Koyo®

Needle Roller Bearings

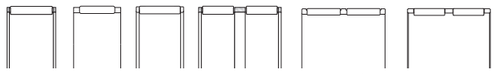
CAT.NO.BS007EN-0DS

Bearing Size Chart

Radial Needle Roller and Cage Assemblies

Metric Series

Single-Row, Double-Row···B-1-8



K, RF, RFN | RS, R, RP | RV, V, VS | K ... ZW, WRF | WR, WRS | WRP

Single-Row···B-1-57

WJ, WJC

Inch Series

Assemblies for Crank Pin End Applications···B-1-47

K.BE | BE, GS | VE, VS P

Assemblies for Wrist Pin End Applications···B-1-51

K.SE | R P | RE, UR P

Drawn Cup Needle Roller Bearings

Metric Series (Caged)

Open Ends, Closed One End···B-2-14

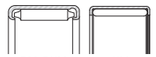
BKM, BSM, HK | BK | BTM, BHTM

Sealed···B-2-24

HK RS | BK RS | BKM UU, BHKM UU, HK .2RS

(Full Complement)

Open Ends···B-2-38



BM, BHM | YM

Inch Series (Caged)

Open Ends, Closed One End···B-2-60

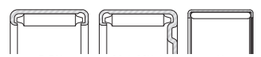
J,JH | MJ-1,MJH-1 | BT

Sealed···B-2-66

JT | JTT

(Full Complement)

Open Ends, Closed One End···B-2-48



B,BH | M-1, MH-1 | Y

Extra-Precision ···B-2-59

GB,GBH

Inner Rings

Metric Series···B-2-28

JR | JR.JS1, JRZ.JS1

Inch Series···B-2-68

IRA, IR (4 digit or less)

Drawn Cup Roller Clutches

Metric Series

Clutches···B-3-10

FC | FCS FCL-K FC-K

Clutch and Bearing Assemblies···B-3-12

FCB | FCBL-K FCBN-K

Miniature one-way clutches…B-3-20

1WC, EWC

Inch Series

Clutches···B-3-14

RC RC-FS

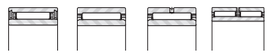
Clutch and Bearing Assemblies···B-3-16

RCB RCB-FS

Heavy-Duty Needle Roller Bearings

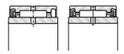
Metric Series (Caged, With Inner Ring)

Unsealed···B-4-13



NKJ | NQI | NKJ,NKJS NA48,49,69 | NA69

Sealed···B-4-30



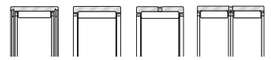
NA49RS | NA49.2RS

Without Flanges ···B-4-32

NAO | +SNSH

(Without Inner Ring)

Unsealed···B-4-20



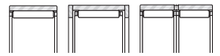
NK | NQ | NK.NKS RNA48,49,69 | RNA69

Inch Series (Without Inner Ring)

Sealed···B-4-31

RNA49RS | RNA49.2RS

Without Flanges···B-4-35



RNAO | +SNSH | RNAO

Inner Rings

Unsealed ···B-4-42

HJ

Sealed···B-4-46

HJ-RS | HJ-.2RS

Inch Series ···B-4-48

IR

Track Rollers

Stud-Type

Metric Series (Caged)

Unsealed···B-5-16

KR. 2SK

Sealed···B-5-18

KR. 2RS, 2SK

(Full Complement)

Unsealed···B-5-20

KRV. 2SK

Cylindrical Rollers···B-5-20

NUKR. 2SK

Inch Series (Full Complement)

Standard···B-5-34

CR, CRS

hex socket···B-5-38

CRSB

Crowned outer ring···B-5-42

CRSC

Hex socket, Crowned outer ring···B-5-46

CRSBC

Hex socket, Eccentric stud, ···B-5-50

CRSBE

Hex socket, Eccentric stud, Crowned outer ring···B-5-54

CRSBCE

Heavy Stud···B-5-58

CRH, CRHS

Heavy Stud, Hex Socket···B-5-62

CRHB, CRHSB

Heavy Stud, Hex Socket Crowned Outer Ring···B-5-66

CRHSBC

Yoke-Type

Metric Series (Caged, Without End Washers)

Unsealed, Without Inner Ring···B-5-22

RSTO | RSTO.DZ

Unsealed, With Inner Ring···B-5-23

STO | STO.DZ

Sealed, Without Inner Ring···B-5-24

RNA22.2RS | RNA22.2RS.DZ

Sealed, With Inner Ring···B-5-25

NA22.2RS | NA22.2RS.DZ

(Caged, With End Washers)

With Inner Ring···B-5-26

NATR | NATR.DZ | STO.ZZ | STO.ZZ.DZ

(Full Complement, With End Washers)

With Inner Ring, Cylindrical Rollers···B-5-27

NUTR | NUTR.DZ

Inch Series (Full Complement, With End Washers)

Non-separable, With Inner Ring···B-5-70

YCR, YCRS

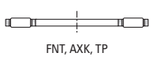
Non-separable, With Inner Ring, Crowned Outer Ring···B-5-74

YCRSC

Thrust Bearings, Assemblies, Washers

Metric Series

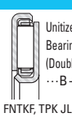
Thrust Needle Roller and Cage Assemblies and Thrust Washers···B-6-12



FNT, AXK, TP

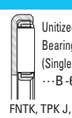
AS, WF | LS, WSF | WS.811, GS.811

Unitized Thrust Bearing Assemblies (Double-Washer) ···B-6-20



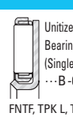
FNTKF, TPK JL, TVK JL

Unitized Thrust Bearing Assemblies (Single-Washer) ···B-6-22



FNTK, TPK J, TVK J

Unitized Thrust Bearing Assemblies (Single-Washer) ···B-6-24



FNTF, TPK L, TVK L

Thrust Cylindrical Roller and Cage Assemblies and Thrust Washers···B-6-30

811, 812 Series | K.811, K.812

Inch Series

Thrust Needle Roller and Cage Assemblies and Thrust Washers···B-6-38

NTA

TRA, TRB, TRC, TRD, TRE, TRF

Thrust Cylindrical Roller and Cage Assembly ···B-6-48

NTH

Cylindrical Roller Thrust Bearing···B-6-50

NTHA

Combined Needle Roller Bearings

Metric Series (Heavy-Duty, Without Inner Ring)

Ball Thrust Series···B-7-6

Separable: NAXK | Non-Separable: NAXK.Z

Cylindrical Roller Thrust Series···B-7-10

Separable: NAXR | Non-Separable: NAXR.Z

Needle Rollers, Accessories

Inner Rings (Caged)

<Metric Series>

For Drawn Cup Needle Roller Bearings, Heavy-Duty···B-8-20

JR | JR.JS1 | JRZ.JS1

End Washer

For Metric Series NAO and RNAO Bearings···B-8-30

SNSH

Koyo®

Needle Roller Bearings

1866 1900 1930 1960 1990 2010 **2013**

Corporate History

- 1866 Torrington is founded
- 1867 Dürkopp-Werke Bielefeld is founded
- 1921 Koyo Seiko Co., Ltd. is founded
- 1930 Nadella is founded
- 1962 FAG purchases Dürkopp-Werke AG
- 1962 Utsunomiya Kiki Co., Ltd. joins the group
- 1963 New needle bearing plant is built in Tokyo
- 1984 SNR (Nadella business partner) and Torrington commence joint venture
- 1993 Torrington purchases needle bearing business from FAG
- 2001 Torrington purchases Nadella business from SNR
- 2003 The Timken Company purchases Torrington
- 2006 JTEKT Corporation is born
- 2010 JTEKT purchases needle bearing business from The Timken Company
- 2013 JTEKT is integrated into **Koyo** brand

Bearing Trends and Market Needs

Smaller → Improvement in seizure resistance → Longer life → Reduced torque and noise, compact and lightweight, usability with less diluted lubricant

Transition of Products

1866 Foundation of Torrington

Founded as manufacturer of sewing machine needles and machinery to produce same

Early model of the swaging machine, designed to produce straight and uniform needle blanks.

Early model swaging machine for uniform needle blanks

This invention is the origin of the extra-precision rollers now produced by JTEKT.

1920 80% market share of automobile wire wheel parts

Cadillac put out its entire line on dressy wire wheels. Packard and a few other major producers followed suit, as eventually did most manufacturers (except Chevrolet). At the height of the trend, over 60% of U.S. passenger cars had wire wheels, and 80% of the spokes and nipples to build them were supplied by The Torrington Company. Effectively, every other passenger car made in America had Torrington spokes and nipples in the wheels.

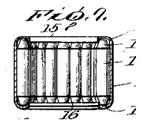
More than 60% of automobiles, including those made by Cadillac, adopt wire wheels. Torrington acquires 80% market share of wire wheel spokes and nipples.

As a result, one in every two U.S.-manufactured automobiles use Torrington spokes and nipples.

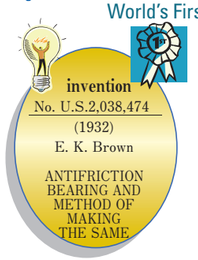
Radial Needle Bearings

1932 Development of the world's first drawn cup needle bearing

< Space-saving and lightweight >



World's First



1957 Development of caged drawn cup needle bearing

< Improved lubrication and support for higher speeds >

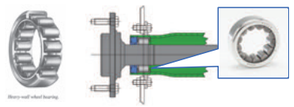
Increased lubricant retention capability

Separated rollers using cages

1968 Development of thick-wall drawn cup bearing

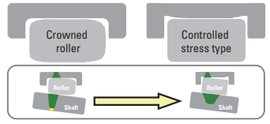
< High capacity >

Applications in axles, transmissions, pumps and motors



1996 Development of controlled stress thick-wall drawn cup needle bearing

< Longer life > Cup bore is profiled.



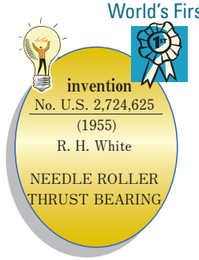
Reduced contact pressure on cup and shaft

Thrust Needle Bearings

1955 Development of the world's first thrust needle bearing: contribution to the progress of AT development

< Lower torque and improved durability >

World's First



Development of the thrust needle bearing solved problems in early automatic transmissions.

< Higher speed, lower torque, and supports thin film lubricant >

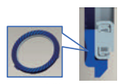
Optimization of washer and cage shapes

2008 Development of thrust needle bearing for high-speed applications

Improved lubricity
Reduced roller end wear

2011 Development of noise-reduced thrust needle bearing

< Noise reduction >



Vibration-resistant

Custom-shaped resin is installed on the back side of the thrust washer.

Planetary Gear Shafts

1971 Development of induction-hardened planetary gear shaft

2001 Cold forging hole processing of planetary gear shaft

< Improved installation capability >

< Weight savings, material waste reduction, and cost effective >

Regarding the Publishing of this Needle Roller Bearing Catalog

Thank you very much for your patronage of **Koyo** brand products.

In terms of environmental friendliness, there has been a rapidly increasing demand for smaller, lighter products, as well as lower friction, higher reliability, and higher functionality in many different industrial fields.

Our needle roller bearings are the optimal solution to all such requirements.

In 2010, as part of JTEKT's continual process for improvement in the needle roller bearing business, we integrated the technology of Torrington, a company with a long history in the United States and Europe, into the Koyo brand of traditional needle roller bearings.
In 2013, the Koyo brand will take the next step in this line of business to pursue stronger distribution and production structures and further technological development with the aim to accommodate our customers' needs on a global scale.

On this occasion, JTEKT has fully renewed its needle roller bearing catalog, which we present here.

We believe that this new catalog will prove useful in your selection and use of our needle roller bearings.

We look forward to your continued patronage.

INDEX

NEEDLE ROLLER BEARING APPLICATIONS

A ENGINEERING

B NEEDLE ROLLER BEARINGS

C SUPPLEMENTARY TABLES, INDEX

PRODUCT BREADTH

DRAWN CUP NEEDLE ROLLER BEARINGS, available in 3 mm to 139.7 mm bore (1/8 to 5 1/2 in), are designed to support radial loads and reduce friction between rotating components. The low cross section of the drawn cup bearing provides maximum load-carrying capability with minimum space required.

DRAWN CUP ROLLER CLUTCHES AND BEARING ASSEMBLIES, available in 3.175 to 35 mm bore (1/8 to 1 3/8 in), are designed to transmit torque between the shaft and housing in one direction and allow free overrun in the opposite direction. When transmitting torque, either the shaft or the housing can be the input member.

RADIAL NEEDLE ROLLER AND CAGE ASSEMBLIES, available in 3 mm to 127 mm bore (1/8 to 5 in), consist of a complement of needle rollers held in place by a cage. With no inner or outer ring, the low cross section provides maximum load-carrying capability within the smallest envelope. The mating shaft and housing are normally used as inner and outer raceways.

NEEDLE ROLLER THRUST BEALINGS, available in 6 mm to 160 mm (15/64 to 6 19/64 in) bore, consist of a complement of needle rollers held in place by a cage.

Needle roller thrust bealings are complements of small diameter needle rollers arranged in a spoke-like configuration. Needle rollers are equally spaced by means of a cage whose web section separates the rollers and provides guidance to keep them tracking in an orbital path. The purpose of these assemblies is to transmit a thrust load between two relatively rotating objects while greatly reducing friction.

Needle roller thrust bealings also can be unitized with lipped washers which service as raceway surfaces for the needle rollers. Washers can be supplied separately or can be mechanically unitized to the needle roller thrust assemblies for ease of handling.

HEAVY-DUTY NEEDLE ROLLER BEARINGS, available in 5 mm to 175 mm bore (3/16 to 6 57/64 in), consist of a machined and ground channel-shaped outer ring with a complement of needle rollers retained and guided by a cage. The thick outer ring provides maximum load capacity and shock resistance with a relatively small radial cross section.

TRACK ROLLERS/CAM FOLLOWERS, available in 12.7 mm to 152.4 mm O.D. (1/2 to 6 in), are characterized by their thick-walled outer rings that run directly on a track. The thick outer rings permit high load-carrying capability while minimizing distortion and bending stresses.

ENGINE BEARINGS include a full line of advanced bearing assemblies for automotive engine valve trains. These assemblies help reduce friction and optimize performance in both overhead valve and overhead cam engines. They include roller rocker arms for overhead valve (pushrod) engines, roller finger followers for overhead cam engines, valve lifter rollers for overhead valve and overhead cam engines.

PRECISION NEEDLE ROLLERS have multiple uses in a variety of industries including automotive, truck, farm and construction equipment, two-cycle engines, outboard engines and consumer durables. Needle rollers are mainly used as bearing rolling elements to transmit torque and reduce friction. They also can serve as precision shafts or as precision locating pins.

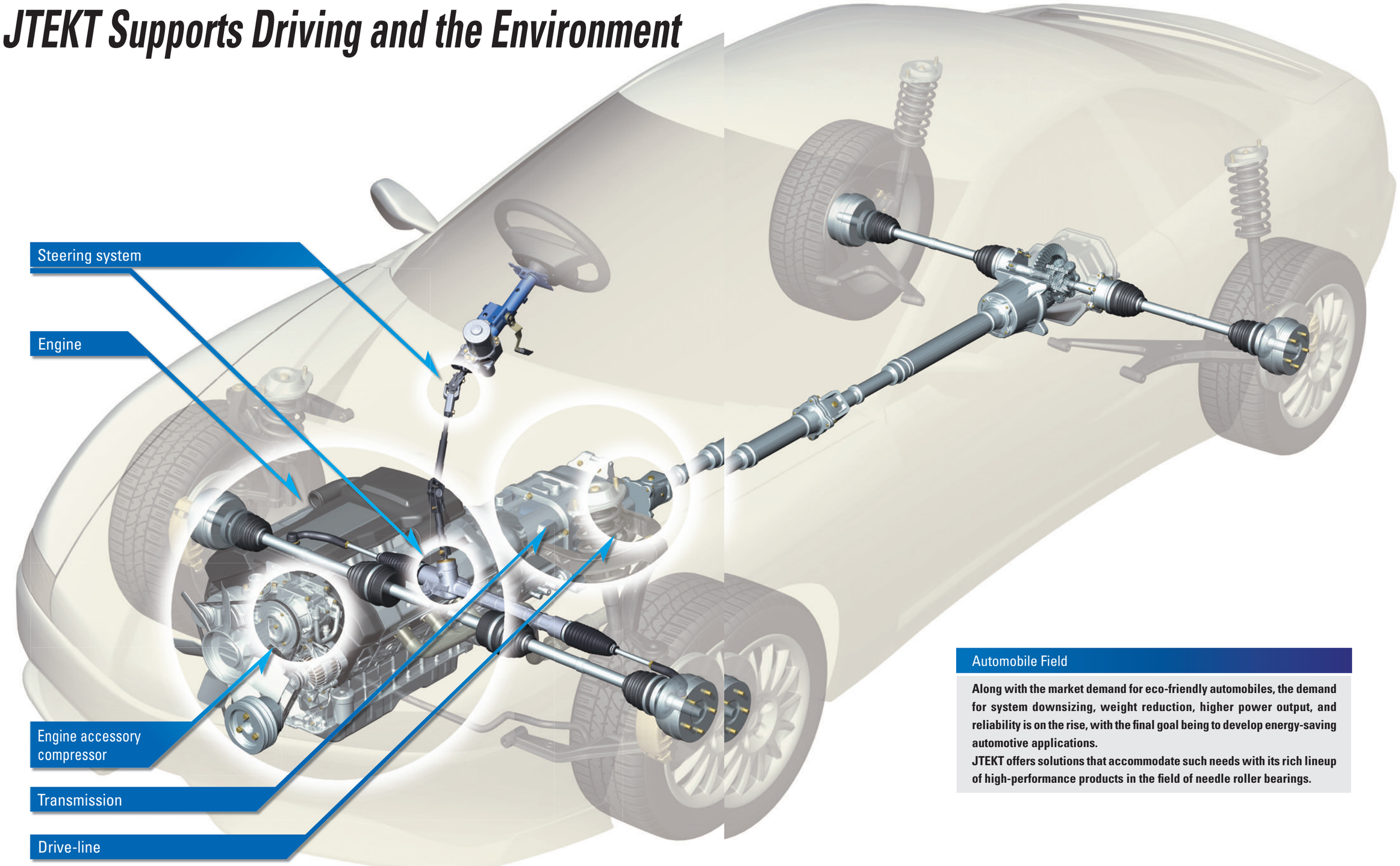
PLANETARY GEAR SHAFTS have multiple uses in a variety of industries including automotive, truck and farm and construction equipment. The shafts are used in planetary gear sets, differentials and engine valve trains.

PRECISION PINS AND SHAFTS are crafted from the highest quality steel within a TS16949/ISO9000/AS9100-certified manufacturing facility. Pins and shafts come in a larger variety of configurations and materials and flexible product volumes. These pins and shafts are found in applications such as gasoline fuel systems components, diesel systems components, aerospace rollers and precision rollers (DFAR-compliant), planet pins, racing applications, rollers for bearing assemblies, gear shafts and steering column pins.

APPLICATIONS

NEEDLE ROLLER BEARING APPLICATIONS

JTEKT Supports Driving and the Environment



Automobile Field

Along with the market demand for eco-friendly automobiles, the demand for system downsizing, weight reduction, higher power output, and reliability is on the rise, with the final goal being to develop energy-saving automotive applications.
JTEKT offers solutions that accommodate such needs with its rich lineup of high-performance products in the field of needle roller bearings.

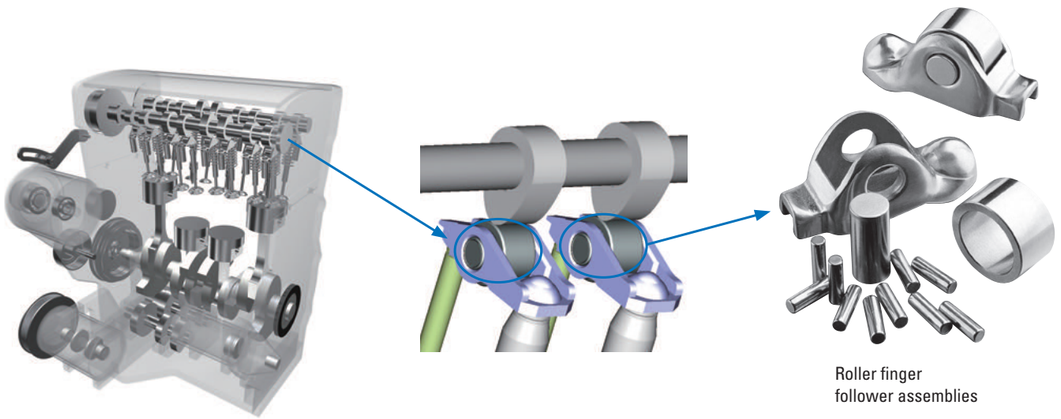
ENGINE

Valve Train Components

JTEKT's needle roller bearings for rocker arms contribute to reductions in energy used by engines and to improvements in engine reliability.

Bearing Features

- Low torque
- Wear resistance



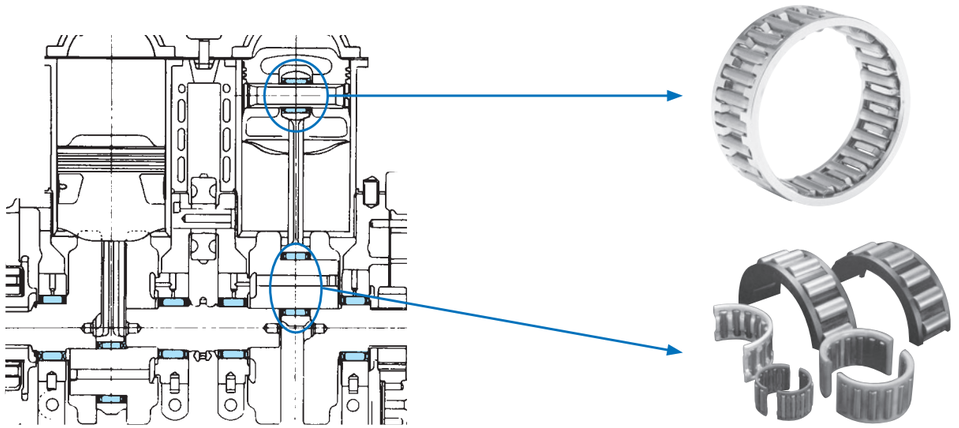
Roller finger follower assemblies

Piston and Crank Components

JTEKT's needle roller bearings for connecting rod applications respond to the need for reductions in energy used by engines and to demanding lubrication requirements, contributing to greater reliability.

Bearing Features

- Durability
- Improvement in seizure resistance
- Supports higher loads



Engines for motorcycles and boats

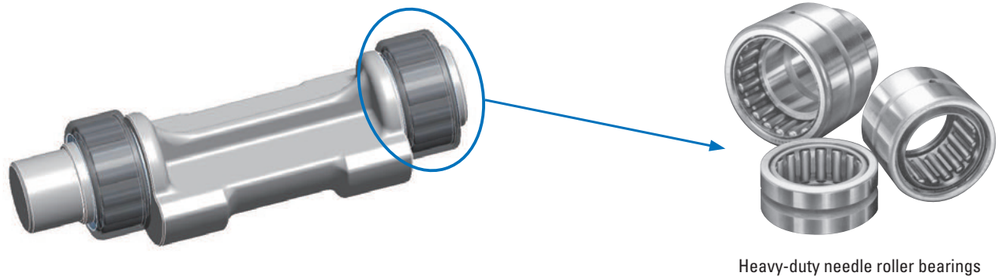
Radial needle roller and cage assemblies

Balance Shaft Components

JTEKT's needle roller bearings for balance shafts contribute to improved lubrication methods, reduced friction, and improved reliability under vibration conditions.

Bearing Features

- High reliability
- Vibration resistance



Heavy-duty needle roller bearings

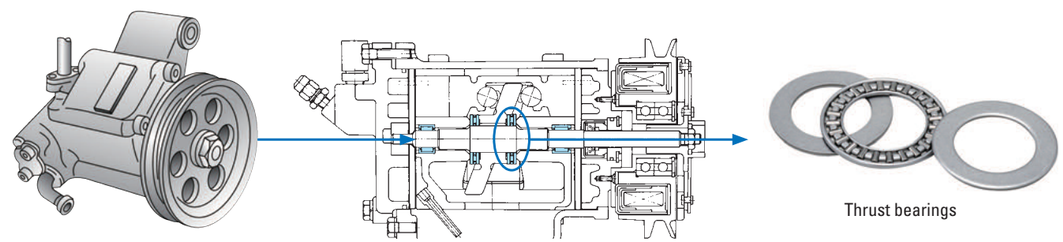
ENGINE ACCESSORIES

Compressor Components

JTEKT's needle roller bearings for compressors contribute to support for thin film lubricants, improved efficiency, and improved reliability.

Bearing Features

- Wear resistance
- Low torque
- Improved lubricity



Thrust bearings

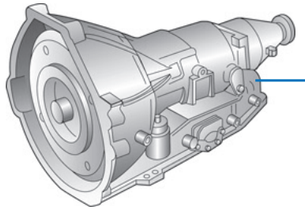
TRANSMISSION

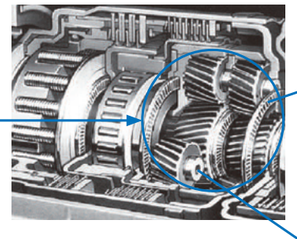
JTEKT's needle roller bearings for transmissions contribute to reductions in the size and weight of the transmission, improved power and fuel efficiency, support for low-viscosity lubricants, and improved reliability.

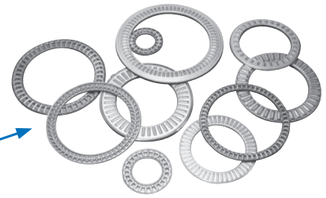
Bearing Features

- Supports higher loads
- Longer life in oil with foreign material
- Low torque

Automatic Transmissions



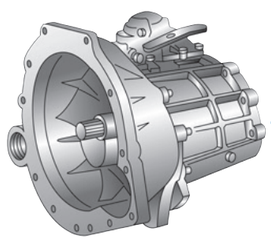


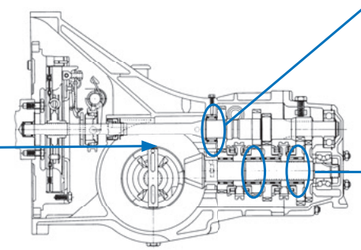


Thrust bearings

Radial needle roller and cage assemblies

Manual Transmissions





Split polymer caged radial assemblies

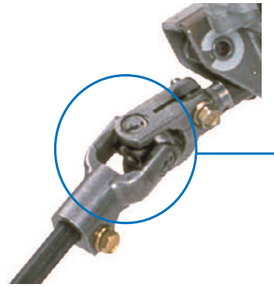
STEERING SYSTEMS

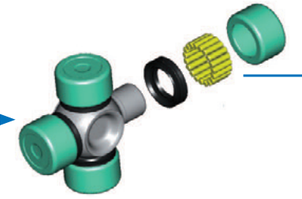
JTEKT's needle roller bearings for steering systems realize smooth steering capability with high reliability and quiet running by drawing on our experience in producing safe steering system components.

Bearing Features

- High reliability
- Reduced noise
- High rigidity

Intermediate Steering Shafts



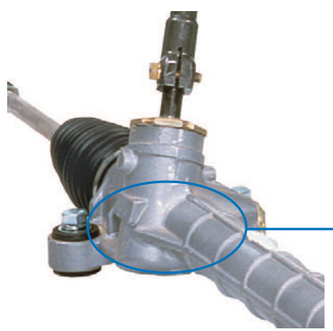


Drawn cup needle roller bearings

Pinion Shafts

Bearing Features

- High reliability
- Reduced noise



Drawn cup needle roller bearings

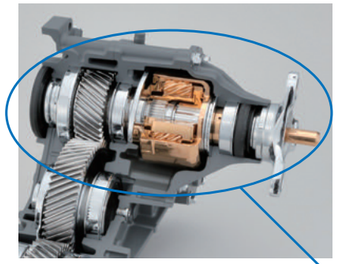
DRIVE-LINES

Torque Sensing LSD

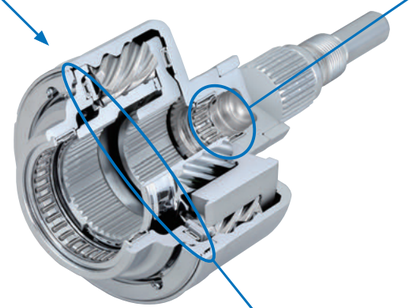
JTEKT's needle roller bearings for torque sensing LSDs contribute to downsizing and weight reduction, higher efficiency, and improved reliability.

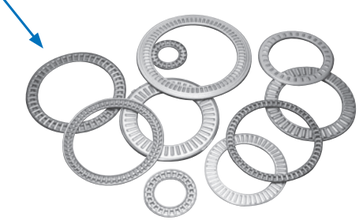
Bearing Features

- Alleviates misalignment
- Supports higher loads



Drawn cup needle roller bearings





Thrust bearings

INDUSTRIAL MACHINERY FIELD

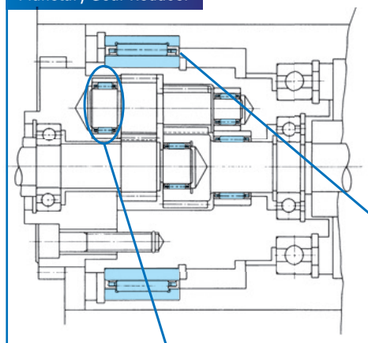
Construction equipment and agricultural machinery are used in dimanding environments and therefore require high durability. JTEKT offers high-performance needle roller bearings that respond to energy-saving requirements and high reliability needs.

Construction Equipment

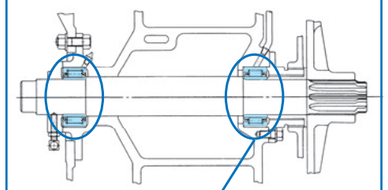
Bearing Features

- High reliability

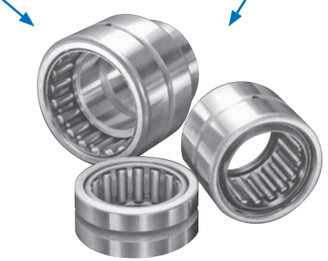
Planetary Gear Reducer



Wheel Drum

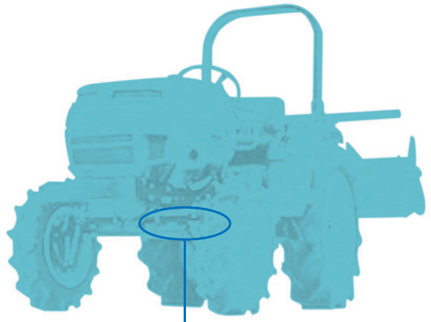


Radial needle roller and cage assemblies



Heavy-duty needle roller bearings

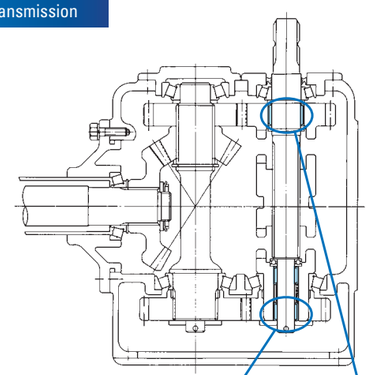
Agricultural Machinery

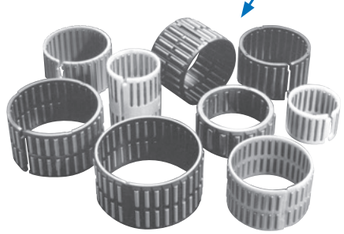


Bearing Features

- High reliability

Transmission



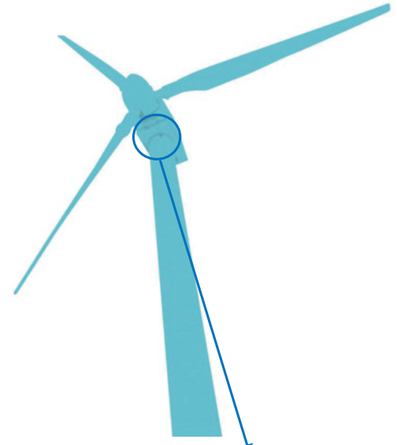


Radial needle roller and cage assemblies

WIND POWER GENERATION

Bearings used in wind power generators require long service lives.
JTEKT offers high-performance needle roller bearings that support high reliability and demanding environmental conditions.

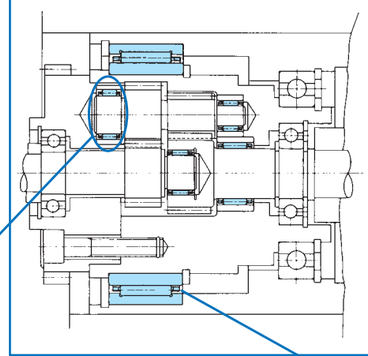
Wind Power Generation



Bearing Features

- Long service life
- Reduced noise

Planetary Gear Reducer



Radial needle roller and cage assemblies

Heavy-duty needle roller bearings

NOTES

A ENGINEERING

ENGINEERING

A

BEARING TYPES

NEEDLE ROLLER BEARINGS

Needle roller bearings are an economical alternative for applications requiring minimal space to carry a given load at a desired speed. Needle roller bearings can be an ideal choice because of their ability to handle a given level of speed and load capacity, yet have the smallest cross section of all roller bearing types.

We offer both metric and inch nominal bearings in popular designs such as: radial caged needle rollers, drawn cup needle roller bearings, machined ring, track rollers, thrust bearings, combined bearings, and drawn cup roller clutches.
Most of these bearing types can be operated directly on a machined shaft of suitable quality, or with a matching inner ring where this requirement cannot be conventionally satisfied.

Radial Needle Roller and Cage Assemblies

Radial needle roller and cage assemblies have a steel cage that provides both inward and outward retention for the needle rollers. The designs provide maximum cage strength consistent with the inherently high load ratings of needle roller bearings. Accurate guidance of the needle rollers by the cage bars allows for operation at high speeds. Also available are needle roller and cage assemblies using molded, one-piece glass-reinforced engineered polymer cages. Needle roller and cage assemblies are manufactured with either one or two rows of needle rollers.

Drawn Cup Bearings

The outer ring in the form of a cup is accurately drawn and no subsequent machining is performed to build the outer raceway. Drawn cup needle roller bearings are available in open ends or single, closed-end designs. They also are available with one or two integral seals. Other options include a single lubricating hole and matching inner ring.

Heavy-Duty Needle Roller Bearings

These bearings are available in a wide range of inch and metric sizes plus an array of design features including: integral seals, side flanges (or separate end washers), inner rings, oil holes and single or double caged sets (or full complement) of rollers.

Track Rollers

Track rollers listed in this catalog are designed with outer rings of large radial cross section to withstand heavy rolling and shock loads on track-type or cam-controlled equipment. The outside diameters of the outer rings are either profiled or cylindrical. Profiled track rollers are designed to alleviate uneven bearing loading resulting from deflection, bending or misalignment in mounting. Stud-type track rollers are available with or without lip contact seals, or with shields. Yoke-type track rollers are designed for straddle mounting. Each yoke-type is available with either radial needle roller and cage assemblies, or with a single (or double) full complement row of cylindrical or needle rollers.

Thrust Bearing Assemblies And Washers

Thrust needle roller and cage assemblies are available in a variety of inch or metric sizes. All types have very small cross sections. If the back up surfaces cannot be used as raceways, hardened washers are available. Thrust bearings are available with needle rollers or heavier cylindrical rollers for high load-carrying capacity.

Combined (Radial and Thrust) Bearings

Combined bearings consist of a radial bearing (needle roller bearing) and a thrust bearing (ball or roller bearing). Like other needle roller bearings, these combined bearings can be matched with an optional inner ring or thrust washer as the opposing raceway.

A

NEEDLE ROLLER BEARING SELECTION

Because of the possible combinations of roller complement orientation, bearing cross section thickness and raceway construction needle roller bearings should be given extra consideration for roller bearing applications selection. The table below should be used as a general guideline for the application of needle roller bearings.

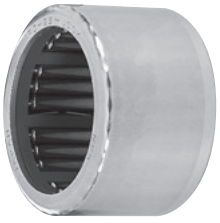
Table A-1. Needle roller bearing capability comparison based on suitable oil lubrication

Bearing type/ design capability	Radial needle roller and cage assembly	Drawn cup needle roller bearing caged	Drawn cup roller bearing full complement	Needle roller bearing and inner ring	Track roller	Thrust needle roller and cage assembly	Needle rollers	Combination bearing radial/thrust
Radial load	High	Moderate	High	High	Moderate	None	Very high	High
Axial load	None	None	None	None	Low	Very high	None	High
Limiting speed	Very high	High	Moderate	Very high	Moderate	High	Moderate	Moderate
Slope tolerance	Moderate	Moderate	Very low	Moderate	Moderate[1)]	Low	Very low	Low
Grease life	High	High	Low	High	Moderate	Low	Low	Low
Friction	Very low	Very low	Moderate	Very low	Low[2)]	Low	Moderate	Moderate
Precision	Very high	Moderate	Moderate	High	High	High	Very high	High
Cross section	Very low	Low	Low	Moderate	High	Very low	Very low	High
Cost	Low	Low	Low	High	High	Moderate	Very low	Very high

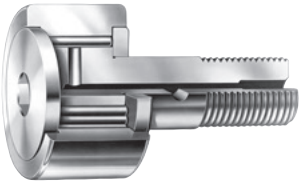
[1)] "Moderate" for full complement track rollers
[2)] "Low" for full complement track rollers

Radial needle roller and cage assembly

Drawn cup needle roller



Heavy-duty needle roller



Track roller

Thrust needle roller and cage assembly

Combined radial/thrust

Drawn cup roller clutch

BEARING REACTIONS, EQUIVALENT LOADS AND BEARING LIFE

DEFINITION OF LOAD RATINGS

Basic Dynamic Load Rating

The "basic dynamic load rating" (Cr) for a radial roller bearing is that calculated, constant, radial load, which a group of apparently identical bearings with stationary outer ring can theoretically endure for a rating life of one million revolutions of the inner ring. For a thrust roller bearing (Ca) is that calculated, constant, centric thrust load, which a group of apparently identical bearings can theoretically endure for a rating life of one million revolutions of one of the bearing washers. The basic dynamic load rating is a reference value only, the base value of one million revolutions has been chosen for ease of calculation. Since applied loading as great as the basic dynamic load tends to cause local plastic deformation of the rolling surfaces, it is not anticipated that such heavy loading would normally be applied.

Basic Static Load Rating

Basic static load rating for a radial roller bearing suitably manufactured from a good quality hardened alloy steel, the static radial load rating (C_{or}) is that uniformly distributed static radial bearing load, which produces a maximum contact stress of 4000 megapascals (580,000 psi) acting at the center of contact of the most heavily loaded rolling element. The static axial load rating (C_{oa}) is that uniformly distributed static centric axial load, which produces a maximum contact stress of 4000 megapascals (580,000 psi) acting at the center of contact of each rolling element.

Note: For a contact stress of 4000 megapascals (580,000 psi) a total permanent deformation of roller and raceway occurs, which is appoximately 0.0001 of the roller diameter.

EQUIVALENT DYNAMIC RADIAL BEARING LOADS (P_R)

To calculate the L_{10} life, it is necessary to calculate a dynamic equivalent radial load, designated by P_r. The dynamic equivalent radial load is defined as a single radial load that, if applied to the bearing, will result in the same life as the combined loading under which the bearing operates.

$$P_r = XF_r + YF_a$$

Where:

- L_{10} = Basic rating life
- P_r = Dynamic equivalent radial load
- F_r = Applied radial load
- F_a = Applied axial load
- X = Radial load factor
- Y = Axial load factor

Radial needle roller bearings are designed to carry radial load with zero thrust load under normal conditions. With the thrust load equal to zero, equivalent radial load (P_r) is equal to the design radial load (F_r). Your representative should be consulted on any applications where thrust load is involved (as the resulting increase in internal friction may require cooling to prevent increased operating temperatures).

STATIC RADIAL AND/OR AXIAL EQUIVALENT LOADS

The static equivalent radial and/or axial loading is dependent on the bearing type selected. For bearings designed to accommodate only radial or thrust loading, the static equivalent load is equal to the applied load.

For all bearings, the maximum contact stress can be approximated using the static equivalent load and the static rating.

For roller bearings:

$$\sigma_0 = 4000 \times \left(\frac{P_0}{C_0}\right)^{1/2} \text{ MPa}$$

$$\sigma_0 = 580 \times \left(\frac{P_0}{C_0}\right)^{1/2} \text{ ksi}$$

Because radial needle roller bearings are not designed to accept thrust loading, their equation to determine static radial equivalent load is:

$$P_{0r} = F_r$$

Thrust needle roller bearings are not designed to accept radial loading, so their equation to determine static thrust equivalent load is:

$$P_{0a} = F_a$$

The determination of the static load safety factor (f_0) serves to ascertain that a bearing with adequate static load rating has been selected.

$$f_0 = \frac{C_0}{P_0}$$

Where:

- f_0 = Static load safety factor
- C_0 = Basic static load rating (kN or lbf)
- P_0 = Maximum applied static load (kN or lbf)

f_0 is a safety factor against permanent deformation of the contact areas of the rolling elements and raceways. Higher f_0 values are required for particulary smooth operation. The following values are generally suggested.

- f_0 = 1.5 ... 3.0 for smooth operation
- f_0 = 1.0 ... 2.0 for less smooth operation

For drawn cup needle roller bearings, f_0 should be ≥3.

A

MINIMUM BEARING LOAD

Slippage can occur if loads are too light and, if accompanied by inadequate lubrication, can cause damage to the bearings. The minimum load for bearings with cage is $P_r/C_r = 0.02$, for full-complement bearings $P_r/C_r = 0.04$ (P_r is the dynamic load and C_r is the basic dynamic load rating).

Thrust needle roller bearings also have an added design requirement such that the minimum thrust load is satisfied to prevent the rollers from skidding on the raceway. The equation for the thrust loading force is different for needle rollers versus cylindrical rollers as noted:

(Needle rollers) $F_{a\,min.} = C_{0a}/2200$ kN
(Cylindrical rollers) $F_{a\,min.} = 0.1C_{0a}/2200$ kN

MAXIMUM BEARING LOAD

The load/life relationship is applicable to a wide range of bearing loads. However, high loading may cause stress concentrations in the roller-raceway contacts. Therefore, for most applications, the maximum applied load should not be greater than one-third of the basic dynamic load rating [$P \leq C/3$] in order for the basic rating life calculation to be valid.

MEAN DYNAMIC EQUIVALENT LOAD

When load magnitude or direction varies, it is necessary to calculate the mean dynamic equivalent load, which provides the same length of bearing service life as that under the actual load fluctuation. If the load and the rotational speed change in levels, as shown in Fig. A-1, the following equation can be used to calculate the mean dynamic equivalent load.

$$P_m = \sqrt[10/3]{\frac{P_1^{10/3} n_1 t_1 + P_2^{10/3} n_2 t_2 + \cdots\cdots + P_n^{10/3} n_n t_n}{n_1 t_1 + n_2 t_2 + \cdots\cdots\cdots + n_n t_n}}$$

In this equation,

P_m : Mean dynamic equivalent load N
P_1 : The load applied at rotational speed n_1 and for t_1 hours N
⋮ ⋮ ⋮
P_n : The load applied at rotational speed n_n and for t_n hours N

What's more, the following equation can be used to calculate the mean rotational speed n_m.

$$n_m = \frac{n_1 t_1 + n_2 t_2 + \cdots\cdots + n_n t_n}{t_1 + t_2 + \cdots\cdots\cdots t_n}$$

When the load changes steadily, as shown in Fig. A-2, the following equation can be used to calculate an approximation of the mean dynamic equivalent load.

$$P_m = \frac{P_{min.} + 2\,P_{max.}}{3}$$

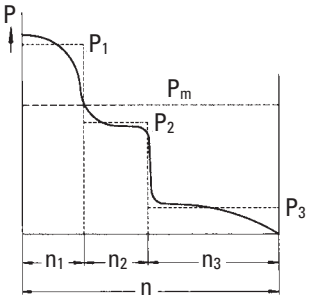


Fig. A-1

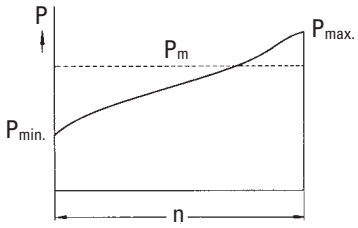


Fig. A-2

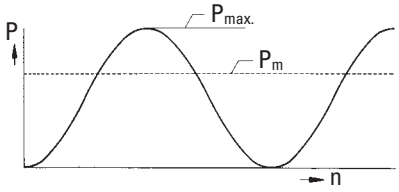


Fig. A-3

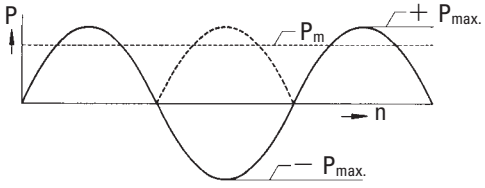


Fig. A-4

In this equation,

$P_{min.}$: The minimum dynamic equivalent load N
$P_{max.}$: The maximum dynamic equivalent load N

When the load changes like a sine wave between 0 and P_{max}, as shown in Fig. A-3, the following equation can be used to calculate an approximation of the mean dynamic equivalent load.

$$P_m \fallingdotseq 0.68\,P_{max.}$$

When the load changes between 0 and $P_{max.}$ in only the upper half of the sine wave, as shown in Fig. A-4, the following equation can be used to calculate an approximation of the mean dynamic equivalent load.

$$P_m \fallingdotseq 0.75\,P_{max.}$$

BEARING LIFE

Even if rolling bearings are rotated under ideal conditions, contact stress is continuously and repeatedly applied to the raceway surfaces of inner and outer rings or rolling contact surfaces of rolling elements, and material flakes from the raceway surfaces and rolling contact surfaces due to fatigue of material. The total number of bearing rotations (or total operating period at a constant speed) until flaking occurs is regarded as the bearing service life.

