55.116	26.308	58	127.87	41.277	91	200.62
11.793	26	57.320	26.762	59	130.07	41.730	92	202.83
12.247	27	59.525	27.216	60	132.28	42.184	93	205.03
12.701	28	61.729	27.669	61	134.48	42.638	94	207.23
13.154	29	63.934	28.123	62	136.69	43.091	95	209.44
13.608	30	66.139	28.576	63	138.89	43.545	96	211.64
14.061	31	68.343	29.030	64	141.10	43.998	97	213.85
14.515	32	70.548	29.484	65	143.30	44.452	98	216.05
14.969	33	72.753	29.937	66	145.51	44.906	99	218.26

Appendix 4 °C-°F Conversion Table

(Method of using this table) For example, to convert 38°C into °F, read the figure in the right °F column adjacent to the 38 in the center column in the 2nd block. This means that 38°C is 100.4°F. To convert 38°F into °C, read the figure in the left °C column of the same row, which indicates that the answer is 3.3°C.

$$C = \frac{5}{9}(F-32)$$

$$F = 32+\frac{9}{5}C$$

°C		°F	°C		°F	°C		°F	°C		°F
−73.3	**−100**	−148.0	0.0	**32**	89.6	21.7	**71**	159.8	43.3	**110**	230
−62.2	**− 80**	−112.0	0.6	**33**	91.4	22.2	**72**	161.6	46.1	**115**	239
−51.1	**− 60**	− 76.0	1.1	**34**	93.2	22.8	**73**	163.4	48.9	**120**	248
−40.0	**− 40**	− 40.0	1.7	**35**	95.0	23.3	**74**	165.2	51.7	**125**	257
−34.4	**− 30**	− 22.0	2.2	**36**	96.8	23.9	**75**	167.0	54.4	**130**	266
−28.9	**− 20**	− 4.0	2.8	**37**	98.6	24.4	**76**	168.8	57.2	**135**	275
−23.3	**− 10**	14.0	3.3	**38**	100.4	25.0	**77**	170.6	60.0	**140**	284
−17.8	**0**	32.0	3.9	**39**	102.2	25.6	**78**	172.4	65.6	**150**	302
−17.2	**1**	33.8	4.4	**40**	104.0	26.1	**79**	174.2	71.1	**160**	320
−16.7	**2**	35.6	5.0	**41**	105.8	26.7	**80**	176.0	76.7	**170**	338
−16.1	**3**	37.4	5.6	**42**	107.6	27.2	**81**	177.8	82.2	**180**	356
−15.6	**4**	39.2	6.1	**43**	109.4	27.8	**82**	179.6	87.8	**190**	374
−15.0	**5**	41.0	6.7	**44**	111.2	28.3	**83**	181.4	93.3	**200**	392
−14.4	**6**	42.8	7.2	**45**	113.0	28.9	**84**	183.2	98.9	**210**	410
−13.9	**7**	44.6	7.8	**46**	114.8	29.4	**85**	185.0	104.4	**220**	428
−13.3	**8**	46.4	8.3	**47**	116.6	30.0	**86**	186.8	110.0	**230**	446
−12.8	**9**	48.2	8.9	**48**	118.4	30.6	**87**	188.6	115.6	**240**	464
−12.2	**10**	50.0	9.4	**49**	120.2	31.1	**88**	190.4	121.1	**250**	482
−11.7	**11**	51.8	10.0	**50**	122.0	31.7	**89**	192.2	148.9	**300**	572
−11.1	**12**	53.6	10.6	**51**	123.8	32.2	**90**	194.0	176.7	**350**	662
−10.6	**13**	55.4	11.1	**52**	125.6	32.8	**91**	195.8	204	**400**	752
−10.0	**14**	57.2	11.7	**53**	127.4	33.3	**92**	197.6	232	**450**	842
− 9.4	**15**	59.0	12.2	**54**	129.2	33.9	**93**	199.4	260	**500**	932
− 8.9	**16**	60.8	12.8	**55**	131.0	34.4	**94**	201.2	288	**550**	1022
− 8.3	**17**	62.6	13.3	**56**	132.8	35.0	**95**	203.0	316	**600**	1112
− 7.8	**18**	64.4	13.9	**57**	134.6	35.6	**96**	204.8	343	**650**	1202
− 7.2	**19**	66.2	14.4	**58**	136.4	36.1	**97**	206.6	371	**700**	1292
− 6.7	**20**	68.0	15.0	**59**	138.2	36.7	**98**	208.4	399	**750**	1382
− 6.1	**21**	69.8	15.6	**60**	140.0	37.2	**99**	210.2	427	**800**	1472
− 5.6	**22**	71.6	16.1	**61**	141.8	37.8	**100**	212.0	454	**850**	1562
− 5.0	**23**	73.4	16.7	**62**	143.6	38.3	**101**	213.8	482	**900**	1652
− 4.4	**24**	75.2	17.2	**63**	145.4	38.9	**102**	215.6	510	**950**	1742
− 3.9	**25**	77.0	17.8	**64**	147.2	39.4	**103**	217.4	538	**1 000**	1832
− 3.3	**26**	78.8	18.3	**65**	149.0	40.0	**104**	219.2	593	**1 100**	2012
− 2.8	**27**	80.6	18.9	**66**	150.8	40.6	**105**	221.0	649	**1 200**	2192
− 2.2	**28**	82.4	19.4	**67**	152.6	41.1	**106**	222.8	704	**1 300**	2372
− 1.7	**29**	84.2	20.0	**68**	154.4	41.7	**107**	224.6	760	**1 400**	2552
− 1.1	**30**	86.0	20.6	**69**	156.2	42.2	**108**	226.4	816	**1 500**	2732
− 0.6	**31**	87.8	21.1	**70**	158.0	42.8	**109**	228.2	871	**1 600**	2912