Even if bearings of the same dimensions, structure, material, and processing method are operated under the same rotating conditions, their service lives are considerably varied.

Since this phenomenon results from fatigue distribution in bearing materials themselves, differences in bearing service life should be statistically considered. When a group of identical bearings are rotated under the same conditions, the total number of revolutions until 90 % of the bearings are left without flaking (i.e. a service life of 90 % reliability) is defined as the basic rating life. Or in operating at a constant speed, it can be expressed by the total number of bearing rotations.

In practical service, however, a bearing fails not only because of fatigue, but other coefficients as well, such as wear, seizure, creep, fretting, brinelling, cracking etc. These bearing failures can be minimized by selecting the proper mounting method and lubricant, as well as the bearing most suitable for the application.

BEARING LIFE EQUATIONS

Basic Rating Life

Generally, the relationship between the basic dynamic load rating, dynamic equivalent load, and basic rating life of needle roller bearings is expressed as follows.

$$L_{10} = \left(\frac{C}{P}\right)^{10/3}$$

Where,

L_{10} : Basic rating life — 10^6 rotations
C : Basic dynamic load rating — N
P : Dynamic equivalent load — N

It is common for the life being expressed in terms of time to be useful when the bearing is rotating at a constant speed.

In this situation, the life can be obtained with the following equation.

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

Where,

L_{10h} : Basic rating life — h
n : Rotational speed — min^{-1}

Accordingly, where the dynamic equivalent load is P and rotational speed is n, the following equation can be used to calculate the basic dynamic load rating C, which is required to meet the design life. The bearing size most suitable for a specified purpose can then be selected by referring to the bearing specification table.

$$C = P\left(L_{10h} \times \frac{60n}{10^6}\right)^{3/10}$$

Modified Rating Life

The life of rolling bearings was standardized as a basic rating life in the 1960s, but in actual applications, sometimes the actual life and the basic rating life have been quite different due to the lubrication status and the influence of the usage environment. To make the calculated life closer to the actual life, a corrected rating life has been considered since the 1980s. In this corrected rating life, bearing characteristic factor a_2 (a correction factor for the case in which the characteristics related to the life are changed due to the bearing materials, manufacturing process, and design) and usage condition factor a_3 (a correction factor that takes into account usage conditions that have a direct influence on the bearing life, such as the lubrication) or factor a_{23} formed from the interdependence of these two factors, are considered with the basic rating life. These factors were handled differently by each bearing manufacturer, but they have been standardized as a modified rating life in **ISO 281** in 2007. In 2013, **JIS B 1518** (dynamic load ratings and rating life) was amended to conform to the **ISO**.

The basic rating life (L_{10}) shown in equation is the (fatigue) life with a dependability of 90 % under normal usage conditions for rolling bearings that have standard factors such as internal design, materials, and manufacturing quality. **JIS B 1518**:2013 specifies a calculation method based on **ISO 281**:2007. To calculate accurate bearing life under a variety of operating conditions, it is necessary to consider elements such as the effect of changes in factors that can be anticipated when using different reliabilities and system approaches, and interactions between factors. Therefore, the specified calculation method considers additional stress due to the lubrication status, lubricant contamination, and fatigue load limit C_u (refer to p. A-9) on the inside of the bearing. The life that uses this life modification factor a_{ISO}, which considers the above factors, is called modified rating life L_{nm} and is calculated with the following equation.

$$L_{nm} = a_1\, a_{ISO}\, L_{10}$$

In this equation,

L_{nm} : Modified rating life — 10^6 rotations
[This rating life has been modified for one of or a combination of the following: reliability of 90 % or higher, fatigue load limit, special bearing characteristics, lubrication contamination, and special operating conditions.]
L_{10} : Basic rating life — 10^6 rotations (reliability: 90 %)
a_1 : Life modification factor for reliability ..... Refer to section (1)
a_{ISO} : Life modification factor ..... Refer to section (2)

[Remark]
When bearing dimensions are to be selected given L_{nm} greater than 90 % in reliability, the strength of shaft and housing must be considered.

A

(1) Life modification factor for reliability a_1

The term "reliability" is defined as "for a group of apparently identical rolling bearings, operating under the same conditions, the percentage of the group that is expected to attain or exceed a specified life" in **ISO 281**:2007. Values of a_1 used to calculate a modified rating life with a reliability of 90 % or higher (a failure probability of 10 % or less) are shown in Table A-2.

Table A-2. Life modification factor for reliability a_1

Reliability, %	L_{nm}	a_1
90	L_{10m}	1
95	L_{5m}	0.64
96	L_{4m}	0.55
97	L_{3m}	0.47
98	L_{2m}	0.37
99	L_{1m}	0.25
99.2	$L_{0.8m}$	0.22
99.4	$L_{0.6m}$	0.19
99.6	$L_{0.4m}$	0.16
99.8	$L_{0.2m}$	0.12
99.9	$L_{0.1m}$	0.093
99.92	$L_{0.08m}$	0.087
99.94	$L_{0.06m}$	0.080
99.95	$L_{0.05m}$	0.077

(Citation from **JIS B 1518**:2013)

(2) Life modification factor a_{ISO}

a) System approach

The various influences on bearing life are dependent on each other. The system approach of calculating the modified life has been evaluated as a practical method for determining life modification factor a_{ISO} (ref. Fig. A-5). Life modification factor a_{ISO} is calculated with the following equation. A diagram is available for each bearing type (radial ball bearings, radial roller bearings, thrust ball bearings, and thrust roller bearings). (Each diagram (Figs. A-6 to A-9) is a citation from **JIS B 1518**:2013.)

Note that in practical use, this is set so that life modification factor $a_{ISO} \leq 50$.

$$a_{ISO} = f\left(\frac{e_c C_u}{P},\ K\right)$$

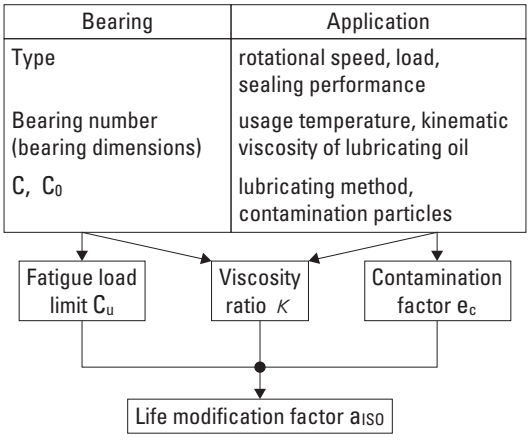


Fig. A-5. System approach

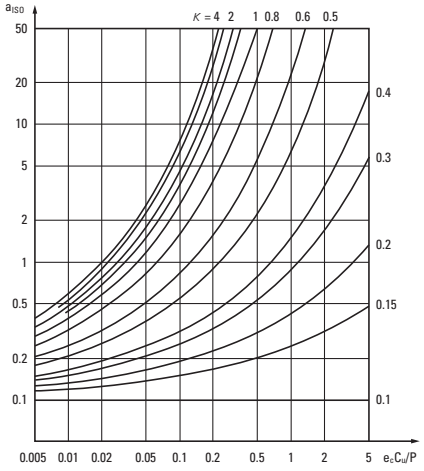


Fig. A-6. Life modification factor a_{ISO} (Radial ball bearings)

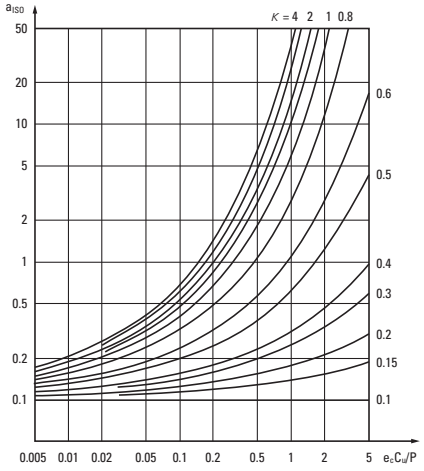


Fig. A-7. Life modification factor a_{ISO} (Radial roller bearings)

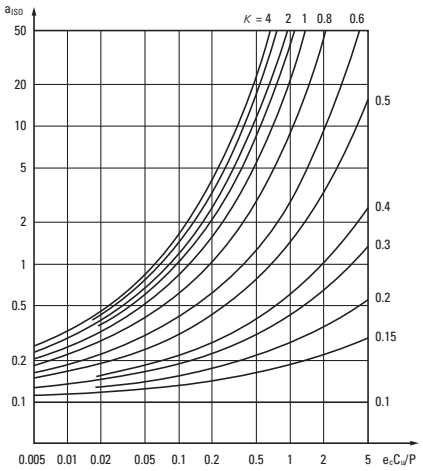


Fig. A-8. Life modification factor a_{ISO} (Thrust ball bearings)

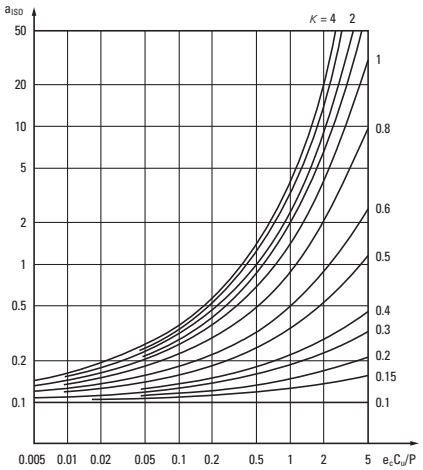


Fig. A-9. Life modification factor a_{ISO} (Thrust roller bearings)

(Figs. A-6 to A-9. Citation from **JIS B 1518**:2013)

b) Fatigue load limit C_u

For regulated steel materials or alloy steel that has equivalent quality, the fatigue life is unlimited so long as the load condition does not exceed a certain value and so long as the lubrication conditions, lubrication cleanliness class, and other operating conditions are favorable. For general high-quality materials and bearings with high manufacturing quality, the fatigue stress limit is reached at a contact stress of approximately 1.5 GPa between the raceway and rolling elements. If one or both of the material quality and manufacturing quality are low, the fatigue stress limit will also be low.

The term "fatigue load limit" C_u is defined as "bearing load under which the fatigue stress limit is just reached in the most heavily loaded raceway contact" in **ISO 281**:2007. and is affected by factors such as the bearing type, size, and material.

For details on the fatigue load limits of special bearings and other bearings not listed in this catalog, contact JTEKT.

c) Contamination factor e_c

If solid particles in the contaminated lubricant are caught between the raceway and the rolling elements, indentations may form on one or both of the raceway and the rolling elements. These indentations will lead to localized increases in stress, which will decrease the life. This decrease in life attributable to the contamination of the lubricant can be calculated from the contamination level as contamination factor e_c.

D_{pw} shown in Table A-3 is the pitch diameter of ball/roller set, which is expressed simply as $D_{pw} = (D + d)/2$. (D: Outside diameter, d: Bore diameter)

For information such as details on special lubricating conditions or detailed investigations, contact JTEKT.

Table A-3. Values of contamination factor e_c

Contamination level	e_c	
	D_{pw} < 100 mm	D_{pw} ≥ 100 mm
Extremely high cleanliness: The size of the particles is approximately equal to the thickness of the lubricant oil film, this is found in laboratory-level environments.	1	1
High cleanliness: The oil has been filtered by an extremely fine filter, this is found with standard grease-packed bearings and sealed bearings.	0.8 to 0.6	0.9 to 0.8
Standard cleanliness: The oil has been filtered by a fine filter, this is found with standard grease-packed bearings and shielded bearings.	0.6 to 0.5	0.8 to 0.6
Minimal contamination: The lubricant is slightly contaminated.	0.5 to 0.3	0.6 to 0.4
Normal contamination: This is found when no seal is used and a coarse filter is used in an environment in which wear debris and particles from the surrounding area penetrate into the lubricant.	0.3 to 0.1	0.4 to 0.2
High contamination: This is found when the surrounding environment is considerably contaminated and the bearing sealing is insufficient.	0.1 to 0	0.1 to 0
Extremely high contamination	0	0

(Table A-3. Citation from **JIS B 1518**:2013)

A

d) Viscosity ratio K

The lubricant forms an oil film on the roller contact surface, which separates the raceway and the rolling elements. The status of the lubricant oil film is expressed by viscosity ratio K, the actual kinematic viscosity at the operating temperature V divided by the reference kinematic viscosity V_1 as shown in the following equation.

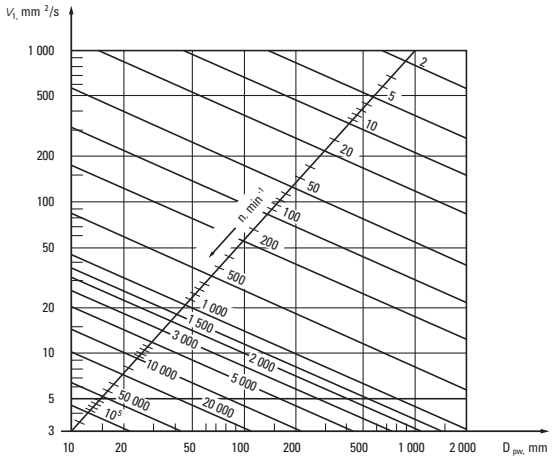
A K greater than 4, equal to 4, or less than 0.1 is not applicable.

For details on lubricants such as grease and lubricants with extreme pressure additives, contact JTEKT.

$$K = \frac{V}{V_1}$$

V : Actual kinematic viscosity at the operating temperature; the viscosity of the lubricant at the operating temperature (refer to Fig. A-14, p. A-22)

V_1 : Reference kinematic viscosity; determined according to the speed and pitch diameter of ball/roller set D_{pw} of the bearing (ref. Fig. A-10)



(Fig. A-10. Citation from **JIS B 1518**:2013)

Fig. A-10. Reference kinematic viscosity V_1

Basic Dynamic Load Rating Correction Due to Temperature

During high-temperature operation, the bearing metal hardness deteriorates as the material compositions are altered. As a result, the basic dynamic load rating is diminished. Once altered, material composition does not recover, even if the operating temperature is returned to normal. Therefore, for bearings used in high temperature operations, the basic dynamic load rating must be corrected by multiplying the basic dynamic load rating values specified in the bearing specification table by the temperature coefficient values in Table A-4.

Table A-4. Temperature coefficient values

Bearing temperature, °C	125	150	175	200	250
Temperature coefficient	1	1	0.95	0.90	0.75

Hardness rating factors

Dynamic and static load ratings are based on a minimum raceway hardness equivalent to 58 HRC (HV 653). If the raceway hardness is lower, the effective load ratings will be decreased. The following factors may be used to estimate life when raceway hardness is lower than 58 HRC. Thorough validation is recommended.

Table A-5. Basic dynamic load rating coefficients

Hardness (HRC)	Coefficient
58	1
57	0.94
56	0.89
55	0.85
54	0.80
53	0.75
52	0.68
51	0.60
50	0.50
49	0.44
48	0.40
47	0.37
46	0.34
45	0.31
40	0.20

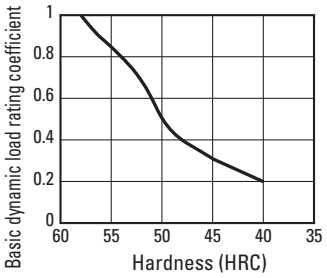


Fig. A-11. Relationship between basic dynamic load rating coefficient and hardness

Table A-6. Basic static load rating coefficients

Hardness (HRC)	Coefficient
58	1
57	0.94
56	0.88
55	0.83
54	0.78
53	0.73
52	0.68
51	0.65
50	0.61
49	0.57
48	0.53
47	0.50
46	0.47
45	0.44
40	0.32

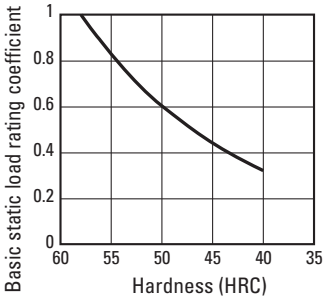


Fig. A-12. Relationship between basic static load rating coefficient and hardness

Service life of bearing system comprising two or more bearings

Even for systems which comprise two or more bearings, if one bearing is damaged, the entire system malfunctions.

Where all bearings used in an application are regarded as one system, the service life of the bearing system can be calculated using the following equation,

$$\frac{1}{L^e} = \frac{1}{L_1{}^e} + \frac{1}{L_2{}^e} + \frac{1}{L_3{}^e} + \cdots\cdots$$

where :

L : rating life of system

L_1 , L_2 , L_3 ····· : rating life of each bearing

e : constant

e = 10/9 ····· ball bearing

e = 9/8 ····· roller bearing

The mean value is for a system using both ball and roller bearings.

[Example]

When a shaft is supported by two roller bearings whose service lives are 50 000 hours and 30 000 hours respectively, the rating life of the bearing system supporting this shaft is calculated as follows :

$$\frac{1}{L^{9/8}} = \frac{1}{50\,000^{9/8}} + \frac{1}{30\,000^{9/8}}$$

$L \fallingdotseq 20\,000$ h

This fact is very important in estimating bearing service life for applications using two or more bearings.

MOUNTING DESIGNS

METRIC SERIES NEEDLE ROLLER BEARINGS (EXCEPT DRAWN CUP NEEDLE ROLLER BEARINGS)

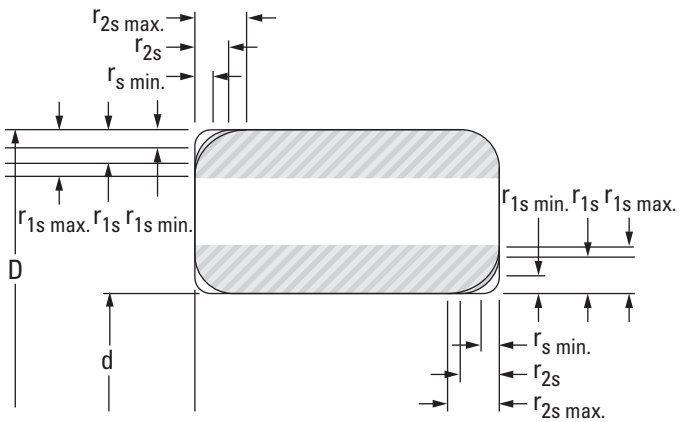
Metric series needle roller bearings are available with Radial Internal Clearance (RIC) designations per either of the following table A-7: per "ISO/ABMA 'C' Clearance." Non-standard values also are available by special request. Standard radial internal clearance values are listed in the following table A-7 based on bore size. The clearance required for a given application depends on the desired operating precision, rotational speed of the bearing and the fitting practice used. Most applications use a normal or C0 (Standard) clearance. Typically, larger clearance reduces the operating zone of the bearing, increases the maximum roller load and reduces the bearing's expected life.

Table A-7. Metric series needle roller bearing radial internal clearance limits

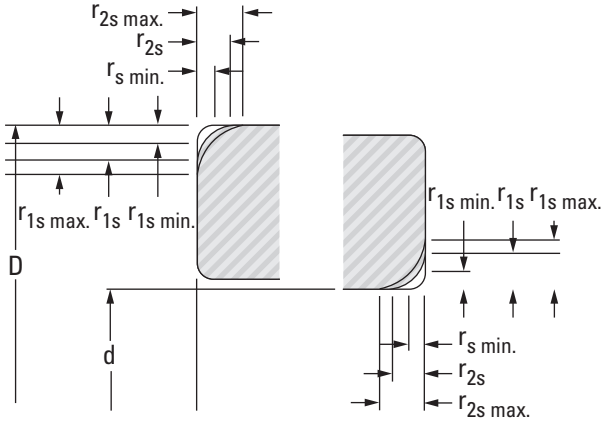
Bore		RIC							
		C2		C0 (Standard)		C3		C4	
over	incl.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in
-	**30.000**	**0.025**	**0.000**	**0.045**	**0.020**	**0.060**	**0.035**	**0.075**	**0.050**
-	1.1811	0.0010	0.0000	0.0018	0.0008	0.0024	0.0014	0.0030	0.0020
30.000	**40.000**	**0.030**	**0.005**	**0.050**	**0.025**	**0.070**	**0.045**	**0.085**	**0.060**
1.1811	1.5748	0.0012	0.0002	0.0020	0.0010	0.0028	0.0018	0.0033	0.0024
40.000	**50.000**	**0.035**	**0.005**	**0.060**	**0.030**	**0.080**	**0.050**	**0.100**	**0.070**
1.5748	1.9685	0.0014	0.0002	0.0024	0.0012	0.0031	0.0020	0.0039	0.0028
50.000	**65.000**	**0.040**	**0.010**	**0.070**	**0.040**	**0.090**	**0.060**	**0.110**	**0.080**
1.9685	2.5591	0.0016	0.0004	0.0028	0.0016	0.0035	0.0024	0.0043	0.0031
65.000	**80.000**	**0.045**	**0.010**	**0.075**	**0.040**	**0.100**	**0.065**	**0.125**	**0.090**
2.5591	3.1496	0.0018	0.0004	0.0030	0.0016	0.0039	0.0026	0.0049	0.0035
80.000	**100.000**	**0.050**	**0.015**	**0.085**	**0.050**	**0.110**	**0.075**	**0.140**	**0.105**
3.1496	3.9370	0.0020	0.0006	0.0033	0.0020	0.0043	0.0030	0.0055	0.0041
100.000	**120.000**	**0.055**	**0.015**	**0.090**	**0.050**	**0.125**	**0.085**	**0.165**	**0.125**
3.9370	4.7244	0.0022	0.0006	0.0035	0.0020	0.0049	0.0033	0.0065	0.0049
120.000	**140.000**	**0.060**	**0.015**	**0.105**	**0.060**	**0.145**	**0.100**	**0.190**	**0.145**
4.7244	5.5118	0.0024	0.0006	0.0041	0.0024	0.0057	0.0039	0.0075	0.0057
140.000	**160.000**	**0.070**	**0.020**	**0.120**	**0.070**	**0.165**	**0.115**	**0.215**	**0.165**
5.5118	6.2992	0.0028	0.0008	0.0047	0.0028	0.0065	0.0045	0.0085	0.0065
160.000	**180.000**	**0.075**	**0.025**	**0.125**	**0.075**	**0.170**	**0.120**	**0.220**	**0.170**
6.2992	7.0866	0.0030	0.0010	0.0049	0.0030	0.0067	0.0047	0.0087	0.0067
180.000	**200.000**	**0.090**	**0.035**	**0.145**	**0.090**	**0.195**	**0.140**	**0.250**	**0.195**
7.0866	7.8740	0.0035	0.0014	0.0057	0.0035	0.0077	0.0055	0.0098	0.0077
200.000	**225.000**	**0.105**	**0.045**	**0.165**	**0.105**	**0.220**	**0.160**	**0.280**	**0.220**
7.8740	8.8583	0.0041	0.0018	0.0065	0.0041	0.0087	0.0063	0.0110	0.0087
225.000	**250.000**	**0.110**	**0.045**	**0.175**	**0.110**	**0.235**	**0.170**	**0.300**	**0.235**
8.8583	9.8425	0.0043	0.0018	0.0069	0.0043	0.0093	0.0067	0.0118	0.0093
250.000	**280.000**	**0.125**	**0.055**	**0.195**	**0.125**	**0.260**	**0.190**	**0.330**	**0.260**
9.8425	11.0236	0.0049	0.0022	0.0077	0.0049	0.0102	0.0075	0.0130	0.0102
280.000	**315.000**	**0.130**	**0.055**	**0.205**	**0.130**	**0.275**	**0.200**	**0.350**	**0.275**
11.0236	12.4016	0.0051	0.0022	0.0081	0.0051	0.0108	0.0079	0.0138	0.0108
315.000	**355.000**	**0.145**	**0.065**	**0.225**	**0.145**	**0.305**	**0.225**	**0.385**	**0.305**
12.4016	13.9764	0.0057	0.0026	0.0089	0.0057	0.0120	0.0089	0.0152	0.0120
355.000	**400.000**	**0.190**	**0.100**	**0.280**	**0.190**	**0.370**	**0.280**	**0.460**	**0.370**
13.9764	15.7480	0.0075	0.0039	0.0110	0.0075	0.0146	0.0110	0.0181	0.0146
400.000	**450.000**	**0.210**	**0.110**	**0.310**	**0.210**	**0.410**	**0.310**	**0.510**	**0.410**
15.7480	17.7165	0.0083	0.0043	0.0122	0.0083	0.0161	0.0122	0.0201	0.0161
450.000	**500.000**	**0.220**	**0.110**	**0.330**	**0.220**	**0.440**	**0.330**	**0.550**	**0.440**
17.7165	19.6850	0.0087	0.0043	0.0130	0.0087	0.0173	0.0130	0.0217	0.0173

A

METRIC SERIES BEARING CHAMFER DIMENSIONS



Radial Bearings



Thrust Bearings

Table A-8. Chamfer dimensions of radial bearings metric series

$r_{s\ min.}$	d Nominal bore dia. >	≤	$r_{1s\ max.}$	$r_{2s\ max.}$
mm in	mm in		mm in	mm in
0.150 0.0059	**all** all		**0.300** 0.0118	**0.600** 0.0236
0.200 0.0079	**all** all		**0.500** 0.0197	**0.800** 0.0315
0.300 0.0118	–	**40.000** 1.5748	**0.600** 0.0236	**1.000** 0.0394
	40.000 1.5748	–	**0.800** 0.0315	**1.000** 0.0394
0.600 0.0236	–	**40.000** 1.5748	**1.000** 0.0394	**2.000** 0.0787
	40.000 1.5748	–	**1.300** 0.0512	**2.000** 0.0787
1.000 0.0394	–	**50.000** 1.9685	**1.500** 0.0591	**3.000** 0.1181
	50.000 1.9685	–	**1.900** 0.0748	**3.000** 0.1181
1.100 0.0433	–	**120.000** 4.7244	**2.000** 0.0787	**3.500** 0.1378
	120.000 4.7244	–	**2.500** 0.0984	**4.000** 0.1575
1.500 0.0591	–	**120.000** 4.7244	**2.300** 0.09055	**4.000** 0.1575
	120.000 4.7244	–	**3.000** 0.1181	**5.000** 0.19685
2.000 0.0787	–	**80.000** 3.1496	**3.000** 0.1181	**4.500** 0.1772
	80.000 3.1496	**220.000** 8.6614	**3.500** 0.1378	**5.000** 0.19685
	220.000 8.6614	–	**3.800** 0.1496	**6.000** 0.2362
2.100 0.0827	–	**280.000** 11.0236	**4.000** 0.1575	**6.500** 0.2559
	280.000 11.0236	–	**4.500** 0.1772	**7.000** 0.2756

Table A-9. Chamfer dimensions of thrust bearings metric series

$r_{s\ min.}$	$r_{1s\ max.}$	$r_{2s\ max.}$
mm in	mm in	mm in
0.300 0.0118	**0.800** 0.0315	**0.800** 0.0315
0.600 0.0236	**1.500** 0.0591	**1.500** 0.0591
1.000 0.0394	**2.200** 0.0866	**2.200** 0.0866
1.100 0.0433	**2.700** 0.1063	**2.700** 0.1063
1.500 0.0591	**3.500** 0.1378	**3.500** 0.1378
2.000 0.0787	**4.000** 0.1575	**4.000** 0.1575

ABMA / ISO Symbols

d	Bearing bore diameter, nominal and shaft-piloted washer bore diameter, nominal.
D	Bearing outside diameter, nominal and housing-piloted washer outside diameter, nominal.
$r_{s\ min.}$	Smallest permissible single chamfer dimension (minimum limit).
$r_{1s\ max.}$	Largest permissible single chamfer dimension in a radial direction.
$r_{2s\ max.}$	Largest permissible single chamfer dimension in an axial direction.

SHAFT DESIGNS

BEARINGS WITHOUT INNER RINGS

When the shaft is used as the inner raceway for needle roller bearings it must have a hardness of 58 HRC or higher and a wave-free finish in order to realize the full load-carrying capability of the bearing.

1. **Metallurgy** – either case-hardening or through-hardening grades of good bearing-quality steel are satisfactory for raceways.

   To realize full bearing capacity, the raceway area must be at least surface hard with a reasonable core strength. During the carburizing or induction-hardening of case hardened steel, not only must the surface hardness requirement of 58 HRC or higher be met, but the basic concept is that the case depth with a hardness of HV 550 (52.3 HRC) must be 0.4 mm or higher. However, if the roller diameter is smaller than 4 mm, a case depth of (0.1 × Dw) mm or higher is recommended.
   (Dw:roller diameter)
2. **Strength** – the shaft must be of sufficient strength to keep the operating deflections within the limits outlined.
3. **Tolerance** – the suggested shaft diameter tolerances for each type of needle roller bearing are indicated in the appropriate section of this catalog.
4. **Variation of mean shaft diameter (taper)** – within the range of the bearing width, 5 µm or less per 25 mm or one-half the diameter tolerance or less (whichever is smaller).
5. **Deviation from circular form** – the radial deviation from true circular form of the raceway should not exceed 2.5 µm for diameters up to and including 25 mm. For raceways greater than 25 mm, the allowable radial deviation should not exceed 2.5 µm multiplied by a factor of the raceway diameter divided by 25.
6. **High frequency lobing** – the lobing that occurs 10 or more times around the circumference of a shaft and exceeds 0.4 µm from peak to valley is called chatter. Chatter usually causes undesirable noise and reduces fatigue life.
7. **Shaft slope** – Operating conditions which cause misalignment (shaft deflection, inaccuracy of shaft and housing, mounting errors) can affect bearing performance. For needle roller bearings, Table A-10 shows misalignment limitations based on bearing width.

Table A-10. Misalignment limitations

Bearing width		Maximum slope (mm/mm)	
mm	in.	Caged	Full complement
<25.4	<1	0.0015	0.0010
25.4 – 50.8	1 – 2	0.0010	0.0005
>50.8	>2	0.0005	0.0005

8. **Surface finish** – In addition to a wave-free finish, the raceway surface roughness of $R_a \leq 0.2$ µm must be maintained for the bearing to utilize its full load rating. The raceway area also must be free of nicks, burrs, scratches and dents. Oil holes are permissible in the raceway area, but care must be taken to blend the edges gently into the raceway, and if possible, the hole should be located in the unloaded zone of the raceway.

   Care also must be taken to prevent grind reliefs, fillets, etc., from extending into the raceway area. If the rollers overhang a grind relief or step on the shaft, there will be high stress concentration with resultant early damage.
9. **End chamfer** – for the most effective assembly of the shaft into a bearing, the end of the shaft should have a large chamfer or rounding. This should help in preventing damage to the roller complement, scratching of the raceway surface, and nicking of the shaft end.
10. **Sealing surface** – in some instances, bearings have integral or immediately adjacent seals that operate on the surface ground for the bearing raceway. Here, particular attention should be paid to the pattern of the shaft finish. In no instance should there be a "lead," or spiral effect, as often occurs with through-feed centerless grinding. Such a "lead" may pump lubricant past the seal.

BEARINGS WITH INNER RINGS

When it is undesirable or impractical to prepare the shaft to be used as a raceway, inner rings are available as listed in the tabular pages. If the shaft is not used directly as a raceway, the following design specifications must be met:

1. **Strength** – the shaft must be of sufficient strength to keep the operating deflections within the limits outlined.
2. **Tolerance** – the suggested shaft diameter tolerances for each type of needle roller bearing are indicated in the appropriate section of the catalog.
3. **Variation of mean shaft raceway diameter (taper) and deviation from circular form of the raceway** – should not exceed one-half the shaft diameter tolerance.
4. **Surface finish** – the surface finish should not exceed a roughness of Ra 0.8 µm.
5. **Locating shoulders or steps** – locating shoulders or steps in the shaft must be held to close concentricity with the bearing seat to prevent imbalance and resultant vibrations.

Table A-11. Shaft designs summary

	Shaft	
	Raceway surface	Fitting surface
Out-of-roundness	Shaft dia. ≤ 25 mm: 2.5 µm or less Shaft dia. > 25 mm: 2.5 µm × (shaft dia./25 mm) or less	One-half of shaft dia. tolerance or less
Variation of mean dia. (taper)	5 µm or less per 25 mm within the range of bearing width, or one-half of shaft dia. tolerance or less (whichever is smaller)	One-half of shaft dia. tolerance or less
Surface roughness	0.2a or less	0.8a or less
Hardness	58 HRC or harder[1)]	–

1) During the carburizing or induction-hardening of case hardened steel, not only must the surface hardness requirement of 58 HRC or higher be met, but the basic concept is that the case depth with a hardness of HV 550 (52.3 HRC) must be 0.4 mm or higher. However, if DW is smaller than 4 mm, a case depth of (0.1 × Dw) mm or higher is recommended. (Dw: roller dia.)

A

HOUSING DESIGNS

BEARINGS WITH OUTER RINGS

For bearings with outer rings, the function of the housing is to locate and support the outer ring. The following specifications must be met:

1. **Strength** – housings should be designed so that the radial loads placed on the bearings will cause a minimum of deflection or distortion of the housing.
2. **Variation of mean housing diameter (taper)** – within the width of the outer ring, 13 µm or one-half the diameter tolerance (whichever is smaller) or less.
3. **Deviation from circular form** – the housing bore should be round within one-half the housing bore tolerance.
4. **Parallelism** – when possible, line bore housings that are common to one shaft to obtain parallelism of the housing bores and the shaft axis.
5. **Surface finish** – The surface finish should not exceed R_a 1.6 µm.
6. **End chamfer** – to permit easy introduction of the bearing into the housing, the end of the housing should have a generous chamfer.

Only heavy-duty needle roller bearings can be installed into housings with a transition fit or a clearance fit. The outer ring should be a transition fit in the housing when it rotates relative to the load. The outer ring may be a clearance fit in the housing when it is stationary relative to the load. In either case, locate the bearings by shoulders, or other locating devices, to prevent axial movement.

Since only the heavy-duty needle roller bearing does not require an interference fit in the housing to round and size it properly, a split housing may be used if desired. Dowels should be used to maintain proper register of the housing sections.

Drawn cup needle roller bearings have a thin case-hardened outer ring that is out-of-round from the hardening operation. For proper mounting it must always be pressed into the housing. Split housings will not round and size a drawn cup bearing. When split housings must be used, the bearing should first be mounted in a cylindrical sleeve.

The housing should be of sufficient tensile strength and section to round and size the bearing. It must be designed for minimum distortion under load. Steel or cast iron housings are preferred.

Housing bores in low tensile strength materials such as aluminum, magnesium, phenolics, etc., should be reduced to provide more interference fit. Thin section cast iron and steel housings may also require reduced bores. Consult your representative for suggestions when working with these lower strength housings.

The housing should be through-bored if possible. When shouldered housing bores are unavoidable, the bearing should be located far enough from the shoulder to avoid the danger of crushing the end of the drawn cup during installation.

When the drawn cup bearing is mounted close to the housing face, care should be taken to mount the bearing at least 0.250 mm (0.0100 in) within the housing face to protect the bearing lip.

BEARINGS WITHOUT OUTER RINGS

In many cases, such as with gear bores, it is desirable to have the housing bore serve as the outer raceway for radial needle roller and cage assemblies or loose needle roller complements. In those instances, as for shafts used as raceways, the housing bore must have a hardness of 58 HRC or harder and a surface roughness Ra ≤ 0.2 µm so that the full load-carrying capacity of the bearing is realized.

1. **Strength** – the housing must be of sufficient cross section to maintain proper roundness and running clearance under maximum load.
2. **Metallurgical** – material selection, hardness and case depth should be consistent with the requirements for inner raceways given in the shaft design.
3. **Variation of mean housing raceway diameter (taper)** – within the range of the bearing width, 5 µm or less per 25 mm or one-half the housing bore diameter tolerance or less (whichever is smaller). In addition, the bore diameter must never be smaller at both ends than in the center [sway-back].
4. **Deviation from circular form** – the raceway out-of-roundness should not exceed one-half the bore tolerance.
5. **Surface finish** – In addition to a wave-free finish, the raceway surface roughness of Ra ≤ 0.2 µm must be maintained for the bearing to utilize its full load rating. The raceway area also must be free of nicks, burrs, scratches and dents.
6. **Grind reliefs** – care must be exercised to ensure that grind reliefs, fillets, etc., do not extend to the raceway. Oil holes in the raceway area are permissible, but the edges must be blended smoothly with the raceway and, if possible, the hole should be located in the unloaded zone of the raceway.

Table A-12. Housing designs summary

	Housing bore	
	Raceway surface	**Fitting surface**
Out-of-roundness	One-half of bore tolerance or less	One-half of bore tolerance or less
Variation of mean dia. (taper)	5 µm or less per 25 mm within the range of outer ring width, or one-half of bore tolerance or less (whichever is smaller)	13 µm or less within the range of outer ring width, or one-half of bore tolerance or less (whichever is smaller)
Surface roughness	0.2a or less	1.6a or less
Hardness	58 HRC or harder[1)]	–

1) During the carburizing or induction-hardening of case hardened steel, not only must the surface hardness requirement of 58 HRC or higher be met, but the basic concept is that the case depth with a hardness of HV 550 (52.3 HRC) must be 0.4 mm or higher. However, if DW is smaller than 4 mm, a case depth of (0.1 × Dw) mm or higher is recommended. (Dw: roller dia.)

FITS

The purpose of fit is to securely fix the inner or outer ring to the shaft or housing, to preclude detrimental circumferential sliding on the fitting surface.

Such detrimental sliding (referred to as "creep") will cause abnormal heat generation, wear of the fitting surface, infiltration of abrasion metal particles into the bearing, vibration, and many other harmful effects, which cause a deterioration of bearing functions.

FIT SELECTION

In selecting the proper fit, careful consideration should be given to bearing operating conditions.
Major specific considerations are :

- Direction of load
- Load characteristics and magnitude
- Temperature distribution in operating
- Bearing internal clearance
- Surface finish, material and thickness of shaft and housing
- Mounting and dismounting methods
- Necessity to compensate for shaft thermal expansion at the fitting surface
- Bearing type and size

In view of these considerations, the following paragraphs explain the details of the important factors in fit selection.

1. Direction of load

Direction of load classified into three types : rotating inner ring load; rotating outer ring load and indeterminate direction load.
Table A-13 tabulates the relationship between these characteristics and fit.

Table A-13. Direction of Load and Fits

Direction of load		Rotating Ring		Type of load	Fit	
		Inner ring	outer ring		Inner ring	outer ring
Rotating inner ring load	Inner ring : Circumferential load Outer ring : Point load	Rotating	Stationary	Rotating load	Tight	Loose
Rotating outer ring load	Inner ring : Point load Outer ring : Circumferential load	Stationary	Rotating	Rotating load	Loose	Tight
Indeterminate direction load	Inner ring : Circumferential load Outer ring : Oscillating load	Rotating Stationary	Stationary Rotating	Stationary load > Rotating load Stationary load < Rotating load	Tight	Slightly tight
	Inner ring : Oscillating load Outer ring : Circumferential load	Rotating Stationary	Stationary Rotating	Stationary load > Rotating load Stationary load < Rotating load	Slightly tight	Tight

2. Effect of load characteristic and magnitude

When a radial load is applied, the inner ring will expand slightly. Since this expansion enlarges the circumference of the bore minutely, the initial interference is reduced.

The reduction can be calculated by the following equations :

[in the case of $F_r \leqq 0.25\ C_0$]

$$\Delta_{dF} = 0.08 \sqrt{\frac{d}{B}} \cdot F_r \times 10^{-3}$$

[in the case of $F_r > 0.25\ C_0$]

$$\Delta_{dF} = 0.02 \frac{F_r}{B} \times 10^{-3}$$

where :

Δ_{dF}	: Reduction of inner ring interference	mm
d	: Nominal bore diameter of bearing	mm
B	: Nominal inner ring width	mm
F_r	: Radial load	N
C_0	: Basic static load rating	N

When the radial load exceeds the C_0 value by 25%, greater interference is needed. When impact loads are expected, much greater interference is needed.

3. Effect of fitting surface roughness

The effective interference obtained after fitting differs from calculated interference due to plastic deformation of the ring fitting surface. When the inner ring is fitted, the effective interference, subject to the effect of the fitting surface finish, can be approximated by the following equations :

[In the case of a ground shaft]

$$\Delta_{deff} \fallingdotseq \frac{d}{d+2} \Delta_d$$

[In the case of a turned shaft]

$$\Delta_{deff} \fallingdotseq \frac{d}{d+3} \Delta_d$$

where :

Δ_{deff}	: Effective interference	mm
Δ_d	: Calculated interference	mm
d	: Nominal bore diameter of bearing	mm

A

4. Effect of temperature

A bearing generally has an operating temperature that is higher than the ambient temperature. When the inner ring operates under load, its temperature generally becomes higher than that of the shaft and the effective interference decreases due to the greater thermal expansion of the inner ring.

If the temperature difference between the bearing inside and surrounding housing is Δt, the temperature difference between the fitting surfaces of the inner ring and shaft will be approximately (0.10 to 0.15) × Δt. The reduction of interference (Δdt) due to the temperature difference is then expressed as follows:

$$\Delta_{dt} = (0.10 \sim 0.15)\ \Delta_t \cdot \alpha \cdot d$$
$$\fallingdotseq 0.001\,5\ \Delta_t \cdot d \times 10^{-3}$$

In this equation,

Δ_{dt} : Reduction of interference due to temperature difference — mm
Δ_t : Temperature difference between the inside of the bearing and the surrounding housing — °C
α : Linear expansion coefficient of bearing steel (approximately equal to 12.5×10^{-6}) — 1/°C
d : Nominal bore diameter of bearing — mm

Consequently, when a bearing is higher in temperature than the shaft, greater interference is required.

However, a difference in temperature or in the coefficient of expansion may sometimes increase the interference between the outer ring and housing. Therefore, care should be taken when clearance is provided to accommodate shaft thermal expansion.

5. Maximum stress due to fit

When a bearing is fitted with interference, the bearing ring will expand or contract, generating internal stress.

Should this stress be excessive, the bearing ring may fracture.

The maximum bearing fitting-generated stress is determined by the equation in Table A-14.

In general, to avoid fracture, it is best to adjust the maximum interference to less than 1/1 000 of the shaft diameter, or the maximum stress (σ), determined by the equation in Table A-14, should be less than 120 MPa.

Table A-14 does not apply to drawn cup needle roller bearings.

Recommended Fits

Recommended fits are listed in each bearing section and within the tabular pages.

Table A-14. Maximum fitting-generated stress in bearings

Shaft & inner ring	Housing bore & outer ring
(In the case of hollow shaft) $\sigma = \frac{E}{2} \cdot \frac{\Delta_{deff}}{d} \cdot \frac{\left(1-\frac{d_0^2}{d^2}\right)\left(1+\frac{d^2}{D_i^2}\right)}{\left(1-\frac{d_0^2}{D_i^2}\right)}$	**(In the case of $D_h \neq \infty$)** $\sigma = E \cdot \frac{\Delta_{Deff}}{D} \cdot \frac{\left(1-\frac{D^2}{D_h^2}\right)}{\left(1-\frac{D_e^2}{D_h^2}\right)}$
(In the case of solid shaft) $\sigma = \frac{E}{2} \cdot \frac{\Delta_{deff}}{d} \cdot \left(1+\frac{d^2}{D_i^2}\right)$	**(In the case of $D_h = \infty$)** $\sigma = E \cdot \frac{\Delta_{Deff}}{D}$

where :

σ : Maximum stress — MPa
d : Nominal bore diameter (shaft diameter) — mm
D_i : Raceway contact diameter of inner ring roller bearing … $D_i \fallingdotseq 0.25\,(D + 3d)$ — mm
Δ_{deff} : Effective interference of inner ring — mm
d_0 : Bore diameter of hollow shaft — mm
D_e : Raceway contact diameter of outer ring roller bearing … $De \fallingdotseq 0.25\,(3D + d)$ — mm
D : Nominal outside diameter (bore diameter of housing) — mm
Δ_{Deff} : Effective interference of outer ring — mm
D_h : Outside diameter of housing — mm
E : Young's modulus = 2.08×10^5 — MPa

[Remark] The above equations are applicable when the shaft and housing are steel.
When other materials are used, JTEKT should be consulted.

CLEARANCE

Bearing internal clearance is defined as the clearance between the bearing ring and the rolling elements. The total distance either inner or outer ring can be moved when the specified measuring load is applied to the ring in radial direction and the other ring is fixed is defined as radial internal clearance.

The term "residual clearance" is also defined as the original clearance decreased owing to expansion or contraction of a raceway due to fitting, when the bearing is mounted in the shaft and housing.

The term "effective clearance" is defined as the residual clearance decreased owing to dimensional change arising from temperature differentials within the bearing.

The term "operating clearance" is defined as the internal clearance present while a bearing mounted in a machine is rotating under a certain load, or, the effective clearance increased due to elastic deformation arising from bearing loads.

The operating clearance is closely related to bearing performance and life. It is therefore desirable to select a clearance with a lower limit value on the positive side of zero.

When selecting the clearance, fitting conditions, temperature conditions, and tolerance of mounting dimensions must all be taken into account.

The operating clearance can be obtained from the equation in Table A-15.

These calculations can be used for machined ring needle roller bearings but not for drawn cup needle roller bearings.

For the drawn cup needle roller bearings refer to page B-2-7.

Table A-15. Operating clearance

Operating clearance (S)	$S=S_o-(S_f+S_{t1}+S_{t2})+S_w$*	* S_w (increase of clearance due to load) is generally small, and thus may be ignored, although there is a equation for determining the value.
Decrease of clearance due to fitting (S_f)	**(In the case of hollow shaft)** $S_{fi}=\Delta_{deff}\frac{d}{D_i}\cdot\frac{\left(1-\frac{d_0^2}{d^2}\right)}{\left(1-\frac{d_0^2}{D_i^2}\right)}$ **(In the case of solid shaft)** $S_{fi}=\Delta_{deff}\frac{d}{D_i}$	**(In the case of $D_h\neq\infty$)** $S_{fo}=\Delta_{Deff}\frac{D_e}{D}\cdot\frac{\left(1-\frac{D^2}{D_h^2}\right)}{\left(1-\frac{D_e^2}{D_h^2}\right)}$ **(In the case of $D_h=\infty$)** $S_{fo}=\Delta_{Deff}\frac{D_e}{D}$
Decrease of clearance due to temperature differentials between inner and outer rings (S_{t1})	The amount of decrease varies depending on the state of housing; however, generally the amount can be approximated by the following equation on the assumption that the outer ring will not expand : $S_{t1}=\alpha(D_i\cdot t_i-D_e\cdot t_e)$	where : $D_e=D_i+2D_w$ Consequently, $S_{t1}+S_{t2}$ will be determined by the following equation : $S_{t1}+S_{t2}=\alpha\cdot D_i\cdot t_1+2\alpha\cdot D_w\cdot t_2$ Temperature differential between the inner and outer rings, t1, can be expressed as follows : $t_1=t_i-t_e$ Temperature differential between the rolling element and outer ring, t2, can be expressed as follows : $t_2=t_w-t_e$
Decrease of clearance due to temperature rise of rolling element (S_{t2})	$S_{t2}=2\alpha\cdot D_w\cdot t_w$	

In Table A-15,

S : Operating clearance	mm	Δ_{Deff} : Effective interference of outer ring	mm
S_o : Clearance before mounting	mm	D_h : Outside diameter of housing	mm
S_f : Decrease of clearance due to fitting	mm	D_e : Outer ring raceway contact diameter	mm
S_{fi} : Expansion of inner ring raceway contact diameter	mm	roller bearing … $D_e\fallingdotseq 0.25\,(3D+d)$	
S_{fo} : Contraction of outer ring raceway contact diameter	mm	D : Nominal outside diameter	mm
S_{t1} : Decrease of clearance due to temperature differentials between inner and outer rings	mm	α : Linear expansion coeffi cient of bearing steel (12.5×10^{-6})	1/°C
S_{t2} : Decrease of clearance due to temperature rise of the rolling elements	mm	D_w : Average diameter of rolling elements roller bearing … $D_w\fallingdotseq 0.25\,(D-d)$	mm
S_w : Increase of clearance due to load	mm	t_i : Temperature rise of the inner ring	°C
Δ_{deff} : Effective interference of inner ring	mm	t_e : Temperature rise of the outer ring	°C
d : Nominal bore diameter (shaft diameter)	mm	t_w : Temperature rise of rolling elements	°C
d_0 : Bore diameter of hollow shaft	mm		
D_i : Inner ring raceway contact diameter roller bearing … $D_i\fallingdotseq 0.25\,(D+3d)$	mm		

■ Bearings are sometimes used with a non-steel shaft or housing.
In the automotive industry, a statistical method is often incorporated for selection of clearance.
In these cases, or when other special operating conditions are involved, JTEKT should be consulted.

A

LUBRICATION

PURPOSE OF LUBRICATION

Lubrication is one of the most important factors determining bearing performance. Since the suitability of the lubricant and lubrication method have a dominant influence on bearing life, the most suitable lubricant should be selected according to operating conditions.

Functions of lubrication :

- To lubricate each part of the bearing, and to reduce friction and wear
- To carry away heat generated inside bearing due to friction and other causes
- To cover rolling contact surface with the proper oil film in order to prolong bearing fatigue life
- To prevent corrosion and contamination by dirt

Although the same general rules for ball bearings and roller bearings can also be applied to needle roller bearing lubrication, the following points should also be considered :

- The space in the bearing is very small; thus, only a little lubricant can be retained.
- The bearing is relatively wide, so circulating the lubricant through the bearing is difficult.
- In the case of full complement type sliding contact between rollers may arise.
- Rollers may skew during rotation.
- Often used in the application where oscillating motion is present.

Accordingly, these points must be given sufficient consideration when selecting the lubricant and method of lubrication.

LUBRICANT

Bearing lubrication is classified broadly into two categories : grease lubrication and oil lubrication. Table A-16 makes a general comparison between the two.

Table A-16. Comparison between grease and oil lubrication

Item	Grease	Oil
Sealing device	Easy	Slightly complicated and special care required for maintenance
Lubricating ability	Good	Excellent
Rotation speed	Low/medium speed	Applicable at high speed as well
Replacement of lubricant	Slightly troublesome	Easy
Life of lubricant	Relatively short	Long
Cooling effect	No cooling effect	Good (circulation is necessary)
Filtration of dirt	Difficult	Easy

GREASE LUBRICATION

Grease is made by mixing and dispersing a solid of high oil-affinity (called a thickener) with lubricant oil (as a base), and transforming it into a semi-solid state.

As well, a variety of additives can be added to improve specific performance.

Many types of grease are marketed in various combinations of thickener, base oil and additives according to the purposes. So, it is very important to select proper types of grease.

The characteristics of various greases are shown in Table A-17.

Table A-17. Characteristics of respective greases

	Lithium grease			Calcium grease (cup grease)	Sodium grease (fiber grease)	Complex base grease		Non-soap base grease		
Thickener	Lithium soap			Calcium soap	Sodium soap	Lithium complex soap	Calcium complex soap	Bentone	Urea compounds	Fluorine compounds
Base oil	Mineral oil	Synthetic oil (diester oil)	Synthetic oil (silicon oil)	Mineral oil	Mineral oil	Mineral oil	Mineral oil	Mineral oil	Mineral/ synthetic oil	Synthetic oil
Dropping point (°C)	170 to 190	170 to 230	220 to 260	80 to 100	160 to 180	250 or higher	200 to 280	–	240 or higher	250 or higher
Operating temperature range (°C)	–30 to +120	–50 to +130	–50 to +180	–10 to +70	0 to +110	–30 to +150	–10 to +130	–10 to +150	–30 to +150	–40 to +250
Rotation speed range	Medium to high	High	Low to medium	Low to medium	Low to high	Low to high	Low to medium	Medium to high	Low to high	Low to medium
Mechanical stability	Excellent	Good to excellent	Good	Fair to good	Good to excellent	Good to excellent	Good	Good	Good to excellent	Good
Water resistance	Good	Good	Good	Good	Bad	Good to excellent	Good	Good	Good to excellent	Good
Pressure resistance	Good	Fair	Bad to fair	Fair	Good to excellent	Good	Good	Good to excellent	Good to excellent	Good
Remarks	Most widely usable for various rolling bearings.	Superior low temperature and friction characteristics.	Superior high and low temperature characteristics.	Suitable for applications at low rotation speed and under light load. Not applicable at high temperature.	Liable to emulsify in the presence of water. Used at relatively high temperature.	Superior mechanical stability and heat resistance. Used at relatively high temperature.	Superior pressure resistance when extreme pressure agent is added.	Suitable for applications at high temperature and under relatively heavy load.	Superior water resistance, oxidation stability, and heat stability. Suitable for applications at high temperature and high speed.	Superior chemical resistance and solvent resistance. Usable at up to 250 °C.

(1) Base oil

Mineral oil is usually used as the base oil for grease.

When low temperature fluidity, high temperature stability, or other special performance is required, diester oil, silicon oil, polyglycolic oil, fluorinated oil, or other synthetic oil is often used.

Generally, grease with a low viscosity base oil is suitable for applications at low temperature or high rotation speed; grease with high viscosity base oils are suitable for applications at high temperature or under heavy load.

(2) Thickener

Most greases use a metallic soap base such as lithium, sodium, or calcium as thickeners. For some applications, however, non-soap base thickeners (inorganic substances such as bentone, silica gel, and organic substances such as urea compounds, fluorine compounds) are also used.

In general, the mechanical stability, bearing operating temperature range, water resistance, and other characteristics of grease are determined by the thickener.

(Lithium soap base grease)
Superior in heat resistance, water resistance and mechanical stability.

(Calcium soap base grease)
Superior in water resistance; inferior in heat resistance.

(Sodium soap base grease)
Superior in heat resistance; inferior in water resistance.

(Non-soap base grease)
Superior in heat resistance.

(3) Additives

Various additives are selectively used to serve the respective purposes of grease applications.

- Extreme pressure agents
  When bearings must tolerate heavy or impact loads.
- Oxidation inhibitors
  When grease is not refilled for a long period.

Structure stabilizers, rust preventives, and corrosion inhibitors are also used.

(4) Consistency

Consistency, which indicates grease hardness, is expressed as a figure obtained, in accordance with ASTM (JIS), by multiplication by 10 the depth (in mm) to which the cone-shaped metallic plunger penetrates into the grease at 25 °C by deadweight in 5 seconds. The softer the grease, the higher the figure.

Table A-18 shows the relationships between the NLGI scales and ASTM (JIS) penetration indexes, service conditions of grease.

(NLGI : National Lubricating Grease Institute)

It is imperative that the bearing operating temperature is always within the temperature range specified for the grease used. Although softer greases provide better lubrication, they are more likely to be churned. Since grease churning tends to cause temperature rise and leakage, this characteristic should be taken into account when selecting grease consistency. For ordinary operating conditions, greases of NLGI No. 0 to 3 are commonly used. When the bearing operating speed is higher, a somewhat harder grease with high mechanical stability should be selected.

Table A-18. Grease consistency and service conditions

ASTM (JIS) penetration index (25 °C, 60 mixing operations)	NLGI scale	Service conditions/applications
355 - 385	0	For centralized lubricating
310 - 340	1	For centralized lubricating, at low temperature
265 - 295	2	For general use
220 - 250	3	For general use, at high temperature
175 - 205	4	For special applications

[Note] The larger the penetration index, the softer is the grease.

(5) Mixing of different greases

Since mixing of different greases changes their properties, greases of different brands should not be mixed.

If mixing cannot be avoided, greases containing the same thickener should be used. Even if the mixed greases contain the same thickener, however, mixing may still produce adverse effects, due to difference in additives or other factors.

Thus it is necessary to check the effects of a mixture in advance, through testing or other methods.

A

REPLENISHMENT/REPLACEMENT OF GREASE

The method of replenishing/replacing grease depends largely on the lubrication method. Whichever method may be utilized, care should be taken to use clean grease and to keep dirt or other foreign matter out of the housing.

When grease is refilled, new grease must be injected inside bearing.

In case of high speed operation or a small air space, because it is necessary to replenish grease often, a grease inlet should be provided as near the bearing as possible so that the deteriorated grease may be replaced by new grease.

Under normal operating conditions, grease life may be approximated by the graphs shown in Fig. A-13. It is recommended you use this diagram as a guide for replenishment and replacement of grease.

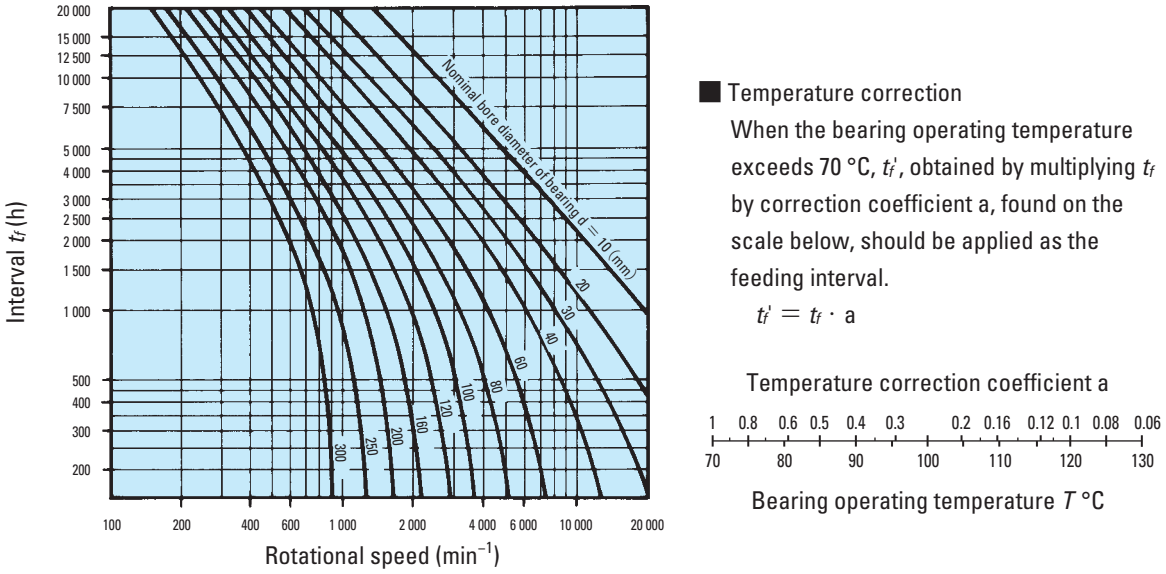


Fig. A-13 Grease feeding interval

⚠ WARNING

Mixing grease types can cause the lubricant to become ineffective, hich can result in equipment failure, creating a risk of serious bodily harm.

LUBRICATING OIL

The most commonly used bearing lubricating oil is super refined mineral oil, which has excellent oxidation stability and rust inhibition as well as high film strength. However, as bearings are being used in a variety of applications, a wide variety of synthetic oils are being used. What's more, a variety of additives (such as oxidation inhibitors, rust inhibitors, and anti-foam agents) are being used to improve the specific properties of these synthetic oils. Table A-19 shows the properties of various lubricating oils.

Table A-19. Properties of various lubricating oils

Lubricating oil type	Super refined mineral oil	Major synthetic oils				
		Diester oil	Silicon oil	Polyglycolic oil	Polyphenyl ether oil	Fluorinated oil
Bearing operating temperature range (°C)	**–40 to +220**	**–55 to +150**	**–70 to +350**	**–30 to +150**	**0 to +330**	**–20 to +300**
Lubricating ability	Excellent	Excellent	Fair	Good	Good	Excellent
Oxidation stability	Good	Good	Fair	Fair	Excellent	Excellent
Radiation resistance	Bad	Bad	Bad to fair	Bad	Excellent	–

LUBRICATING OIL SELECTION

The most important thing to consider when selecting a lubricating oil is to select an oil that has a viscosity that is appropriate for the operating temperature of the bearing.

Use Table A-20 to select the proper kinematic viscosity for your bearing operating conditions. Use this value as a guideline.

If the viscosity of the lubricating oil is too low, an insufficient oil film will form. If the viscosity of the lubricating oil is too high, heat will be generated due to viscous resistance.

Generally, the larger the load or the higher the operating temperature, the higher the viscosity of the used lubricating oil and the higher the rotational speed, the lower the viscosity of the used lubricating oil.

The relationship between the lubricating oil viscosity and temperature is shown in Fig. A-14.

Table A-20. Proper kinematic viscosities by bearing operating conditions

Operating temperature	$d_m n$ value	Proper kinematic viscosity (expressed in the ISO viscosity grade or the SAE No.)	
		Light/normal load	Heavy/impact load
–30 to 0°C	All rotation speeds	ISO VG 15, 22, 46 (Refrigerating Machine oil)	——
0 to 60°C	300 000 or lower	ISO VG 46 (Bearing oil Turbine oil)	ISO VG 68 SAE 30 (Bearing oil Turbine oil)
	300 000 to 600 000	ISO VG 32 (Bearing oil Turbine oil)	ISO VG 68 (Bearing oil Turbine oil)
	600 000 or higher	ISO VG 7, 10, 22 (Bearing oil)	——
60 to 100°C	300 000 or lower	ISO VG 68 (Bearing oil)	ISO VG 68, 100 SAE 30 (Bearing oil)
	300 000 to 600 000	ISO VG 32, 46 (Bearing oil Turbine oil)	ISO VG 68 (Bearing oil Turbine oil)
	600 000 or higher	ISO VG 22, 32, 46 (Bearing oil Turbine oil Machine oil)	——
100 to 150°C	300 000 or lower	ISO VG 68, 100 SAE 30, 40 (Bearing oil)	ISO VG 100 to 460 (Bearing oil Gear oil)
	300 000 to 600 000	ISO VG 68 SAE 30 (Bearing oil Turbine oil)	ISO VG 68, 100 SAE 30, 40 (Bearing oil)

[Remarks] 1. $d_m n = \frac{D+d}{2} \times n$ ..... {D : nominal outside diameter (mm), d : nominal bore diameter (mm), n : rotational speed (min^{-1})}

2. Please contact with JTEKT if the bearing operating temperature is under –30 °C or over 150 °C.

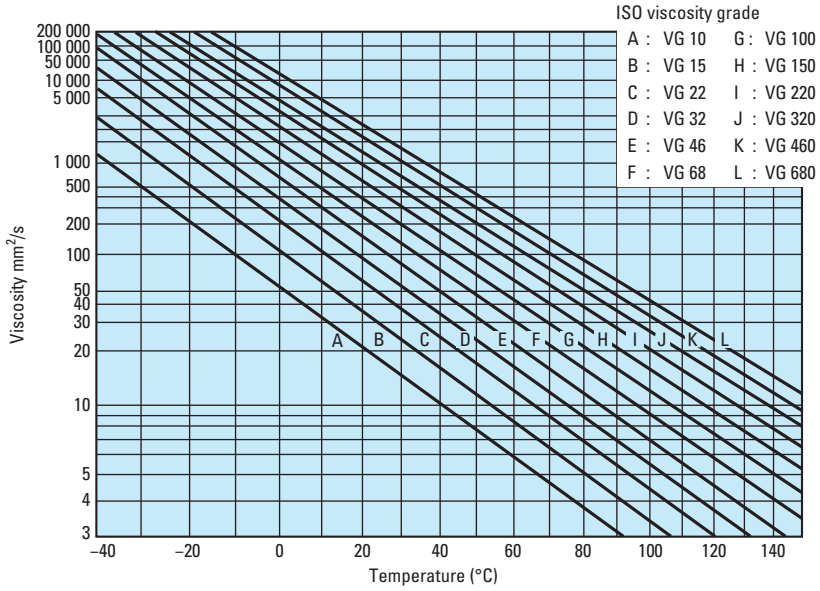


Fig. A-14. Relationship between lubricating oil viscosity and temperature (viscosity index : 100)

CLASSIFICATION

There are several classifications of oils based on viscosity grades. The most familiar are the Society of Automotive Engineers (SAE) classifications for automotive engine and gear oils. The American Society for Testing and Materials (ASTM) and the International Organization for Standardization (ISO) have adopted standard viscosity grades for industrial fluids. Fig. A-15 shows the viscosity comparisons of ISO/ASTM with SAE classification systems at 40°C (104°F).

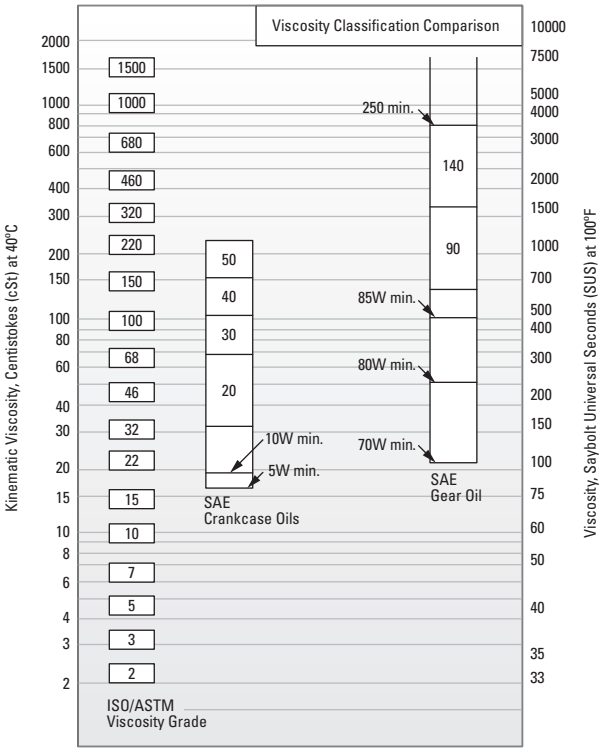


Fig. A-15. Viscosity classification comparison between ISO/ASTM grades (ISO 3448/ASTM D2442) and SAE grades (SAE J 300-80 for crankcase oils, SAE J 306-81 for axle and manual transmission oils)

OIL LUBRICATION METHOD

Oil lubrication is usable even with high speed rotation and at somewhat high temperatures and is effective in reducing bearing vibration and noise. Therefore, oil lubrication is used in many cases where grease lubrication does not work.
The main types and methods of oil lubrication are shown in Table A-21.

Table A-21. Types and methods of oil lubrication

Oil bath	• This is the simplest method. Bearings are soaked in oil before operation. • This method is applicable for low and medium rotational speeds. • Attaching an oil level gauge makes it possible to adjust the oil amount. • For horizontal shafts, approximately half of the rolling element in the lowest position is immersed. For vertical shafts, approximately 70 to 80% of the bearings are immersed. • Using magnetic lids is advantageous as it prevents iron powder generated by friction from being dispersed in the oil.
Oil drip	• An oiler is used to drip the oil, and the rotating parts are operated to fill the inside of the housing with an oil mist, which also has a cooling effect. • This method can be used with up to relatively high speeds and medium-sized loads. • The most common example of this method uses five to six drops of oil per minute. (It is difficult to adjust the amount of oil used to 1 mL/h or less.) • Ensure that oil does not accumulate in the bottom of the housing.
Oil splash	• A simple flinger or gears are attached to the shaft to supply the oil to its destination by means of flinging or splashing operations. This method can be used to supply oil even to bearings that are far away from the oil tank. • This method can be used with up to relatively high speeds. • The oil level must be maintained within a certain range. • Using magnetic lids is advantageous as it prevents iron powder generated by friction from being dispersed in the oil. What's more, to prevent the intrusion of foreign materials into the bearing, it is advisable to use a shield board or baffle.
Forced oil circulation	• This method uses an oil circulation system. After the supplied oil lubricates and cools the inside of the bearing, the oil passes through the oil return pipe to the tank. The oil is filtered and cooled and is then forcibly supplied once more by way of a pump. • This method is used a great deal under high rotational speed and high temperature conditions. • To prevent the lubricating oil from accumulating inside the housing, it is advisable to make the oil return pipe approximately twice as thick as the oil supply pipe.
Oil jet	• In this method, oil is sprayed from nozzles at a constant pressure (approximately 0.1 to 0.5 MPa). This method provides a large cooling effect. • This method is applicable for high rotational speeds and heavy loads. • Generally, the nozzle diameters are between 0.5 and 2 mm, and nozzles are installed in positions between 5 and 10 mm from the sides of the bearings. It is advisable to use between 2 and 4 nozzles for situations in which a large amount of heat is generated. • The oil jet method supplies a large quantity of oil, so it is advisable to use an oil discharge pump to forcibly discharge oil in order to prevent against the stagnation of unnecessary oil.
Oil mist lubrication (fog lubrication)	• In this method, dry mist (air that contains oil in mist form) obtained from an oil mist generator is continuously sent to the location where oil is to be applied to the bearing. The dry mist is then changed to wet mist (oil drops that can easily be affixed to a surface) by the nozzles attached to the housing or bearing, and the oil is then applied to the bearing. • This method forms and retains the minimum necessary oil film for lubrication, which provides benefits such as prevention of oil pollution, simplification of bearing maintenance, extension of bearing fatigue life, and reduction of oil consumption.
Oil and air lubrication	• In this method, a metering piston is used to eject a minuscule amount of oil, a mixing valve is used to mix the oil with compressed air, and the oil and air mixture is then applied to the bearing continuously and stably. • It's possible to perform metering management of the minuscule amount of oil, so new lubricating oil can always be supplied. Therefore, this method is applicable to usages with high rotational speeds such as machine tool main spindles. • The spindle's internal pressure rises because compressed air is supplied together with the lubricating oil. Therefore, this method is also effective at preventing the intrusion of external materials such as debris and cutting fluid. What's more, the lubricating oil flows through the oil supply pipe, so this method results in an extremely small amount of air pollution.

LIMITING SPEEDS

In addition to the bearing load ratings, the tabular pages also list the limiting speed values which are the maximum speeds at which the bearings may operate. These speeds have been calculated for unsealed and sealed bearings of conventional design, tolerances and internal clearances, properly mounted with low applied loads using normal splash, drip feed or other methods of lubrication which will provide adequate cooling of the bearings. A bearing may operate at a speed higher than the listed limiting speed with the use of a clean, good quality oil and after prior consultation with JTEKT's Engineering Department. With high speeds and high acceleration rates, the ratio of P/C should not fall below 0.02 to prevent skidding of the rolling elements.

Also the bearing should not be subjected to uneven stress distribution due to the effects of misalignment between the bearing housings, deformation of the shaft or housing.

Speeds Inadequate for Elastohydrodynamic Lubricating Film

International Standard ISO 281 which covers calculation of dynamic load ratings and rating life states that at exceptionally low rotational speeds (i.e. the product of speed and pitch diameter (D_{pw}) in mm is less than 10000) the generated lubricant film is unlikely to be adequate to separate the rolling element/raceway contacts. At such operating conditions it may be inappropriate to calculate the bearing life although practical improvement in life, may be achieved with the use of lubricants of higher kinematic viscosity or containing EP additives.

BEARING TOLERANCES, INCH AND METRIC

TOLERANCES OF NEEDLE ROLLER BEARINGS

The tolerances given in the following table apply to the rings of needle roller radial bearing types whose rings are precision finished.

TOLERANCE TERMS, SYMBOLS AND DEFINITIONS
Axes, planes etc.

Inner ring axis: Axis of the cylinder inscribed in a basically cylindrical bore. The inner ring axis is also the bearing axis.

Outer ring axis: Axis of the cylinder circumscribed around a basically cylindrical outside surface.

Radial plane: Plane perpendicular to the bearing or ring axis. It is, however, acceptable to consider radial planes referred to in the definitions as being parallel with the plane tangential to the reference face of a ring or the back face of a thrust bearing washer.

Radial direction: Direction through the bearing or ring axis in a radial plane.

Axial plane: Plane containing the bearing or ring axis.

Axial direction: Direction parallel with the bearing or ring axis. It is, however, acceptable to consider axial directions referred to in the definitions as being perpendicular to the plane tangential to the reference face of a ring or the back face of a thrust bearing washer.

Reference face: Face designated by the manufacturer of the bearings and that may be used as the reference face in measurements.

The reference face for measurement is generally taken as the unmarked face. In case of symmetrical rings, when it is not possible to identify the reference face, the tolerances are deemed to comply relative to either face, but not to both.

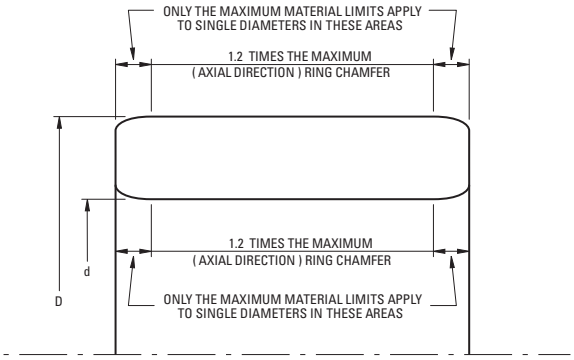
Outer ring flange back face: That side of an outer ring flange that is intended to support axial load.

Middle of raceway: Point or line on a raceway surface halfway between the two edges of the raceway.

Raceway contact diameter: Diameter of the theoretical circle through the nominal points of contact between the rolling elements and the raceway.

NOTE: For roller bearings, the nominal point of contact is generally at the middle of the roller.

Diameter deviation near ring faces: In radial planes, when nearer to the face of a ring than 1.2 times the maximum (axial direction) ring chamfer, only the maximum material limits apply.



ABMA / ISO Symbols - Inner Ring

Δd_{mp} Single plane mean bore diameter deviation from basic bore diameter, e.g., bore tolerance for a basically tapered bore, Δd_{mp} refers only to the theoretical small bore end of the bore.

V_{dsp} Difference between the largest and the smallest of the single bore diameters in a single radial plane.

V_{dmp} Difference between the largest and smallest of the mean bore diameters in a single radial plane of an individual ring.

ABMA / ISO Symbols - Outer Ring

ΔD_{mp} Single plane mean outside diameter deviation from basic outside diameter, e.g., O.D. tolerance.

V_{Dsp} Difference between the largest and smallest of the single outside diameters in a single radial plane.

A

The following tables provide standard ISO tolerance information. They are provided for general use and are referenced throughout this catalog.

ISO Tolerances for Holes – Metric

Diameters **mm**		Deviations **mm**								Deviations **mm**					
		B10		B11		B12		B13		C9		C10		C11	
>	≤	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
3	**6**	**0.188**	**0.140**	**0.215**	**0.140**	**0.260**	**0.140**	**0.320**	**0.140**	**0.100**	**0.070**	**0.118**	**0.070**	**0.145**	**0.070**
6	**10**	**0.208**	**0.150**	**0.240**	**0.150**	**0.300**	**0.150**	**0.370**	**0.150**	**0.116**	**0.080**	**0.138**	**0.080**	**0.170**	**0.080**
10	**18**	**0.220**	**0.150**	**0.260**	**0.150**	**0.330**	**0.150**	**0.420**	**0.150**	**0.138**	**0.095**	**0.165**	**0.095**	**0.205**	**0.095**
18	**30**	**0.244**	**0.160**	**0.290**	**0.160**	**0.370**	**0.160**	**0.490**	**0.160**	**0.162**	**0.110**	**0.194**	**0.110**	**0.240**	**0.110**
30	**40**	**0.270**	**0.170**	**0.330**	**0.170**	**0.420**	**0.170**	**0.560**	**0.170**	**0.182**	**0.120**	**0.220**	**0.120**	**0.280**	**0.120**
40	**50**	**0.280**	**0.180**	**0.340**	**0.180**	**0.430**	**0.180**	**0.570**	**0.180**	**0.192**	**0.130**	**0.230**	**0.130**	**0.290**	**0.130**
50	**65**	**0.310**	**0.190**	**0.380**	**0.190**	**0.490**	**0.190**	**0.650**	**0.190**	**0.214**	**0.140**	**0.260**	**0.140**	**0.330**	**0.140**
65	**80**	**0.320**	**0.200**	**0.390**	**0.200**	**0.500**	**0.200**	**0.660**	**0.200**	**0.224**	**0.150**	**0.270**	**0.150**	**0.340**	**0.150**
80	**100**	**0.360**	**0.220**	**0.440**	**0.220**	**0.570**	**0.220**	**0.760**	**0.220**	**0.257**	**0.170**	**0.310**	**0.170**	**0.390**	**0.170**
100	**120**	**0.380**	**0.240**	**0.460**	**0.240**	**0.590**	**0.240**	**0.780**	**0.240**	**0.267**	**0.180**	**0.320**	**0.180**	**0.400**	**0.180**
120	**140**	**0.420**	**0.260**	**0.510**	**0.260**	**0.660**	**0.260**	**0.890**	**0.260**	**0.300**	**0.200**	**0.360**	**0.200**	**0.450**	**0.200**
140	**160**	**0.440**	**0.280**	**0.530**	**0.280**	**0.680**	**0.280**	**0.910**	**0.280**	**0.310**	**0.210**	**0.370**	**0.210**	**0.460**	**0.210**
160	**180**	**0.470**	**0.310**	**0.560**	**0.310**	**0.710**	**0.310**	**0.940**	**0.310**	**0.330**	**0.230**	**0.390**	**0.230**	**0.480**	**0.230**
180	**200**	**0.525**	**0.340**	**0.630**	**0.340**	**0.800**	**0.340**	**1.060**	**0.340**	**0.355**	**0.240**	**0.425**	**0.240**	**0.530**	**0.240**
200	**225**	**0.565**	**0.380**	**0.670**	**0.380**	**0.840**	**0.380**	**1.100**	**0.380**	**0.375**	**0.260**	**0.445**	**0.260**	**0.550**	**0.260**
225	**250**	**0.605**	**0.420**	**0.710**	**0.420**	**0.880**	**0.420**	**1.140**	**0.420**	**0.395**	**0.280**	**0.465**	**0.280**	**0.570**	**0.280**
250	**280**	**0.690**	**0.480**	**0.800**	**0.480**	**1.000**	**0.480**	**1.290**	**0.480**	**0.430**	**0.300**	**0.510**	**0.300**	**0.620**	**0.300**
280	**315**	**0.750**	**0.540**	**0.860**	**0.540**	**1.060**	**0.540**	**1.350**	**0.540**	**0.460**	**0.330**	**0.540**	**0.330**	**0.650**	**0.330**
315	**355**	**0.830**	**0.600**	**0.960**	**0.600**	**1.170**	**0.600**	**1.490**	**0.600**	**0.500**	**0.360**	**0.590**	**0.360**	**0.720**	**0.360**
355	**400**	**0.910**	**0.680**	**1.040**	**0.680**	**1.250**	**0.680**	**1.570**	**0.680**	**0.540**	**0.400**	**0.630**	**0.400**	**0.760**	**0.400**
400	**450**	**1.010**	**0.760**	**1.160**	**0.760**	**1.390**	**0.760**	**1.730**	**0.760**	**0.595**	**0.440**	**0.690**	**0.440**	**0.840**	**0.440**
450	**500**	**1.090**	**0.840**	**1.240**	**0.840**	**1.470**	**0.840**	**1.810**	**0.840**	**0.635**	**0.480**	**0.730**	**0.480**	**0.880**	**0.480**

Diameters **mm**		Deviations **mm**							
		E9		E10		E11		E12		E13	
>	≤	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
3	**6**	**0.050**	**0.020**	**0.068**	**0.020**	**0.095**	**0.020**	**0.140**	**0.020**	**0.200**	**0.020**
6	**10**	**0.061**	**0.025**	**0.083**	**0.025**	**0.115**	**0.025**	**0.175**	**0.025**	**0.245**	**0.025**
10	**18**	**0.075**	**0.032**	**0.102**	**0.032**	**0.142**	**0.032**	**0.212**	**0.032**	**0.302**	**0.032**
18	**30**	**0.092**	**0.040**	**0.124**	**0.040**	**0.170**	**0.040**	**0.250**	**0.040**	**0.370**	**0.040**
30	**50**	**0.112**	**0.050**	**0.150**	**0.050**	**0.210**	**0.050**	**0.300**	**0.050**	**0.440**	**0.050**
50	**80**	**0.134**	**0.060**	**0.180**	**0.060**	**0.250**	**0.060**	**0.360**	**0.060**	**0.520**	**0.060**
80	**120**	**0.159**	**0.072**	**0.212**	**0.072**	**0.292**	**0.072**	**0.422**	**0.072**	**0.612**	**0.072**
120	**180**	**0.185**	**0.085**	**0.245**	**0.085**	**0.335**	**0.085**	**0.485**	**0.085**	**0.715**	**0.085**
180	**250**	**0.215**	**0.100**	**0.285**	**0.100**	**0.390**	**0.100**	**0.560**	**0.100**	**0.820**	**0.100**
250	**315**	**0.240**	**0.110**	**0.320**	**0.110**	**0.430**	**0.110**	**0.630**	**0.110**	**0.920**	**0.110**
315	**400**	**0.265**	**0.125**	**0.355**	**0.125**	**0.485**	**0.125**	**0.695**	**0.125**	**1.015**	**0.125**
400	**500**	**0.290**	**0.135**	**0.385**	**0.135**	**0.535**	**0.135**	**0.765**	**0.135**	**1.105**	**0.135**

Diameters **mm**		Deviations **mm**							
		F5		F6		F7		F8	
>	≤	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
3	**6**	**0.015**	**0.010**	**0.018**	**0.010**	**0.022**	**0.010**	**0.028**	**0.010**
6	**10**	**0.019**	**0.013**	**0.022**	**0.013**	**0.028**	**0.013**	**0.035**	**0.013**
10	**18**	**0.024**	**0.016**	**0.027**	**0.016**	**0.034**	**0.016**	**0.043**	**0.016**
18	**30**	**0.029**	**0.020**	**0.033**	**0.020**	**0.041**	**0.020**	**0.053**	**0.020**
30	**50**	**0.036**	**0.025**	**0.041**	**0.025**	**0.050**	**0.025**	**0.064**	**0.025**
50	**80**	**0.043**	**0.030**	**0.049**	**0.030**	**0.060**	**0.030**	**0.076**	**0.030**
80	**120**	**0.051**	**0.036**	**0.058**	**0.036**	**0.071**	**0.036**	**0.090**	**0.036**
120	**180**	**0.061**	**0.043**	**0.068**	**0.043**	**0.083**	**0.043**	**0.106**	**0.043**
180	**250**	**0.070**	**0.050**	**0.079**	**0.050**	**0.096**	**0.050**	**0.122**	**0.050**
250	**315**	**0.079**	**0.056**	**0.088**	**0.056**	**0.108**	**0.056**	**0.137**	**0.056**
315	**400**	**0.087**	**0.062**	**0.098**	**0.062**	**0.119**	**0.062**	**0.151**	**0.062**
400	**500**	**0.095**	**0.068**	**0.108**	**0.068**	**0.131**	**0.068**	**0.165**	**0.068**

ISO Tolerances for Holes – Metric								
Diameter **mm**		Deviations **mm**						
		G5		G6		G7		
>	≤	Max.	Min.	Max.	Min.	Max.	Min.	
3	**6**	**0.009**	**0.004**	**0.012**	**0.004**	**0.016**	**0.004**	
6	**10**	**0.011**	**0.005**	**0.014**	**0.005**	**0.020**	**0.005**	
10	**18**	**0.014**	**0.006**	**0.017**	**0.006**	**0.024**	**0.006**	
18	**30**	**0.016**	**0.007**	**0.020**	**0.007**	**0.028**	**0.007**	
30	**50**	**0.020**	**0.009**	**0.025**	**0.009**	**0.034**	**0.009**	
50	**80**	**0.023**	**0.010**	**0.029**	**0.010**	**0.040**	**0.010**	
80	**120**	**0.027**	**0.012**	**0.034**	**0.012**	**0.047**	**0.012**	
120	**180**	**0.032**	**0.014**	**0.039**	**0.014**	**0.054**	**0.014**	
180	**250**	**0.035**	**0.015**	**0.044**	**0.015**	**0.061**	**0.015**	
250	**315**	**0.040**	**0.017**	**0.049**	**0.017**	**0.069**	**0.017**	
315	**400**	**0.043**	**0.018**	**0.054**	**0.018**	**0.075**	**0.018**	
400	**500**	**0.047**	**0.020**	**0.060**	**0.020**	**0.083**	**0.020**	

Diameters **mm**		Deviations **mm**									
		H4		H5		H6		H7		H8	
>	≤	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
3	**6**	**0.004**	**0.000**	**0.005**	**0.000**	**0.008**	**0.000**	**0.012**	**0.000**	**0.018**	**0.000**
6	**10**	**0.004**	**0.000**	**0.006**	**0.000**	**0.009**	**0.000**	**0.015**	**0.000**	**0.022**	**0.000**
10	**18**	**0.005**	**0.000**	**0.008**	**0.000**	**0.011**	**0.000**	**0.018**	**0.000**	**0.027**	**0.000**
18	**30**	**0.006**	**0.000**	**0.009**	**0.000**	**0.013**	**0.000**	**0.021**	**0.000**	**0.033**	**0.000**
30	**50**	**0.007**	**0.000**	**0.011**	**0.000**	**0.016**	**0.000**	**0.025**	**0.000**	**0.039**	**0.000**
50	**80**	**0.008**	**0.000**	**0.013**	**0.000**	**0.019**	**0.000**	**0.030**	**0.000**	**0.046**	**0.000**
80	**120**	**0.010**	**0.000**	**0.015**	**0.000**	**0.022**	**0.000**	**0.035**	**0.000**	**0.054**	**0.000**
120	**180**	**0.012**	**0.000**	**0.018**	**0.000**	**0.025**	**0.000**	**0.040**	**0.000**	**0.063**	**0.000**
180	**250**	**0.014**	**0.000**	**0.020**	**0.000**	**0.029**	**0.000**	**0.046**	**0.000**	**0.072**	**0.000**
250	**315**	**0.016**	**0.000**	**0.023**	**0.000**	**0.032**	**0.000**	**0.052**	**0.000**	**0.081**	**0.000**
315	**400**	**0.018**	**0.000**	**0.025**	**0.000**	**0.036**	**0.000**	**0.057**	**0.000**	**0.089**	**0.000**
400	**500**	**0.020**	**0.000**	**0.027**	**0.000**	**0.040**	**0.000**	**0.063**	**0.000**	**0.097**	**0.000**

Diameters **mm**		Deviations **mm**							
		H9		H10		H11		H12	
>	≤	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
3	**6**	**0.030**	**0.000**	**0.048**	**0.000**	**0.075**	**0.000**	**0.120**	**0.000**
6	**10**	**0.036**	**0.000**	**0.058**	**0.000**	**0.090**	**0.000**	**0.150**	**0.000**
10	**18**	**0.043**	**0.000**	**0.070**	**0.000**	**0.110**	**0.000**	**0.180**	**0.000**
18	**30**	**0.052**	**0.000**	**0.084**	**0.000**	**0.130**	**0.000**	**0.210**	**0.000**
30	**50**	**0.062**	**0.000**	**0.100**	**0.000**	**0.160**	**0.000**	**0.250**	**0.000**
50	**80**	**0.074**	**0.000**	**0.120**	**0.000**	**0.190**	**0.000**	**0.300**	**0.000**
80	**120**	**0.087**	**0.000**	**0.140**	**0.000**	**0.220**	**0.000**	**0.350**	**0.000**
120	**180**	**0.100**	**0.000**	**0.160**	**0.000**	**0.250**	**0.000**	**0.400**	**0.000**
180	**250**	**0.115**	**0.000**	**0.185**	**0.000**	**0.290**	**0.000**	**0.460**	**0.000**
250	**315**	**0.130**	**0.000**	**0.210**	**0.000**	**0.320**	**0.000**	**0.520**	**0.000**
315	**400**	**0.140**	**0.000**	**0.230**	**0.000**	**0.360**	**0.000**	**0.570**	**0.000**
400	**500**	**0.155**	**0.000**	**0.250**	**0.000**	**0.400**	**0.000**	**0.630**	**0.000**

ISO Tolerances for Holes – Metric

Diameters mm		Deviations mm						Deviations mm					
		J6		J7		J8		K6		K7		K8	
>	≤	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
3	6	0.005	-0.003	0.006	-0.006	0.010	-0.008	0.002	-0.006	0.003	-0.009	0.005	-0.013
6	10	0.005	-0.004	0.008	-0.007	0.012	-0.010	0.002	-0.007	0.005	-0.010	0.006	-0.016
10	18	0.006	-0.005	0.010	-0.008	0.015	-0.012	0.002	-0.009	0.006	-0.012	0.008	-0.019
18	30	0.008	-0.005	0.012	-0.009	0.020	-0.013	0.002	-0.011	0.006	-0.015	0.010	-0.023
30	50	0.010	-0.006	0.014	-0.011	0.024	-0.015	0.003	-0.013	0.007	-0.018	0.012	-0.027
50	80	0.013	-0.006	0.018	-0.012	0.028	-0.018	0.004	-0.015	0.009	-0.021	0.014	-0.032
80	120	0.016	-0.006	0.022	-0.013	0.034	-0.020	0.004	-0.018	0.010	-0.025	0.016	-0.038
120	180	0.018	-0.007	0.026	-0.014	0.041	-0.022	0.004	-0.021	0.012	-0.028	0.020	-0.043
180	250	0.022	-0.007	0.030	-0.016	0.047	-0.025	0.005	-0.024	0.013	-0.033	0.022	-0.050
250	315	0.025	-0.007	0.036	-0.016	0.055	-0.026	0.005	-0.027	0.016	-0.036	0.025	-0.056
315	400	0.029	-0.007	0.039	-0.018	0.060	-0.029	0.007	-0.029	0.017	-0.040	0.028	-0.061
400	500	0.033	-0.007	0.043	-0.020	0.066	-0.031	0.008	-0.032	0.018	-0.045	0.029	-0.068

Diameters mm		Deviations mm						Deviations mm					
		M5		M6		M7		N6		N7		N8	
>	≤	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
3	6	-0.003	-0.008	-0.001	-0.009	0.000	-0.012	-0.005	-0.013	-0.004	-0.016	-0.002	-0.020
6	10	-0.004	-0.010	-0.003	-0.012	0.000	-0.015	-0.007	-0.016	-0.004	-0.019	-0.003	-0.025
10	18	-0.004	-0.012	-0.004	-0.015	0.000	-0.018	-0.009	-0.020	-0.005	-0.023	-0.003	-0.030
18	30	-0.005	-0.014	-0.004	-0.017	0.000	-0.021	-0.011	-0.024	-0.007	-0.028	-0.003	-0.036
30	50	-0.005	-0.016	-0.004	-0.020	0.000	-0.025	-0.012	-0.028	-0.008	-0.033	-0.003	-0.042
50	80	-0.006	-0.019	-0.005	-0.024	0.000	-0.030	-0.014	-0.033	-0.009	-0.039	-0.004	-0.050
80	120	-0.008	-0.023	-0.006	-0.028	0.000	-0.035	-0.016	-0.038	-0.010	-0.045	-0.004	-0.058
120	180	-0.009	-0.027	-0.008	-0.033	0.000	-0.040	-0.020	-0.045	-0.012	-0.052	-0.004	-0.067
180	250	-0.011	-0.031	-0.008	-0.037	0.000	-0.046	-0.022	-0.051	-0.014	-0.060	-0.005	-0.077
250	315	-0.013	-0.036	-0.009	-0.041	0.000	-0.052	-0.025	-0.057	-0.014	-0.066	-0.005	-0.086
315	400	-0.014	-0.039	-0.010	-0.046	0.000	-0.057	-0.026	-0.062	-0.016	-0.073	-0.005	-0.094
400	500	-0.016	-0.043	-0.010	-0.050	0.000	-0.063	-0.027	-0.067	-0.017	-0.080	-0.006	-0.103