Appendix 5 Viscosity Conversion Table

Kinematic Viscosity mm²/s	Saybolt Universal SUS (sec)		No.1 Type Redwood R (sec)		Engler E (degree)	Saybolt Universal SUS (sec)
	100°F	210°F	50℃	100℃		100

inch		0	1	2	3	4	5	6
Fraction	Decimal	mm						
0	**0.000000**	**0.000**	**25.400**	**50.800**	**76.200**	**101.600**	**127.000**	**152.400**
1/64	0.015625	0.397	25.797	51.197	76.597	101.997	127.397	152.797
1/32	0.031250	0.794	26.194	51.594	76.994	102.394	127.794	153.194
3/64	0.046875	1.191	26.591	51.991	77.391	102.791	128.191	153.591
1/16	**0.062500**	**1.588**	**26.988**	**52.388**	**77.788**	**103.188**	**128.588**	**153.988**
5/64	0.078125	1.984	27.384	52.784	78.184	103.584	128.984	154.384
3/32	0.093750	2.381	27.781	53.181	78.581	103.981	129.381	154.781
7/64	0.109375	2.778	28.178	53.578	78.978	104.378	129.778	155.178
1/8	**0.125000**	**3.175**	**28.575**	**53.975**	**79.375**	**104.775**	**130.175**	**155.575**
9/64	0.140625	3.572	28.972	54.372	79.772	105.172	130.572	155.972
5/32	0.156250	3.969	29.369	54.769	80.169	105.569	130.969	156.369
11/64	0.171875	4.366	29.766	55.166	80.566	105.966	131.366	156.766
3/16	**0.187500**	**4.762**	**30.162**	**55.562**	**80.962**	**106.362**	**131.762**	**157.162**
13/64	0.203125	5.159	30.559	55.959	81.359	106.759	132.159	157.559
7/32	0.218750	5.556	30.956	56.356	81.756	107.156	132.556	157.956
15/64	0.234375	5.953	31.353	56.753	82.153	107.553	132.953	158.353
1/4	**0.250000**	**6.350**	**31.750**	**57.150**	**82.550**	**107.950**	**133.350**	**158.750**
17/64	0.265625	6.747	32.147	57.547	82.947	108.347	133.747	159.147
9/32	0.281250	7.144	32.544	57.944	83.344	108.744	134.144	159.544
19/64	0.296875	7.541	32.941	58.341	83.741	109.141	134.541	159.941
5/16	**0.312500**	**7.938**	**33.338**	**58.738**	**84.138**	**109.538**	**134.938**	**160.338**
21/64	0.328125	8.334	33.734	59.134	84.534	109.934	135.334	160.734
11/32	0.343750	8.731	34.131	59.531	84.931	110.331	135.731	161.131
23/64	0.359375	9.128	34.528	59.928	85.328	110.728	136.128	161.528
3/8	**0.375000**	**9.525**	**34.925**	**60.325**	**85.725**	**111.125**	**136.525**	**161.925**
25/64	0.390625	9.992	35.322	60.722	86.122	111.522	136.922	162.322
13/32	0.406250	10.319	35.719	61.119	86.519	111.919	137.319	162.719
27/64	0.421875	10.716	36.116	61.516	86.916	112.316	137.716	163.116
7/16	**0.437500**	**11.112**	**36.512**	**61.912**	**87.312**	**112.712**	**138.112**	**163.512**
29/64	0.453125	11.509	36.909	62.309	87.709	113.109	138.509	163.909
15/32	0.468750	11.906	37.306	62.706	88.106	113.506	138.906	164.306