Diameters mm		Deviations mm				Deviations mm					
		P6		P7		R6		R7		R8	
>	≤	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
3	6	-0.009	-0.017	-0.008	-0.020	-0.012	-0.020	-0.011	-0.023	-0.015	-0.033
6	10	-0.012	-0.021	-0.009	-0.024	-0.016	-0.025	-0.013	-0.028	-0.019	-0.041
10	18	-0.015	-0.026	-0.011	-0.029	-0.020	-0.031	-0.016	-0.034	-0.023	-0.050
18	30	-0.018	-0.031	-0.014	-0.035	-0.024	-0.037	-0.020	-0.041	-0.028	-0.061
30	50	-0.021	-0.037	-0.017	-0.042	-0.029	-0.045	-0.025	-0.050	-0.034	-0.073
50	65	-0.026	-0.045	-0.021	-0.051	-0.035	-0.054	-0.030	-0.060	-0.041	-0.087
65	80	-0.026	-0.045	-0.021	-0.051	-0.037	-0.056	-0.032	-0.062	-0.043	-0.089
80	100	-0.030	-0.052	-0.024	-0.059	-0.044	-0.066	-0.038	-0.073	-0.051	-0.105
100	120	-0.030	-0.052	-0.024	-0.059	-0.047	-0.069	-0.041	-0.076	-0.054	-0.108
120	140	-0.037	-0.061	-0.028	-0.068	-0.056	-0.081	-0.048	-0.088	-0.063	-0.126
140	160	-0.036	-0.061	-0.028	-0.068	-0.058	-0.083	-0.050	-0.090	-0.065	-0.128
160	180	-0.036	-0.061	-0.028	-0.068	-0.061	-0.086	-0.053	-0.093	-0.068	-0.131
180	200	-0.041	-0.070	-0.033	-0.079	-0.068	-0.097	-0.060	-0.106	-0.077	-0.149
200	225	-0.041	-0.070	-0.033	-0.079	-0.071	-0.100	-0.063	-0.109	-0.080	-0.152
225	250	-0.041	-0.070	-0.033	-0.079	-0.075	-0.104	-0.067	-0.113	-0.084	-0.156
250	280	-0.047	-0.079	-0.036	-0.088	-0.085	-0.117	-0.074	-0.126	-0.094	-0.175
280	315	-0.047	-0.079	-0.036	-0.088	-0.089	-0.121	-0.078	-0.130	-0.098	-0.179
315	355	-0.051	-0.087	-0.041	-0.098	-0.097	-0.133	-0.087	-0.144	-0.108	-0.197
355	400	-0.051	-0.087	-0.041	-0.098	-0.103	-0.139	-0.093	-0.150	-0.114	-0.203
400	450	-0.055	-0.095	-0.045	-0.108	-0.113	-0.153	-0.103	-0.166	-0.126	-0.223
450	500	-0.055	-0.095	-0.045	-0.108	-0.119	-0.159	-0.109	-0.172	-0.132	-0.229

ISO Tolerances for Shafts – Metric									
Diameters **mm**		Deviations **mm**							
		a10		a11		a12		a13	
>	≤	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
—	3	-0.270	-0.310	-0.270	-0.330	-0.270	-0.370	-0.270	-0.410
3	6	-0.270	-0.318	-0.270	-0.345	-0.270	-0.390	-0.270	-0.450
6	10	-0.280	-0.338	-0.280	-0.370	-0.280	-0.430	-0.280	-0.500
10	18	-0.290	-0.360	-0.290	-0.400	-0.290	-0.470	-0.290	-0.560
18	30	-0.300	-0.384	-0.300	-0.430	-0.300	-0.510	-0.300	-0.630
30	40	-0.310	-0.410	-0.310	-0.470	-0.310	-0.560	-0.310	-0.700
40	50	-0.320	-0.420	-0.320	-0.480	-0.320	-0.570	-0.320	-0.710
50	65	-0.340	-0.460	-0.340	-0.530	-0.340	-0.640	-0.340	-0.800
65	80	-0.360	-0.480	-0.360	-0.550	-0.360	-0.660	-0.360	-0.820
80	100	-0.380	-0.520	-0.380	-0.600	-0.380	-0.730	-0.380	-0.920
100	120	-0.410	-0.550	-0.410	-0.630	-0.410	-0.760	-0.410	-0.950
120	140	-0.460	-0.620	-0.460	-0.710	-0.460	-0.860	-0.460	-1.090
140	160	-0.520	-0.680	-0.520	-0.770	-0.520	-0.920	-0.520	-1.150
160	180	-0.580	-0.740	-0.580	-0.830	-0.580	-0.980	-0.580	-1.210
180	200	-0.660	-0.845	-0.660	-0.950	-0.660	-1.120	-0.660	-1.380
200	225	-0.740	-0.925	-0.740	-1.030	-0.740	-1.200	-0.740	-1.460
225	250	-0.820	-1.005	-0.820	-1.110	-0.820	-1.280	-0.820	-1.540
250	280	-0.920	-1.130	-0.920	-1.240	-0.920	-1.440	-0.920	-1.730
280	315	-1.050	-1.260	-1.050	-1.370	-1.050	-1.570	-1.050	-1.860
315	355	-1.200	-1.430	-1.200	-1.560	-1.200	-1.770	-1.200	-2.090
355	400	-1.350	-1.580	-1.350	-1.710	-1.350	-1.920	-1.350	-2.240

Diameters **mm**		Deviations **mm**						Deviations **mm**					
		c11		c12		c13		e11		e12		e13	
>	≤	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
—	3	-0.060	-0.120	-0.060	-0.160	-0.060	-0.200	-0.014	-0.074	-0.014	-0.114	-0.014	-0.154
3	6	-0.070	-0.145	-0.070	-0.190	-0.070	-0.250	-0.020	-0.095	-0.020	-0.140	-0.020	-0.200
6	10	-0.080	-0.170	-0.080	-0.230	-0.080	-0.300	-0.025	-0.115	-0.025	-0.175	-0.025	-0.245
10	18	-0.095	-0.205	-0.095	-0.275	-0.095	-0.365	-0.032	-0.142	-0.032	-0.212	-0.032	-0.302
18	30	-0.110	-0.240	-0.110	-0.320	-0.110	-0.440	-0.040	-0.170	-0.040	-0.250	-0.040	-0.370
30	40	-0.120	-0.280	-0.120	-0.370	-0.120	-0.510	-0.050	-0.210	-0.050	-0.300	-0.050	-0.440
40	50	-0.130	-0.290	-0.130	-0.380	-0.130	-0.520	-0.050	-0.210	-0.050	-0.300	-0.050	-0.440
50	65	-0.140	-0.330	-0.140	-0.440	-0.140	-0.600	-0.060	-0.250	-0.060	-0.360	-0.060	-0.520
65	80	-0.150	-0.340	-0.150	-0.450	-0.150	-0.610	-0.060	-0.250	-0.060	-0.360	-0.060	-0.520
80	100	-0.170	-0.390	-0.170	-0.520	-0.170	-0.710	-0.072	-0.292	-0.072	-0.422	-0.072	-0.612
100	120	-0.180	-0.400	-0.180	-0.530	-0.180	-0.720	-0.072	-0.292	-0.072	-0.422	-0.072	-0.612
120	140	-0.200	-0.450	-0.200	-0.600	-0.200	-0.830	-0.085	-0.335	-0.085	-0.485	-0.085	-0.715
140	160	-0.210	-0.460	-0.210	-0.610	-0.210	-0.840	-0.085	-0.335	-0.085	-0.485	-0.085	-0.715
160	180	-0.230	-0.480	-0.230	-0.630	-0.230	-0.860	-0.085	-0.335	-0.085	-0.485	-0.085	-0.715
180	200	-0.240	-0.530	-0.240	-0.700	-0.240	-0.960	-0.100	-0.390	-0.100	-0.560	-0.100	-0.820
200	225	-0.260	-0.550	-0.260	-0.720	-0.260	-0.980	-0.100	-0.390	-0.100	-0.560	-0.100	-0.820
225	250	-0.280	-0.570	-0.280	-0.740	-0.280	-1.000	-0.100	-0.390	-0.100	-0.560	-0.100	-0.820
250	280	-0.300	-0.620	-0.300	-0.820	-0.300	-1.110	-0.110	-0.430	-0.110	-0.630	-0.110	-0.920
280	315	-0.330	-0.650	-0.330	-0.850	-0.330	-1.140	-0.110	-0.430	-0.110	-0.630	-0.110	-0.920
315	355	-0.360	-0.720	-0.360	-0.930	-0.360	-1.250	-0.125	-0.485	-0.125	-0.695	-0.125	-1.015
355	400	-0.400	-0.760	-0.400	-0.970	-0.400	-1.290	-0.125	-0.485	-0.125	-0.695	-0.125	-1.015

A

ISO Tolerances for Shafts – Metric

Diameters **mm**		Deviations **mm**						Deviations **mm**					
		f5		f6		f7		g5		g6		g7	
>	≤	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
—	3	-0.006	-0.010	-0.006	-0.012	-0.006	-0.016	-0.002	-0.006	-0.002	-0.008	-0.002	-0.012
3	6	-0.010	-0.015	-0.010	-0.018	-0.010	-0.022	-0.004	-0.009	-0.004	-0.012	-0.004	-0.016
6	10	-0.013	-0.019	-0.013	-0.022	-0.013	-0.028	-0.005	-0.011	-0.005	-0.014	-0.005	-0.020
10	18	-0.016	-0.024	-0.016	-0.027	-0.016	-0.034	-0.006	-0.014	-0.006	-0.017	-0.006	-0.024
18	30	-0.020	-0.029	-0.020	-0.033	-0.020	-0.041	-0.007	-0.016	-0.007	-0.020	-0.007	-0.028
30	50	-0.025	-0.036	-0.025	-0.041	-0.025	-0.050	-0.009	-0.020	-0.009	-0.025	-0.009	-0.034
50	80	-0.030	-0.043	-0.030	-0.049	-0.030	-0.060	-0.010	-0.023	-0.010	-0.029	-0.010	-0.040
80	120	-0.036	-0.051	-0.036	-0.058	-0.036	-0.071	-0.012	-0.027	-0.012	-0.034	-0.012	-0.047
120	180	-0.043	-0.061	-0.043	-0.068	-0.043	-0.083	-0.014	-0.032	-0.014	-0.039	-0.014	-0.054
180	250	-0.050	-0.070	-0.050	-0.079	-0.050	-0.096	-0.015	-0.035	-0.015	-0.044	-0.015	-0.061
250	315	-0.056	-0.079	-0.056	-0.088	-0.056	-0.108	-0.017	-0.040	-0.017	-0.049	-0.017	-0.069
315	400	-0.062	-0.087	-0.062	-0.098	-0.062	-0.119	-0.018	-0.043	-0.018	-0.054	-0.018	-0.075

Diameters **mm**		Deviations **mm**									
		h4		h5		h6		h7		h8	
>	≤	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
—	3	0.000	-0.003	0.000	-0.004	0.000	-0.006	0.000	-0.010	0.000	-0.014
3	6	0.000	-0.004	0.000	-0.005	0.000	-0.008	0.000	-0.012	0.000	-0.018
6	10	0.000	-0.004	0.000	-0.006	0.000	-0.009	0.000	-0.015	0.000	-0.022
10	18	0.000	-0.005	0.000	-0.008	0.000	-0.011	0.000	-0.018	0.000	-0.027
18	30	0.000	-0.006	0.000	-0.009	0.000	-0.013	0.000	-0.021	0.000	-0.033
30	50	0.000	-0.007	0.000	-0.011	0.000	-0.016	0.000	-0.025	0.000	-0.039
50	80	0.000	-0.008	0.000	-0.013	0.000	-0.019	0.000	-0.030	0.000	-0.046
80	120	0.000	-0.010	0.000	-0.015	0.000	-0.022	0.000	-0.035	0.000	-0.054
120	180	0.000	-0.012	0.000	-0.018	0.000	-0.025	0.000	-0.040	0.000	-0.063
180	250	0.000	-0.014	0.000	-0.020	0.000	-0.029	0.000	-0.046	0.000	-0.072
250	315	0.000	-0.016	0.000	-0.023	0.000	-0.032	0.000	-0.052	0.000	-0.081
315	400	0.000	-0.018	0.000	-0.025	0.000	-0.036	0.000	-0.057	0.000	-0.089

Diameters **mm**		Deviations **mm**									
		h9		h10		h11		h12		h13	
>	≤	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
—	3	0.000	-0.025	0.000	-0.040	0.000	-0.060	0.000	-0.100	0.000	-0.140
3	6	0.000	-0.030	0.000	-0.048	0.000	-0.075	0.000	-0.120	0.000	-0.180
6	10	0.000	-0.036	0.000	-0.058	0.000	-0.090	0.000	-0.150	0.000	-0.220
10	18	0.000	-0.043	0.000	-0.070	0.000	-0.110	0.000	-0.180	0.000	-0.270
18	30	0.000	-0.052	0.000	-0.084	0.000	-0.130	0.000	-0.210	0.000	-0.330
30	50	0.000	-0.062	0.000	-0.100	0.000	-0.160	0.000	-0.250	0.000	-0.390
50	80	0.000	-0.074	0.000	-0.120	0.000	-0.190	0.000	-0.300	0.000	-0.460
80	120	0.000	-0.087	0.000	-0.140	0.000	-0.220	0.000	-0.350	0.000	-0.540
120	180	0.000	-0.100	0.000	-0.160	0.000	-0.250	0.000	-0.400	0.000	-0.630
180	250	0.000	-0.115	0.000	-0.185	0.000	-0.290	0.000	-0.460	0.000	-0.720
250	315	0.000	-0.130	0.000	-0.210	0.000	-0.320	0.000	-0.520	0.000	-0.810
315	400	0.000	-0.140	0.000	-0.230	0.000	-0.360	0.000	-0.570	0.000	-0.890

ISO Tolerances for Shafts – Metric

Diameter **mm**		Deviations **mm**						Deviations **mm**					
		j5		j6		j7		k5		k6		k7	
>	≤	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
—	3	0.002	-0.002	0.004	-0.002	0.006	-0.004	0.004	0.000	0.006	0.000	0.010	0.000
3	6	0.003	-0.002	0.006	-0.002	0.008	-0.004	0.006	0.001	0.009	0.001	0.013	0.001
6	10	0.004	-0.002	0.007	-0.002	0.010	-0.005	0.007	0.001	0.010	0.001	0.016	0.001
10	18	0.005	-0.003	0.008	-0.003	0.012	-0.006	0.009	0.001	0.012	0.001	0.019	0.001
18	30	0.005	-0.004	0.009	-0.004	0.013	-0.008	0.011	0.002	0.015	0.002	0.023	0.002
30	50	0.006	-0.005	0.011	-0.005	0.015	-0.010	0.013	0.002	0.018	0.002	0.027	0.002
50	80	0.006	-0.007	0.012	-0.007	0.018	-0.012	0.015	0.002	0.021	0.002	0.032	0.002
80	120	0.006	-0.009	0.013	-0.009	0.020	-0.015	0.018	0.003	0.025	0.003	0.038	0.003
120	180	0.007	-0.011	0.014	-0.011	0.022	-0.018	0.021	0.003	0.028	0.003	0.043	0.003
180	250	0.007	-0.013	0.016	-0.013	0.025	-0.021	0.024	0.004	0.033	0.004	0.050	0.004
250	315	0.007	-0.016	0.016	-0.016	0.026	-0.026	0.027	0.004	0.036	0.004	0.056	0.004
315	400	0.007	-0.018	0.018	-0.018	0.029	-0.028	0.029	0.004	0.040	0.004	0.061	0.004

Diameter **mm**		Deviations **mm**						Deviations **mm**					
		m5		m6		m7		n5		n6		n7	
>	≤	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
—	3	0.006	0.002	0.008	0.002	0.012	0.002	0.008	0.004	0.010	0.004	0.014	0.004
3	6	0.009	0.004	0.012	0.004	0.016	0.004	0.013	0.008	0.016	0.008	0.020	0.008
6	10	0.012	0.006	0.015	0.006	0.021	0.006	0.016	0.010	0.019	0.010	0.025	0.010
10	18	0.015	0.007	0.018	0.007	0.025	0.007	0.020	0.012	0.023	0.012	0.030	0.012
18	30	0.017	0.008	0.021	0.008	0.029	0.008	0.024	0.015	0.028	0.015	0.036	0.015
30	50	0.020	0.009	0.025	0.009	0.034	0.009	0.028	0.017	0.033	0.017	0.042	0.017
50	80	0.024	0.011	0.030	0.011	0.041	0.011	0.033	0.020	0.039	0.020	0.050	0.020
80	120	0.028	0.013	0.035	0.013	0.048	0.013	0.038	0.023	0.045	0.023	0.058	0.023
120	180	0.033	0.015	0.040	0.015	0.055	0.015	0.045	0.027	0.052	0.027	0.067	0.027
180	250	0.037	0.017	0.046	0.017	0.063	0.017	0.051	0.031	0.060	0.031	0.077	0.031
250	315	0.043	0.020	0.052	0.020	0.072	0.020	0.057	0.034	0.066	0.034	0.086	0.034
315	400	0.046	0.021	0.057	0.021	0.078	0.021	0.062	0.037	0.073	0.037	0.094	0.037

Diameter **mm**		Deviations **mm**					
		p6		r6		r7	
>	≤	Max.	Min.	Max.	Min.	Max.	Min.
80	100	0.059	0.037	-	-	-	-
100	120	0.059	0.037	-	-	-	-
120	140	0.068	0.043	0.090	0.065	-	-
140	160	0.068	0.043	0.090	0.065	-	-
160	180	0.068	0.043	0.090	0.065	-	-
180	200	0.079	0.050	0.106	0.077	-	-
200	225	0.079	0.050	0.109	0.080	0.126	0.080
225	250	0.079	0.050	0.113	0.084	0.130	0.084
250	280	0.088	0.056	0.126	0.094	0.146	0.094
280	315	0.088	0.056	0.130	0.098	0.150	0.098
315	355	0.098	0.062	0.144	0.108	0.165	0.108
355	400	0.098	0.062	0.150	0.114	0.171	0.114
400	450	0.108	0.068	0.166	0.126	0.189	0.126
450	500	0.108	0.068	0.172	0.132	0.195	0.132

A

ISO Tolerances for Holes – inch

Diameter **in**		Deviations **in**											
		B10		B11		B12		C9		C10		C11	
>	≤	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
0.1181	0.2362	+0.0074	+0.0055	+0.0085	+0.0055	+0.0102	+0.0055	+0.0039	+0.0028	+0.0046	+0.0028	+0.0057	+0.0028
0.2362	0.3937	+0.0082	+0.0059	+0.0094	+0.0059	+0.0118	+0.0059	+0.0046	+0.0031	+0.0054	+0.0031	+0.0067	+0.0031
0.3937	0.7087	+0.0087	+0.0059	+0.0102	+0.0059	+0.0130	+0.0059	+0.0054	+0.0037	+0.0065	+0.0037	+0.0081	+0.0037
0.7087	1.1811	+0.0096	+0.0063	+0.0114	+0.0063	+0.0146	+0.0063	+0.0064	+0.0043	+0.0076	+0.0043	+0.0094	+0.0043
1.1811	1.5748	+0.0106	+0.0067	+0.0130	+0.0067	+0.0165	+0.0067	+0.0072	+0.0047	+0.0087	+0.0047	+0.0110	+0.0047
1.5748	1.9685	+0.0110	+0.0071	+0.0134	+0.0071	+0.0169	+0.0071	+0.0076	+0.0051	+0.0091	+0.0051	+0.0114	+0.0051
1.9685	2.5591	+0.0122	+0.0075	+0.0150	+0.0075	+0.0193	+0.0075	+0.0084	+0.0055	+0.0102	+0.0055	+0.0120	+0.0055
2.5591	3.1496	+0.0126	+0.0079	+0.0154	+0.0079	+0.0197	+0.0079	+0.0088	+0.0059	+0.0106	+0.0059	+0.0134	+0.0059
3.1496	3.9370	+0.0142	+0.0087	+0.0173	+0.0087	+0.0224	+0.0087	+0.0101	+0.0067	+0.0122	+0.0067	+0.0154	+0.0067
3.9370	4.7244	+0.0150	+0.0094	+0.0181	+0.0094	+0.0232	+0.0094	+0.0105	+0.0071	+0.0126	+0.0071	+0.0157	+0.0071
4.7244	5.5118	+0.0165	+0.0102	+0.0201	+0.0102	+0.0260	+0.0102	+0.0118	+0.0079	+0.0142	+0.0079	+0.0177	+0.0079
5.5118	6.2992	+0.0173	+0.0110	+0.0209	+0.0110	+0.0268	+0.0110	+0.0122	+0.0083	+0.0146	+0.0083	+0.0181	+0.0083
6.2992	7.0866	+0.0185	+0.0122	+0.0220	+0.0122	+0.0280	+0.0122	+0.0130	+0.0091	+0.0154	+0.0091	+0.0189	+0.0091
7.0866	7.8740	+0.0207	+0.0134	+0.0248	+0.0134	+0.0315	+0.0134	+0.0140	+0.0094	+0.0167	+0.0094	+0.0209	+0.0094
7.8740	8.8583	+0.0222	+0.0150	+0.0264	+0.0150	+0.0331	+0.0150	+0.0148	+0.0102	+0.0175	+0.0102	+0.0217	+0.0102
8.8583	9.8425	+0.0238	+0.0165	+0.0280	+0.0165	+0.0346	+0.0165	+0.0156	+0.0110	+0.0183	+0.0110	+0.0224	+0.0110
9.8425	11.0236	+0.0272	+0.0189	+0.0315	+0.0189	+0.0394	+0.0189	+0.0169	+0.0118	+0.0201	+0.0118	+0.0244	+0.0118
11.0236	12.4016	+0.0295	+0.0213	+0.0339	+0.0213	+0.0417	+0.0213	+0.0181	+0.0130	+0.0213	+0.0130	+0.0256	+0.0130
12.4016	13.9764	+0.0327	+0.0236	+0.0378	+0.0236	+0.0461	+0.0236	+0.0197	+0.0142	+0.0232	+0.0142	+0.0283	+0.0142
13.9764	15.7480	+0.0358	+0.0268	+0.0409	+0.0268	+0.0492	+0.0268	+0.0213	+0.0157	+0.0248	+0.0157	+0.0299	+0.0157
15.7480	17.7165	+0.0398	+0.0299	+0.0457	+0.0299	+0.0547	+0.0299	+0.0234	+0.0173	+0.0272	+0.0173	+0.0331	+0.0173
17.71654	19.6850	+0.0429	+0.0331	+0.0488	+0.0331	+0.0579	+0.0331	+0.0250	+0.0189	+0.0287	+0.0189	+0.0346	+0.0189

Diameter **in**		Deviations **in**									
		E9		E10		E11		E12		E13	
>	≤	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
0.1181	0.2362	+0.0020	+0.0008	+0.0027	+0.0008	+0.0037	+0.0008	+0.0055	+0.0008	+0.0079	+0.0008
0.2362	0.3937	+0.0024	+0.0010	+0.0033	+0.0010	+0.0045	+0.0010	+0.0069	+0.0010	+0.0096	+0.0010
0.3937	0.7087	+0.0030	+0.0013	+0.0040	+0.0013	+0.0056	+0.0013	+0.0083	+0.0013	+0.0119	+0.0013
0.7087	1.1811	+0.0036	+0.0016	+0.0049	+0.0016	+0.0067	+0.0016	+0.0098	+0.0016	+0.0146	+0.0016
1.1811	1.9685	+0.0044	+0.0020	+0.0059	+0.0020	+0.0083	+0.0020	+0.0118	+0.0020	+0.0173	+0.0020
1.9685	3.1496	+0.0053	+0.0024	+0.0071	+0.0024	+0.0098	+0.0024	+0.0142	+0.0024	+0.0205	+0.0024
3.1496	4.7244	+0.0063	+0.0028	+0.0083	+0.0028	+0.0115	+0.0028	+0.0166	+0.0028	+0.0241	+0.0028
4.7244	7.0866	+0.0073	+0.0033	+0.0096	+0.0033	+0.0132	+0.0033	+0.0191	+0.0033	+0.0281	+0.0033
7.0866	9.8425	+0.0085	+0.0039	+0.0112	+0.0039	+0.0154	+0.0039	+0.0220	+0.0039	+0.0323	+0.0039
9.8425	12.4016	+0.0094	+0.0043	+0.0126	+0.0043	+0.0169	+0.0043	+0.0248	+0.0043	+0.0362	+0.0043
12.4016	15.7480	+0.0104	+0.0049	+0.0140	+0.0049	+0.0191	+0.0049	+0.0274	+0.0049	+0.0400	+0.0049
15.7480	19.6850	+0.0114	+0.0053	+0.0152	+0.0053	+0.0211	+0.0053	+0.0301	+0.0053	+0.0435	+0.0053

Diameter **in**		Deviations **in**							
		F5		F6		F7		F8	
>	≤	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
0.1181	0.2362	+0.0006	+0.0004	+0.0007	+0.0004	+0.0009	+0.0004	+0.0011	+0.0004
0.2362	0.3937	+0.0007	+0.0005	+0.0009	+0.0005	+0.0011	+0.0005	+0.0014	+0.0005
0.3937	0.7087	+0.0009	+0.0006	+0.0011	+0.0006	+0.0013	+0.0006	+0.0017	+0.0006
0.7087	1.1811	+0.0011	+0.0008	+0.0013	+0.0008	+0.0016	+0.0008	+0.0021	+0.0008
1.1811	1.9685	+0.0014	+0.0010	+0.0016	+0.0010	+0.0020	+0.0010	+0.0025	+0.0010
1.9685	3.1496	+0.0017	+0.0012	+0.0019	+0.0012	+0.0024	+0.0012	+0.0030	+0.0012
3.1496	4.7244	+0.0020	+0.0014	+0.0023	+0.0014	+0.0028	+0.0014	+0.0035	+0.0014
4.7244	7.0866	+0.0024	+0.0017	+0.0027	+0.0017	+0.0033	+0.0017	+0.0042	+0.0017
7.0866	9.8425	+0.0028	+0.0020	+0.0031	+0.0020	+0.0038	+0.0020	+0.0048	+0.0020
9.8425	12.4016	+0.0031	+0.0022	+0.0035	+0.0022	+0.0043	+0.0022	+0.0054	+0.0022
12.4016	15.7480	+0.0034	+0.0024	+0.0039	+0.0024	+0.0047	+0.0024	+0.0059	+0.0024
15.7480	19.6850	+0.0037	+0.0027	+0.0043	+0.0027	+0.0052	+0.0027	+0.0065	+0.0027

ISO Tolerances for Holes – inch							
Diameter **in**		Deviations **in**					
		G5		G6		G7	
>	≤	Max.	Min.	Max.	Min.	Max.	Min.
0.1181	0.2362	+0.0004	+0.0002	+0.0005	+0.0002	+0.0006	+0.0002
0.2362	0.3937	+0.0004	+0.0002	+0.0006	+0.0002	+0.0008	+0.0002
0.3937	0.7087	+0.0006	+0.0002	+0.0007	+0.0002	+0.0009	+0.0002
0.7087	1.1811	+0.0006	+0.0003	+0.0008	+0.0003	+0.0011	+0.0003
1.1811	1.9685	+0.0008	+0.0004	+0.0010	+0.0004	+0.0013	+0.0004
1.9685	3.1496	+0.0009	+0.0004	+0.0011	+0.0004	+0.0016	+0.0004
3.1496	4.7244	+0.0011	+0.0005	+0.0013	+0.0005	+0.0019	+0.0005
4.7244	7.0866	+0.0013	+0.0006	+0.0015	+0.0006	+0.0021	+0.0006
7.0866	9.8425	+0.0014	+0.0006	+0.0017	+0.0006	+0.0024	+0.0006
9.8425	12.4016	+0.0016	+0.0007	+0.0019	+0.0007	+0.0027	+0.0007
12.4016	15.7480	+0.0017	+0.0007	+0.0021	+0.0007	+0.0030	+0.0007
15.7480	19.6850	+0.0019	+0.0008	+0.0024	+0.0008	+0.0033	+0.0008

Diameter **in**		Deviations **in**									
		H4		H5		H6		H7		H8	
>	≤	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
0.1181	0.2362	+0.0002	0	+0.0002	0	+0.0003	0	+0.0005	0	+0.0007	0
0.2362	0.3937	+0.0002	0	+0.0002	0	+0.0004	0	+0.0006	0	+0.0009	0
0.3937	0.7087	+0.0002	0	+0.0003	0	+0.0004	0	+0.0007	0	+0.0011	0
0.7087	1.1811	+0.0002	0	+0.0004	0	+0.0005	0	+0.0008	0	+0.0013	0
1.1811	1.9685	+0.0003	0	+0.0004	0	+0.0006	0	+0.0010	0	+0.0015	0
1.9685	3.1496	+0.0003	0	+0.0005	0	+0.0007	0	+0.0012	0	+0.0018	0
3.1496	4.7244	+0.0004	0	+0.0006	0	+0.0009	0	+0.0014	0	+0.0021	0
4.7244	7.0866	+0.0005	0	+0.0007	0	+0.0010	0	+0.0016	0	+0.0025	0
7.0866	9.8425	+0.0006	0	+0.0008	0	+0.0011	0	+0.0018	0	+0.0028	0
9.8425	12.4016	+0.0006	0	+0.0009	0	+0.0013	0	+0.0020	0	+0.0032	0
12.4016	15.7480	+0.0007	0	+0.0010	0	+0.0014	0	+0.0022	0	+0.0035	0
15.7480	19.6850	+0.0008	0	+0.0011	0	+0.0016	0	+0.0025	0	+0.0038	0

Diameter **in**		Deviations **in**							
		H9		H10		H11		H12	
>	≤	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
0.1181	0.2362	+0.0012	0	+0.0019	0	+0.0030	0	+0.0047	0
0.2362	0.3937	+0.0014	0	+0.0023	0	+0.0035	0	+0.0059	0
0.3937	0.7087	+0.0017	0	+0.0028	0	+0.0043	0	+0.0071	0
0.7087	1.1811	+0.0020	0	+0.0033	0	+0.0051	0	+0.0083	0
1.1811	1.9685	+0.0024	0	+0.0039	0	+0.0063	0	+0.0098	0
1.9685	3.1496	+0.0029	0	+0.0047	0	+0.0075	0	+0.0118	0
3.1496	4.7244	+0.0034	0	+0.0055	0	+0.0087	0	+0.0138	0
4.7244	7.0866	+0.0039	0	+0.0063	0	+0.0098	0	+0.0157	0
7.0866	9.8425	+0.0045	0	+0.0073	0	+0.0114	0	+0.0181	0
9.8425	12.4016	+0.0051	0	+0.0083	0	+0.0126	0	+0.0205	0
12.4016	15.7480	+0.0055	0	+0.0091	0	+0.0142	0	+0.0224	0
15.7480	19.6850	+0.0061	0	+0.0098	0	+0.0157	0	+0.0248	0

A

ISO Tolerances for Holes – inch

Diameter **in**		Deviations **in**						Deviations **in**					
		J6		J7		J8		K6		K7		K8	
>	≤	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
0.1181	0.2362	+0.00020	-0.00012	+0.00024	-0.00024	+0.00039	-0.00031	+0.00008	-0.00024	+0.00012	-0.00035	+0.00020	-0.00051
0.2362	0.3937	+0.00020	-0.00016	+0.00031	-0.00028	+0.00047	-0.00039	+0.00008	-0.00028	+0.00020	-0.00039	+0.00024	-0.00063
0.3937	0.7087	+0.00024	-0.00020	+0.00039	-0.00031	+0.00059	-0.00047	+0.00008	-0.00035	+0.00024	-0.00047	+0.00031	-0.00075
0.7087	1.1811	+0.00031	-0.00020	+0.00047	-0.00035	+0.00079	-0.00051	+0.00008	-0.00043	+0.00024	-0.00059	+0.00039	-0.00091
1.1811	1.9685	+0.00039	-0.00024	+0.00055	-0.00043	+0.00094	-0.00059	+0.00012	-0.00051	+0.00028	-0.00071	+0.00047	-0.00106
1.9685	3.1496	+0.00051	-0.00024	+0.00071	-0.00047	+0.00110	-0.00071	+0.00016	-0.00059	+0.00035	-0.00083	+0.00055	-0.00126
3.1496	4.7244	+0.00063	-0.00024	+0.00087	-0.00051	+0.00134	-0.00079	+0.00016	-0.00071	+0.00039	-0.00098	+0.00063	-0.00150
4.7244	7.0866	+0.00071	-0.00028	+0.00102	-0.00055	+0.00161	-0.00087	+0.00016	-0.00083	+0.00047	-0.00110	+0.00079	-0.00169
7.0866	9.8425	+0.00087	-0.00028	+0.00118	-0.00063	+0.00185	-0.00098	+0.00020	-0.00094	+0.00051	-0.00130	+0.00087	-0.00197
9.8425	12.4016	+0.00098	-0.00028	+0.00142	-0.00063	+0.00217	-0.00102	+0.00020	-0.00106	+0.00063	-0.00142	+0.00098	-0.00220
12.4016	15.7480	+0.00114	-0.00028	+0.00154	-0.00071	+0.00236	-0.00114	+0.00028	-0.00114	+0.00067	-0.00157	+0.00110	-0.00240
15.7480	19.6850	+0.00130	-0.00028	+0.00169	-0.00079	+0.00259	-0.00122	+0.00031	-0.00126	+0.00071	-0.00177	+0.00114	-0.00268

Diameter **in**		Deviations **in**						Deviations **in**					
		M5		M6		M7		N6		N7		N8	
>	≤	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
0.1181	0.2362	-0.00012	-0.00031	-0.00004	-0.00035	0	-0.00047	-0.0002	-0.0005	-0.0002	-0.0006	-0.0001	-0.0008
0.2362	0.3937	-0.00016	-0.00039	-0.00012	-0.00047	0	-0.00059	-0.0003	-0.0006	-0.0002	-0.0007	-0.0001	-0.0010
0.3937	0.7087	-0.00016	-0.00047	-0.00016	-0.00059	0	-0.00071	-0.0004	-0.0008	-0.0002	-0.0009	-0.0001	-0.0012
0.7087	1.1811	-0.00020	-0.00055	-0.00016	-0.00067	0	-0.00083	-0.0004	-0.0009	-0.0003	-0.0011	-0.0001	-0.0014
1.1811	1.9685	-0.00020	-0.00063	-0.00016	-0.00079	0	-0.00098	-0.0005	-0.0011	-0.0003	-0.0013	-0.0001	-0.0017
1.9685	3.1496	-0.00024	-0.00075	-0.00020	-0.00094	0	-0.00118	-0.0006	-0.0013	-0.0004	-0.0015	-0.0002	-0.0020
3.1496	4.7244	-0.00031	-0.00091	-0.00024	-0.00110	0	-0.00138	-0.0006	-0.0015	-0.0004	-0.0018	-0.0002	-0.0023
4.7244	7.0866	-0.00035	-0.00106	-0.00031	-0.00130	0	-0.00157	-0.0008	-0.0018	-0.0005	-0.0020	-0.0002	-0.0026
7.0866	9.8425	-0.00043	-0.00122	-0.00031	-0.00146	0	-0.00181	-0.0009	-0.0020	-0.0006	-0.0024	-0.0002	-0.0030
9.8425	12.4016	-0.00051	-0.00142	-0.00035	-0.00161	0	-0.00205	-0.0000	-0.0022	-0.0006	-0.0026	-0.0002	-0.0034
12.4016	15.7480	-0.00055	-0.00154	-0.00039	-0.00181	0	-0.00224	-0.0010	-0.0024	-0.0006	-0.0029	-0.0002	-0.0037
15.7480	19.6850	-0.00063	-0.00169	-0.00039	-0.00197	0	-0.00248	-0.0011	-0.0026	-0.0007	-0.0031	-0.0002	-0.0041

Diameter **in**		Deviations **in**				Deviations **in**					
		P6		P7		R6		R7		R8	
>	≤	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
0.1181	0.2362	-0.0004	-0.0007	-0.0003	-0.0008	-0.0005	-0.0008	-0.0004	-0.0009	-0.0006	-0.0013
0.2362	0.3937	-0.0005	-0.0008	-0.0004	-0.0009	-0.0006	-0.0010	-0.0005	-0.0011	-0.0007	-0.0016
0.3937	0.7087	-0.0006	-0.0010	-0.0004	-0.0011	-0.0008	-0.0012	-0.0006	-0.0013	-0.0009	-0.0020
0.7087	1.1811	-0.0007	-0.0012	-0.0006	-0.0014	-0.0009	-0.0015	-0.0008	-0.0016	-0.0011	-0.0024
1.1811	1.9685	-0.0008	-0.0015	-0.0007	-0.0017	-0.0011	-0.0018	-0.0010	-0.0020	-0.0013	-0.0029
1.9685	2.5591	-0.0010	-0.0018	-0.0008	-0.0020	-0.0014	-0.0021	-0.0012	-0.0024	-0.0016	-0.0034
2.5591	3.1496	-0.0010	-0.0018	-0.0008	-0.0020	-0.0015	-0.0022	-0.0013	-0.0024	-0.0017	-0.0035
3.1496	3.9370	-0.0012	-0.0020	-0.0009	-0.0023	-0.0017	-0.0026	-0.0015	-0.0029	-0.0020	-0.0041
3.9370	4.7244	-0.0012	-0.0020	-0.0009	-0.0023	-0.0019	-0.0027	-0.0016	-0.0030	-0.0021	-0.0043
4.7244	5.5118	-0.0014	-0.0024	-0.0011	-0.0027	-0.0022	-0.0032	-0.0019	-0.0035	-0.0025	-0.0050
5.5118	6.2992	-0.0014	-0.0024	-0.0011	-0.0027	-0.0023	-0.0033	-0.0020	-0.0035	-0.0026	-0.0050
6.2992	7.0866	-0.0014	-0.0024	-0.0011	-0.0027	0.0024	-0.0034	-0.0021	-0.0037	-0.0027	-0.0052
7.0866	7.8740	-0.0016	-0.0028	-0.0013	-0.0031	-0.0027	-0.0038	-0.0024	-0.0042	-0.0030	-0.0059
7.8740	8.8583	-0.0016	-0.0028	-0.0013	-0.0031	0.0028	-0.0039	-0.0025	-0.0043	-0.0031	-0.0060
8.8583	9.8425	-0.0016	-0.0028	-0.0013	-0.0031	-0.0030	-0.0041	-0.0026	-0.0044	-0.0033	-0.0061
9.8425	11.0236	-0.0019	-0.0031	-0.0014	-0.0035	-0.0033	-0.0046	-0.0029	-0.0050	-0.0037	-0.0069
11.0236	12.4016	-0.0019	-0.0031	-0.0014	-0.0035	-0.0035	-0.0048	-0.0031	-0.0051	-0.0039	-0.0070
12.4016	13.9764	-0.0020	-0.0034	-0.0016	-0.0039	-0.0038	-0.0052	-0.0034	-0.0057	-0.0043	-0.0078
13.9764	15.7480	-0.0020	-0.0034	-0.0016	-0.0039	-0.0041	-0.0055	-0.0037	-0.0059	-0.0045	-0.0080
15.7480	17.7165	-0.0022	-0.0037	-0.0018	-0.0043	-0.0044	-0.0060	-0.0041	-0.0065	-0.0050	-0.0088
17.7165	19.6850	-0.0022	-0.0037	-0.0018	-0.0043	-0.0047	-0.0063	-0.0043	-0.0068	-0.0052	-0.0090

ISO Tolerances for Shafts – inch

Diameter **in**		Deviations **in**							
		a10		a11		a12		a13	
>	≤	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
–	0.1181	-0.0106	-0.0122	-0.0106	-0.0130	-0.0106	-0.0146	-0.0106	-0.0161
0.1181	0.2362	-0.0106	-0.0125	-0.0106	-0.0136	-0.0106	-0.0154	-0.0106	-0.0177
0.2362	0.3937	-0.0110	-0.0133	-0.0110	-0.0146	-0.0110	-0.0169	-0.0110	-0.0197
0.3937	0.7087	-0.0114	-0.0142	-0.0114	-0.0157	-0.0114	-0.0185	-0.0114	-0.0220
0.7087	1.1811	-0.0118	-0.0151	-0.0118	-0.0169	-0.0118	-0.0201	-0.0118	-0.0248
1.1811	1.5748	-0.0122	-0.0161	-0.0122	-0.0185	-0.0122	-0.0220	-0.0122	-0.0276
1.5748	1.9685	-0.0126	-0.0165	-0.0126	-0.0189	-0.0126	-0.0224	-0.0126	-0.0280
1.9685	2.5591	-0.0134	-0.0181	-0.0134	-0.0209	-0.0134	-0.0252	-0.0134	-0.0315
2.5591	3.1496	-0.0142	-0.0189	-0.0142	-0.0217	-0.0142	-0.0260	-0.0142	-0.0323
3.1496	3.9370	-0.0150	-0.0205	-0.0150	-0.0236	-0.0150	-0.0287	-0.0150	-0.0362
3.9370	4.7244	-0.0161	-0.0217	-0.0161	-0.0248	-0.0161	-0.0299	-0.0161	-0.0374
4.7244	5.5118	-0.0181	-0.0244	-0.0181	-0.0280	-0.0181	-0.0339	-0.0181	-0.0429
5.5118	6.2992	-0.0205	-0.0268	-0.0205	-0.0303	-0.0205	-0.0362	-0.0205	-0.0453
6.2992	7.0866	-0.0228	-0.0291	-0.0228	-0.0327	-0.0228	-0.0386	-0.0228	-0.0476
7.0866	7.8740	-0.0260	-0.0333	-0.0260	-0.0374	-0.0260	-0.0441	-0.0260	-0.0543
7.8740	8.8583	-0.0291	-0.0364	-0.0291	-0.0406	-0.0291	-0.0472	-0.0291	-0.0575
8.8583	9.8425	-0.0323	-0.0396	-0.0323	-0.0437	-0.0323	-0.0504	-0.0323	-0.0606
9.8425	11.0236	-0.0362	-0.0445	-0.0362	-0.0488	-0.0362	-0.0567	-0.0362	-0.0681
11.0236	12.4016	-0.0413	-0.0496	-0.0413	-0.0539	-0.0413	-0.0618	-0.0413	-0.0732
12.4016	13.9764	-0.0472	-0.0563	-0.0472	-0.0614	-0.0472	-0.0697	-0.0472	-0.0823
13.9764	15.7480	-0.0531	-0.0622	-0.0531	-0.0673	-0.0531	-0.0756	-0.0531	-0.0882

Diameter **in**		Deviations **in**						Deviations **in**					
		c11		c12		c13		e11		e12		e13	
>	≤	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
—	0.1181	-0.0024	-0.0047	-0.0024	-0.0063	-0.0024	-0.0079	-0.0006	-0.0029	-0.0006	-0.0045	-0.0006	-0.0061
0.1181	0.2362	-0.0028	-0.0057	-0.0028	-0.0075	-0.0028	-0.0098	-0.0008	-0.0037	-0.0008	-0.0055	-0.0008	-0.0079
0.2362	0.3937	-0.0031	-0.0067	-0.0031	-0.0091	-0.0031	-0.0118	-0.0010	-0.0045	-0.0010	-0.0069	-0.0010	-0.0096
0.3937	0.7087	-0.0037	-0.0081	-0.0037	-0.0108	-0.0037	-0.0144	-0.0013	-0.0056	-0.0013	-0.0083	-0.0013	-0.0119
0.7087	1.1811	-0.0043	-0.0094	-0.0043	-0.0126	-0.0043	-0.0173	-0.0016	-0.0067	-0.0016	-0.0098	-0.0016	-0.0146
1.1811	1.5748	-0.0047	-0.0110	-0.0047	-0.0146	-0.0047	-0.0201	-0.0020	-0.0083	-0.0020	-0.0118	-0.0020	-0.0173
1.5748	1.9685	-0.0051	-0.0114	-0.0051	-0.0150	-0.0051	-0.0205	-0.0020	-0.0083	-0.0020	-0.0118	-0.0020	-0.0173
1.9685	2.5591	-0.0055	-0.0130	-0.0055	-0.0173	-0.0055	-0.0236	-0.0024	-0.0098	-0.0024	-0.0142	-0.0024	-0.0205
2.5591	3.1496	-0.0059	-0.0134	-0.0059	-0.0177	-0.0059	-0.0240	-0.0024	-0.0098	-0.0024	-0.0142	-0.0024	-0.0205
3.1496	3.9370	-0.0067	-0.0154	-0.0067	-0.0205	-0.0067	-0.0280	-0.0028	-0.0115	-0.0028	-0.0166	-0.0028	-0.0241
3.9370	4.7244	-0.0071	-0.0157	-0.0071	-0.0209	-0.0071	-0.0283	-0.0028	-0.0115	-0.0028	-0.0166	-0.0028	-0.0241
4.7244	5.5118	-0.0079	-0.0177	-0.0079	-0.0236	-0.0079	-0.0327	-0.0033	-0.0132	-0.0033	-0.0191	-0.0033	-0.0281
5.5118	6.2992	-0.0083	-0.0181	-0.0083	-0.0240	-0.0083	-0.0331	-0.0033	-0.0132	-0.0033	-0.0191	-0.0033	-0.0281
6.2992	7.0866	-0.0091	-0.0189	-0.0091	-0.0248	-0.0091	-0.0339	-0.0033	-0.0132	-0.0033	-0.0191	-0.0033	-0.0281
7.0866	7.8740	-0.0094	-0.0209	-0.0094	-0.0276	-0.0094	-0.0378	-0.0039	-0.0154	-0.0039	-0.0220	-0.0039	-0.0323
7.8740	8.8583	-0.0102	-0.0217	-0.0102	-0.0283	-0.0102	-0.0386	-0.0039	-0.0154	-0.0039	-0.0220	-0.0039	-0.0323
8.8583	9.8425	-0.0110	-0.0224	-0.0110	-0.0291	-0.0110	-0.0394	-0.0039	-0.0154	-0.0039	-0.0220	-0.0039	-0.0323
9.8425	11.0236	-0.0118	-0.0244	-0.0118	-0.0323	-0.0118	-0.0437	-0.0043	-0.0169	-0.0043	-0.0248	-0.0043	-0.0362
11.0236	12.4016	-0.0130	-0.0256	-0.0130	-0.0335	-0.0130	-0.0449	-0.0043	-0.0169	-0.0043	-0.0248	-0.0043	-0.0362
12.4016	13.9764	-0.0142	-0.0283	-0.0142	-0.0366	-0.0142	-0.0492	-0.0049	-0.0191	-0.0049	-0.0274	-0.0049	-0.0400
13.9764	15.7480	-0.0157	-0.0299	-0.0157	-0.0382	-0.0157	-0.0508	-0.0049	-0.0191	-0.0049	-0.0274	-0.0049	-0.0400