31/64	0.484375	12.303	37.703	63.103	88.503	113.903	139.303	164.703
1/2	**0.500000**	**12.700**	**38.100**	**63.500**	**88.900**	**114.300**	**139.700**	**165.100**
33/64	0.515625	13.097	38.497	63.897	89.297	114.697	140.097	165.497
17/32	0.531250	13.494	38.894	64.294	89.694	115.094	140.494	165.894
35/64	0.546875	13.891	39.291	64.691	90.091	115.491	140.891	166.291
9/16	**0.562500**	**14.288**	**39.688**	**65.088**	**90.488**	**115.888**	**141.288**	**166.688**
37/54	0.578125	14.684	40.084	65.484	90.884	116.284	141.684	167.084
19/32	0.593750	15.081	40.481	65.881	91.281	116.681	142.081	167.481
39/64	0.609375	15.478	40.878	66.278	91.678	117.078	142.478	167.878
5/8	**0.625000**	**15.875**	**41.275**	**66.675**	**92.075**	**117.475**	**142.875**	**168.275**
41/64	0.640625	16.272	41.672	67.072	92.472	117.872	143.272	168.672
21/32	0.656250	16.669	42.069	67.469	92.869	118.269	143.669	169.069
43/64	0.671875	17.066	42.466	67.866	93.266	118.666	144.066	169.466
11/16	**0.687500**	**17.462**	**42.862**	**68.262**	**93.662**	**119.062**	**144.462**	**169.862**
45/64	0.703125	17.859	43.259	68.659	94.059	119.459	144.859	170.259
23/32	0.718750	18.256	43.656	69.056	94.456	119.856	145.256	170.656
47/64	0.734375	18.653	44.053	69.453	94.853	120.253	145.653	171.053
3/4	**0.750000**	**19.050**	**44.450**	**69.850**	**95.250**	**120.650**	**146.050**	**171.450**
49/64	0.765625	19.447	44.847	70.247	95.647	121.047	146.447	171.847
25/32	0.781250	19.844	45.244	70.644	96.044	121.444	146.844	172.244
51/64	0.796875	20.241	45.641	71.041	96.441	121.841	147.241	172.641
13/16	**0.812500**	**20.638**	**46.038**	**71.438**	**96.838**	**122.238**	**147.638**	**173.038**
53/64	0.828125	21.034	46.434	71.834	97.234	122.634	148.034	173.434
27/32	0.843750	21.431	46.831	72.231	97.631	123.031	148.431	173.831
55/64	0.859375	21.828	47.228	72.628	98.028	123.428	148.828	174.228
7/8	**0.875000**	**22.225**	**47.625**	**73.025**	**98.425**	**123.825**	**149.225**	**174.625**
57/64	0.890625	22.622	48.022	73.422	98.822	124.222	149.622	175.022
29/32	0.906250	23.019	48.419	73.819	99.219	124.619	150.019	175.419
59/64	0.921875	23.416	48.816	74.216	99.616	125.016	150.416	175.816
15/16	**0.937500**	**23.812**	**49.212**	**74.612**	**100.012**	**125.412**	**150.812**	**176.212**
61/64	0.953125	24.209	49.609	75.009	100.409	125.809	151.209	176.609
31/32	0.968750	24.606	50.006	75.406	100.806	126.206	151.606	177.006
63/64	0.984375	25.003	50.403	75.803	101.203	126.603	152.003	177.403

inch		7	8
Fraction	Decimal	mm	
0			
1/64			
1/32			
3/64			
1			

Diameter Classification (mm)		Single Plane Mean Bore Deviation (Normal) Δ_{dmp}	a	c	d	e	f		g		h				
over	incl		a13	c12	d6	e6	f5	f6	g5	g6	h5	h6	h7	h8	h9	h10
3	6	0 − 8	−270 −450	− 70 −190	−											
6			−280 −500	− 80 −230												
10			−290 −560	− 95 −275												
14																
18			−300 −630	−110 −320												
24																
30			− 310 − 700	− 120 − 370												
40			− 320 − 710	− 130 − 380												
50			− 340 − 800	− 140 − 440												
65			− 360 − 820	− 150 − 450												
80			− 380 − 920	− 170 − 520												
100			− 410 − 959	− 180 − 530												
120			− 460 −1 090	− 200 − 600												
140			− 520 −1 150	− 210 − 610												
160			− 580 −1 210	− 230 − 630												
180			− 660 −1 380	− 240 − 700												
200			− 740 −1 460	− 260 − 720												
225			− 820 −1 540	− 280 − 740												
250			− 920 −1 730	− 300 − 820												
280			−1 050 −1 860	− 330 − 850												
315			−1 200 −2 090	− 360 − 930												
355			−1 350 −2 240	− 400 − 970												
400			−1 500 −2 470	− 440 −1 070												
450			−1 650 −2 620	− 480 −1 110												

Appendix 10 Tolerances for Housing Bore Diameters

Units: μm

Diameter Classification (mm)		Single Plane Mean O. D. Deviation (Normal) Δ_{Dmp}	E		F			G		H					
over	incl		E10	E11	F6	F7	F8	G6	G7	H5	H6	H7	H8	H9	H10
3	6	0 − 8	+ 68 + 20	+ 95 + 20	+ 18 + 10	+ 22 + 10	+ 28 + 10	+12 + 4	+16 + 4	+ 5 0	+ 8 0	+12 0	+18 0	+ 30 0	+ 48 0
6	10	0 − 8	+ 83 + 25	+115 + 25	+ 22 + 13	+ 28 + 13	+ 35 + 13	+14 + 5	+20 + 5	+ 6 0	+ 9 0	+15 0	+22 0	+ 36 0	+ 58 0
10	14	0 − 8	+102 + 32	+142 + 32	+ 27 + 16	+ 34 + 16	+ 43 + 16	+17 + 6	+24 + 6	+ 8 0	+11 0	+18 0	+27 0	+ 43 0	+ 70 0
14	18														
18	24	0 − 9	+124 + 40	+170 + 40	+ 33 + 20	+ 41 + 20	+ 53 + 20	+20 + 7	+28 + 7	+ 9 0	+13 0	+21 0	+33 0	+ 52 0	+ 84 0
24	30														
30	40	0 −11	+150 + 50	+210 + 50	+ 41 + 25	+ 50 + 25	+ 64 + 25	+25 + 9	+34 + 9	+11 0	+16 0	+25 0	+39 0	+ 62 0	+100 0
40	50														
50	65	0 −13	+180 + 60	+250 + 60	+ 49 + 30	+ 60 + 30	+ 76 + 30	+29 +10	+40 +10	+13 0	+19 0	+30 0	+46 0	+ 74 0	+120 0
65	80														
80	100	0 −15	+212 + 72	+292 + 72	+ 58 + 36	+ 71 + 36	+ 90 + 36	+34 +12	+47 +12	+15 0	+22 0	+35 0	+54 0	+ 87 0	+140 0
100	120														
120	140	0 −18 ($D \leqq 150$)	+245 + 85	+335 + 85	+ 68 + 43	+ 83 + 43	+106 + 43	+39 +14	+54 +14	+18 0	+25 0	+40 0	+63 0	+100 0	+160 0
140	160														
160	180	0 −25 ($D > 150$)													
180	200	0 −30	+285 +100	+390 +100	+ 79 + 50	+ 96 + 50	+122 + 50	+44 +15	+61 +15	+20 0	+29 0	+46 0	+72 0	+115 0	+185 0
200	225														
225	250														
250	280	0 −35	+320 +110	+430 +110	+ 88 + 56	+108 + 56	+137 + 56	+46 +17	+69 +17	+23 0	+32 0	+52 0	+81 0	+130 0	+210 0
280	315														
315	355	0 −40	+355 +125	+485 +125	+ 98 + 62	+119 + 62	+151 + 62	+54 +18	+75 +18	+25 0	+36 0	+57 0	+89 0	+140 0	+230 0
355	400														
400	450	0 −45	+385 +135	+535 +135	+108 + 68	+131 + 68	+165 + 68	+60 +20	+83 +20	+27 0	+40 0	+63 0	+97 0	+155 0	+250 0
450	500														