A

ISO Tolerances for Shafts – inch

Diameter **in**		Deviations **in**						Deviations **in**					
		f5		f6		f7		g5		g6		g7	
>	≤	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
—	0.1181	-0.0002	-0.0004	-0.0002	-0.0005	-0.0002	-0.0006	-0.0001	-0.0002	-0.0001	-0.0003	-0.0001	-0.0005
0.1181	0.2362	-0.0004	-0.0006	-0.0004	-0.0007	-0.0004	-0.0009	-0.0002	-0.0004	-0.0002	-0.0005	-0.0002	-0.0006
0.2362	0.3937	-0.0005	-0.0007	-0.0005	-0.0009	-0.0005	-0.0011	-0.0002	-0.0004	-0.0002	-0.0006	-0.0002	-0.0008
0.3937	0.7087	-0.0006	-0.0009	-0.0006	-0.0011	-0.0006	-0.0013	-0.0002	-0.0006	-0.0002	-0.0007	-0.0002	-0.0009
0.7087	1.1811	-0.0008	-0.0011	-0.0008	-0.0013	-0.0008	-0.0016	-0.0003	-0.0006	-0.0003	-0.0008	-0.0003	-0.0011
1.1811	1.9685	-0.0010	-0.0014	-0.0010	-0.0016	-0.0010	-0.0020	-0.0004	-0.0008	-0.0004	-0.0010	-0.0004	-0.0013
1.9685	3.1496	-0.0012	-0.0017	-0.0012	-0.0019	-0.0012	-0.0024	-0.0004	-0.0009	-0.0004	-0.0011	-0.0004	-0.0016
3.1496	4.7244	-0.0014	-0.0020	-0.0014	-0.0023	-0.0014	-0.0028	-0.0005	-0.0011	-0.0005	-0.0013	-0.0005	-0.0019
4.7244	7.0866	-0.0017	-0.0024	-0.0017	-0.0027	-0.0017	-0.0033	-0.0006	-0.0013	-0.0006	-0.0015	-0.0006	-0.0021
7.0866	9.8425	-0.0020	-0.0028	-0.0020	-0.0031	-0.0020	-0.0038	-0.0006	-0.0014	-0.0006	-0.0017	-0.0006	-0.0024
9.8425	12.4016	-0.0022	-0.0031	-0.0022	-0.0035	-0.0022	-0.0043	-0.0007	-0.0016	-0.0007	-0.0019	-0.0007	-0.0027
12.4016	15.7480	-0.0024	-0.0034	-0.0024	-0.0039	-0.0024	-0.0047	-0.0007	-0.0017	-0.0007	-0.0021	-0.0007	-0.0030

Diameter **in**		Deviations **in**									
		h4		h5		h6		h7		h8	
>	≤	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
—	0.1181	0	-0.00012	0	-0.00016	0	-0.00024	0	-0.0004	0	-0.0006
0.1181	0.2362	0	-0.00016	0	-0.00020	0	-0.00031	0	-0.0005	0	-0.0007
0.2362	0.3937	0	-0.0002	0	-0.00024	0	-0.0004	0	-0.0006	0	-0.0009
0.3937	0.7087	0	-0.0002	0	-0.00031	0	-0.0004	0	-0.0007	0	-0.0011
0.7087	1.1811	0	-0.0002	0	-0.0004	0	-0.0005	0	-0.0008	0	-0.0013
1.1811	1.9685	0	-0.0003	0	-0.0004	0	-0.0006	0	-0.0010	0	-0.0015
1.9685	3.1496	0	-0.0003	0	-0.0005	0	-0.0007	0	-0.0012	0	-0.0018
3.1496	4.7244	0	-0.0004	0	-0.0006	0	-0.0009	0	-0.0014	0	-0.0021
4.7244	7.0866	0	-0.0005	0	-0.0007	0	-0.0010	0	-0.0016	0	-0.0025
7.0866	9.8425	0	-0.0006	0	-0.0008	0	-0.0011	0	-0.0018	0	-0.0028
9.8425	12.4016	0	-0.0006	0	-0.0009	0	-0.0013	0	-0.0020	0	-0.0032
12.4016	15.7480	0	-0.0007	0	-0.0010	0	-0.0014	0	-0.0022	0	-0.0035

Diameter **in**		Deviations **in**									
		h9		h10		h11		h12		h13	
>	≤	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
—	0.1181	0	-0.0010	0	-0.0016	0	-0.0024	0	-0.0039	0	-0.0055
0.1181	0.2362	0	-0.0012	0	-0.0019	0	-0.0030	0	-0.0047	0	-0.0071
0.2362	0.3937	0	-0.0014	0	-0.0023	0	-0.0035	0	-0.0059	0	-0.0087
0.3937	0.7087	0	-0.0017	0	-0.0028	0	-0.0043	0	-0.0071	0	-0.0106
0.7087	1.1811	0	-0.0020	0	-0.0033	0	-0.0051	0	-0.0083	0	-0.0130
1.1811	1.9685	0	-0.0024	0	-0.0039	0	-0.0063	0	-0.0098	0	-0.0154
1.9685	3.1496	0	-0.0029	0	-0.0047	0	-0.0075	0	-0.0118	0	-0.0181
3.1496	4.7244	0	-0.0034	0	-0.0055	0	-0.0087	0	-0.0138	0	-0.0213
4.7244	7.0866	0	-0.0039	0	-0.0063	0	-0.0098	0	-0.0157	0	-0.0248
7.0866	9.8425	0	-0.0045	0	-0.0073	0	-0.0114	0	-0.0181	0	-0.0283
9.8425	12.4016	0	-0.0051	0	-0.0083	0	-0.0126	0	-0.0205	0	-0.0319
12.4016	15.7480	0	-0.0055	0	-0.0091	0	-0.0142	0	-0.0224	0	-0.0350

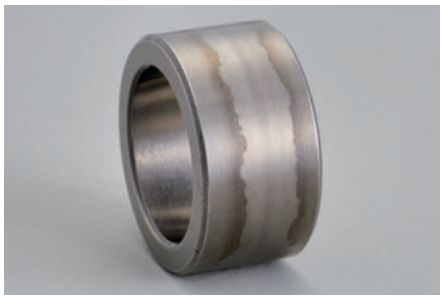
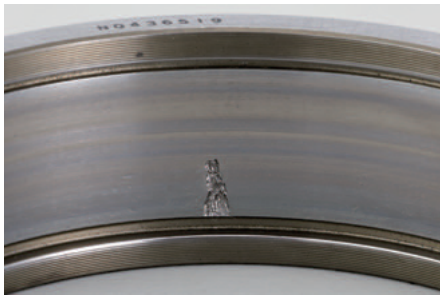
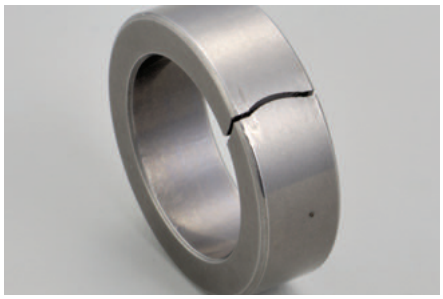
ISO Tolerances for Shafts – inch

Diameter **in**		Deviations **in**						Deviations **in**					
		j5		j6		j7		k5		k6		k7	
>	≤	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
—	0.1181	+0.00008	-0.00008	+0.00016	-0.00008	+0.00024	-0.00016	+0.00016	0	+0.00024	0	+0.00039	0
0.1181	0.2362	+0.00012	-0.00008	+0.00024	-0.00008	+0.00031	-0.00016	+0.00024	+0.00004	+0.00035	+0.00004	+0.00051	+0.00004
0.2362	0.3937	+0.00016	-0.00008	+0.00028	-0.00008	+0.00039	-0.00020	+0.00028	+0.00004	+0.00039	+0.00004	+0.00063	+0.00004
0.3937	0.7087	+0.00020	-0.00012	+0.00031	-0.00012	+0.00047	-0.00024	+0.00035	+0.00004	+0.00047	+0.00004	+0.00075	+0.00004
0.7087	1.1811	+0.00020	-0.00016	+0.00035	-0.00016	+0.00051	-0.00031	+0.00043	+0.00008	+0.00059	+0.00008	+0.00091	+0.00008
1.1811	1.9685	+0.00024	-0.00020	+0.00043	-0.00020	+0.00059	-0.00039	+0.00051	+0.00008	+0.00071	+0.00008	+0.00106	+0.00008
1.9685	3.1496	+0.00024	-0.00028	+0.00047	-0.00028	+0.00071	-0.00047	+0.00059	+0.00008	+0.00083	+0.00008	+0.00126	+0.00008
3.1496	4.7244	+0.00024	-0.00035	+0.00051	-0.00035	+0.00079	-0.00059	+0.00071	+0.00012	+0.00098	+0.00012	+0.00150	+0.00012
4.7244	7.0866	+0.00028	-0.00043	+0.00055	-0.00043	+0.00087	-0.00071	+0.00083	+0.00012	+0.00110	+0.00012	+0.00169	+0.00012
7.0866	9.8425	+0.00028	-0.00051	+0.00063	-0.00051	+0.00098	-0.00083	+0.00094	+0.00016	+0.00130	+0.00016	+0.00197	+0.00016
9.8425	12.4016	+0.00028	-0.00063	+0.00063	-0.00063	+0.00102	-0.00102	+0.00106	+0.00016	+0.00142	+0.00016	+0.00220	+0.00016
12.4016	15.7480	+0.00028	-0.00071	+0.00071	-0.00071	+0.00114	-0.00110	+0.00114	+0.00016	+0.00157	+0.00016	+0.00240	+0.00016

Diameter **in**		Deviations **in**						Deviations **in**					
		m5		m6		m7		n5		n6		n7	
>	≤	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
—	0.1181	+0.00024	+0.00008	+0.00031	+0.00008	+0.00047	+0.00008	+0.0003	+0.0002	+0.0004	+0.0002	+0.0006	+0.0002
0.1181	0.2362	+0.00035	+0.00016	+0.00047	+0.00016	+0.00063	+0.00016	+0.0005	+0.0003	+0.0006	+0.0003	+0.0008	+0.0003
0.2362	0.3937	+0.00047	+0.00024	+0.00059	+0.00024	+0.00083	+0.00024	+0.0006	+0.0004	+0.0007	+0.0004	+0.0010	+0.0004
0.3937	0.7087	+0.00059	+0.00028	+0.00071	+0.00028	+0.00098	+0.00028	+0.0008	+0.0005	+0.0009	+0.0005	+0.0012	+0.0005
0.7087	1.1811	+0.00067	+0.00031	+0.00083	+0.00031	+0.00114	+0.00031	+0.0009	+0.0006	+0.0011	+0.0006	+0.0014	+0.0006
1.1811	1.9685	+0.00079	+0.00035	+0.00098	+0.00035	+0.00134	+0.00035	+0.0011	+0.0007	+0.0013	+0.0007	+0.0017	+0.0007
1.9685	3.1496	+0.00094	+0.00043	+0.00118	+0.00043	+0.00161	+0.00043	+0.0013	+0.0008	+0.0015	+0.0008	+0.0020	+0.0008
3.1496	4.7244	+0.00110	+0.00051	+0.00138	+0.00051	+0.00189	+0.00051	+0.0015	+0.0009	+0.0018	+0.0009	+0.0023	+0.0009
4.7244	7.0866	+0.00130	+0.00059	+0.00157	+0.00059	+0.00217	+0.00059	+0.0018	+0.0011	+0.0020	+0.0011	+0.0026	+0.0011
7.0866	9.8425	+0.00146	+0.00067	+0.00181	+0.00067	+0.00248	+0.00067	+0.0020	+0.0012	+0.0024	+0.0012	+0.0030	+0.0012
9.8425	12.4016	+0.00169	+0.00079	+0.00205	+0.00079	+0.00283	+0.00079	+0.0022	+0.0013	+0.0026	+0.0013	+0.0034	+0.0013
12.4016	15.7480	+0.00181	+0.00083	+0.00224	+0.00083	+0.00307	+0.00083	+0.0024	+0.0015	+0.0029	+0.0015	+0.0037	+0.0015

Diameter **in**		Deviations **in**					
		p6		r6		r7	
>	≤	Max.	Min.	Max.	Min.	Max.	Min.
3.1496	3.9370	+0.0023	+0.0015	-	-	-	-
3.9370	4.7244	+0.0023	+0.0015	-	-	-	-
4.7244	5.5118	+0.0027	+0.0017	+0.0035	+0.0026	-	-
5.5118	6.2992	+0.0027	+0.0017	+0.0035	+0.0026	-	-
6.2992	7.0866	+0.0027	+0.0017	+0.0035	+0.0026	-	-
7.0866	7.8740	+0.0031	+0.0020	+0.0042	+0.0030	-	-
7.8740	8.8583	+0.0031	+0.0020	+0.0043	+0.0031	+0.0050	+0.0031
8.8583	9.8425	+0.0031	+0.0020	+0.0044	+0.0033	+0.0051	+0.0033
9.8425	11.0236	+0.0035	+0.0022	+0.0050	+0.0037	+0.0057	+0.0037
11.0236	12.4016	+0.0035	+0.0022	+0.0051	+0.0039	+0.0059	+0.0039
12.4016	13.9764	+0.0039	+0.0024	+0.0057	+0.0043	+0.0065	+0.0043
13.9764	15.7480	+0.0039	+0.0024	+0.0059	+0.0045	+0.0067	+0.0045
15.7480	17.7165	+0.0043	+0.0027	+0.0065	+0.0050	+0.0074	+0.0050
17.7165	19.6850	+0.0043	+0.0027	+0.0068	+0.0052	+0.0077	+0.0052

EXAMPLES OF BEARING FAILURES

Failures	Characteristics	
(1) Flaking	  	Flaking is a phenomenon that material is removed in flakes from a surface layer of the bearing raceways or rolling elements due to rolling fatigue. This phenomenon is generally attributed to the approaching end of bearing service life. However, if flaking occurs at early stages of bearing service life, it is necessary to determine causes and adopt countermeasures, since there is a possibility of abnormality in this case. Pitting Pitting is another type of failure caused by rolling fatigue, in which minute holes of approx. 0.1 mm in depth are generated on the raceway surface. Peeling (shown in middle figure) Peeling is a phenomenon in which the lubricant film separation is insuffcient for complete surface separation (0.02 mm or less) of the rolling surfaces causing fatigue and peeling due to concentrated stress acting on microscopic peaks of surface roughness.	
(2) Cracking Chipping	 	Cracking is mainly triggered by debris initiated defects due to wear of other system components, partial shape defects, and concentrated stress and overload caused by edge load. It may occur on bearing rings due to fatigue caused by repeated bend stress.	

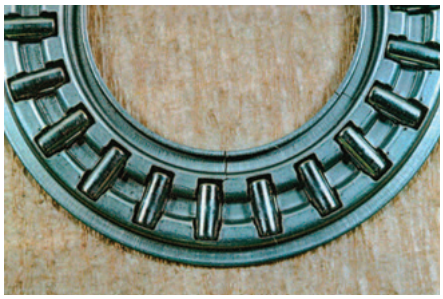
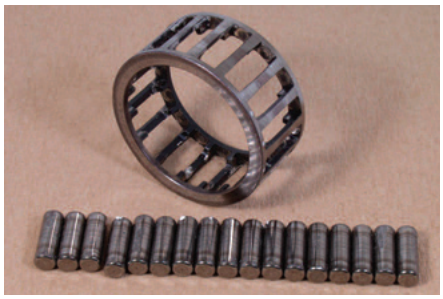
	Damages	Causes	Countermeasures
	Flaking occurring at an incipient stage	· Too small internal clearance · Improper or insufficient lubricant · Load too high · Rust	· Provide proper internal clearance. · Select proper lubricating method or lubricant.
	Symmetrical flaking along circumference of raceway	· Inaccurate housing roundness	· Correct processing accuracy of housing bore. Especially for split housings, care should be taken to ensure processing accuracy.
	Flaking occurring near the edge of the raceway or rolling contact surface	· Improper mounting · Shaft deflection · Inaccuracy of the shaft and housing	· Correct centering. · Correct squareness of shaft or housing shoulder.
	Flaking on the raceway surface at the same interval as rolling element spacing	· Heavy impact load during mounting · A flaw caused during mounting · Rust generated while out of operation	· Improve mounting procedure. · Provide rust prevention treatment before long cessation of operation.
	Cracking in outer ring, inner ring or race	· Excessive interference · Excessive fillet on shaft or housing · Heavy impact load · Advanced flaking or seizure · Impact on race during mounting	· Select proper fit. · Adjust fillet in the shaft or in the housing to smaller than that of the bearing chamfer dimension. · Re-examine load conditions. · Improve mounting procedures.
	Cracking on rolling elements	· Heavy impact load · Advanced flaking	· Improve mounting and handling procedures. · Re-examine load conditions.

A

Failures		Characteristics	
(3) Brinelling Nicks		· Brinelling is a small surface indentation generated either on the raceway through plastic deformation at the contact point between the raceway and rolling elements, or on the rolling surfaces from insertion of foreign matter, when heavy load is applied while the bearing is stationary or rotating at a low rotation speed. · Nicks are indentations produced directly by rough handling such as hammering.	
(4) Wear		Normally, wear of bearing is observed on sliding contact surfaces such as roller end faces and rib faces, cage pockets, the guide surface of cages and cage riding lands. Wear is not directly related to material fatigue. Wear caused by foreign matter and corrosion can affect not only sliding surfaces but rolling surfaces.	
(5) Fretting	 	Fretting occurs to bearings which are subject to vibration while in stationary condition or which are exposed to minute vibrations. It is characterized by rust-colored wear particles. Since fretting on the raceways often appears similar to brinelling, it is sometimes called “false brinelling”.	
(6) Creeping		Creeping is a phenomenon in which bearing rings move relative to the shaft or housing during operation.	

	Damages	Causes	Countermeasures
	Brinelling on the raceway or rolling contact surface	· Entry of foreign matter	· Clean bearing and its peripheral parts. · Improve sealing devices.
	Brinelling on the raceway surface at the same interval as the rolling element spacing	· Impact load during mounting · Excessive load applied while bearing is stationary	· Improve mounting procedure. · Improve machine handling.
	Nicks on the raceway or rolling contact surface	· Careless handling	· Improve mounting and handling procedure.
	Wear on the contact surfaces (cage pockets, cage riding land)	· Improper or insufficient lubricant	· Select proper lubricating method or lubricant. · Improve sealing device. · Clean the bearing and its peripheral parts.
	Wear on raceways and rolling contact surfaces	· Entry of foreign matter · Improper or insufficient lubricant	
	Rust-colored wear particles generated on the fitting surface (fretting corrosion)	· Insufficient interference	· Provide greater interference. · Apply lubricant to the fitting surface.
	Brinelling on the raceway surface at the same interval as rolling element spacing (false brinelling)	· Vibration and oscillation when bearings are stationary.	· Improve fixing method of the shaft and housing.
	Wear, discoloration, and scuffing caused by slipping on the fitting surfaces	· Insufficient interference · Insufficient tightening of sleeve	· Provide greater interference. · Proper tightening of sleeve.

A

Failures	Characteristics	
(7) Damage to Cages	 	Since cages are made of low hardness materials, external pressure and contact with other parts can easily produce flaws and distortion. In some cases, these are aggravated and become chips and cracks. Large chips and cracks are often accompanied by deformation, which may reduce the accuracy of the cage itself and may hinder the smooth movement of rolling elements.
(8) Seizing	 	A phenomenon caused by abnormal heating in bearings due to various reasons

	Damages	Causes	Countermeasures
	Flaws, distortion, chipping, cracking and excessive wear in cages.	· Extraordinary vibration, impact, moment · Improper or insufficient lubricant · Dents made during mounting	· Re-examine load conditions. · Select proper lubricating method or lubricant. · Re-examine cage types. · Improve mounting.
	Discoloration, distortion, and melting together due to heating in bearings	· Too small internal clearance · Improper or insufficient lubricant · Excessive load · Aggravated by other bearing flaws	· Provide proper internal clearance. · Select proper lubricating method or lubricant. · Re-examine bearing type. · Earlier discovery of bearing flaws

NOTES

NEEDLE ROLLER BEARINGS

B

B NEEDLE ROLLER BEARINGS

B

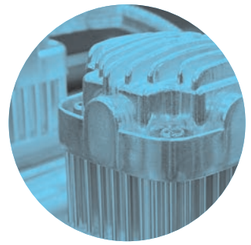
NEEDLE ROLLER BEARINGS

B

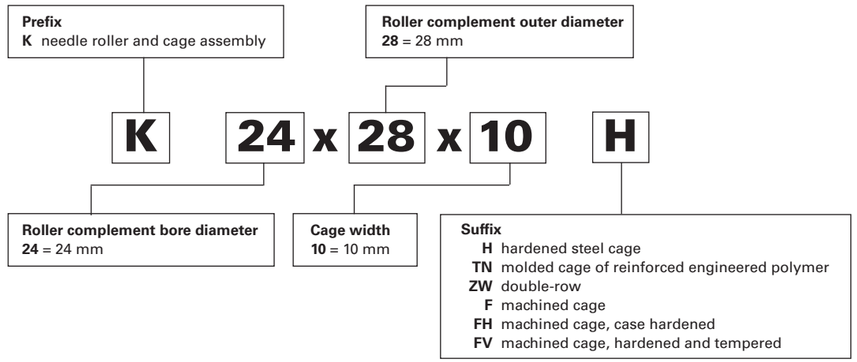
RADIAL NEEDLE ROLLER AND CAGE ASSEMBLIES

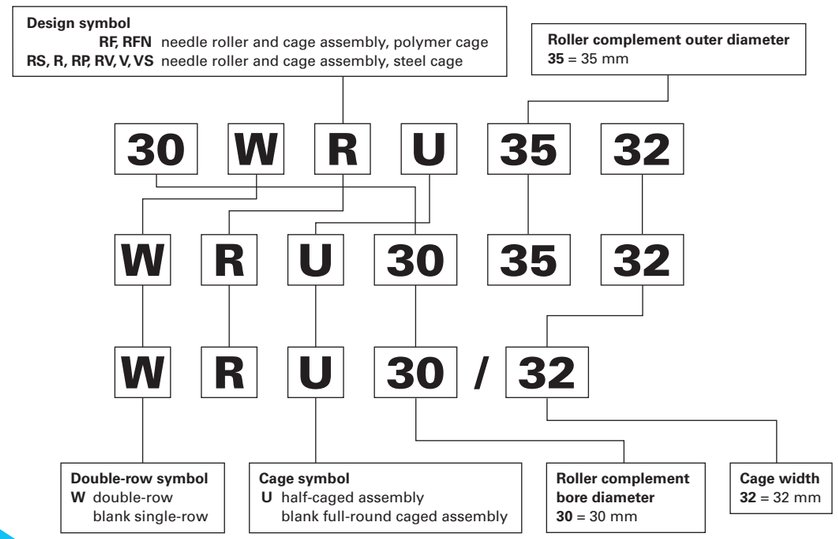
Overview: Needle roller and cage assemblies feature a complement of needles held in place by a cage with no inner or outer ring. The minimal cross section provides maximum load-carrying capability within the smallest envelope.

- **Catalog range:** 3 mm – 127 mm (0.1181 in – 5.0000 in) bore.
- **Markets:** Automotive and truck transmissions, agricultural and construction equipment, two-cycle engines, pumps and compressors.
- **Features and Benefits:**
  - Unitized design simplifies handling and installation while allowing for increased lube flow.
  - Split and segmented designs allow mounting at difficult positions on crankshafts and gear shafts.
  - Controlled contour rollers optimize contact stress distribution.
  - Special manufacturing processes help increase roller fatigue resistance and minimize axial drift effects in critical applications.
  - Optimized cage piloting geometry minimizes pressure velocity effects.
  - Steel or polymer cages are available to suit your application requirements.
  - Coatings are available to help avoid corrosion and improve wear resistance.

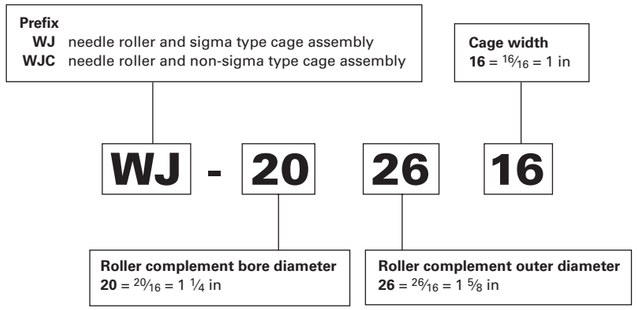


Radial Needle Roller and Cage Assemblies – Metric Nominal Dimensions

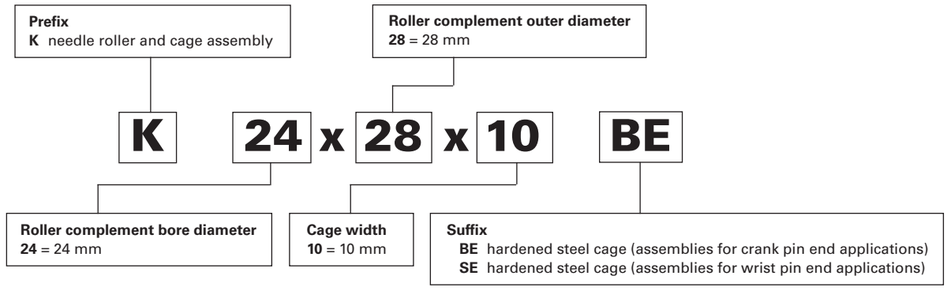


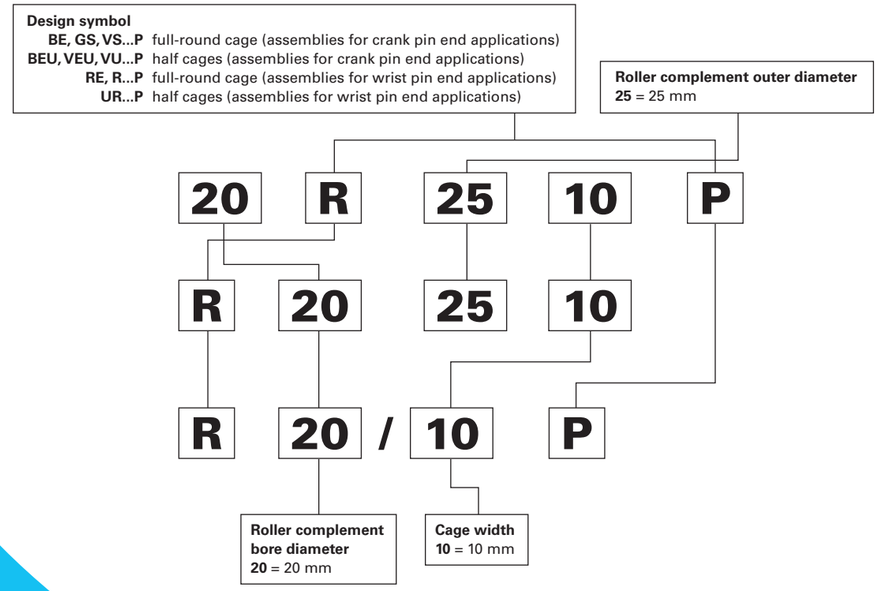


Inch Nominal Dimensions



Radial Needle Roller and Cage Assemblies for Connecting Rod Applications – Nominal Dimensions





Radial Needle Roller and Cage Assemblies

RADIAL NEEDLE ROLLER AND CAGE ASSEMBLIES

METRIC SERIES

Metric series radial needle roller and cage assemblies are available in a variety of sizes and designs. This catalog includes the most popular, standardized designs.

REFERENCE STANDARDS ARE:

- **ISO 3030** – needle roller bearings – radial needle roller and cage assemblies – boundary dimensions and tolerances.
- **DIN 5405 Part 1** – rolling bearings – needle roller bearings – radial needle roller and cage assemblies.
- **ANSI/ABMA 18.1** – needle roller bearings – radial, metric design.
- **JIS B 1536** – roller bearings – boundary dimensions and tolerances of needle roller bearings.

Before selecting specific metric series radial needle roller and cage assemblies, the engineering section should be reviewed.

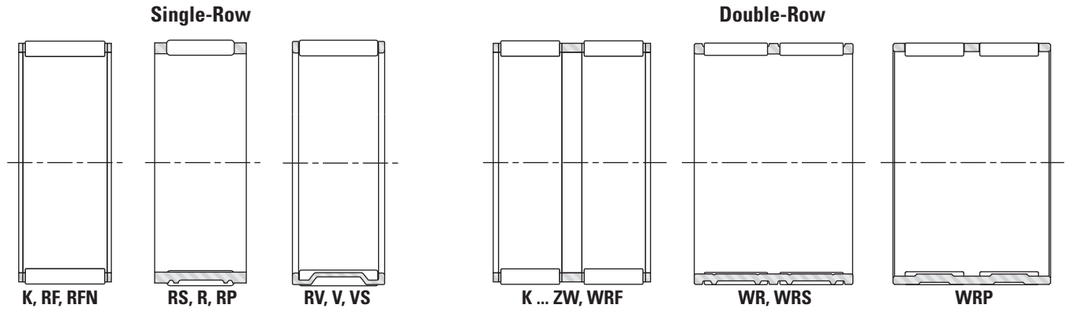


Fig. B1-1. Types of Metric Series Radial Needle Roller and Cage Assemblies

CONSTRUCTION

Radial needle roller and cage assemblies have a steel cage that provides both inward and outward retention for the needle rollers. The designs provide maximum cage strength consistent with the inherent high load-ratings of needle roller bearings. Accurate guidance of the needle rollers by the cage bars allows for operation at high speeds. Needle roller and cage assemblies have either one or two rows of needle rollers.

Also listed are metric series needle roller and cage assemblies using molded, one-piece glass-reinforced engineered polymer cages. These operate well at temperatures up to 120° C (250° F) over extended periods. However, care should be exercised when these assemblies are lubricated with oils containing additives as service life may be reduced if the operating temperature exceeds 100° C (212° F). At such high temperatures oil can deteriorate with time and it is suggested that oil change intervals are observed.

Needle rollers with relieved ends used in these assemblies are made of high-carbon chrome steel, through-hardened, ground and lapped to close tolerances for diameter and roundness. See the engineering section for further discussion of relieved end rollers.

DIMENSIONAL ACCURACY

NEEDLE ROLLER GROUPS (GAGES)

Applicable: K, K .. ZW series

Metric series radial needle roller and cage assemblies are supplied with needle roller complements subdivided into groups (gages) shown in Table B1-1. This is in accordance with Grade G2 specified in ISO 3096 standard (see needle rollers, page B8-13). The group limits of the needle rollers are indicated on the package. Labels of identifying colors show the group limits of the needle rollers. The needle roller and cage assemblies of one shipment usually contain needle rollers with group limits of between 0.000 to -0.002 mm (0.0000 to -0.00008 in) and -0.005 to -0.007 mm (-0.0002 to -0.0003 in) [colors red, blue and white]. For additional information on needle roller and cage assemblies with needle rollers of different group limits contact your representative.

Applicable: RF, RFN, RS, R, RP, RV, V, VS, WRF, WR, WRS, WRP series

The purchased group is 0.000 to -0.006 mm.

Table B1-1. Needle roller group limits (Grade G2)

Group tolerance		Marking gage
mm in	**mm** in	
0.000 0.0000	**-0.002** -0.00008	P0M2
-0.001 -0.00004	**-0.003** -0.00012	M1M3
-0.002 -0.00008	**-0.004** -0.0002	M2M4
-0.003 -0.00012	**-0.005** -0.0002	M3M5
-0.004 -0.0002	**-0.006** -0.0002	M4M6
-0.005 -0.0002	**-0.007** -0.0003	M5M7
-0.006 -0.0002	**-0.008** -0.0003	M6M8
-0.007 -0.0003	-0.009 -0.0004	M7M9
-0.008 -0.0003	**-0.010** -0.0004	M8M10
-0.009 -0.0004	**-0.011** -0.0004	M9M11

In the marking of the gages, P identifies zero (0) or plus (+), M identifies minus (-).

MOUNTING DIMENSIONS

DESIGN OF RACEWAYS

Radial needle roller and cage assemblies use the housing bore as the outer raceway and the shaft as the inner raceway. To realize full bearing load rating and life, the housing bore and the shaft raceways must have the correct geometric and metallurgical characteristics. The housing should be of sufficient cross section to maintain adequate roundness and running clearance under load. Additional design details for housings and shafts used as outer and inner raceways can be found in the engineering section. The only limit to precision of the radial clearance of a mounted assembly is the capability of the user to hold close tolerances on the inner and outer raceways. The suggested shaft tolerances listed in Table B1-2 are based on housing bore tolerance G6 and apply to metric series needle roller bearing and cage assemblies.

Table B1-2. Suggested shaft tolerances for housing bores machined to G6

Condition	Tolerance zone class		
	Axis		Housing hole
Radial clearance	Fw ≤ 50 mm	Fw > 50 mm	
Smaller than normal	j5	h5	G6
Normal	h5	g5	
Larger than normal	g6	f6	

AXIAL GUIDANCE REQUIREMENTS

Radial needle roller and cage assembly must be axially guided by shoulders or other suitable means. The end guiding surfaces should be hardened to minimize wear and must provide sufficient axial clearance to prevent end-locking of the assembly. Length tolerance H11 is suggested.

If end guidance is provided by a housing shoulder at one end and by a shaft shoulder at the other end, the shaft must be axially positioned to prevent end-locking of needle roller and cage assembly. The housing and shaft shoulder heights should be 70 percent to 90 percent of the needle roller diameter to provide proper axial guidance.

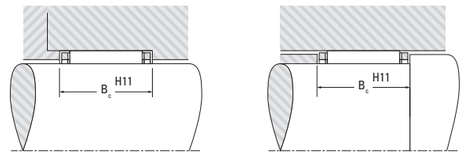


Fig. B1-2. Axial guidance requirements

MOUNTING IN SETS

Radial needle roller and cage assemblies that are mounted side by side must have needle rollers of the same group limits to ensure uniform load distribution.

LUBRICATION

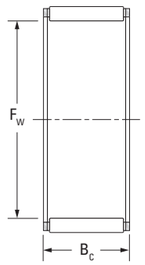
Oil is the preferred lubricant for most applications. In critical applications involving high speeds, ample oil flow must be provided. Where assemblies are subjected to high centrifugal forces – such as in epicyclic gearing, or inertia forces, as in the small end of a connecting rod – the contact pressure between the cage and the raceway guiding surface becomes critical. The allowable contact pressure depends on a combination of the induced force and the relative velocity between the cage and raceway and the rate of lubricant flow. Consult your representative when cages will be subjected to high induced forces.

SPECIAL DESIGNS

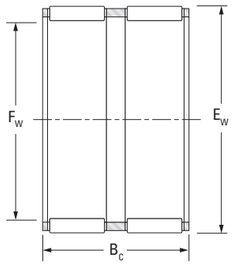
Radial needle roller and cage assemblies made to special dimensions or configurations – such as those which are split to assemble around a one-piece crankshaft – can be made available on special order. Special coated or plated cages to enhance life, under conditions of marginal lubrication and high induced forces, also can be made available.

SINGLE-ROW, DOUBLE-ROW ASSEMBLIES

METRIC SERIES
K, K ZW SERIES



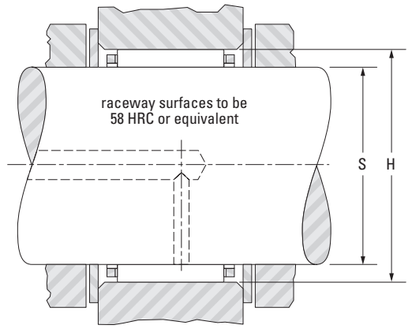
K



K ZW

Shaft Dia.	F_w	E_w	B_c -0.20 -0.008 -0.55 -0.022	Assembly Designation	Load Ratings Dynamic C	Load Ratings Static C_0	Fatigue Load Limit C_u	Cage material(1) P/S	Speed Ratings Grease	Speed Ratings Oil	Approx. Wt.	Mounting Dimensions S Max.	Mounting Dimensions S Min.	Mounting Dimensions H Max.	Mounting Dimensions H Min.
mm in	mm in	mm in	mm in		kN lbf		kN		min^{-1}		kg lbs	mm in	mm in	mm in	mm in
3 0.1181	**3** 0.1181	**5** 0.1969	**7** 0.2756	K3X5X7TN	**1.56** 351	**1.29** 290	0.200	P	48000	74000	**0.0002** 0.0004	**3.000** 0.1181	**2.996** 0.1180	**5.004** 0.1970	**5.012** 0.1973
4 0.1575	**4** 0.1575	**7** 0.2756	**7** 0.276	K4X7X7TN	**1.83** 411	**1.32** 297	0.200	P	34000	52000	**0.0005** 0.001	**4.000** 0.1575	**3.995** 0.1573	**7.014** 0.2761	**7.005** 0.2758
5 0.1969	**5** 0.1969	**8** 0.315	**8** 0.315	K5X8X8TN	**2.18** 490	**1.71** 384	0.260	P	31000	47000	**0.0007** 0.002	**5.000** 0.1969	**4.995** 0.1967	**8.014** 0.3155	**8.005** 0.3152
	5 0.1969	**8** 0.315	**10** 0.394	K5X8X10TN	**3.04** 683	**2.63** 591	0.400	P	31000	47000	**0.0008** 0.002	**5.000** 0.1969	**4.995** 0.1967	**8.014** 0.3155	**8.005** 0.3152
	5 0.1969	**9** 0.3543	**13** 0.512	K5X9X13TN	**4.29** 964	**3.55** 798	0.540	P	26000	40000	**0.002** 0.004	**5.000** 0.1969	**4.995** 0.1967	**9.014** 0.3549	**9.005** 0.3545
6 0.2362	**6** 0.2362	**9** 0.3543	**8** 0.315	K6X9X8H	**3.19** 717	**2.90** 652	0.420	S	29000	44000	**0.0008** 0.002	**6.000** 0.2362	**5.995** 0.2360	**9.014** 0.3549	**9.005** 0.3545
	6 0.2362	**9** 0.3543	**8** 0.315	K6X9X8TN	**2.47** 555	**2.07** 465	0.310	P	29000	44000	**0.001** 0.002	**6.000** 0.2362	**5.995** 0.2360	**9.014** 0.3549	**9.005** 0.3545
	6 0.2362	**9** 0.3543	**10** 0.394	K6X9X10TN	**3.07** 690	**2.74** 616	0.420	P	29000	44000	**0.001** 0.002	**6.000** 0.2362	**5.995** 0.2360	**9.014** 0.3549	**9.005** 0.3545
7 0.2756	**7** 0.2756	**10** 0.3937	**8** 0.315	K7X10X8TN	**2.74** 616	**2.44** 549	0.370	P	28000	42000	**0.001** 0.002	**7.000** 0.2756	**6.994** 0.2754	**10.014** 0.3943	**10.005** 0.3939
	7 0.2756	**10** 0.3937	**10** 0.394	K7X10X10TN	**3.40** 764	**3.22** 724	0.490	P	28000	42000	**0.001** 0.002	**7.000** 0.2756	**6.994** 0.2754	**10.014** 0.3943	**10.005** 0.3939
	7 0.2756	**11** 0.4331	**15** 0.591	K7X11X15TN	**6.44** 1450	**6.24** 1400	0.940	P	23000	35000	**0.003** 0.007	**7.000** 0.2756	**6.994** 0.2754	**11.017** 0.4337	**11.006** 0.4333
8 0.3150	**8** 0.315	**11** 0.4331	**8** 0.315	K8X11X8FV	**3.23** 726	**3.11** 699	0.470	S	26000	41000	**0.002** 0.004	**8.000** 0.3150	**7.994** 0.3147	**11.017** 0.4337	**11.006** 0.4333
	8 0.315	**11** 0.4331	**8** 0.315	K8X11X8TN	**2.34** 526	**2.05** 461	0.300	P	26000	41000	**0.001** 0.002	**8.000** 0.3150	**7.994** 0.3147	**11.017** 0.4337	**11.006** 0.4333
	8 0.315	**11** 0.4331	**10** 0.394	K8X11X10H	**4.57** 1030	**4.89** 1100	0.740	S	26000	41000	**0.002** 0.004	**8.000** 0.3150	**7.994** 0.3147	**11.017** 0.4337	**11.006** 0.4333
	8 0.315	**11** 0.4331	**10** 0.394	K8X11X10FV	**4.01** 901	**4.11** 924	0.630	S	26000	41000	**0.002** 0.004	**8.000** 0.3150	**7.994** 0.3147	**11.017** 0.4337	**11.006** 0.4333
	8 0.315	**11** 0.4331	**10** 0.394	K8x11x10TN	**3.84** 864	**3.91** 880	0.600	P	26000	41000	**0.001** 0.002	**8.000** 0.3150	**7.994** 0.3147	**11.006** 0.4333	**11.017** 0.4337
	8 0.315	**11** 0.4331	**13** 0.512	K8x11x13TN	**5.18** 1170	**5.75** 1290	0.870	P	26000	41000	**0.002** 0.004	**8.000** 0.3150	**7.994** 0.3147	**11.006** 0.4333	**11.017** 0.4337

(1) Cage material: P: polymer cage, S: steel cage



Shaft Dia.	F_w	E_w	B_c -0.20 -0.008 -0.55 -0.022	Assembly Designation	Load Ratings Dynamic C	Load Ratings Static C_0	Fatigue Load Limit C_u	Cage material(1) P/S	Speed Ratings Grease	Speed Ratings Oil	Approx. Wt.	Mounting Dimensions S Max.	Mounting Dimensions S Min.	Mounting Dimensions H Max.	Mounting Dimensions H Min.
mm in	mm in	mm in	mm in		kN lbf		kN		min^{-1}		kg lbs	mm in	mm in	mm in	mm in
8 0.3150	**8** 0.315	**11** 0.4331	**13** 0.512	K8X11X13H	**5.22** 1170	**5.78** 1300	0.880	S	26000	41000	**0.003** 0.007	**8.000** 0.3150	**7.994** 0.3147	**11.017** 0.4337	**11.006** 0.4333
9 0.3543	**9** 0.3543	**12** 0.4724	**10** 0.394	K9X12X10FH	**4.27** 960	**4.60** 1030	0.700	S	26000	40000	**0.003** 0.007	**9.000** 0.3543	**8.994** 0.3541	**12.017** 0.4731	**12.006** 0.4727
	9 0.3543	**12** 0.4724	**10** 0.394	K9X12X10FV	**4.27** 960	**4.60** 1030	0.700	S	26000	40000	**0.002** 0.004	**9.000** 0.3543	**8.994** 0.3541	**12.017** 0.4731	**12.006** 0.4727
	9 0.3543	**12** 0.4724	**13** 0.512	K9X12X13FH	**5.57** 1250	**6.47** 1450	0.980	S	26000	40000	**0.003** 0.007	**9.000** 0.3543	**8.994** 0.3541	**12.017** 0.4731	**12.006** 0.4727
	9 0.3543	**12** 0.4724	**13** 0.512	K9X12X13FV	**5.57** 1250	**6.47** 1450	0.980	S	26000	40000	**0.003** 0.007	**9.000** 0.3543	**8.994** 0.3541	**12.017** 0.4731	**12.006** 0.4727
	9 0.3543	**13** 0.5118	**8** 0.315	K9X13X8H	**3.96** 890	**3.50** 787	0.530	S	21000	32000	**0.003** 0.007	**9.000** 0.3543	**8.994** 0.3541	**13.017** 0.5125	**13.006** 0.5120
10 0.3937	**10** 0.3937	**13** 0.5118	**10** 0.394	K10X13X10H	**5.40** 1210	**6.43** 1450	0.980	S	25000	39000	**0.002** 0.004	**10.000** 0.3937	**9.994** 0.3935	**13.017** 0.5125	**13.006** 0.5120
	10 0.3937	**13** 0.5118	**10** 0.394	K10X13X10TN	**4.29** 964	**4.77** 1070	0.730	P	25000	39000	**0.002** 0.004	**10.000** 0.3937	**9.994** 0.3935	**13.017** 0.5125	**13.006** 0.5120
	10 0.3937	**13** 0.5118	**13** 0.512	K10X13X13	**5.90** 1330	**7.16** 1610	1.10	S	25000	39000	**0.003** 0.007	**10.000** 0.3937	**9.994** 0.3935	**13.017** 0.5125	**13.006** 0.5120
	10 0.3937	**13** 0.5118	**16** 0.63	K10X13X16	**7.43** 1670	**9.64** 2170	1.50	S	25000	39000	**0.004** 0.009	**10.000** 0.3937	**9.994** 0.3935	**13.017** 0.5125	**13.006** 0.5120
	10 0.3937	**14** 0.5512	**10** 0.394	K10X14X10H	**6.12** 1380	**6.29** 1410	0.960	S	20000	31000	**0.003** 0.007	**10.000** 0.3937	**9.994** 0.3935	**14.017** 0.5519	**14.006** 0.5514
	10 0.3937	**14** 0.5512	**13** 0.512	K10X14X13H	**7.88** 1770	**8.71** 1960	1.35	S	20000	31000	**0.004** 0.009	**10.000** 0.3937	**9.994** 0.3935	**14.017** 0.5519	**14.006** 0.5514
	10 0.3937	**16** 0.6299	**12** 0.472	K10X16X12F	**8.39** 1890	**7.47** 1680	1.15	S	15000	24000	**0.006** 0.013	**10.000** 0.3937	**9.994** 0.3935	**16.017** 0.6306	**16.006** 0.6302
	10 0.3937	**16** 0.6299	**12** 0.472	K10X16X12TN	**7.50** 1690	**6.40** 1440	0.970	P	15000	24000	**0.005** 0.011	**10.000** 0.3937	**9.994** 0.3935	**16.017** 0.6306	**16.006** 0.6302
12 0.4724	**12** 0.4724	**15** 0.5906	**10** 0.394	K12X15X10H	**5.85** 1320	**7.51** 1690	1.15	S	24000	37000	**0.003** 0.007	**12.000** 0.4724	**11.992** 0.4721	**15.017** 0.5912	**15.006** 0.5908
	12 0.4724	**15** 0.5906	**13** 0.512	K12X15X13H	**6.78** 1520	**9.03** 2030	1.40	S	24000	37000	**0.004** 0.009	**12.000** 0.4724	**11.992** 0.4721	**15.017** 0.5912	**15.006** 0.5908
	12 0.4724	**16** 0.6299	**13** 0.512	K12X16X13H	**7.49** 1680	**8.51** 1910	1.60	S	19000	30000	**0.006** 0.013	**12.000** 0.4724	**11.992** 0.4721	**16.017** 0.6306	**16.006** 0.6302

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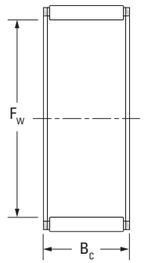
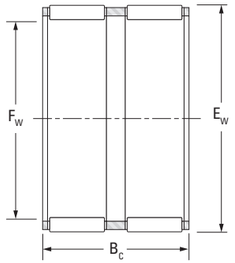
SINGLE-ROW, DOUBLE-ROW ASSEMBLIES

METRIC SERIES
K, K ZW SERIES

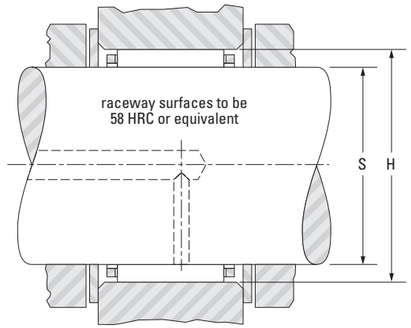


K



K ZW

Shaft Dia.	F_w	E_w	B_c -0.20 -0.008 -0.55 -0.022	Assembly Designation	Load Ratings Dynamic C	Load Ratings Static C_0	Fatigue Load Limit C_u	Cage material(1) P/S	Speed Ratings Grease	Speed Ratings Oil	Approx. Wt.	Mounting Dimensions S Max.	Mounting Dimensions S Min.	Mounting Dimensions H Max.	Mounting Dimensions H Min.
mm in	mm in	mm in	mm in		kN lbf		kN		min^{-1}		kg lbs	mm in	mm in	mm in	mm in
12 0.4724	**12** 0.4724	**17** 0.6693	**13** 0.512	K12X17X13	**8.93** 2010	**9.29** 2090	1.20	S	16000	25000	**0.008** 0.018	**12.000** 0.4724	**11.992** 0.4721	**17.017** 0.6700	**17.006** 0.6695
	12 0.4724	**18** 0.7087	**12** 0.472	K12X18X12H	**9.76** 2190	**9.40** 2110	1.40	S	14000	22000	**0.009** 0.020	**12.000** 0.4724	**11.992** 0.4721	**18.017** 0.7093	**18.006** 0.7089
13 0.5118	**13** 0.5118	**17** 0.6693	**10** 0.394	K13X17X10	**7.22** 1620	**8.33** 1870	1.25	S	19000	29000	**0.004** 0.009	**13.000** 0.5118	**12.992** 0.5115	**17.017** 0.6700	**17.006** 0.6695
	13 0.5118	**18** 0.7087	**15** 0.591	K13X18X15F	**10.8** 2430	**12.1** 2720	1.85	S	16000	25000	**0.008** 0.01	**13.000** 0.5118	**12.992** 0.5115	**18.017** 0.7093	**18.006** 0.7089
14 0.5512	**14** 0.5512	**18** 0.7087	**8** 0.315	K14X18X8	**5.39** 1210	**5.82** 1310	0.880	S	19000	29000	**0.004** 0.009	**14.000** 0.5512	**13.992** 0.5509	**18.017** 0.7093	**18.006** 0.7089
	14 0.5512	**18** 0.7087	**10** 0.394	K14X18X10	**7.17** 1 610	**8.41** 1890	1.30	S	19000	29000	**0.005** 0.011	**14.000** 0.5512	**13.992** 0.5509	**18.017** 0.7093	**18.006** 0.7089
	14 0.5512	**18** 0.7087	**13** 0.512	K14X18X13	**9.73** 2190	**12.5** 2810	1.90	S	19000	29000	**0.006** 0.013	**14.000** 0.5512	**13.992** 0.5509	**18.017** 0.7093	**18.006** 0.7089
	14 0.5512	**18** 0.7087	**15** 0.591	K14X18X15	**10.5** 2360	**13.8** 3100	2.15	S	19000	29000	**0.007** 0.015	**14.000** 0.5512	**13.992** 0.5509	**18.017** 0.7093	**18.006** 0.7089
	14 0.5512	**18** 0.7087	**17** 0.669	K14X18X17H	**12.4** 2790	**17.1** 3840	2.65	S	19000	29000	**0.008** 0.018	**14.000** 0.5512	**13.992** 0.5509	**18.017** 0.7093	**18.006** 0.7089
	14 0.5512	**19** 0.748	**13** 0.512	K14X19X13H	**10.2** 2290	**11.4** 2560	1.75	S	16000	24000	**0.008** 0.018	**14.000** 0.5512	**13.992** 0.5509	**19.020** 0.7488	**19.007** 0.7483
	14 0.5512	**19** 0.748	**18** 0.709	K14X19X18F	**13.2** 2970	**16.0** 3600	2.50	S	16000	24000	**0.011** 0.024	**14.000** 0.5512	**13.992** 0.5509	**19.020** 0.7488	**19.007** 0.7483
	14 0.5512	**20** 0.7874	**12** 0.472	K14X20X12	**10.5** 2360	**10.6** 2380	1.60	S	14000	21000	**0.009** 0.020	**14.000** 0.5512	**13.992** 0.5509	**20.020** 0.7882	**20.007** 0.7877
15 0.5906	**15** 0.5906	**18** 0.7087	**14** 0.551	K15X18X14TN	**7.92** 1780	**11.9** 2680	1.80	P	13000	23000	**0.003** 0.007	**15.000** 0.5906	**14.992** 0.5902	**18.017** 0.7093	**18.006** 0.7089
	15 0.5906	**18** 0.7087	**16** 0.63	K15X18X16F	**8.36** 1880	**12.6** 2830	1.95	S	13000	23000	**0.005** 0.011	**15.000** 0.5906	**14.992** 0.5902	**18.017** 0.7093	**18.006** 0.7089
	15 0.5906	**18** 0.7087	**17** 0.669	K15X18X17	**8.08** 1820	**12.1** 2720	1.85	S	23000	36000	**0.005** 0.011	**15.000** 0.5906	**14.992** 0.5902	**18.017** 0.7093	**18.006** 0.7089
	15 0.5906	**19** 0.748	**10** 0.394	K15X19X10	**7.87** 1770	**9.69** 2180	1.45	S	18000	28000	**0.005** 0.011	**15.000** 0.5906	**14.992** 0.5902	**19.020** 0.7488	**19.007** 0.7483
	15 0.5906	**19** 0.748	**13** 0.512	K15X19X13	**9.66** 2170	**12.6** 2830	1.90	S	18000	28000	**0.007** 0.015	**15.000** 0.5906	**14.992** 0.5902	**19.020** 0.7488	**19.007** 0.7483



Shaft Dia.	F_w	E_w	B_c -0.20 -0.008 -0.55 -0.022	Assembly Designation	Load Ratings Dynamic C	Load Ratings Static C_0	Fatigue Load Limit C_u	Cage material(1) P/S	Speed Ratings Grease	Speed Ratings Oil	Approx. Wt.	Mounting Dimensions S Max.	Mounting Dimensions S Min.	Mounting Dimensions H Max.	Mounting Dimensions H Min.
mm in	mm in	mm in	mm in		kN lbf		kN		min^{-1}		kg lbs	mm in	mm in	mm in	mm in
15 0.5906	**15** 0.5906	**19** 0.748	**17** 0.669	K15X19X17H	**12.3** 2770	**17.2** 3870	2.65	S	18000	28000	**0.009** 0.020	**15.000** 0.5906	**14.992** 0.5902	**19.020** 0.7488	**19.007** 0.7483
	15 0.5906	**19** 0.748	**22** 0.866	K15X19X22ZW	**12.2** 2740	**17.0** 3820	2.60	S	18000	28000	**0.010** 0.022	**15.000** 0.5906	**14.992** 0.5902	**19.020** 0.7488	**19.007** 0.7483
	15 0.5906	**20** 0.7874	**13** 0.512	K15X20X13H	**9.93** 2230	**11.3** 2540	1.80	S	16000	24000	**0.008** 0.018	**15.000** 0.5906	**14.992** 0.5902	**20.020** 0.7882	**20.007** 0.7877
	15 0.5906	**21** 0.8268	**15** 0.591	K15X21X15	**13.4** 3010	**14.8** 3330	2.30	S	14000	21000	**0.013** 0.029	**15.000** 0.5906	**14.992** 0.5902	**21.020** 0.8276	**21.007** 0.8270
	15 0.5906	**21** 0.8268	**21** 0.827	K15X21X21H	**18.0** 4050	**21.7** 4880	3.40	S	14000	21000	**0.018** 0.040	**15.000** 0.5906	**14.992** 0.5902	**21.020** 0.8276	**21.007** 0.8270
16 0.6299	**16** 0.6299	**20** 0.7874	**8** 0.315	K16X20X8F	**6.37** 1430	**7.51** 1690	1.15	S	18000	28000	**0.005** 0.011	**16.000** 0.6299	**15.992** 0.6296	**20.020** 0.7882	**20.007** 0.7877
	16 0.6299	**20** 0.7874	**10** 0.394	K16X20X10H	**7.82** 1760	**9.76** 2190	1.50	S	18000	28000	**0.006** 0.013	**16.000** 0.6299	**15.992** 0.6296	**20.020** 0.7882	**20.007** 0.7877
	16 0.6299	**20** 0.7874	**13** 0.512	K16X20X13	**10.1** 2270	**13.5** 3030	2.05	S	18000	28000	**0.007** 0.015	**16.000** 0.6299	**15.992** 0.6296	**20.020** 0.7882	**20.007** 0.7877
	16 0.6299	**20** 0.7874	**14** 0.551	K16X20X14	**10.8** 2430	**14.8** 3330	2.25	S	18000	28000	**0.007** 0.015	**16.000** 0.6299	**15.992** 0.6296	**20.020** 0.7882	**20.007** 0.7877
	16 0.6299	**20** 0.7874	**17** 0.669	K16X20X17H	**12.9** 2900	**18.5** 4160	2.85	S	18000	28000	**0.008** 0.018	**16.000** 0.6299	**15.992** 0.6296	**20.020** 0.7882	**20.007** 0.7877
	16 0.6299	**20** 0.7874	**20** 0.787	K16X20X20	**13.4** 3010	**19.5** 4380	3.05	S	18000	28000	**0.011** 0.024	**16.000** 0.6299	**15.992** 0.6296	**20.020** 0.7882	**20.007** 0.7877
	16 0.6299	**22** 0.8661	**12** 0.472	K16X22X12	**11.2** 2520	**11.9** 2680	1.80	S	19000	29000	**0.010** 0.022	**16.000** 0.6299	**15.992** 0.6296	**22.020** 0.8669	**22.007** 0.8664
	16 0.6299	**22** 0.8661	**16** 0.63	K16X22X16H	**14.9** 3350	**17.2** 3870	2.70	S	19000	29000	**0.014** 0.031	**16.000** 0.6299	**15.992** 0.6296	**22.020** 0.8669	**22.007** 0.8664
	16 0.6299	**22** 0.8661	**20** 0.787	K16X22X20	**18.6** 4180	**22.9** 5150	3.60	S	19000	29000	**0.017** 0.037	**16.000** 0.6299	**15.992** 0.6296	**22.020** 0.8669	**22.007** 0.8664
	16 0.6299	**24** 0.9449	**20** 0.787	K16X24X20	**20.2** 4540	**21.4** 4810	3.45	S	20000	30000	**0.025** 0.055	**16.000** 0.6299	**15.992** 0.6296	**24.020** 0.9457	**24.007** 0.9452
17 0.6693	**17** 0.6693	**20** 0.7874	**10** 0.394	K17X20X10	**5.96** 1340	**8.53** 1920	1.30	S	16000	25000	**0.004** 0.009	**17.000** 0.6693	**16.992** 0.6690	**20.020** 0.7882	**20.007** 0.7877
	17 0.6693	**21** 0.8268	**10** 0.394	K17X21X10	**8.12** 1830	**10.4** 2340	1.60	S	17000	26000	**0.006** 0.013	**17.000** 0.6693	**16.992** 0.6690	**21.020** 0.8276	**21.007** 0.8270

(1) Cage material: P: polymer cage, S: steel cage

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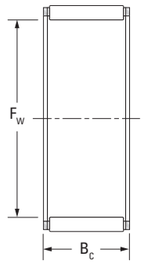
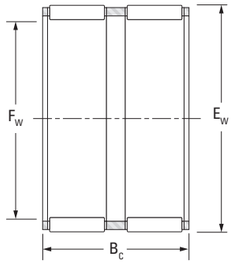
SINGLE-ROW, DOUBLE-ROW ASSEMBLIES

METRIC SERIES
K, K ZW SERIES



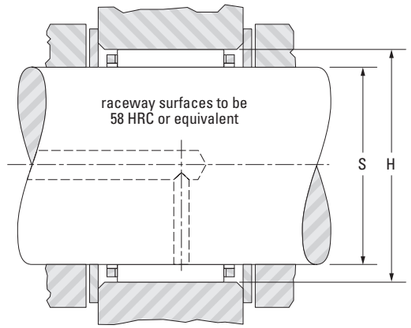
K



K ZW

Shaft Dia.	F_w	E_w	B_c -0.20 -0.008 -0.55 -0.022	Assembly Designation	Load Ratings Dynamic C	Load Ratings Static C_0	Fatigue Load Limit C_u	Cage material(1) P/S	Speed Ratings Grease	Speed Ratings Oil	Approx. Wt.	Mounting Dimensions S Max.	Mounting Dimensions S Min.	Mounting Dimensions H Max.	Mounting Dimensions H Min.
mm in	mm in	mm in	mm in		kN lbf		kN		min^{-1}		kg lbs	mm in	mm in	mm in	mm in
17 0.6693	**17** 0.6693	**21** 0.8268	**13** 0.512	K17X21X13H	**10.5** 2360	**14.5** 3260	2.20	S	17000	26000	**0.008** 0.018	**17.000** 0.6693	**16.992** 0.6690	**21.020** 0.8276	**21.007** 0.8270
	17 0.6693	**21** 0.8268	**15** 0.591	K17X21X15	**11.4** 2560	**16.1** 3620	2.50	S	17000	26000	**0.008** 0.018	**17.000** 0.6693	**16.992** 0.6690	**21.020** 0.8276	**21.007** 0.8270
	17 0.6693	**21** 0.8268	**17** 0.669	K17X21X17H	**13.4** 3010	**19.8** 4450	3.05	S	17000	26000	**0.011** 0.024	**17.000** 0.6693	**16.992** 0.6690	**21.020** 0.8276	**21.007** 0.8270
	17 0.6693	**22** 0.8661	**20** 0.787	K17X22X20FH	**17.0** 3820	**23.3** 5240	3.65	S	17000	27000	**0.015** 0.033	**17.000** 0.6693	**16.992** 0.6690	**22.020** 0.8669	**22.007** 0.8664
	17 0.6693	**23** 0.9055	**15** 0.591	K17X23X15F	**14.1** 3170	**16.3** 3660	2.55	S	18000	27000	**0.010** 0.022	**17.000** 0.6693	**16.992** 0.6690	**23.020** 0.9063	**23.007** 0.9058
18 0.7087	**18** 0.7087	**22** 0.8661	**8** 0.315	K18X22X8F	**6.32** 1420	**7.70** 1730	1.15	S	16000	24000	**0.005** 0.011	**18.000** 0.7087	**17.992** 0.7083	**22.020** 0.8669	**22.007** 0.8664
	18 0.7087	**22** 0.8661	**10** 0.394	K18X22X10H	**8.41** 1890	**11.1** 2500	1.70	S	16000	24000	**0.006** 0.013	**18.000** 0.7087	**17.992** 0.7083	**22.020** 0.8669	**22.007** 0.8664
	18 0.7087	**22** 0.8661	**13** 0.512	K18X22X13H	**10.8** 2430	**15.4** 3460	2.35	S	16000	24000	**0.008** 0.018	**18.000** 0.7087	**17.992** 0.7083	**22.020** 0.8669	**22.007** 0.8664
	18 0.7087	**22** 0.8661	**14** 0.551	K18X22X14	**11.6** 2610	**16.8** 3780	2.55	S	16000	24000	**0.009** 0.020	**18.000** 0.7087	**17.992** 0.7083	**22.020** 0.8669	**22.007** 0.8664
	18 0.7087	**22** 0.8661	**14** 0.551	K18X22X14FV	**11.3** 2540	**16.3** 3660	2.45	S	16000	24000	**0.009** 0.020	**18.000** 0.7087	**17.992** 0.7083	**22.020** 0.8669	**22.007** 0.8664
	18 0.7087	**22** 0.8661	**17** 0.669	K18X22X17H	**13.3** 2990	**19.9** 4470	3.10	S	16000	24000	**0.009** 0.020	**18.000** 0.7087	**17.992** 0.7083	**22.020** 0.8669	**22.007** 0.8664
	18 0.7087	**22** 0.8661	**20** 0.787	K18X22X20F	**15.0** 3370	**23.4** 5260	3.65	S	16000	24000	**0.011** 0.024	**18.000** 0.7087	**17.992** 0.7083	**22.020** 0.8669	**22.007** 0.8664
	18 0.7087	**24** 0.9449	**12** 0.472	K18X24X12	**11.8** 2650	**13.1** 2940	1.95	S	17000	25000	**0.011** 0.024	**18.000** 0.7087	**17.992** 0.7083	**24.020** 0.9457	**24.007** 0.9452
	18 0.7087	**24** 0.9449	**20** 0.787	K18X24X20H	**19.4** 4360	**24.9** 5600	3.90	S	16000	25000	**0.019** 0.042	**18.000** 0.7087	**17.992** 0.7083	**24.020** 0.9457	**24.007** 0.9452
	18 0.7087	**25** 0.9843	**22** 0.866	K18X25X22H	**23.3** 5240	**28.6** 6430	4.50	S	17000	26000	**0.025** 0.055	**18.000** 0.7087	**17.992** 0.7083	**25.020** 0.9850	**25.007** 0.9845
	18 0.7087	**26** 1.0236	**12** 0.472	K18X26X12FV	**13.8** 3100	**13.5** 3030	2.10	S	11000	17000	**0.020** 0.044	**18.000** 0.7087	**17.992** 0.7083	**26.020** 1.0244	**26.007** 1.0239
	18 0.7087	**26** 1.0236	**20** 0.787	K18X26X20F	**21.7** 4880	**24.1** 5420	3.85	S	17000	26000	**0.027** 0.060	**18.000** 0.7087	**17.992** 0.7083	**26.020** 1.0244	**26.007** 1.0239

(1) Cage material: P: polymer cage, S: steel cage



Shaft Dia.	F_w	E_w	B_c -0.20 -0.008 -0.55 -0.022	Assembly Designation	Load Ratings Dynamic C	Load Ratings Static C_0	Fatigue Load Limit C_u	Cage material(1) P/S	Speed Ratings Grease	Speed Ratings Oil	Approx. Wt.	Mounting Dimensions S Max.	Mounting Dimensions S Min.	Mounting Dimensions H Max.	Mounting Dimensions H Min.
mm in	mm in	mm in	mm in		kN lbf		kN		min^{-1}		kg lbs	mm in	mm in	mm in	mm in
19 0.7480	**19** 0.748	**23** 0.9055	**13** 0.512	K19X23X13	**10.8** 2430	**15.5** 3480	2.35	S	15000	23000	**0.008** 0.018	**19.000** 0.7480	**18.991** 0.7477	**23.020** 0.9063	**23.007** 0.9058
	19 0.748	**23** 0.9055	**17** 0.669	K19X23X17	**13.4** 3010	**20.6** 4630	3.20	S	15000	23000	**0.011** 0.024	**19.000** 0.7480	**18.991** 0.7477	**23.020** 0.9063	**23.007** 0.9058
20 0.7874	**20** 0.7874	**24** 0.9449	**8** 0.315	K20X24X8F	**7.31** 1640	**9.60** 2160	1.50	S	14000	22000	**0.005** 0.011	**20.000** 0.7874	**19.991** 0.7870	**24.020** 0.9457	**24.007** 0.9452
	20 0.7874	**24** 0.9449	**10** 0.394	K20X24X10H	**8.97** 2020	**12.5** 2810	2.05	S	14000	22000	**0.006** 0.013	**20.000** 0.7874	**19.991** 0.7870	**24.020** 0.9457	**24.007** 0.9452
	20 0.7874	**24** 0.9449	**12** 0.472	K20X24X12	**10.7** 2410	**15.7** 3530	2.40	S	14000	22000	**0.008** 0.018	**20.000** 0.7874	**19.991** 0.7870	**24.020** 0.9457	**24.007** 0.9452
	20 0.7874	**24** 0.9449	**13** 0.512	K20X24X13H	**11.5** 2590	**17.3** 3890	1.30	S	14000	22000	**0.009** 0.020	**20.000** 0.7874	**19.991** 0.7870	**24.020** 0.9457	**24.007** 0.9452
	20 0.7874	**24** 0.9449	**14** 0.551	K20X24X14	**12.4** 2790	**18.9** 4250	2.85	S	14000	22000	**0.009** 0.020	**20.000** 0.7874	**19.991** 0.7870	**24.020** 0.9457	**24.007** 0.9452
	20 0.7874	**24** 0.9449	**17** 0.669	K20X24X17H	**14.8** 3330	**23.7** 5330	3.65	S	14000	22000	**0.011** 0.024	**20.000** 0.7874	**19.991** 0.7870	**24.020** 0.9457	**24.007** 0.9452
	20 0.7874	**26** 1.0236	**12** 0.472	K20X26X12	**13.0** 2920	**15.3** 3440	2.30	S	15000	23000	**0.012** 0.026	**20.000** 0.7874	**19.991** 0.7870	**26.020** 1.0244	**26.007** 1.0239
	20 0.7874	**26** 1.0236	**13** 0.512	K20X26X13H	**13.4** 3010	**15.9** 3570	2.35	S	15000	23000	**0.014** 0.031	**20.000** 0.7874	**19.991** 0.7870	**26.020** 1.0244	**26.007** 1.0239
	20 0.7874	**26** 1.0236	**17** 0.669	K20X26X17H	**19.3** 4340	**25.5** 5730	4.00	S	15000	23000	**0.017** 0.037	**20.000** 0.7874	**19.991** 0.7870	**26.020** 1.0244	**26.007** 1.0239
	20 0.7874	**26** 1.0236	**20** 0.787	K20X26X20	**20.3** 4560	**27.2** 6110	4.25	S	15000	23000	**0.020** 0.044	**20.000** 0.7874	**19.991** 0.7870	**26.020** 1.0244	**26.007** 1.0239
	20 0.7874	**28** 1.1024	**20** 0.787	K20X28X20H	**24.6** 5530	**29.0** 6520	2.70	S	15000	23000	**0.028** 0.062	**20.000** 0.7874	**19.991** 0.7870	**28.020** 1.1031	**28.007** 1.1026
	20 0.7874	**28** 1.1024	**25** 0.984	K20X28X25H	**29.7** 6680	**37.0** 8320	5.80	S	15000	23000	**0.036** 0.079	**20.000** 0.7874	**19.991** 0.7870	**28.020** 1.1031	**28.007** 1.1026
	20 0.7874	**30** 1.1811	**30** 1.181	K20X30X30H	**38.9** 8750	**45.8** 10300	7.20	S	16000	24000	**0.055** 0.121	**20.000** 0.7874	**19.991** 0.7870	**30.020** 1.1819	**30.007** 1.1814
	20 0.7874	**32** 1.2598	**36** 1.417	K20X32X36H	**49.9** 11220	**57.0** 12810	9.15	S	16000	25000	**0.082** 0.181	**20.000** 0.7874	**19.991** 0.7870	**32.025** 1.2608	**32.009** 1.2602
21 0.8268	**21** 0.8268	**25** 0.9843	**17** 0.669	K21X25X17H	**14.3** 3210	**23.1** 5190	3.60	S	14000	21000	**0.013** 0.029	**21.000** 0.8268	**20.991** 0.8264	**25.020** 0.9850	**25.007** 0.9845

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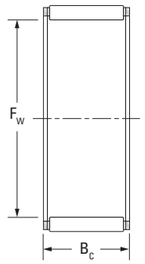
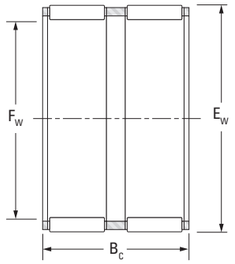
SINGLE-ROW, DOUBLE-ROW ASSEMBLIES

METRIC SERIES
K, K ZW SERIES

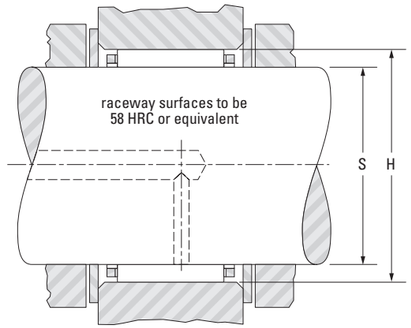


K



K ZW

Shaft Dia.	F_w	E_w	B_c	Assembly Designation	Load Ratings		Fatigue Load Limit C_u	Cage material(1) P/S	Speed Ratings		Approx. Wt.	Mounting Dimensions			
					Dynamic	Static						S		H	
					C	C_0			Grease	Oil		Max.	Min.	Max.	Min.
mm in	mm in	mm in	mm in		kN lbf		kN		min^{-1}		kg lbs	mm in	mm in	mm in	mm in
22 0.8661	**22** 0.8661	**26** 1.0236	**10** 0.394	K22X26X10H	**9.81** 2210	**14.5** 3 260	2.20	S	13000	20000	**0.007** 0.015	**22.000** 0.8661	**21.991** 0.8658	**26.020** 1.0244	**26.007** 1.0239
	22 0.8661	**26** 1.0236	**13** 0.512	K22X26X13H	**11.8** 2650	**18.3** 4110	2.95	S	13000	20000	**0.012** 0.026	**22.000** 0.8661	**21.991** 0.8658	**26.020** 1.0244	**26.007** 1.0239
	22 0.8661	**26** 1.0236	**17** 0.669	K22X26X17H	**15.6** 3510	**26.3** 5910	4.05	S	13000	20000	**0.012** 0.026	**22.000** 0.8661	**21.991** 0.8658	**26.020** 1.0244	**26.007** 1.0239
	22 0.8661	**26** 1.0236	**18** 0.709	K22X26X18H	**15.3** 3440	**25.5** 5730	4.00	S	13000	20000	**0.017** 0.037	**22.000** 0.8661	**21.991** 0.8658	**26.020** 1.0244	**26.007** 1.0239
	22 0.8661	**28** 1.1024	**13** 0.512	K22X28X13	**13.9** 3120	**17.1** 3840	2.60	S	13000	20000	**0.015** 0.033	**22.000** 0.8661	**21.991** 0.8658	**28.020** 1.1031	**28.007** 1.1026
	22 0.8661	**28** 1.1024	**17** 0.669	K22X28X17H	**18.2** 4090	**24.2** 5440	3.80	S	13000	20000	**0.020** 0.044	**22.000** 0.8661	**21.991** 0.8658	**28.020** 1.1031	**28.007** 1.1026
	22 0.8661	**30** 1.1811	**15** 0.591	K22X30X15H	**19.7** 4430	**22.3** 5010	3.45	S	14000	21000	**0.023** 0.051	**22.000** 0.8661	**21.991** 0.8658	**30.020** 1.1819	**30.007** 1.1814
	22 0.8661	**30** 1.1811	**20** 0.787	K22X30X20FV	**24.4** 5490	**29.4** 6610	4.70	S	14000	21000	**0.031** 0.068	**22.000** 0.8661	**21.991** 0.8658	**30.020** 1.1819	**30.007** 1.1814
	22 0.8661	**32** 1.2598	**24** 0.945	K22X32X24F	**33.1** 7440	**37.9** 8520	6.05	S	14000	22000	**0.046** 0.101	**22.000** 0.8661	**21.991** 0.8658	**32.025** 1.2608	**32.009** 1.2602
	22 0.8661	**32** 1.2598	**30** 1.181	K22X32X30H	**41.8** 9400	**51.3** 11530	8.05	S	14000	22000	**0.057** 0.126	**22.000** 0.8661	**21.991** 0.8658	**32.025** 1.2608	**32.009** 1.2602
23 0.9055	**23** 0.9055	**28** 1.1024	**24** 0.945	K23X28X24F	**22.4** 5040	**36.2** 8140	5.70	S	12000	19000	**0.023** 0.051	**23.000** 0.9055	**22.991** 0.9052	**28.020** 1.1031	**28.007** 1.1026
	23 0.9055	**35** 1.378	**16** 0.63	K23X35X16H	**25.9** 5820	**25.1** 5640	3.90	S	14000	21000	**0.040** 0.088	**23.000** 0.9055	**22.991** 0.9052	**35.025** 1.3789	**35.009** 1.3783
24 0.9449	**24** 0.9449	**28** 1.1024	**10** 0.394	K24X28X10H	**9.67** 2170	**14.6** 3280	2.20	S	12000	18000	**0.027** 0.060	**24.000** 0.9449	**23.991** 0.9445	**28.020** 1.1031	**28.007** 1.1026
	24 0.9449	**28** 1.1024	**13** 0.512	K24X28X13H	**12.5** 2810	**20.2** 4540	3.05	S	12000	18000	**0.010** 0.022	**24.000** 0.9449	**23.991** 0.9445	**28.020** 1.1031	**28.007** 1.1026
	24 0.9449	**28** 1.1024	**16** 0.63	K24X28X16F	**12.6** 2830	**20.4** 4590	3.10	S	12000	18000	**0.012** 0.026	**24.000** 0.9449	**23.991** 0.9445	**28.020** 1.1031	**28.007** 1.1026
	24 0.9449	**28** 1.1024	**17** 0.669	K24X28X17H	**15.4** 3460	**26.4** 5930	4.10	S	12000	18000	**0.013** 0.029	**24.000** 0.9449	**23.991** 0.9445	**28.020** 1.1031	**28.007** 1.1026
	24 0.9449	**30** 1.1811	**10** 0.394	K24X30X10TN	**11.3** 2540	**13.5** 3030	2.05	P	12000	19000	**0.008** 0.018	**24.000** 0.9449	**23.991** 0.9445	**30.020** 1.1819	**30.007** 1.1814



Shaft Dia.	F_w	E_w	B_c	Assembly Designation	Load Ratings		Fatigue Load Limit C_u	Cage material(1) P/S	Speed Ratings		Approx. Wt.	Mounting Dimensions			
					Dynamic	Static						S		H	
					C	C_0			Grease	Oil		Max.	Min.	Max.	Min.
mm in	mm in	mm in	mm in		kN lbf		kN		min^{-1}		kg lbs	mm in	mm in	mm in	mm in
24 0.9449	**24** 0.9449	**30** 1.1811	**17** 0.669	K24X30X17H	**19.8** 4450	**27.7** 6230	4.35	S	12000	19000	**0.020** 0.044	**24.000** 0.9449	**23.991** 0.9445	**30.020** 1.1819	**30.007** 1.1814
	24 0.9449	**30** 1.1811	**22** 0.866	K24X30X22	**25.0** 5620	**37.3** 8390	5.80	S	12000	19000	**0.024** 0.053	**24.000** 0.9449	**23.991** 0.9445	**30.020** 1.1819	**30.007** 1.1814
	24 0.9449	**36** 1.4173	**23** 0.906	K24X36X23H	**37.1** 8340	**40.1** 9010	6.40	S	13000	20000	**0.070** 0.154	**24.000** 0.9449	**23.991** 0.9445	**36.025** 1.4183	**36.009** 1.4177
25 0.9843	**25** 0.9843	**29** 1.1417	**10** 0.394	K25X29X10H	**9.61** 2160	**14.6** 3280	2.25	S	11000	17000	**0.008** 0.018	**25.000** 0.9843	**24.991** 0.9839	**29.020** 1.1425	**29.007** 1.1420
	25 0.9843	**29** 1.1417	**13** 0.512	K25X29X13H	**12.8** 2880	**21.1** 4740	3.20	S	11000	17000	**0.010** 0.022	**25.000** 0.9843	**24.991** 0.9839	**29.020** 1.1425	**29.007** 1.1420
	25 0.9843	**29** 1.1417	**17** 0.669	K25X29X17H	**15.1** 3390	**26.2** 5890	4.10	S	11000	17000	**0.016** 0.035	**25.000** 0.9843	**24.991** 0.9839	**29.020** 1.1425	**29.007** 1.1420
	25 0.9843	**30** 1.1811	**13** 0.512	K25X30X13	**14.6** 3280	**21.4** 4810	3.25	S	11000	17000	**0.012** 0.026	**25.000** 0.9843	**24.991** 0.9839	**30.020** 1.1819	**30.007** 1.1814
	25 0.9843	**30** 1.1811	**17** 0.669	K25X30X17H	**18.8** 4230	**29.8** 6700	4.60	S	11000	17000	**0.016** 0.035	**25.000** 0.9843	**24.991** 0.9839	**30.020** 1.1819	**30.007** 1.1814
	25 0.9843	**30** 1.1811	**18** 0.709	K25X30X18	**20.6** 4630	**33.4** 7510	5.30	S	11000	17000	**0.017** 0.037	**25.000** 0.9843	**24.991** 0.9839	**30.020** 1.1819	**30.007** 1.1814
	25 0.9843	**30** 1.1811	**20** 0.787	K25X30X20H	**21.9** 4920	**36.1** 8120	5.65	S	11000	17000	**0.019** 0.042	**25.000** 0.9843	**24.991** 0.9839	**30.020** 1.1819	**30.007** 1.1814
	25 0.9843	**30** 1.1811	**24** 0.945	K25X30X24H	**24.8** 5580	**42.4** 9530	6.60	S	11000	17000	**0.024** 0.053	**25.000** 0.9843	**24.991** 0.9839	**30.020** 1.1819	**30.007** 1.1814
	25 0.9843	**30** 1.1811	**26** 1.024	K25X30X26ZW	**23.0** 5170	**38.6** 8680	5.90	S	11000	17000	**0.027** 0.060	**25.000** 0.9843	**24.991** 0.9839	**30.020** 1.1819	**30.007** 1.1814
	25 0.9843	**31** 1.2205	**14** 0.551	K25X31X14H	**16.8** 3780	**22.7** 5100	3.45	S	12000	18000	**0.017** 0.037	**25.000** 0.9843	**24.991** 0.9839	**31.025** 1.2215	**31.009** 1.2208
	25 0.9843	**31** 1.2205	**17** 0.669	K25X31X17H	**19.7** 4430	**27.8** 6250	4.35	S	12000	18000	**0.020** 0.044	**25.000** 0.9843	**24.991** 0.9839	**31.025** 1.2215	**31.009** 1.2208
	25 0.9843	**31** 1.2205	**21** 0.827	K25X31X21H	**25.1** 5640	**38.0** 8540	5.95	S	12000	18000	**0.026** 0.057	**25.000** 0.9843	**24.991** 0.9839	**31.025** 1.2215	**31.009** 1.2208
	25 0.9843	**31** 1.2205	**24** 0.945	K25X31X24FH	**25.3** 5690	**38.5** 8660	6.05	S	12000	18000	**0.031** 0.068	**25.000** 0.9843	**24.991** 0.9839	**31.025** 1.2215	**31.009** 1.2208
	25 0.9843	**32** 1.2598	**16** 0.63	K25X32X16	**19.8** 4450	**25.3** 5690	4.00	S	12000	18000	**0.027** 0.060	**25.000** 0.9843	**24.991** 0.9839	**32.025** 1.2608	**32.009** 1.2602

(1) Cage material: P: polymer cage, S: steel cage

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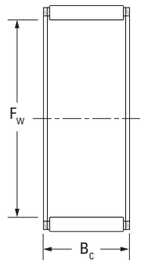
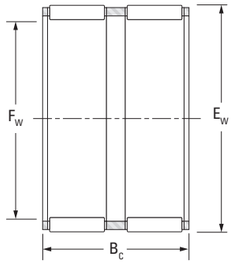
SINGLE-ROW, DOUBLE-ROW ASSEMBLIES

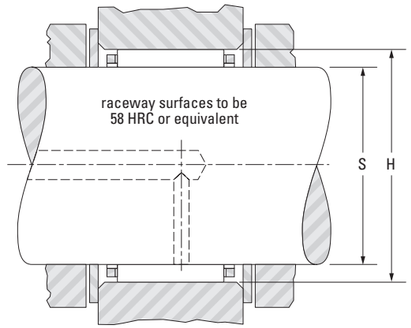
METRIC SERIES
K, K ZW SERIES



K



K ZW



Shaft Dia.	F_w	E_w	B_c	Assembly Designation	Load Ratings		Fatigue Load Limit C_u	Cage material(1) P/S	Speed Ratings		Approx. Wt.	Mounting Dimensions			
					Dynamic	Static						S		H	
					C	C_0			Grease	Oil		Max.	Min.	Max.	Min.
mm in	mm in	mm in	mm in		kN lbf		kN		min^{-1}		kg lbs	mm in	mm in	mm in	mm in
25 0.9843	**25** 0.9843	**33** 1.2992	**20** 0.787	K25X33X20H	**28.8** 6470	**37.6** 8450	5.95	S	12000	18000	**0.035** 0.077	**25.000** 0.9843	**24.991** 0.9839	**33.025** 1.3002	**33.009** 1.2996
	25 0.9843	**33** 1.2992	**24** 0.945	K25X33X24H	**32.3** 7260	**43.5** 9780	6.85	S	12000	18000	**0.038** 0.084	**25.000** 0.9843	**24.991** 0.9839	**33.025** 1.3002	**33.009** 1.2996
	25 0.9843	**33** 1.2992	**25** 0.984	K25X33X25H	**33.0** 7420	**44.6** 10030	7.00	S	12000	18000	**0.041** 0.090	**25.000** 0.9843	**24.991** 0.9839	**33.025** 1.3002	**33.009** 1.2996
	25 0.9843	**35** 1.378	**23.7** 0.933	K25X35X23,7H	**35.9** 8070	**42.3** 9510	6.90	S	12000	19000	**0.050** 0.110	**25.000** 0.9843	**24.991** 0.9839	**35.025** 1.3789	**35.009** 1.3783
	25 0.9843	**35** 1.378	**25** 0.984	K25X35X25H	**37.8** 8500	**46.2** 10390	7.25	S	12000	19000	**0.054** 0.119	**25.000** 0.9843	**24.991** 0.9839	**35.025** 1.3789	**35.009** 1.3783
	25 0.9843	**35** 1.378	**30** 1.181	K25X35X30H	**44.6** 10030	**57.2** 12860	9.00	S	12000	19000	**0.060** 0.132	**25.000** 0.9843	**24.991** 0.9839	**35.025** 1.3789	**35.009** 1.3783
	25 0.9843	**35** 1.378	**36** 1.417	K25X35X36H	**52.4** 11780	**70.4** 15830	11.0	S	12000	19000	**0.074** 0.163	**25.000** 0.9843	**24.991** 0.9839	**35.025** 1.3789	**35.009** 1.3783
	25 0.9843	**37** 1.4567	**20** 0.787	K25X37X20H	**32.5** 7310	**34.1** 7670	5.45	S	12000	19000	**0.055** 0.121	**25.000** 0.9843	**24.991** 0.9839	**37.025** 1.4577	**37.009** 1.4570
26 1.0236	**26** 1.0236	**30** 1.1811	**10** 0.394	K26X30X10F	**9.46** 2130	**14.5** 3260	2.20	S	11000	16000	**0.007** 0.015	**26.000** 1.0236	**25.991** 1.0233	**30.020** 1.1819	**30.007** 1.1814
	26 1.0236	**30** 1.1811	**13** 0.512	K26X30X13	**12.3** 2770	**20.4** 4590	3.10	S	10000	16000	**0.011** 0.024	**26.000** 1.0236	**25.991** 1.0233	**30.020** 1.1819	**30.007** 1.1814
	26 1.0236	**30** 1.1811	**17** 0.669	K26X30X17	**15.0** 3370	**26.3** 5910	3.10	S	10000	16000	**0.014** 0.031	**26.000** 1.0236	**25.991** 1.0233	**30.020** 1.1819	**30.007** 1.1814
	26 1.0236	**30** 1.1811	**22** 0.866	K26X30X22ZW	**16.7** 3750	**30.2** 6790	4.60	S	10000	16000	**0.018** 0.040	**26.000** 1.0236	**25.991** 1.0233	**30.020** 1.1819	**30.007** 1.1814
28 1.1024	**28** 1.1024	**32** 1.2598	**21** 0.827	K28X32X21F	**18.7** 4200	**35.7** 8030	5.55	S	9900	15000	**0.018** 0.040	**28.000** 1.1024	**27.991** 1.1020	**32.025** 1.2608	**32.009** 1.2602
	28 1.1024	**33** 1.2992	**13** 0.512	K28X33X13F	**14.1** 3170	**21.4** 4810	3.25	S	10000	15000	**0.015** 0.033	**28.000** 1.1024	**27.991** 1.1020	**33.025** 1.3002	**33.009** 1.2996
	28 1.1024	**33** 1.2992	**17** 0.669	K28X33X17H	**19.8** 4450	**33.0** 7420	5.10	S	10000	15000	**0.018** 0.040	**28.000** 1.1024	**27.991** 1.1020	**33.025** 1.3002	**33.009** 1.2996
	28 1.1024	**33** 1.2992	**27** 1.063	K28X33X27	**29.0** 6520	**53.8** 12090	8.30	S	10000	15000	**0.027** 0.060	**28.000** 1.1024	**27.991** 1.1020	**33.025** 1.3002	**33.009** 1.2996
	28 1.1024	**34** 1.3386	**17** 0.669	K28X34X17	**21.1** 4740	**31.5** 7080	6.30	S	10000	16000	**0.022** 0.049	**28.000** 1.1024	**27.991** 1.1020	**34.025** 1.3396	**34.009** 1.3389
28 1.1024	**28** 1.1024	**34** 1.3386	**20** 0.787	K28X34X20H	**24.4** 5490	**37.8** 8500	7.65	S	10000	16000	**0.025** 0.055	**28.000** 1.1024	**27.991** 1.1020	**34.025** 1.3396	**34.009** 1.3389
	28 1.1024	**35** 1.378	**15** 0.591	K28X35X15H	**19.5** 4380	**25.6** 5760	3.95	S	10000	16000	**0.025** 0.055	**28.000** 1.1024	**27.991** 1.1020	**35.025** 1.3789	**35.009** 1.3783
	28 1.1024	**35** 1.378	**16** 0.63	K28X35X16H	**21.5** 4830	**29.1** 6540	4.60	S	10000	16000	**0.026** 0.057	**28.000** 1.1024	**27.991** 1.1020	**35.025** 1.3789	**35.009** 1.3783
	28 1.1024	**35** 1.378	**27** 1.063	K28X35X27H	**35.2** 7910	**54.7** 12300	8.50	S	10000	16000	**0.042** 0.093	**28.000** 1.1024	**27.991** 1.1020	**35.025** 1.3789	**35.009** 1.3783
	28 1.1024	**36** 1.4173	**20** 0.787	K28X36X20FV	**27.8** 6250	**37.0** 8320	5.95	S	10000	16000	**0.039** 0.086	**28.000** 1.1024	**27.991** 1.1020	**36.025** 1.4183	**36.009** 1.4177
	28 1.1024	**38** 1.4961	**25.5** 1.004	K28X38X25,5	**40.9** 9190	**52.7** 11850	8.25	S	11000	16000	**0.059** 0.130	**28.000** 1.1024	**27.991** 1.1020	**38.025** 1.4970	**38.009** 1.4964
	28 1.1024	**40** 1.5748	**18** 0.709	K28X40X18H	**33.6** 7550	**36.5** 8210	5.90	S	11000	17000	**0.060** 0.132	**28.000** 1.1024	**27.991** 1.1020	**40.025** 1.5758	**40.009** 1.5752
	28 1.1024	**40** 1.5748	**25** 0.984	K28X40X25H	**45.5** 10230	**54.0** 12140	8.55	S	11000	17000	**0.072** 0.159	**28.000** 1.1024	**27.991** 1.1020	**40.025** 1.5758	**40.009** 1.5752
	28 1.1024	**40** 1.5748	**30** 1.181	K28X40X30H	**54.3** 12210	**67.8** 15240	10.7	S	11000	17000	**0.100** 0.220	**28.000** 1.1024	**27.991** 1.1020	**40.025** 1.5758	**40.009** 1.5752
	28 1.1024	**41** 1.6142	**25** 0.984	K28X41X25H	**49.2** 11060	**57.1** 12840	9.05	S	11000	17000	**0.082** 0.181	**28.000** 1.1024	**27.991** 1.1020	**41.025** 1.6152	**41.009** 1.6145
29 1.1417	**29** 1.1417	**34** 1.3386	**27** 1.063	K29X34X27F	**28.9** 6500	**54.0** 12140	8.40	S	9700	15000	**0.033** 0.073	**29.000** 1.1417	**28.991** 1.1414	**34.025** 1.3396	**34.009** 1.3389
30 1.1811	**30** 1.1811	**34** 1.3386	**13** 0.512	K30X34X13	**13.5** 3030	**24.1** 5420	3.65	S	9200	14000	**0.011** 0.024	**30.000** 1.1811	**29.991** 1.1807	**34.025** 1.3396	**34.009** 1.3389
	30 1.1811	**35** 1.378	**13** 0.512	K30X35X13H	**15.6** 3510	**24.9** 5600	3.80	S	9300	14000	**0.017** 0.037	**30.000** 1.1811	**29.991** 1.1807	**35.025** 1.3789	**35.009** 1.3783
	30 1.1811	**35** 1.378	**17** 0.669	K30X35X17H	**20.2** 4540	**34.6** 7780	5.35	S	9300	14000	**0.022** 0.049	**30.000** 1.1811	**29.991** 1.1807	**35.025** 1.3789	**35.009** 1.3783
	30 1.1811	**35** 1.378	**20** 0.787	K30X35X20H	**23.5** 5280	**41.9** 9420	6.55	S	9300	14000	**0.023** 0.051	**30.000** 1.1811	**29.991** 1.1807	**35.025** 1.3789	**35.009** 1.3783
	30 1.1811	**35** 1.378	**23** 0.906	K30X35X23F	**25.6** 5760	**46.8** 10520	7.40	S	9300	14000	**0.028** 0.062	**30.000** 1.1811	**29.991** 1.1807	**35.025** 1.3789	**35.009** 1.3783
	30 1.1811	**35** 1.378	**27** 1.063	K30X35X27H	**30.6** 6880	**59.0** 13260	9.10	S	9300	14000	**0.032** 0.071	**30.000** 1.1811	**29.991** 1.1807	**35.025** 1.3789	**35.009** 1.3783