JS		J		K		M		N		P		R		Diameter Classification (mm)	
JS6	JS7	J6	J7	K6	K7	M6	M7	N6	N7	P6	P7	R6	R7	over	incl
± 4	± 6	+ 5 − 3	± 6	+ 2 − 6	+ 3 − 9	− 1 − 9	0 −12	− 5 −13	− 4 −16	− 9 −17	− 8 − 20	− 12 − 20	− 11 − 23	3	6
±4.5	± 7	+ 5 − 4	+ 8 − 7	+ 2 − 7	+ 5 −10	− 3 −12	0 −15	− 7 −16	− 4 −19	−12 −21	− 9 − 24	− 16 − 25	− 13 − 28	6	10
±5.5	± 9	+ 6 − 5	+10 − 8	+ 2 − 9	+ 6 −12	− 4 −15	0 −18	− 9 −20	− 5 −23	−15 −26	− 11 − 29	− 20 − 31	− 16 − 34	10	14
														14	18
±6.5	±10.5	+ 8 − 5	+12 − 9	+ 2 −11	+ 6 −15	− 4 −17	0 −21	−11 −24	− 7 −28	−18 −31	− 14 − 35	− 24 − 37	− 20 − 41	18	24
														24	30
± 8	±12.5	+10 − 6	+14 −11	+ 3 −13	+ 7 −18	− 4 −20	0 −25	−12 −28	− 8 −33	−21 −37	− 17 − 42	− 29 − 45	− 25 − 50	30	40
														40	50
±9.5	±15	+13 − 6	+18 −12	+ 4 −15	+ 9 −21	− 5 −24	0 −30	−14 −33	− 9 −39	−26 −45	− 21 − 51	− 35 − 54	− 30 − 60	50	65
												− 37 − 56	− 32 − 62	65	80
±11	±17.5	+16 − 6	+22 −13	+ 4 −18	+10 −25	− 6 −28	0 −35	−16 −38	−10 −45	−30 −52	− 24 − 59	− 44 − 66	− 38 − 73	80	100
												− 47 − 69	− 41 − 76	100	120
±12.5	±20	+18 − 7	+26 −14	+ 4 −21	+12 −28	− 8 −33	0 −40	−20 −45	−12 −52	−36 −61	− 28 − 68	− 56 − 81	− 48 − 88	120	140
												− 58 − 83	− 50 − 90	140	160
												− 61 − 86	− 53 − 93	160	180
±14.5	±23	+22 − 7	+30 −16	+ 5 −24	+13 −33	− 8 −37	0 −46	−22 −51	−14 −60	−41 −70	− 33 − 79	− 68 − 97	− 60 −106	180	200
												− 71 −100	− 63 −109	200	225
												− 75 −104	− 67 −113	225	250
±16	±26	+25 − 7	+36 −16	+ 5 −27	+16 −36	− 9 −41	0 −52	−25 −57	−14 −66	−47 −79	− 36 − 88	− 85 −117	− 74 −126	250	280
												− 89 −121	− 78 −130	280	315
±18	±28.5	+29 − 7	+39 −18	+ 7 −29	+17 −40	−10 −46	0 −57	−26 −62	−16 −73	−51 −87	− 41 − 98	− 97 −133	− 87 −144	315	355
												−103 −139	− 93 −150	355	400
±20	±31.5	+33 − 7	+43 −20	+ 8 −32	+18 −45	−10 −50	0 −63	−27 −67	−17 −80	−55 −95	− 45 −108	−113 −153	−103 −166	400	450
												−119 −159	−109 −172	450	500

Speed *n*	

Bore Diameter	Diameter Series 8						Diameter Series 9					
	Dimension Series						Dimension Series					
	D^*	38	48	58	68	38~68	D^*	39	49	59	69	39~69
d		B				r(min)		B				r(min)
0.6	2.5	1.4	—	—	—	0.05	—	—	—	—		
1	4	2	—	—	—	0.05	5	2.6	—	—		
1.5	5	2.3	—	—	—	0.08	6	3	—	—		
2	6	2.6	—	—	—	0.08	7	3.5	—	—		
2.5	7	3	—	—	—	0.1	8	4	—	—		
3	9	4	—	—	—	0.1	11	5	—	—		
4	11	5	—	—	—	0.15	13	6	10	—		
5	13	6	—	—	—	0.15	15	7	10	—		
6	14	6	—	—	—	0.15	17	7	10	—		
7	16	6	8	—	—	0.2	19	9	11	—		
8	17	6	8	—	—	0.2	20	9	11	—		
9	19	7	9	—	—	0.3	22	10	13	16		
10	21	7	9	—	—	0.3	24	10	13	16		
12	24	7	9	—	—	0.3	28	10	13	18		
15	26	7	9	—	—	0.3	30	10	13	18		
17	32	10	12	16	22	0.3	37	13	17	23		
20	34	10	—	16	22	0.3	39	13	17	23		
22	37	10	12	16	22	0.3	42	13	17	23		
25	40	10	—	16	22	0.3	45	13	17	23		
28	42	10	12	16	22	0.3	47	13	17	23		
30	44	10	—	16	22	0.3	52	15	20	27		
32	47	10	12	16	22	0.3	55	15	20	27		
35	52	10	12	16	22	0.3	62	16	22	30		
40	58	10	13	18	23	0.3	68	16	22	30		
45	65	12	15	20	27	0.3	73	16	22	30		
50	70	12	15	20	27	0.6	78	16	22	30		
55	75	13	16	20	27	0.6	90	18	25	34		
60	85	13	16	20	27	0.6	95	18	25	34		
65	90	13	16	20	27	0.6	100	18	25	34		
70	95	15	20	27	36	0.6	105	23	30	40		
75	100	15	20	27	36	0.6	110	23	30	40		
80	110	19	25	34	45	1	120	26	35	46		
85	115	19	25	34	45	1	125	26	35	46		
90	120	19	25	34	45	1	130	26	35	46		
95	125	19	25	34	45	1	140	30	40	54		
100	130	19	25	34	45	1	145	30	40	54		
105	140	23	30	40	54	1	150	30	40	54		
110	150	23	30	40	54	1	165	34	45	60		
120	165	26	35	46	63	1.1	180	37	50	67		
130	175	26	35	46	63	1.1	190	37	50	67		
140	190	30	40	54	71	1.1	210	45	60			
150	200	30	40	54	71	1.1	220	45	60			
160	215	34	45	60	80	1.1	230	45	60			
170	225	34	45	60	80	1.1	250	52	69			
180	240	37	50	67	90	1.5	260	52	69			
190	250	37	50	67	90	1.5	280	60	80			
200	270	37	50	67	90	1.5	300	60	80			
220	300	45	60	80	109	2	320	60	80			
240	320	45	60	80	109	2	360	75	100			
260	350	52	69	95	125	2	380	75	100			
280	380	60	80	109	145	2.1	420	90	118			
300	400	60	80	109	145	2.1	440	90	118			
320	420	60	80	109	145	2.1	460	90	118			
340	440	60	80	109	145	2.1	480	90	118			
360	480	75	100	136	180	2.1	520	106	140			
380	500	75	100	136	180	2.1	540	106	140			
400	520	75	100	136	180	2.1	560	106	140			
420	540	75	100	136	180	2.1	600	118	160			
440												

P R E C I S O R A T N S K A M E
P : 2 4 3 4 8 9 2 2 3 1 B E (