(1) Cage material: P: polymer cage, S: steel cage

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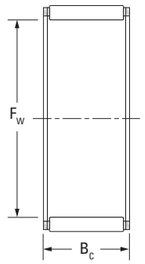
SINGLE-ROW, DOUBLE-ROW ASSEMBLIES

METRIC SERIES
K, K ZW SERIES



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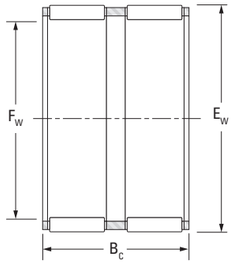
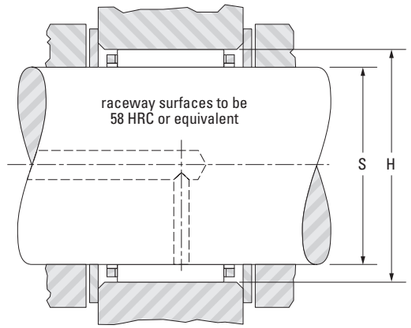


K ZW



Shaft Dia.	F_w	E_w	B_c	Assembly Designation	Load Ratings		Fatigue Load Limit C_u	Cage material(1) P/S	Speed Ratings		Approx. Wt.	Mounting Dimensions			
					Dynamic	Static						S		H	
					C	C_0			Grease	Oil		Max.	Min.	Max.	Min.
mm in	mm in	mm in	mm in		kN lbf		kN		min^{-1}		kg lbs	mm in	mm in	mm in	mm in
30 1.1811	**30** 1.1811	**35** 1.378	**27** 1.063	K30X35X27HZW	**19.9** 4470	**33.6** 7550	5.10	S	9300	14000	**0.033** 0.073	**30.000** 1.1811	**29.991** 1.1807	**35.025** 1.3789	**35.009** 1.3783
	30 1.1811	**36** 1.4173	**14** 0.551	K30X36X14	**18.0** 4050	**26.2** 5890	4.00	S	9500	15000	**0.020** 0.044	**30.000** 1.1811	**29.991** 1.1807	**36.025** 1.4183	**36.009** 1.4177
	30 1.1811	**37** 1.4567	**18** 0.709	K30X37X18	**24.3** 5460	**34.8** 7820	6.00	S	9600	15000	**0.033** 0.073	**30.000** 1.1811	**29.991** 1.1807	**37.025** 1.4577	**37.009** 1.4570
	30 1.1811	**40** 1.5748	**30** 1.181	K30X40X30H	**49.2** 11060	**67.8** 15240	10.6	S	9900	15000	**0.077** 0.170	**30.000** 1.1811	**29.991** 1.1807	**40.025** 1.5758	**40.009** 1.5752
	30 1.1811	**42** 1.6535	**30** 1.181	K30X42X30H	**54.2** 12180	**68.6** 15420	10.8	S	10000	16000	**0.096** 0.212	**30.000** 1.1811	**29.991** 1.1807	**42.025** 1.6545	**42.009** 1.6539
	30 1.1811	**44** 1.7323	**26** 1.024	K30X44X26H	**52.4** 11780	**59.9** 13470	9.55	S	10000	16000	**0.095** 0.209	**30.000** 1.1811	**29.991** 1.1807	**44.025** 1.7333	**44.009** 1.7326
32 1.2598	**32** 1.2598	**36** 1.4173	**15** 0.591	K32X36X15F	**11.6** 2610	**20.2** 4540	3.10	S	8600	13000	**0.015** 0.033	**32.000** 1.2598	**31.989** 1.2594	**36.025** 1.4183	**36.009** 1.4177
	32 1.2598	**37** 1.4567	**13** 0.512	K32X37X13	**15.2** 3420	**24.4** 5490	4.00	S	8700	13000	**0.018** 0.040	**32.000** 1.2598	**31.989** 1.2594	**37.025** 1.4577	**37.009** 1.4570
	32 1.2598	**37** 1.4567	**17** 0.669	K32X37X17H	**20.0** 4500	**34.8** 7820	5.40	S	8700	13000	**0.020** 0.044	**32.000** 1.2598	**31.989** 1.2594	**37.025** 1.4577	**37.009** 1.4570
	32 1.2598	**37** 1.4567	**27** 1.063	K32X37X27	**29.3** 6590	**56.8** 12770	8.85	S	8700	13000	**0.035** 0.077	**32.000** 1.2598	**31.989** 1.2594	**37.025** 1.4577	**37.009** 1.4570
	32 1.2598	**38** 1.4961	**20** 0.787	K32X38X20H	**27.3** 6140	**45.7** 10270	7.15	S	8800	14000	**0.030** 0.066	**32.000** 1.2598	**31.989** 1.2594	**38.025** 1.4970	**38.009** 1.4964
	32 1.2598	**38** 1.4961	**26** 1.024	K32X38X26H	**33.2** 7460	**58.8** 13220	9.15	S	8800	14000	**0.037** 0.082	**32.000** 1.2598	**31.989** 1.2594	**38.025** 1.4970	**38.009** 1.4964
	32 1.2598	**39** 1.5354	**16** 0.63	K32X39X16H	**23.0** 5170	**33.0** 7420	5.20	S	8900	14000	**0.030** 0.066	**32.000** 1.2598	**31.989** 1.2594	**39.025** 1.5364	**39.009** 1.5358
	32 1.2598	**39** 1.5354	**18** 0.709	K32X39X18H	**25.8** 5800	**38.2** 8590	6.05	S	8900	14000	**0.033** 0.073	**32.000** 1.2598	**31.989** 1.2594	**39.025** 1.5364	**39.009** 1.5358
	32 1.2598	**40** 1.5748	**25** 0.984	K32X40X25H	**37.9** 8520	**57.2** 12860	8.90	S	9000	14000	**0.052** 0.115	**32.000** 1.2598	**31.989** 1.2594	**40.025** 1.5758	**40.009** 1.5752
	32 1.2598	**40** 1.5748	**36** 1.417	K32X40X36H	**52.3** 11760	**86.4** 19420	13.6	S	9000	14000	**0.080** 0.176	**32.000** 1.2598	**31.989** 1.2594	**40.025** 1.5758	**40.009** 1.5752
	32 1.2598	**42** 1.6535	**42** 1.654	K32X42X42H	**69.2** 15560	**108** 24280	17.1	S	9200	14000	**0.110** 0.243	**32.000** 1.2598	**31.989** 1.2594	**42.025** 1.6545	**42.009** 1.6539
32 1.2598	**32** 1.2598	**46** 1.811	**18** 0.709	K32X46X18H	**39.2** 8810	**41.9** 9420	6.80	S	9600	15000	**0.075** 0.165	**32.000** 1.2598	**31.989** 1.2594	**46.025** 1.8120	**46.009** 1.8114
	32 1.2598	**46** 1.811	**32** 1.26	K32X46X32H	**67.0** 15060	**83.4** 18750	13.1	S	9600	15000	**0.140** 0.309	**32.000** 1.2598	**31.989** 1.2594	**46.025** 1.8120	**46.009** 1.8114
	32 1.2598	**46** 1.811	**40** 1.575	K32X46X40H	**81.7** 18370	**108** 24280	12.2	S	9600	15000	**0.158** 0.348	**32.000** 1.2598	**31.989** 1.2594	**46.025** 1.8120	**46.009** 1.8114
33 1.2992	**33** 1.2992	**51** 2.0079	**23** 0.906	K33X51X23H	**55.9** 12570	**57.6** 12950	9.35	S	9600	15000	**0.140** 0.309	**33.000** 1.2992	**32.989** 1.2988	**51.029** 2.0090	**51.010** 2.0083
34 1.3386	**34** 1.3386	**38** 1.4961	**11** 0.433	K34X38X11	**12.2** 2740	**21.9** 4920	3.35	S	8100	12000	**0.011** 0.024	**34.000** 1.3386	**33.989** 1.3381	**38.025** 1.4970	**38.009** 1.4964
	34 1.3386	**44** 1.7323	**26** 1.024	K34X44X26FH	**42.9** 9640	**58.9** 13240	9.40	S	8600	13000	**0.080** 0.176	**34.000** 1.3386	**33.989** 1.3381	**44.025** 1.7333	**44.009** 1.7326
35 1.3780	**35** 1.378	**40** 1.5748	**13** 0.512	K35X40X13H	**16.2** 3640	**27.2** 6110	4.15	S	7900	12000	**0.018** 0.040	**35.000** 1.3780	**34.989** 1.3775	**40.025** 1.5758	**40.009** 1.5752
	35 1.378	**40** 1.5748	**17** 0.669	K35X40X17H	**22.1** 4970	**40.8** 9170	6.35	S	7900	12000	**0.025** 0.055	**35.000** 1.3780	**34.989** 1.3775	**40.025** 1.5758	**40.009** 1.5752
	35 1.378	**40** 1.5748	**19** 0.748	K35X40X19H	**23.2** 5220	**43.2** 9710	6.80	S	7900	12000	**0.025** 0.055	**35.000** 1.3780	**34.989** 1.3775	**40.025** 1.5758	**40.009** 1.5752
	35 1.378	**40** 1.5748	**25** 0.984	K35X40X25H	**28.4** 6380	**56.2** 12630	8.70	S	7900	12000	**0.035** 0.077	**35.000** 1.3780	**34.989** 1.3775	**40.025** 1.5758	**40.009** 1.5752
	35 1.378	**40** 1.5748	**27** 1.063	K35X40X27H	**29.8** 6700	**59.6** 13400	9.20	S	7900	12000	**0.037** 0.082	**35.000** 1.3780	**34.989** 1.3775	**40.025** 1.5758	**40.009** 1.5752
	35 1.378	**42** 1.6535	**16** 0.63	K35X42X16AH	**24.5** 5510	**36.8** 8270	5.80	S	8100	12000	**0.031** 0.068	**35.000** 1.3780	**34.989** 1.3775	**42.025** 1.6545	**42.009** 1.6539
	35 1.378	**42** 1.6535	**18** 0.709	K35X42X18	**27.5** 6180	**42.6** 9580	6.75	S	8100	12000	**0.035** 0.077	**35.000** 1.3780	**34.989** 1.3775	**42.025** 1.6545	**42.009** 1.6539
	35 1.378	**42** 1.6535	**20** 0.787	K35X42X20H	**30.4** 6830	**48.5** 10900	7.65	S	8100	12000	**0.037** 0.082	**35.000** 1.3780	**34.989** 1.3775	**42.025** 1.6545	**42.009** 1.6539
	35 1.378	**42** 1.6535	**30** 1.181	K35X42X30FH	**40.5** 9100	**70.0** 15740	10.9	S	8100	12000	**0.061** 0.134	**35.000** 1.3780	**34.989** 1.3775	**42.025** 1.6545	**42.009** 1.6539
	35 1.378	**45** 1.7717	**20** 0.787	K35X45X20FH	**36.5** 8210	**49.9** 11220	8.00	S	8400	13000	**0.059** 0.130	**35.000** 1.3780	**34.989** 1.3775	**45.025** 1.7726	**45.009** 1.7720
	35 1.378	**45** 1.7717	**30** 1.181	K35X45X30F	**51.2** 11510	**74.5** 16750	11.7	S	8400	13000	**0.100** 0.220	**35.000** 1.3780	**34.989** 1.3775	**45.025** 1.7726	**45.009** 1.7720

(1) Cage material: P: polymer cage, S: steel cage

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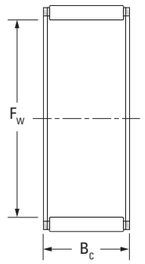
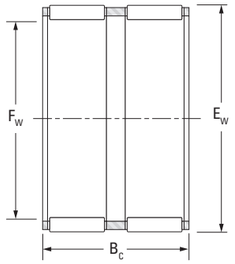
SINGLE-ROW, DOUBLE-ROW ASSEMBLIES

METRIC SERIES
K, K ZW SERIES



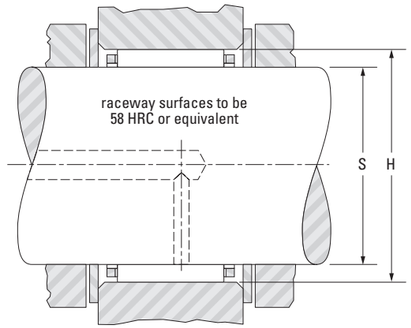
K



K ZW

Shaft Dia.	F_w	E_w	B_c -0.20 -0.008 -0.55 -0.022	Assembly Designation	Load Ratings Dynamic C	Load Ratings Static C_0	Fatigue Load Limit C_u	Cage material(1) P/S	Speed Ratings Grease	Speed Ratings Oil	Approx. Wt.	Mounting Dimensions S Max.	Mounting Dimensions S Min.	Mounting Dimensions H Max.	Mounting Dimensions H Min.
mm in	mm in	mm in	mm in		kN lbf		kN		min^{-1}		kg lbs	mm in	mm in	mm in	mm in
35 1.3780	**35** 1.378	**45** 1.7717	**35** 1.378	K35X45X35H	**62.1** 13960	**95.5** 21470	15.0	S	8400	13000	**0.085** 0.187	**35.000** 1.3780	**34.989** 1.3775	**45.025** 1.7726	**45.009** 1.7720
	35 1.378	**45** 1.7717	**41** 1.614	K35X45X41	**70.8** 15920	**113** 25400	17.7	S	8400	13000	**0.120** 0.265	**35.000** 1.3780	**34.989** 1.3775	**45.025** 1.7726	**45.009** 1.7720
	35 1.378	**45** 1.7717	**49** 1.929	K35X45X49H	**82.5** 18550	**138** 31020	21.4	S	8400	13000	**0.143** 0.315	**35.000** 1.3780	**34.989** 1.3775	**45.025** 1.7726	**45.009** 1.7720
	35 1.378	**45** 1.7717	**49** 1.929	K35X45X49HZW	**71.8** 16140	**115** 25850	18.1	S	8400	13000	**0.143** 0.315	**35.000** 1.3780	**34.989** 1.3775	**45.025** 1.7726	**45.009** 1.7720
	35 1.378	**50** 1.9685	**23** 0.906	K35X50X23H	**53.0** 11910	**60.3** 13550	9.75	S	8700	13000	**0.110** 0.242	**35.000** 1.3780	**34.989** 1.3775	**50.025** 1.9695	**50.009** 1.9689
	35 1.378	**50** 1.9685	**40** 1.575	K35X50X40F	**79.7** 17920	**102** 22930	16.2	S	8700	13000	**0.200** 0.441	**35.000** 1.3780	**34.989** 1.3775	**50.025** 1.9695	**50.009** 1.9689
36 1.4173	**36** 1.4173	**40** 1.5748	**29** 1.142	K36X40X29TN	**21.2** 4770	**45.2** 10160	7.15	P	7600	12000	**0.029** 0.064	**36.000** 1.4173	**35.989** 1.4169	**40.025** 1.5758	**40.009** 1.5752
	36 1.4173	**42** 1.6535	**16** 0.63	K36X42X16	**22.8** 5130	**37.7** 8480	5.95	S	7800	12000	**0.027** 0.060	**36.000** 1.4173	**35.989** 1.4169	**42.025** 1.6545	**42.009** 1.6539
37 1.4567	**37** 1.4567	**42** 1.6535	**13** 0.512	K37X42X13H	**16.9** 3800	**29.4** 6610	4.50	S	7500	11000	**0.017** 0.037	**37.000** 1.4567	**36.989** 1.4563	**42.025** 1.6545	**42.009** 1.6539
	37 1.4567	**42** 1.6535	**17** 0.669	K37X42X17H	**21.9** 4920	**41.0** 9220	6.35	S	7500	11000	**0.025** 0.055	**37.000** 1.4567	**36.989** 1.4563	**42.025** 1.6545	**42.009** 1.6539
	37 1.4567	**42** 1.6535	**27** 1.063	K37X42X27F	**32.1** 7220	**66.9** 15040	10.4	S	7500	11000	**0.039** 0.086	**37.000** 1.4567	**36.989** 1.4563	**42.025** 1.6545	**42.009** 1.6539
	37 1.4567	**44** 1.7323	**19** 0.748	K37X44X19H	**29.7** 6680	**48.0** 10790	7.65	S	7600	12000	**0.039** 0.086	**37.000** 1.4567	**36.989** 1.4563	**44.025** 1.7333	**44.009** 1.7326
38 1.4961	**38** 1.4961	**41** 1.6142	**9** 0.354	K38X41X9TN	**5.93** 1330	**11.0** 2470	1.65	P	7100	11000	**0.004** 0.009	**38.000** 1.4961	**37.989** 1.4956	**41.025** 1.6152	**41.009** 1.6145
	38 1.4961	**43** 1.6929	**17** 0.669	K38X43X17H	**21.8** 4900	**41.0** 9220	6.35	S	7300	11000	**0.032** 0.071	**38.000** 1.4961	**37.989** 1.4956	**43.025** 1.6939	**43.009** 1.6933
	38 1.4961	**43** 1.6929	**27** 1.063	K38X43X27	**31.9** 7170	**67.0** 15060	10.4	S	7300	11000	**0.041** 0.090	**38.000** 1.4961	**37.989** 1.4956	**43.025** 1.6939	**43.009** 1.6933
	38 1.4961	**46** 1.811	**20** 0.787	K38X46X20H	**33.3** 7490	**51.0** 11470	8.10	S	7500	12000	**0.055** 0.121	**38.000** 1.4961	**37.989** 1.4956	**46.025** 1.8120	**46.009** 1.8114
	38 1.4961	**46** 1.811	**32** 1.26	K38X46X32H	**55.2** 12410	**98.1** 22050	15.3	S	7500	12000	**0.090** 0.198	**38.000** 1.4961	**37.989** 1.4956	**46.025** 1.8120	**46.009** 1.8114

(1) Cage material: P: polymer cage, S: steel cage



Shaft Dia.	F_w	E_w	B_c -0.20 -0.008 -0.55 -0.022	Assembly Designation	Load Ratings Dynamic C	Load Ratings Static C_0	Fatigue Load Limit C_u	Cage material(1) P/S	Speed Ratings Grease	Speed Ratings Oil	Approx. Wt.	Mounting Dimensions S Max.	Mounting Dimensions S Min.	Mounting Dimensions H Max.	Mounting Dimensions H Min.
mm in	mm in	mm in	mm in		kN lbf		kN		min^{-1}		kg lbs	mm in	mm in	mm in	mm in
38 1.4961	**38** 1.4961	**50** 1.9685	**25** 0.984	K38X50X25	**53.0** 11910	**70.8** 15920	11.2	S	7800	12000	**0.100** 0.220	**38.000** 1.4961	**37.989** 1.4956	**50.025** 1.9695	**50.009** 1.9689
	38 1.4961	**50** 1.9685	**33** 1.299	K38X50X33H	**68.3** 15350	**98.2** 22080	15.4	S	7800	12000	**0.126** 0.278	**38.000** 1.4961	**37.989** 1.4956	**50.025** 1.9695	**50.009** 1.9689
	38 1.4961	**50** 1.9685	**40** 1.575	K38X50X40FH	**76.2** 17130	**113** 25400	17.8	S	7800	12000	**0.170** 0.375	**38.000** 1.4961	**37.989** 1.4956	**50.025** 1.9695	**50.009** 1.9689
40 1.5748	**40** 1.5748	**45** 1.7717	**13** 0.512	K40X45X13H	**17.6** 3960	**31.7** 7130	4.80	S	6900	11000	**0.022** 0.049	**40.000** 1.5748	**39.989** 1.5744	**45.025** 1.7726	**45.009** 1.7720
	40 1.5748	**45** 1.7717	**18** 0.709	K40X45X18H	**25.1** 5640	**50.4** 11330	8.00	S	6900	11000	**0.031** 0.068	**40.000** 1.5748	**39.989** 1.5744	**45.025** 1.7726	**45.009** 1.7720
	40 1.5748	**45** 1.7717	**21** 0.827	K40X45X21H	**23.3** 5240	**45.2** 10160	8.50	S	6900	11000	**0.033** 0.073	**40.000** 1.5748	**39.989** 1.5744	**45.025** 1.7726	**45.009** 1.7720
	40 1.5748	**45** 1.7717	**27** 1.063	K40X45X27H	**32.7** 7350	**70.2** 15780	10.8	S	6900	11000	**0.040** 0.088	**40.000** 1.5748	**39.989** 1.5744	**45.025** 1.7726	**45.009** 1.7720
	40 1.5748	**45** 1.7717	**27** 1.063	K40X45X27TN	**33.3** 7490	**72.1** 16210	11.2	P	6900	11000	**0.030** 0.066	**40.000** 1.5748	**39.989** 1.5744	**45.025** 1.7726	**45.009** 1.7720
	40 1.5748	**45** 1.7717	**29** 1.142	K40X45X29H	**34.7** 7800	**75.9** 17060	11.7	S	6900	11000	**0.050** 0.110	**40.000** 1.5748	**39.989** 1.5744	**45.025** 1.7726	**45.009** 1.7720
	40 1.5748	**46** 1.811	**17** 0.669	K40X46X17	**25.2** 5670	**44.0** 9890	6.95	S	7000	11000	**0.033** 0.073	**40.000** 1.5748	**39.989** 1.5744	**46.025** 1.8120	**46.009** 1.8114
	40 1.5748	**47** 1.8504	**18** 0.709	K40X47X18	**28.0** 6290	**45.6** 10250	7.25	S	7000	11000	**0.041** 0.090	**40.000** 1.5748	**39.989** 1.5744	**47.025** 1.8514	**47.009** 1.8507
	40 1.5748	**47** 1.8504	**20** 0.787	K40X47X20	**31.1** 6990	**52.1** 11710	8.25	S	7000	11000	**0.042** 0.093	**40.000** 1.5748	**39.989** 1.5744	**47.025** 1.8514	**47.009** 1.8507
	40 1.5748	**48** 1.8898	**20** 0.787	K40X48X20FV1	**35.5** 7980	**56.3** 12660	8.45	S	7100	11000	**0.052** 0.115	**40.000** 1.5748	**39.989** 1.5744	**48.025** 1.8907	**48.009** 1.8901
	40 1.5748	**48** 1.8898	**20** 0.787	K40X48X20H	**35.5** 7980	**56.3** 12660	8.95	S	7100	11000	**0.050** 0.110	**40.000** 1.5748	**39.989** 1.5744	**48.025** 1.8907	**48.009** 1.8901
	40 1.5748	**48** 1.8898	**35** 1.378	K40X48X35H	**57.3** 12880	**104** 23380	16.3	S	7100	11000	**0.098** 0.216	**40.000** 1.5748	**39.989** 1.5744	**48.025** 1.8907	**48.009** 1.8901
	40 1.5748	**50** 1.9685	**27** 1.063	K40X50X27H	**53.0** 11910	**81.0** 18210	12.7	S	7200	11000	**0.084** 0.185	**40.000** 1.5748	**39.989** 1.5744	**50.025** 1.9695	**50.009** 1.9689
	40 1.5748	**55** 2.1654	**45** 1.772	K40X55X45H	**103** 23160	**146** 32820	23.0	S	7500	12000	**0.221** 0.487	**40.000** 1.5748	**39.989** 1.5744	**55.029** 2.1665	**55.010** 2.1657

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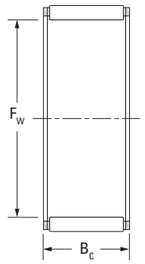
SINGLE-ROW, DOUBLE-ROW ASSEMBLIES

METRIC SERIES
K, K ZW SERIES



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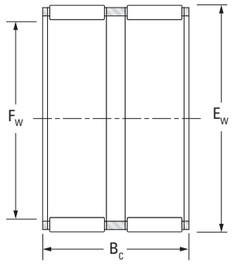
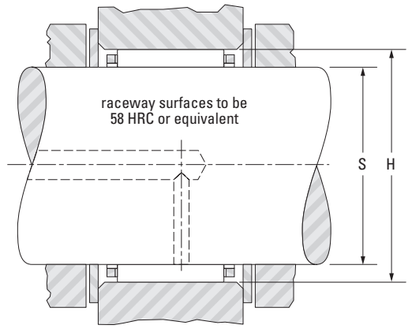


K ZW



Shaft Dia.	F_w	E_w	B_c	Assembly Designation	Load Ratings		Fatigue Load Limit C_u	Cage material(1) P/S	Speed Ratings		Approx. Wt.	Mounting Dimensions			
			-0.20 -0.008 -0.55 -0.022		Dynamic	Static						S		H	
					C	C_0						Max.	Min.	Max.	Min.
mm in	mm in	mm in	mm in		kN lbf		kN		min^{-1}		kg lbs	mm in	mm in	mm in	mm in
40 1.5748	**40** 1.5748	**56** 2.2047	**26** 1.024	K40X56X26H	**63.7** 14320	**75.7** 17020	12.0	S	7600	12000	**0.138** 0.304	**40.000** 1.5748	**39.989** 1.5744	**56.029** 2.2059	**56.010** 2.2051
41 1.6142	**41** 1.6142	**48** 1.8898	**31** 1.22	K41X48X31HZW	**38.0** 8540	**68.1** 15310	10.6	S	6800	11000	**0.067** 0.148	**41.000** 1.6142	**40.989** 1.6137	**48.025** 1.8907	**48.009** 1.8901
42 1.6535	**42** 1.6535	**47** 1.8504	**13** 0.512	K42X47X13H	**18.7** 4200	**34.9** 7850	5.30	S	6500	10000	**0.027** 0.060	**42.000** 1.6535	**41.989** 1.6531	**47.025** 1.8514	**47.009** 1.8507
	42 1.6535	**47** 1.8504	**17** 0.669	K42X47X17H	**22.8** 5130	**45.2** 10160	7.30	S	6500	10000	**0.028** 0.062	**42.000** 1.6535	**41.989** 1.6531	**47.025** 1.8514	**47.009** 1.8507
	42 1.6535	**47** 1.8504	**27** 1.063	K42X47X27H	**33.8** 7600	**74.7** 16790	11.6	S	6500	10000	**0.041** 0.090	**42.000** 1.6535	**41.989** 1.6531	**47.025** 1.8514	**47.009** 1.8507
	42 1.6535	**48** 1.8898	**24** 0.945	K42X48X24F	**33.1** 7440	**63.9** 14370	10.1	S	6600	10000	**0.046** 0.101	**42.000** 1.6535	**41.989** 1.6531	**48.025** 1.8907	**48.009** 1.8901
	42 1.6535	**50** 1.9685	**13** 0.512	K42X50X13H	**20.9** 4700	**28.9** 6500	4.45	S	6700	10000	**0.035** 0.077	**42.000** 1.6535	**41.989** 1.6531	**50.025** 1.9695	**50.009** 1.9689
	42 1.6535	**50** 1.9685	**20** 0.787	K42X50X20H	**35.2** 7910	**56.6** 12720	9.00	S	6700	10000	**0.054** 0.119	**42.000** 1.6535	**41.989** 1.6531	**50.025** 1.9695	**50.009** 1.9689
	42 1.6535	**50** 1.9685	**30** 1.181	K42X50X30H	**51.3** 11530	**91.9** 20660	14.4	S	6700	10000	**0.080** 0.176	**42.000** 1.6535	**41.989** 1.6531	**50.025** 1.9695	**50.009** 1.9689
43 1.6929	**43** 1.6929	**48** 1.8898	**17** 0.669	K43X48X17FH	**23.0** 5170	**45.8** 10300	6.85	S	6400	9800	**0.036** 0.079	**43.000** 1.6929	**42.989** 1.6925	**48.025** 1.8907	**48.009** 1.8901
	43 1.6929	**48** 1.8898	**27** 1.063	K43X48X27H	**34.8** 7820	**78.0** 17540	12.1	S	6400	9800	**0.050** 0.110	**43.000** 1.6929	**42.989** 1.6925	**48.025** 1.8907	**48.009** 1.8901
44 1.7323	**44** 1.7323	**50** 1.9685	**22** 0.866	K44X50X22H	**31.6** 7100	**60.6** 13620	9.45	S	6400	9900	**0.046** 0.101	**44.000** 1.7323	**43.989** 1.7319	**50.025** 1.9695	**50.009** 1.9689
	44 1.7323	**50** 1.9685	**30** 1.201	K44X50X30,5HZW	**35.5** 7980	**70.5** 15850	10.7	S	6400	9900	**0.068** 0.150	**44.000** 1.7323	**43.989** 1.7319	**50.025** 1.9695	**50.009** 1.9689
45 1.7717	**45** 1.7717	**50** 1.9685	**13** 0.512	K45X50X13H	**18.4** 4140	**35.1** 7890	5.35	S	6100	9400	**0.022** 0.049	**45.000** 1.7717	**44.989** 1.7712	**50.025** 1.9695	**50.009** 1.9689
	45 1.7717	**50** 1.9685	**15** 0.591	K45X50X15H	**19.4** 4360	**37.3** 8390	5.75	S	6100	9400	**0.028** 0.062	**45.000** 1.7717	**44.989** 1.7712	**50.025** 1.9695	**50.009** 1.9689
	45 1.7717	**50** 1.9685	**17** 0.669	K45X50X17H	**24.9** 5600	**51.8** 11650	8.05	S	6100	9400	**0.030** 0.066	**45.000** 1.7717	**44.989** 1.7712	**50.025** 1.9695	**50.009** 1.9689
	45 1.7717	**50** 1.9685	**20** 0.787	K45X50X20F	**27.0** 6070	**57.4** 12900	9.00	S	6100	9400	**0.040** 0.088	**45.000** 1.7717	**44.989** 1.7712	**50.025** 1.9695	**50.009** 1.9689
	45 1.7717	**52** 2.0472	**18** 0.709	K45X52X18H	**30.1** 6770	**52.0** 11690	8.25	S	6200	9500	**0.045** 0.099	**45.000** 1.7717	**44.989** 1.7712	**52.029** 2.0484	**52.010** 2.0476
	45 1.7717	**52** 2.0472	**21** 0.827	K45X52X21F	**35.0** 7870	**63.2** 14210	9.90	S	6200	9500	**0.055** 0.121	**45.000** 1.7717	**44.989** 1.7712	**52.029** 2.0484	**52.010** 2.0476
	45 1.7717	**53** 2.0866	**20** 0.787	K45X53X20H	**36.0** 8090	**59.5** 13380	9.45	S	6200	9600	**0.054** 0.119	**45.000** 1.7717	**44.989** 1.7712	**53.029** 2.0878	**53.010** 2.0870
	45 1.7717	**53** 2.0866	**25** 0.984	K45X53X25H	**45.9** 10320	**81.5** 18320	12.7	S	6200	9600	**0.072** 0.159	**45.000** 1.7717	**44.989** 1.7712	**53.029** 2.0878	**53.010** 2.0870
	45 1.7717	**53** 2.0866	**25** 0.984	K45X53X25F	**42.5** 9550	**73.7** 16570	11.7	S	6200	9600	**0.075** 0.165	**45.000** 1.7717	**44.989** 1.7712	**53.029** 2.0878	**53.010** 2.0870
	45 1.7717	**53** 2.0866	**28** 1.102	K45X53X28H	**49.3** 11080	**89.2** 20050	13.9	S	6200	9600	**0.078** 0.172	**45.000** 1.7717	**44.989** 1.7712	**53.029** 2.0878	**53.010** 2.0870
	45 1.7717	**55** 2.1654	**20** 0.787	K45X55X20H	**42.0** 9440	**62.2** 13980	10.0	S	6400	9800	**0.074** 0.163	**45.000** 1.7717	**44.989** 1.7712	**55.029** 2.1665	**55.010** 2.1657
	45 1.7717	**59** 2.3228	**18** 0.709	K45X59X18H	**47.8** 10750	**58.9** 13240	9.60	S	6600	10000	**0.107** 0.236	**45.000** 1.7717	**44.989** 1.7712	**59.029** 2.3240	**59.010** 2.3232
	45 1.7717	**59** 2.3228	**18** 0.709	K45X59X18TN	**45.7** 10270	**55.4** 12450	9.00	P	6600	10000	**0.097** 0.214	**45.000** 1.7717	**44.989** 1.7712	**59.029** 2.3240	**59.010** 2.3232
	45 1.7717	**59** 2.3228	**36** 1.417	K45X59X36H	**82.4** 18520	**118** 26530	18.6	S	6600	10000	**0.181** 0.399	**45.000** 1.7717	**44.989** 1.7712	**59.029** 2.3240	**59.010** 2.3232
	45 1.7717	**60** 2.3622	**30** 1.181	K45X60X30H	**75.5** 16970	**101** 22710	16.0	S	6600	10000	**0.171** 0.377	**45.000** 1.7717	**44.989** 1.7712	**60.029** 2.3633	**60.010** 2.3626
	45 1.7717	**60** 2.3622	**45** 1.772	K45X60X45H	**108** 24280	**160** 35970	25.2	S	6600	10000	**0.280** 0.617	**45.000** 1.7717	**44.989** 1.7712	**60.029** 2.3633	**60.010** 2.3626
46 1.8110	**46** 1.811	**53** 2.0866	**36** 1.417	K46X53X36HZW	**48.6** 10930	**96.7** 21740	15.3	S	6100	9300	**0.100** 0.220	**46.000** 1.8110	**45.989** 1.8106	**53.029** 2.0878	**53.010** 2.0870
47 1.8504	**47** 1.8504	**52** 2.0472	**15** 0.591	K47X52X15FH	**20.1** 4520	**39.8** 8950	6.15	S	5800	8900	**0.030** 0.066	**47.000** 1.8504	**46.989** 1.8500	**52.029** 2.0484	**52.010** 2.0476

(1) Cage material: P: polymer cage, S: steel cage

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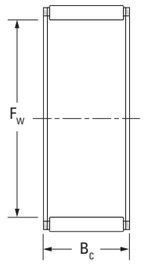
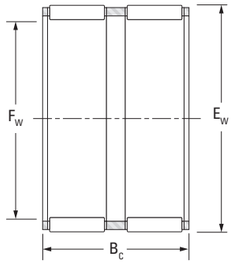
SINGLE-ROW, DOUBLE-ROW ASSEMBLIES

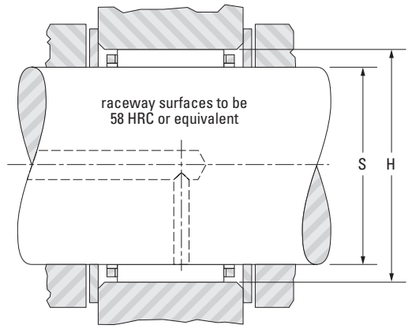
METRIC SERIES
K, K ZW SERIES



K



K ZW



Shaft Dia.	F_w	E_w	B_c	Assembly Designation	Load Ratings		Fatigue Load Limit C_u	Cage material(1) P/S	Speed Ratings		Approx. Wt.	Mounting Dimensions			
					Dynamic	Static						S		H	
			-0.20 -0.008 -0.55 -0.022		C	C_0			Grease	Oil		Max.	Min.	Max.	Min.
mm in	mm in	mm in	mm in		kN lbf		kN		min^{-1}		kg lbs	mm in	mm in	mm in	mm in
47 1.8504	**47** 1.8504	**52** 2.0472	**17** 0.669	K47X52X17H	**24.2** 5440	**50.4** 11330	7.85	S	5800	8900	**0.032** 0.071	**47.000** 1.8504	**46.989** 1.8500	**52.029** 2.0484	**52.010** 2.0476
	47 1.8504	**52** 2.0472	**27** 1.063	K47X52X27H	**36.6** 8230	**85.9** 19310	13.3	S	5800	8900	**0.045** 0.099	**47.000** 1.8504	**46.989** 1.8500	**52.029** 2.0484	**52.010** 2.0476
	47 1.8504	**55** 2.1654	**28** 1.102	K47X55X28FV1	**48.9** 10990	**89.5** 20120	14.0	S	6000	9200	**0.092** 0.203	**47.000** 1.8504	**46.989** 1.8500	**55.029** 2.1665	**55.010** 2.1657
48 1.8898	**48** 1.8898	**53** 2.0866	**17** 0.669	K48X53X17H	**25.7** 5780	**54.9** 12340	8.55	S	5700	8700	**0.032** 0.071	**48.000** 1.8898	**47.989** 1.8893	**53.029** 2.0878	**53.010** 2.0870
	48 1.8898	**54** 2.126	**19** 0.748	K48X54X19H	**30.9** 6950	**61.2** 13760	9.85	S	5700	8800	**0.042** 0.093	**48.000** 1.8898	**47.989** 1.8893	**54.029** 2.1271	**54.010** 2.1264
49 1.9291	**49** 1.9291	**55** 2.1654	**32** 1.26	K49X55X32HZW	**40.2** 9040	**86.4** 19420	13.4	S	5600	8600	**0.080** 0.176	**49.000** 1.9291	**48.989** 1.9287	**55.029** 2.1665	**55.010** 2.1657
	49 1.9291	**65** 2.5591	**38** 1.496	K49X65X38H	**100** 22480	**142** 31920	22.7	S	6100	9300	**0.244** 0.538	**49.000** 1.9291	**48.989** 1.9287	**65.029** 2.5602	**65.010** 2.5594
50 1.9685	**50** 1.9685	**55** 2.1654	**17** 0.669	K50X55X17H	**25.5** 5730	**55.0** 12360	8.55	S	5400	8400	**0.032** 0.071	**50.000** 1.9685	**49.989** 1.9681	**55.029** 2.1665	**55.010** 2.1657
	50 1.9685	**55** 2.1654	**20** 0.787	K50X55X20H	**30.2** 6790	**68.5** 15400	10.7	S	5400	8400	**0.038** 0.084	**50.000** 1.9685	**49.989** 1.9681	**55.029** 2.1665	**55.010** 2.1657
	50 1.9685	**55** 2.1654	**30** 1.181	K50X55X30	**38.2** 8590	**92.4** 20770	14.4	S	5400	8400	**0.057** 0.120	**50.000** 1.9685	**49.989** 1.9681	**55.029** 2.1665	**55.010** 2.1657
	50 1.9685	**55** 2.1654	**30** 1.181	K50X55X30FV1	**38.2** 8590	**92.4** 20770	14.4	S	5400	8400	**0.057** 0.126	**50.000** 1.9685	**49.989** 1.9681	**55.029** 2.1665	**55.010** 2.1657
	50 1.9685	**56** 2.2047	**23** 0.906	K50X56X23	**35.5** 7980	**74.1** 16660	11.7	S	5500	8500	**0.051** 0.112	**50.000** 1.9685	**49.989** 1.9681	**56.029** 2.2059	**56.010** 2.2051
	50 1.9685	**57** 2.2441	**18** 0.709	K50X57X18FH	**31.3** 7040	**56.4** 12680	8.95	S	5500	8500	**0.050** 0.110	**50.000** 1.9685	**49.989** 1.9681	**57.029** 2.2452	**57.010** 2.2445
	50 1.9685	**58** 2.2835	**20** 0.787	K50X58X20H	**38.8** 8720	**67.8** 15240	10.8	S	5600	8600	**0.065** 0.143	**50.000** 1.9685	**49.989** 1.9681	**58.029** 2.2846	**58.010** 2.2839
	50 1.9685	**58** 2.2835	**25** 0.984	K50X58X25H	**46.5** 10450	**85.6** 19240	13.4	S	5600	8600	**0.081** 0.179	**50.000** 1.9685	**49.989** 1.9681	**58.029** 2.2846	**58.010** 2.2839
	50 1.9685	**58** 2.2835	**35** 1.378	K50X58X35H	**64.9** 14590	**131** 29450	20.6	S	5600	8600	**0.105** 0.231	**50.000** 1.9685	**49.989** 1.9681	**58.029** 2.2846	**58.010** 2.2839
	50 1.9685	**62** 2.4409	**30** 1.181	K50X62X30H	**64.6** 14520	**98.1** 22050	15.5	S	5800	8900	**0.136** 0.300	**50.000** 1.9685	**49.989** 1.9681	**62.029** 2.4421	**62.010** 2.4413
50 1.9685	**50** 1.9685	**66** 2.5984	**30** 1.181	K50X66X30H	**80.9** 18190	**109** 24500	17.4	S	5900	9100	**0.192** 0.423	**50.000** 1.9685	**49.989** 1.9681	**66.029** 2.5996	**66.010** 2.5988
	50 1.9685	**70** 2.7559	**32** 1.26	K50X70X32H	**103** 23160	**129** 29000	20.6	S	6100	9300	**0.224** 0.494	**50.000** 1.9685	**49.989** 1.9681	**70.029** 2.7570	**70.010** 2.7563
52 2.0472	**52** 2.0472	**57** 2.2441	**12** 0.472	K52X57X12	**18.4** 4140	**36.7** 8250	5.60	S	5200	8000	**0.022** 0.049	**52.000** 2.0472	**51.987** 2.0467	**57.029** 2.2452	**57.010** 2.2445
	52 2.0472	**57** 2.2441	**17** 0.669	K52X57X17H	**21.4** 4810	**44.3** 9960	6.90	S	5200	8000	**0.035** 0.077	**52.000** 2.0472	**51.987** 2.0467	**57.029** 2.2452	**57.010** 2.2445
	52 2.0472	**60** 2.3622	**24** 0.945	K52X60X24	**47.1** 10600	**88.3** 19900	13.9	S	5400	8200	**0.078** 0.172	**52.000** 2.0472	**51.987** 2.0467	**60.029** 2.3633	**60.010** 2.3626
55 2.1654	**55** 2.1654	**60** 2.3622	**17** 0.669	K55X60X17	**26.0** 5850	**58.3** 13100	9.10	S	4900	7600	**0.037** 0.082	**55.000** 2.1654	**54.987** 2.1648	**60.029** 2.3633	**60.010** 2.3626
	55 2.1654	**60** 2.3622	**20** 0.787	K55X60X20H	**30.7** 6900	**72.4** 16300	11.3	S	4900	7600	**0.042** 0.093	**55.000** 2.1654	**54.987** 2.1648	**60.029** 2.3633	**60.010** 2.3626
	55 2.1654	**60** 2.3622	**27** 1.063	K55X60X27H	**40.1** 9010	**102** 22900	15.7	S	4900	7600	**0.055** 0.121	**55.000** 2.1654	**54.987** 2.1648	**60.029** 2.3633	**60.010** 2.3626
	55 2.1654	**60** 2.3622	**30** 1.181	K55X60X30FH	**40.6** 9130	**103** 23200	16.1	S	4900	7600	**0.068** 0.150	**55.000** 2.1654	**54.987** 2.1648	**60.029** 2.3633	**60.010** 2.3626
	55 2.1654	**61** 2.4016	**26** 1.024	K55X61X26H	**44.3** 9960	**102** 22900	15.9	S	5000	7600	**0.063** 0.139	**55.000** 2.1654	**54.987** 2.1648	**61.029** 2.4027	**61.010** 2.4020
	55 2.1654	**62** 2.4409	**18** 0.709	K55X62X18H	**33.2** 7460	**62.8** 14100	10.0	S	5000	7700	**0.055** 0.121	**55.000** 2.1654	**54.987** 2.1648	**62.029** 2.4421	**62.010** 2.4413
	55 2.1654	**63** 2.4803	**15** 0.591	K55X63X15F	**30.5** 6860	**51.5** 11600	8.00	S	5000	7800	**0.054** 0.119	**55.000** 2.1654	**54.987** 2.1648	**63.029** 2.4815	**63.010** 2.4807
	55 2.1654	**63** 2.4803	**20** 0.787	K55X63X20	**40.3** 9060	**73.5** 16500	11.7	S	5000	7800	**0.072** 0.159	**55.000** 2.1654	**54.987** 2.1648	**63.029** 2.4815	**63.010** 2.4807
	55 2.1654	**63** 2.4803	**25** 0.984	K55X63X25	**49.8** 11200	**96.5** 21700	15.1	S	5000	7800	**0.080** 0.176	**55.000** 2.1654	**54.987** 2.1648	**63.029** 2.4815	**63.010** 2.4807
	55 2.1654	**63** 2.4803	**32** 1.26	K55X63X32	**62.3** 14000	**129** 29000	20.0	S	5000	7800	**0.108** 0.238	**55.000** 2.1654	**54.987** 2.1648	**63.029** 2.4815	**63.010** 2.4807
58 2.2835	**58** 2.2835	**63** 2.4803	**17** 0.669	K58X63X17F	**27.0** 6070	**62.6** 14100	9.80	S	4700	7200	**0.037** 0.082	**58.000** 2.2835	**57.987** 2.2830	**63.029** 2.4815	**63.010** 2.4807
	58 2.2835	**64** 2.5197	**19** 0.748	K58X64X19H	**32.9** 7400	**70.6** 15900	11.3	S	4700	7200	**0.037** 0.082	**58.000** 2.2835	**57.987** 2.2830	**64.029** 2.5208	**64.010** 2.5201

(1) Cage material: P: polymer cage, S: steel cage

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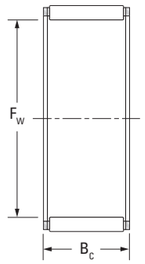
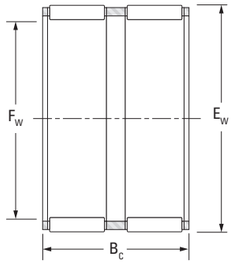
SINGLE-ROW, DOUBLE-ROW ASSEMBLIES

METRIC SERIES
K, K ZW SERIES



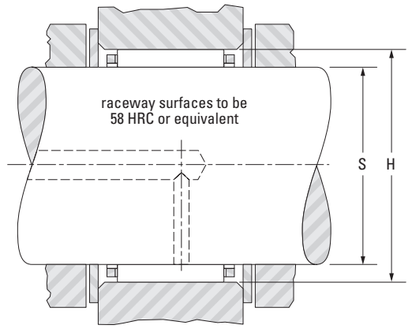
K



K ZW

Shaft Dia.	F_w	E_w	B_c -0.20 -0.008 -0.55 -0.022	Assembly Designation	Load Ratings Dynamic C	Load Ratings Static C_0	Fatigue Load Limit C_u	Cage material(1) P/S	Speed Ratings Grease	Speed Ratings Oil	Approx. Wt.	Mounting Dimensions S Max.	Mounting Dimensions S Min.	Mounting Dimensions H Max.	Mounting Dimensions H Min.
mm in	mm in	mm in	mm in		kN lbf		kN		min^{-1}		kg lbs	mm in	mm in	mm in	mm in
58 2.2835	**58** 2.2835	**65** 2.5591	**18** 0.709	K58X65X18H	**34.3** 7710	**67.1** 15100	10.7	S	4700	7300	**0.058** 0.128	**58.000** 2.2835	**57.987** 2.2830	**65.029** 2.5602	**65.010** 2.5594
60 2.3622	**60** 2.3622	**65** 2.5591	**20** 0.787	K60X65X20H	**31.9** 7170	**78.1** 17600	12.2	S	4500	6900	**0.046** 0.101	**60.000** 2.3622	**59.987** 2.3617	**65.029** 2.5602	**65.010** 2.5594
	60 2.3622	**65** 2.5591	**27** 1.063	K60X65X27FH	**39.5** 8880	**103** 23200	16.0	S	4500	6900	**0.059** 0.130	**60.000** 2.3622	**59.987** 2.3617	**65.029** 2.5602	**65.010** 2.5594
	60 2.3622	**65** 2.5591	**30** 1.181	K60X65X30FH	**42.9** 9640	**114** 25600	17.8	S	4500	6900	**0.085** 0.187	**60.000** 2.3622	**59.987** 2.3617	**65.029** 2.5602	**65.010** 2.5594
	60 2.3622	**65** 2.5591	**30** 1.181	K60X65X30	**42.9** 9640	**114** 25600	17.8	S	4500	6900	**0.070** 0.154	**60.000** 2.3622	**59.987** 2.3617	**65.029** 2.5602	**65.010** 2.5594
	60 2.3622	**68** 2.6772	**17** 0.669	K60X68X17F	**34.2** 7690	**61.4** 13800	9.50	S	4600	7100	**0.066** 0.146	**60.000** 2.3622	**59.987** 2.3617	**68.029** 2.6783	**68.010** 2.6776
	60 2.3622	**68** 2.6772	**20** 0.787	K60X68X20H	**41.8** 9400	**79.2** 17800	12.6	S	4600	7100	**0.066** 0.146	**60.000** 2.3622	**59.987** 2.3617	**68.029** 2.6783	**68.010** 2.6776
	60 2.3622	**68** 2.6772	**23** 0.906	K60X68X23H	**49.0** 11000	**97.2** 21900	15.4	S	4600	7100	**0.089** 0.196	**60.000** 2.3622	**59.987** 2.3617	**68.029** 2.6783	**68.010** 2.6776
	60 2.3622	**68** 2.6772	**25** 0.984	K60X68X25	**51.6** 11600	**104** 23400	16.3	S	4600	7100	**0.091** 0.201	**60.000** 2.3622	**59.987** 2.3617	**68.029** 2.6783	**68.010** 2.6776
	60 2.3622	**68** 2.6772	**30** 1.181	K60X68X30ZW	**46.4** 10400	**90.1** 20300	13.9	S	4600	7100	**0.119** 0.262	**60.000** 2.3622	**59.987** 2.3617	**68.029** 2.6783	**68.010** 2.6776
63 2.4803	**63** 2.4803	**71** 2.7953	**20** 0.787	K63X71X20	**41.4** 9310	**79.4** 17800	12.7	S	4400	6700	**0.070** 0.154	**63.000** 2.4803	**62.987** 2.4798	**71.029** 2.7964	**71.010** 2.7957
64 2.5197	**64** 2.5197	**70** 2.7559	**16** 0.63	K64X70X16	**26.4** 5930	**55.1** 12400	8.55	S	4200	6500	**0.049** 0.108	**64.000** 2.5197	**63.987** 2.5192	**70.029** 2.7570	**70.010** 2.7563
65 2.5591	**65** 2.5591	**70** 2.7559	**20** 0.787	K65X70X20CH	**28.6** 6430	**69.2** 15600	10.8	S	4100	6400	**0.050** 0.110	**65.000** 2.5591	**64.987** 2.5585	**70.029** 2.7570	**70.010** 2.7563
	65 2.5591	**70** 2.7559	**30** 1.181	K65X70X30	**44.4** 9980	**123** 27700	19.1	S	4100	6400	**0.075** 0.165	**65.000** 2.5591	**64.987** 2.5585	**70.029** 2.7570	**70.010** 2.7563
	65 2.5591	**73** 2.874	**23** 0.906	K65X73X23H	**48.2** 10800	**97.7** 22000	15.5	S	4200	6500	**0.091** 0.201	**65.000** 2.5591	**64.987** 2.5585	**73.029** 2.8752	**73.010** 2.8744
	65 2.5591	**73** 2.874	**30** 1.181	K65X73X30H	**60.1** 13500	**129** 29100	20.3	S	4200	6500	**0.116** 0.256	**65.000** 2.5591	**64.987** 2.5585	**73.029** 2.8752	**73.010** 2.8744
68 2.6772	**68** 2.6772	**74** 2.9134	**20** 0.787	K68X74X20FH	**37.5** 8430	**88.1** 19800	13.2	S	4000	6100	**0.062** 0.137	**68.000** 2.6772	**67.987** 2.6767	**74.029** 2.9145	**74.010** 2.9138

(1) Cage material: P: polymer cage, S: steel cage

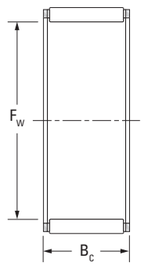


Shaft Dia.	F_w	E_w	B_c -0.20 -0.008 -0.55 -0.022	Assembly Designation	Load Ratings Dynamic C	Load Ratings Static C_0	Fatigue Load Limit C_u	Cage material(1) P/S	Speed Ratings Grease	Speed Ratings Oil	Approx. Wt.	Mounting Dimensions S Max.	Mounting Dimensions S Min.	Mounting Dimensions H Max.	Mounting Dimensions H Min.
mm in	mm in	mm in	mm in		kN lbf		kN		min^{-1}		kg lbs	mm in	mm in	mm in	mm in
68 2.6772	**68** 2.6772	**74** 2.9134	**28** 1.102	K68X74X28CH	**44.8** 10100	**110** 24700	17.1	S	4000	6100	**0.082** 0.181	**68.000** 2.6772	**67.987** 2.6767	**74.029** 2.9145	**74.010** 2.9138
	68 2.6772	**74** 2.9134	**30** 1.181	K68X74X30H	**47.6** 10700	**119** 26800	18.5	S	4000	6100	**0.098** 0.216	**68.000** 2.6772	**67.987** 2.6767	**74.029** 2.9145	**74.010** 2.9138
	68 2.6772	**74** 2.9134	**35** 1.378	K68X74X35HZW	**45.1** 10100	**111** 25000	17.1	S	4000	6100	**0.120** 0.265	**68.000** 2.6772	**67.987** 2.6767	**74.029** 2.9145	**74.010** 2.9138
	68 2.6772	**76** 2.9921	**20** 0.787	K68X76X20	**43.8** 9850	**87.8** 19700	14.0	S	4000	6200	**0.086** 0.190	**68.000** 2.6772	**67.987** 2.6767	**76.029** 2.9933	**76.010** 2.9925
70 2.7559	**70** 2.7559	**76** 2.9921	**20** 0.787	K70X76X20	**36.1** 8120	**84.7** 19000	13.5	S	3900	5900	**0.065** 0.143	**70.000** 2.7559	**69.987** 2.7554	**76.029** 2.9933	**76.010** 2.9925
	70 2.7559	**76** 2.9921	**30** 1.181	K70X76X30	**51.6** 11600	**134.0** 30100	20.9	S	3900	5900	**0.097** 0.214	**70.000** 2.7559	**69.987** 2.7554	**76.029** 2.9933	**76.010** 2.9925
	70 2.7559	**78** 3.0709	**20** 0.787	K70X78X20H	**43.6** 9800	**87.9** 19800	14.0	S	3900	6000	**0.090** 0.198	**70.000** 2.7559	**69.987** 2.7554	**78.029** 3.0720	**78.010** 3.0713
	70 2.7559	**78** 3.0709	**23** 0.906	K70X78X23F	**49.8** 11200	**104.0** 23400	16.6	S	3900	6000	**0.115** 0.254	**70.000** 2.7559	**69.987** 2.7554	**78.029** 3.0720	**78.010** 3.0713
	70 2.7559	**78** 3.0709	**24.8** 0.976	K70X78X25F	**49.8** 11200	**104.0** 23400	16.6	S	3900	6000	**0.115** 0.254	**70.000** 2.7559	**69.987** 2.7554	**78.029** 3.0720	**78.010** 3.0713
	70 2.7559	**78** 3.0709	**30** 1.181	K70X78X30H	**62.2** 14000	**139.0** 31200	21.8	S	3900	6000	**0.140** 0.309	**70.000** 2.7559	**69.987** 2.7554	**78.029** 3.0720	**78.010** 3.0713
	70 2.7559	**78** 3.0709	**46** 1.811	K70X78X46ZW	**78.4** 17600	**187.0** 42000	29.5	S	3900	6000	**0.188** 0.414	**70.000** 2.7559	**69.987** 2.7554	**78.029** 3.0720	**78.010** 3.0713
	70 2.7559	**85** 3.3465	**40** 1.575	K70X85X40F	**118** 26500	**203** 45600	32.4	S	4100	6300	**0.338** 0.745	**70.000** 2.7559	**69.987** 2.7554	**85.034** 3.3478	**85.012** 3.3469
	70 2.7559	**88** 3.4646	**30** 1.181	K70X88X30H	**115** 25900	**175** 39300	28.1	S	4100	6400	**0.205** 0.452	**70.000** 2.7559	**69.987** 2.7554	**88.034** 3.4659	**88.012** 3.4650
72 2.8346	**72** 2.8346	**80** 3.1496	**20** 0.787	K72X80X20	**44.4** 9980	**90.7** 20400	14.5	S	3800	5800	**0.084** 0.185	**72.000** 2.8346	**71.987** 2.8341	**80.029** 3.1507	**80.010** 3.1500
73 2.8740	**73** 2.874	**79** 3.1102	**20** 0.787	K73X79X20	**37.0** 8320	**88.7** 19900	14.1	S	3700	5700	**0.068** 0.150	**73.000** 2.8740	**72.987** 2.8735	**79.029** 3.1114	**79.010** 3.1106
75 2.9528	**75** 2.9528	**81** 3.189	**20** 0.787	K75X81X20F	**37.4** 8410	**90.7** 20400	14.5	S	3600	5500	**0.075** 0.165	**75.000** 2.9528	**74.987** 2.9522	**81.034** 3.1903	**81.012** 3.1894
	75 2.9528	**83** 3.2677	**23** 0.906	K75X83X23	**52.5** 11800	**114.0** 25600	18.2	S	3600	5600	**0.104** 0.229	**75.000** 2.9528	**74.987** 2.9522	**83.034** 3.2691	**83.012** 3.2682

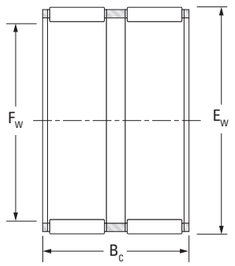
Continued on next page.

SINGLE-ROW, DOUBLE-ROW ASSEMBLIES

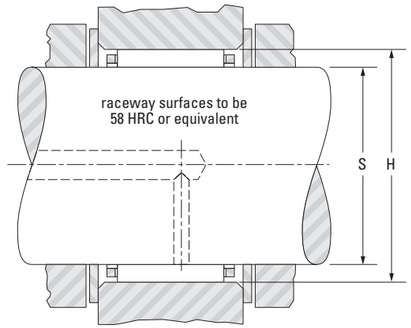
METRIC SERIES
K, K ZW SERIES



K



K ZW

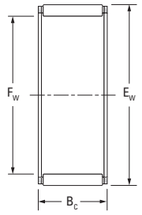


Shaft Dia.	F_w	E_w	B_c -0.20 -0.008 -0.55 -0.022	Assembly Designation	Load Ratings Dynamic C	Load Ratings Static C_0	Fatigue Load Limit C_u	Cage material(1) P/S	Speed Ratings Grease	Speed Ratings Oil	Approx. Wt.	Mounting Dimensions S Max.	Mounting Dimensions S Min.	Mounting Dimensions H Max.	Mounting Dimensions H Min.
mm in	mm in	mm in	mm in		kN lbf		kN		min^{-1}		kg lbs	mm in	mm in	mm in	mm in
75 2.9528	**75** 2.9528	**83** 3.2677	**30** 1.181	K75X83X30	**60.9** 13700	**138** 31000	21.7	S	3600	5600	**0.141** 0.311	**75.000** 2.9528	**74.987** 2.9522	**83.034** 3.2691	**83.012** 3.2682
	75 2.9528	**83** 3.2677	**30** 1.181	K75X83X30FH	**60.9** 13700	**138** 31000	21.7	S	3600	5600	**0.141** 0.311	**75.000** 2.9528	**74.987** 2.9522	**83.034** 3.2691	**83.012** 3.2682
80 3.1496	**80** 3.1496	**86** 3.3858	**20** 0.787	K80X86X20H	**38.6** 8680	**96.7** 21700	15.4	S	3400	5200	**0.072** 0.159	**80.000** 3.1496	**79.987** 3.1491	**86.034** 3.3872	**86.012** 3.3863
	80 3.1496	**88** 3.4646	**25** 0.984	K80X88X25FV1	**54.0** 12100	**121** 27200	19.2	S	3400	5200	**0.134** 0.295	**80.000** 3.1496	**79.987** 3.1491	**88.034** 3.4659	**88.012** 3.4650
	80 3.1496	**88** 3.4646	**30** 1.181	K80X88X30	**67.5** 15200	**161** 36200	25.4	S	3400	5200	**0.153** 0.337	**80.000** 3.1496	**79.987** 3.1491	**88.034** 3.4659	**88.012** 3.4650
85 3.3465	**85** 3.3465	**92** 3.622	**20** 0.787	K85X92X20H	**39.9** 8970	**91.7** 20600	14.6	S	3200	4900	**0.085** 0.187	**84.988** 3.3460	**84.973** 3.3454	**92.034** 3.6234	**92.012** 3.6225
	85 3.3465	**93** 3.6614	**25** 0.984	K85X93X25F	**58.8** 13200	**138** 31000	21.7	S	3200	4900	**0.128** 0.282	**84.988** 3.3460	**84.973** 3.3454	**93.034** 3.6628	**93.012** 3.6619
	85 3.3465	**93** 3.6614	**30** 1.181	K85X93X30H	**69.4** 15600	**170.4** 38200	26.8	S	3200	4900	**0.166** 0.366	**84.988** 3.3460	**84.973** 3.3454	**93.034** 3.6628	**93.012** 3.6619
90 3.5433	**90** 3.5433	**97** 3.8189	**20** 0.787	K90X97X20	**46.3** 10400	**114** 25600	18.1	S	3000	4600	**0.095** 0.209	**89.988** 3.5428	**89.973** 3.5422	**97.034** 3.8202	**97.012** 3.8194
	90 3.5433	**98** 3.8583	**25** 0.984	K90X98X25F	**54.8** 12300	**128** 28800	20.3	S	3000	4600	**0.134** 0.295	**89.988** 3.5428	**89.973** 3.5422	**98.034** 3.8596	**98.012** 3.8587
	90 3.5433	**98** 3.8583	**30** 1.181	K90X98X30	**63.6** 14300	**155** 34800	24.3	S	3000	4600	**0.168** 0.370	**89.988** 3.5428	**89.973** 3.5422	**98.034** 3.8596	**98.012** 3.8587
95 3.7402	**95** 3.7402	**103** 4.0551	**20** 0.787	K95X103X20	**49.3** 11100	**114** 25600	18.3	S	2800	4400	**0.130** 0.287	**94.988** 3.7397	**94.973** 3.7391	**103.034** 4.0565	**103.012** 4.0556
	95 3.7402	**103** 4.0551	**30** 1.181	K95X103X30F	**71.0** 16000	**183** 41100	28.6	S	2800	4400	**0.180** 0.39	**94.988** 3.7397	**94.973** 3.7391	**103.034** 4.0565	**103.012** 4.0556
100 3.9370	**100** 3.937	**108** 4.252	**30** 1.181	K100X108X30	**72.4** 16300	**191** 42900	29.5	S	2700	4200	**0.210** 0.463	**99.988** 3.9365	**99.973** 3.9359	**108.034** 4.2533	**108.012** 4.2524
110 4.3307	**110** 4.3307	**118** 4.6457	**24** 0.945	K110X118X24	**64.0** 14400	**168** 37800	25.6	S	2400	3800	**0.165** 0.364	**109.988** 4.3302	**109.973** 4.3296	**118.034** 4.6470	**118.012** 4.6461
	110 4.3307	**118** 4.6457	**30** 1.181	K110X118X30H	**75.3** 16900	**207** 46500	31.2	S	2400	3800	**0.200** 0.441	**109.988** 4.3302	**109.973** 4.3296	**118.034** 4.6470	**118.012** 4.6461

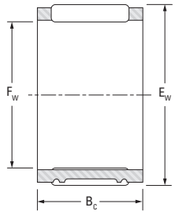
(1) Cage material: P: polymer cage, S: steel cage

SINGLE-ROW, DOUBLE-ROW ASSEMBLIES

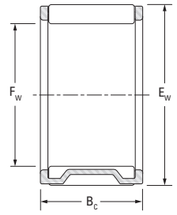
METRIC SERIES
R, RF, RFN, RP, RS, RV, V, VS, WR, WRF, WRP, WRS SERIES



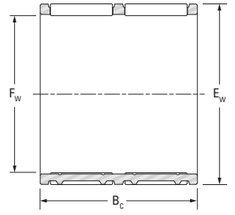
RF, RFN



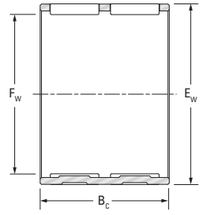
RS, R, RP



RV, V, VS



WR, WRS



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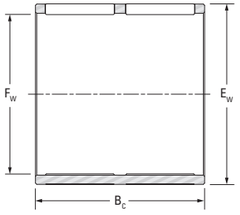

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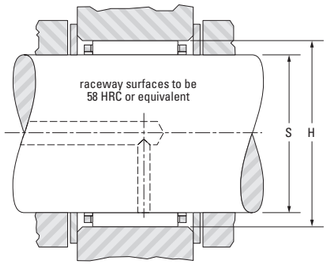


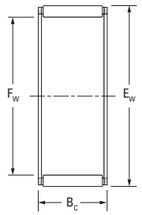
Shaft Dia.	F_w	E_w	B_c	Assembly Designation	Load Ratings		Fatigue Load Limit C_u	Cage material[1] P/S	Speed Ratings		Approx. Wt.	Mounting Dimensions			
					Dynamic	Static						S		H	
					C	C_0			Grease	Oil		Max.	Min.	Max.	Min.
mm in	mm in	mm in	mm in		kN lbf		kN		min^{-1}		kg lbs	mm in	mm in	mm in	mm in
12 0.4724	**12**	**16**	**20**	12R1620A	**9.5**	**11.5**	1.80	S	20000	30000	**0.010**	**12.000**	**11.992**	**16.017**	**16.006**
	12	**17**	**11.5**	RV121712A-2	**8.25**	**8.4**	1.25	S	16000	25000	**0.007**	**12.000**	**11.992**	**17.017**	**17.006**
13 0.5118	**13**	**17**	**10**	RS131710-2	**5.85**	**6.35**	0.970	S	23000	29000	**0.006**	**13.000**	**12.992**	**17.017**	**17.006**
	13	**17**	**12**	RS131712	**7.25**	**8.35**	1.25	S	23000	29000	**0.007**	**13.000**	**12.992**	**17.017**	**17.006**
15 0.5906	**15**	**19**	**10**	R15/10-1	**6.3**	**7.2**	1.10	S	18000	28000	**0.006**	**15.000**	**14.992**	**19.02**	**19.007**
	15	**19**	**20**	R15/20	**12.6**	**17.7**	2.80	S	18000	28000	**0.012**	**15.000**	**14.992**	**19.02**	**19.007**
	15	**21**	**9**	RV152109-4	**7.65**	**7.15**	1.10	S	14000	21000	**0.008**	**15.000**	**14.992**	**21.02**	**21.007**
17 0.6693	**17**	**21**	**13**	R17/13	**9.4**	**12.6**	1.90	S	17000	26000	**0.009**	**17.000**	**16.992**	**21.02**	**21.007**
	17	**23**	**13**	RS17/13	**11.4**	**12.4**	1.90	S	18000	27000	**0.014**	**17.000**	**16.992**	**23.02**	**23.007**
18 0.7087	**18**	**22**	**16**	R18/16-8	**11.2**	**16**	2.45	S	16000	24000	**0.011**	**18.000**	**17.992**	**22.02**	**22.007**
	18	**22**	**17**	R18/17	**11.9**	**17.4**	2.65	S	16000	24000	**0.012**	**18.000**	**17.992**	**22.02**	**22.007**
	18	**24**	**17.2**	RS182417	**15.1**	**17.9**	2.75	S	16000	25000	**0.019**	**18.000**	**17.992**	**24.02**	**24.007**
	18	**26**	**21.9**	RF182622A-1	**19.1**	**20.3**	3.20	P	17000	26000	**0.019**	**18.000**	**17.992**	**26.02**	**26.007**
	18	**26**	**21.9**	RV182622A-2	**22.7**	**25.5**	4.00	S	17000	26000	**0.031**	**18.000**	**17.992**	**26.02**	**26.007**
	18	**27**	**11**	RF182711-1	**15.5**	**14.6**	2.25	P	18000	27000	**0.014**	**18.000**	**17.992**	**27.02**	**27.007**
20 0.7874	**20**	**24**	**10**	R20/10	**7.25**	**9.4**	1.45	S	14000	22000	**0.008**	**20.000**	**19.991**	**24.02**	**24.007**
	20	**25**	**25**	RF202525	**19.1**	**28.2**	4.45	P	14000	22000	**0.014**	**20.000**	**19.991**	**25.02**	**25.007**
20 0.7874	**20**	**25**	**26**	20WR2526	**15.8**	**22**	3.30	S	14000	22000	**0.027**	**20.000**	**19.991**	**25.02**	**25.007**
	20	**26**	**11.7**	20VS2612	**10.8**	**11.9**	1.85	S	15000	23000	**0.012**	**20.000**	**19.991**	**26.02**	**26.007**
	20	**26**	**12**	RV202612-4	**13.1**	**15.4**	2.35	S	15000	23000	**0.014**	**20.000**	**19.992**	**26.02**	**26.007**
	20	**27**	**15**	20V2715	**16.2**	**18.3**	2.80	S	15000	23000	**0.019**	**20.000**	**19.991**	**27.02**	**27.007**
	20	**28**	**20**	RP202820	**24.3**	**28.5**	4.55	S	15000	23000	**0.028**	**20.000**	**19.992**	**28.02**	**28.007**
22 0.8661	**22**	**26**	**17**	R22/17	**13**	**20.7**	3.15	S	13000	20000	**0.014**	**22.000**	**21.991**	**26.02**	**26.007**
	22	**28**	**17**	RS22/17	**16.2**	**20.7**	3.15	S	13000	20000	**0.022**	**22.000**	**21.991**	**28.02**	**28.007**
	22	**28**	**23.2**	VS22/23B	**24.3**	**35.1**	5.45	S	13000	20000	**0.025**	**22.000**	**21.991**	**28.02**	**28.007**
	22	**30**	**20**	RV223020-1	**24.2**	**29**	4.60	S	14000	21000	**0.031**	**22.000**	**21.991**	**30.02**	**30.007**
	22	**32**	**11**	RF223211-1	**19.5**	**19.3**	2.95	P	14000	22000	**0.019**	**22.000**	**21.991**	**32.025**	**32.009**
	22	**32**	**15**	RV223215	**21.8**	**22.1**	3.45	S	14000	22000	**0.032**	**22.000**	**21.991**	**32.025**	**32.009**
	22	**32**	**16**	RV223216	**21.8**	**22.1**	3.45	S	14000	22000	**0.035**	**22.000**	**21.991**	**32.025**	**32.009**
23 0.9055	**23**	**33**	**20.3**	23V3320-1	**27.6**	**30.2**	4.85	S	13000	20000	**0.044**	**23.000**	**22.991**	**33.025**	**33.009**
24 0.9449	**24**	**28**	**13**	RS242813-1	**11.2**	**17.6**	2.65	S	12000	18000	**0.012**	**24.000**	**23.991**	**28.02**	**28.007**
	24	**28**	**17**	R24/17A	**13.7**	**22.8**	3.45	S	12000	18000	**0.016**	**24.000**	**23.991**	**28.02**	**28.007**
	24	**28**	**34**	WR24/34	**22**	**41.6**	6.35	S	12000	18000	**0.031**	**24.000**	**23.991**	**28.02**	**28.007**
	24	**32**	**15**	RV243215-4	**20.2**	**23.4**	3.60	S	12000	19000	**0.027**	**24.000**	**23.991**	**32.025**	**32.009**

(1) Cage material: P: polymer cage, S: steel cage

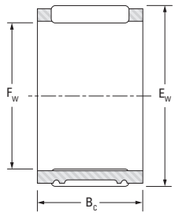
Continued on next page.

SINGLE-ROW, DOUBLE-ROW ASSEMBLIES

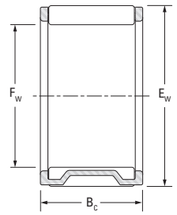
METRIC SERIES
R, RF, RFN, RP, RS, RV, V, VS, WR, WRF, WRP, WRS SERIES



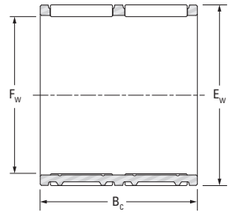
RF, RFN



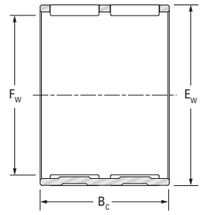
RS, R, RP



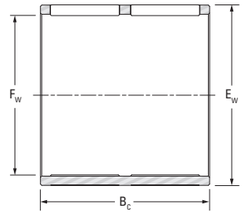
RV, V, VS



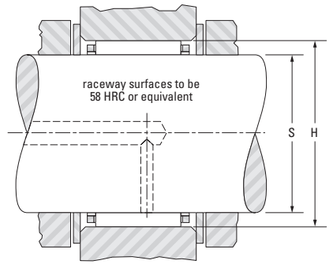
WR, WRS



WRP



WRF



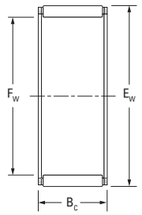
Shaft Dia.	F_w	E_w	B_c	Assembly Designation	Load Ratings		Fatigue Load Limit C_u	Cage material[1] P/S	Speed Ratings		Approx. Wt.	Mounting Dimensions			
					Dynamic	Static						S		H	
					C	C_0			Grease	Oil		Max.	Min.	Max.	Min.
mm in	mm in	mm in	mm in		kN lbf		kN		min^{-1}		kg lbs	mm in	mm in	mm in	mm in
24.9 0.9803	**24.9**	**29.9**	**26.8**	RFU253027A	**20.3**	**32.3**	5.05	P	12000	18000	**0.017**	**24.900**	**24.891**	**29.92**	**29.907**
25 0.9843	**25**	**29**	**10.1**	R25/10A	**7.25**	**10.1**	1.55	S	11000	17000	**0.010**	**25.000**	**24.991**	**29.02**	**29.007**
	25	**29**	**17**	RF252917	**14**	**23.7**	3.70	P	11000	17000	**0.009**	**25.000**	**24.991**	**29.02**	**29.007**
	25	**29**	**22**	VR25/22	**16**	**28.2**	4.30	S	11000	17000	**0.022**	**25.000**	**24.991**	**29.02**	**29.007**
	25	**30**	**12**	25R3012	**10.5**	**14.1**	2.10	S	11000	17000	**0.015**	**25.000**	**24.991**	**30.02**	**30.007**
	25	**30**	**20**	RFU253020	**17.7**	**27.4**	4.35	P	11000	17000	**0.014**	**25.000**	**24.991**	**30.02**	**30.007**
	25	**30**	**26**	25WR3026	**22.4**	**37.2**	5.75	S	11000	17000	**0.032**	**25.000**	**24.991**	**30.02**	**30.007**
	25	**31**	**24**	25R3124	**25.1**	**37.8**	5.90	S	12000	18000	**0.035**	**25.000**	**24.991**	**31.025**	**31.009**
	25	**32**	**16**	25V3216	**19.5**	**24.7**	3.80	S	12000	18000	**0.025**	**25.000**	**24.991**	**32.025**	**32.009**
	25	**32**	**32**	RV253232	**40**	**62.5**	9.75	S	12000	18000	**0.049**	**25.000**	**24.991**	**32.025**	**32.009**
	25	**33**	**24**	25R3324B-1	**30.3**	**40**	6.35	S	12000	18000	**0.048**	**25.000**	**24.991**	**33.025**	**33.009**
	25	**33**	**30**	RF253330	**38.7**	**54.8**	8.50	P	12000	18000	**0.041**	**25.000**	**24.991**	**33.025**	**33.009**
	25	**34**	**32**	RV253432	**46.1**	**63.9**	10.0	S	12000	18000	**0.066**	**25.000**	**24.991**	**34.025**	**34.009**
	25	**35**	**25**	25R3525	**32.5**	**38**	6.00	S	12000	19000	**0.065**	**25.000**	**24.991**	**35.025**	**35.009**
	25	**37**	**24**	25V3724	**34.4**	**36.6**	5.85	S	12000	19000	**0.072**	**25.000**	**24.991**	**37.025**	**37.009**
	25	**37**	**25**	25V3725A	**38.9**	**43.1**	6.85	S	12000	19000	**0.077**	**25.000**	**24.991**	**37.025**	**37.009**
	25	**37**	**33**	RV253733	**48.2**	**56.7**	8.90	S	12000	19000	**0.100**	**25.000**	**24.991**	**37.025**	**37.009**
26 1.0236	**26**	**30**	**17**	RFU263017	**13.9**	**23.7**	3.70	P	10000	16000	**0.009**	**26.000**	**25.991**	**30.02**	**30.007**
	26	**30**	**20**	RS263020	**17.1**	**31.1**	4.90	S	10000	16000	**0.020**	**26.000**	**25.991**	**30.02**	**30.007**
	26	**30**	**21.9**	RS263022A	**16.9**	**30.4**	4.75	S	10000	16000	**0.022**	**26.000**	**25.991**	**30.02**	**30.007**
	26	**31**	**24**	26WR3124-2	**20.7**	**33.9**	5.20	S	11000	17000	**0.030**	**26.000**	**25.991**	**31.025**	**31.009**
	26	**33**	**34**	RPU263334F	**30.7**	**44.3**	6.90	S	11000	17000	**0.043**	**26.000**	**25.991**	**33.025**	**33.009**
27 1.0630	**27**	**31**	**23.8**	WRS273124A	**19.1**	**36.2**	5.50	S	10000	16000	**0.025**	**27.000**	**26.991**	**31.025**	**31.009**
28 1.1024	**28**	**32**	**26**	28R3226	**17.1**	**31.5**	4.95	S	10000	15000	**0.027**	**28.000**	**27.991**	**32.025**	**32.009**
	28	**32**	**27**	RF283227	**22**	**43.9**	6.80	P	10000	15000	**0.017**	**28.000**	**27.991**	**32.025**	**32.009**
	28	**33**	**17**	28R3317	**18**	**29**	4.50	S	10000	15000	**0.022**	**28.000**	**27.991**	**33.025**	**33.009**
	28	**33**	**20**	RF283320	**19.5**	**32.2**	5.10	P	10000	15000	**0.016**	**28.000**	**27.991**	**33.025**	**33.009**
	28	**33**	**27**	R28/27	**25.1**	**44.5**	6.95	S	10000	15000	**0.036**	**28.000**	**27.991**	**33.025**	**33.009**
	28	**34**	**20**	RFU283420	**20.2**	**29.6**	4.70	P	10000	16000	**0.018**	**28.000**	**27.991**	**34.025**	**34.009**
	28	**35**	**37.5**	RPU283538A	**37**	**57.9**	9.05	S	10000	16000	**0.048**	**28.000**	**27.991**	**35.025**	**35.009**
	28	**38**	**20**	28VU3820	**21.6**	**22.9**	3.65	S	10000	16000	**0.048**	**28.000**	**27.991**	**38.025**	**38.009**
	28	**38**	**24**	RS283824	**31.7**	**37.9**	6.05	S	10000	16000	**0.070**	**28.000**	**27.991**	**38.025**	**38.009**
	28	**41**	**25**	RV284125	**40.9**	**44.6**	7.15	S	11000	17000	**0.088**	**28.000**	**27.991**	**41.025**	**41.009**
	28	**42**	**50.5**	RF284251A	**89.5**	**118**	18.4	P	11000	17000	**0.182**	**28.000**	**27.991**	**42.025**	**42.009**

(1) Cage material: P: polymer cage, S: steel cage

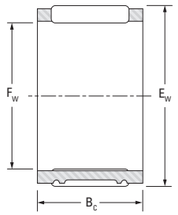
Continued on next page.

SINGLE-ROW, DOUBLE-ROW ASSEMBLIES

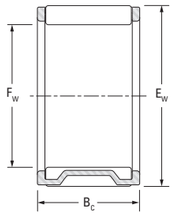
METRIC SERIES
R, RF, RFN, RP, RS, RV, V, VS, WR, WRF, WRP, WRS SERIES



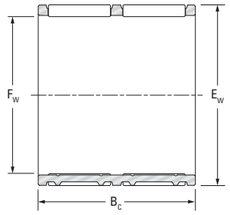
RF, RFN



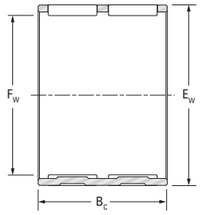
RS, R, RP



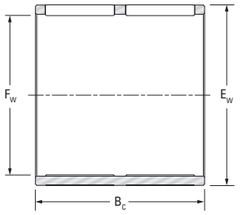
RV, V, VS



WR, WRS



WRP



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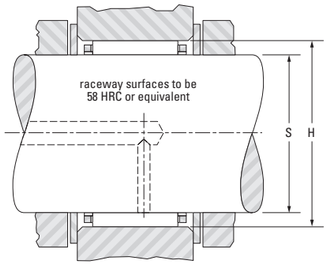


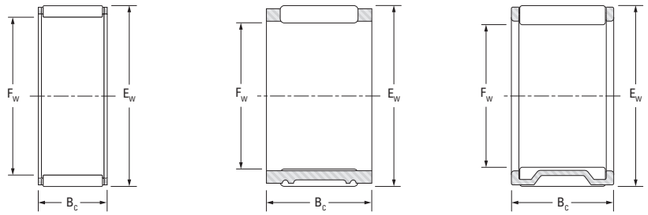
Shaft Dia.	F_w	E_w	B_c	Assembly Designation	Load Ratings		Fatigue Load Limit C_u	Cage material[1] P/S	Speed Ratings		Approx. Wt.	Mounting Dimensions			
					Dynamic	Static						S		H	
					C	C_0			Grease	Oil		Max.	Min.	Max.	Min.
mm in	mm in	mm in	mm in		kN lbf		kN		min^{-1}		kg lbs	mm in	mm in	mm in	mm in
29 1.1417	29	34	22	R29/22A	17.3	27.6	4.30	S	10000	15000	0.030	29.000	28.991	34.025	34.009
	29	34	24.4	RFU293424A-1	19.9	33.2	5.15	P	10000	15000	0.017	29.000	28.991	34.025	34.009
	29	34	27	29R3427A-1	25.8	46.7	7.30	S	10000	15000	0.037	29.000	28.991	34.025	34.009
	29	43	43	RV294343	74.4	93.3	14.7	S	10000	16000	0.177	29.000	28.991	43.025	43.009
30 1.1811	30	34	29	30WR3429A	14.3	25.2	3.85	S	9100	14000	0.032	30.000	29.991	34.025	34.009
	30	34	29	RF303429	20.6	41.2	6.50	P	9100	14000	0.016	30.000	29.991	34.025	34.009
	30	35	16	RS303516	18	29.7	4.55	S	9100	14000	0.023	30.000	29.991	35.025	35.009
	30	35	17	R30/17-1	18	29.7	4.55	S	9100	14000	0.024	30.000	29.991	35.025	35.009
	30	35	21.1	RS303521A	22.4	39.5	6.20	S	9100	14000	0.030	30.000	29.991	35.025	35.009
	30	35	24	RS303524	24.8	44.8	7.05	S	9100	14000	0.034	30.000	29.991	35.025	35.009
	30	37	16	RV303716	21.9	30.3	4.65	S	10000	15000	0.029	30.000	29.991	37.025	37.009
	30	37	26	RV303726	35.2	55.8	8.75	S	10000	15000	0.047	30.000	29.991	37.025	37.009
	30	37	32	WRS30/32B	32.6	50.4	7.75	S	10000	15000	0.066	30.000	29.991	37.025	37.009
	30	40	15.5	RV304016A-4	27.5	32.3	4.90	S	10000	15000	0.046	30.000	29.991	40.025	40.009
	30	42	32.2	30V4232	53.3	67.1	10.6	S	10000	16000	0.108	30.000	29.991	42.025	42.009
	30	45	30	30V4530	55.1	61.2	9.75	S	10000	16000	0.134	30.000	29.991	45.025	45.009
31 1.2205	31	36	20.3	RFU313620A-1	20.1	34.7	5.40	P	9100	14000	0.017	31.000	30.989	36.025	36.009
31 1.2205	31	36	24.4	RFU313624A	21.3	37.1	5.75	P	9100	14000	0.019	31.000	30.989	36.025	36.009
32 1.2598	32	37	17	R32/17-1	18.9	32.4	4.95	S	8500	13000	0.026	32.000	31.989	37.025	37.009
	32	37	35	WRS323735	33.1	66.5	10.3	S	8500	13000	0.053	32.000	31.989	37.025	37.009
	32	38	25.9	RP323826	27.6	46.1	7.20	S	9100	14000	0.034	32.000	31.989	38.025	38.009
	32	39	16	RS323916	20.8	28.9	4.40	S	9100	14000	0.035	32.000	31.989	39.025	39.009
	32	39	42	RVU323942	41.3	69.3	10.9	S	9100	14000	0.078	32.000	31.989	39.025	39.009
	32	42	16	RV324216	28.4	34.1	5.35	S	9100	14000	0.049	32.000	31.989	42.025	42.009
	32	42	20.5	RV324221-1	34.3	43.4	7.00	S	9100	14000	0.060	32.000	31.989	42.025	42.009
	32	45	28	32V4528	48.7	57.6	9.20	S	10000	15000	0.112	32.000	31.989	45.025	45.009
	32	46	18	RV324618-1	31.1	30.8	4.85	S	10000	15000	0.075	32.000	31.989	46.025	46.009
33 1.2992	33	37	26	RF333726	23	49.1	7.65	P	8500	13000	0.018	33.000	32.989	37.025	37.009
34 1.3386	34	39	20.3	RFU343920A	19.8	34.9	5.40	P	8500	13000	0.018	34.000	33.989	39.025	39.009
	34	39	62.1	WRFU343962A	46.6	105	16.3	P	8500	13000	0.052	34.000	33.989	39.025	39.009
	34	42	38.2	34R4238	49.5	81.9	12.8	S	8500	13000	0.098	34.000	33.989	42.025	42.009
35 1.3780	35	40	25	RS354025-1	27.2	53.2	8.40	S	7800	12000	0.041	35.000	34.989	40.025	40.009
	35	40	28	RF354028	28.7	56.9	8.90	P	7800	12000	0.027	35.000	34.989	40.025	40.009
	35	40	28.9	RP354029-1	30.6	61.7	9.50	S	7800	12000	0.033	35.000	34.989	40.025	40.009

(1) Cage material: P: polymer cage, S: steel cage

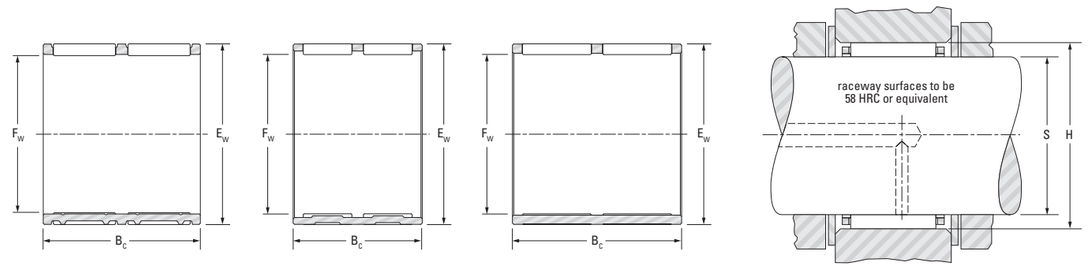
Continued on next page.

SINGLE-ROW, DOUBLE-ROW ASSEMBLIES

METRIC SERIES
R, RF, RFN, RP, RS, RV, V, VS, WR, WRF, WRP, WRS SERIES



RF, RFN **RS, R, RP** **RV, V, VS**



WR, WRS **WRP** **WRF**

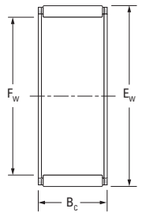
Shaft Dia.	F_w	E_w	B_c	Assembly Designation	Load Ratings		Fatigue Load Limit C_u	Cage material[1] P/S	Speed Ratings		Approx. Wt.	Mounting Dimensions			
					Dynamic	Static						S		H	
					C	C_0			Grease	Oil		Max.	Min.	Max.	Min.
mm in	mm in	mm in	mm in		kN lbf		kN		min^{-1}		kg lbs	mm in	mm in	mm in	mm in
35 1.3780	**35**	**40**	**31**	RP354031	**30.8**	**62.1**	9.60	S	7800	12000	**0.037**	**35.000**	**34.989**	**40.025**	**40.009**
	35	**40**	**33**	RP354033-1	**31.3**	**63.8**	9.85	S	7800	12000	**0.040**	**35.000**	**34.989**	**40.025**	**40.009**
	35	**40**	**35**	RF354035	**31.8**	**64.9**	10.1	P	7800	12000	**0.032**	**35.000**	**34.989**	**40.025**	**40.009**
	35	**42**	**20**	VS35/20	**27.5**	**42.6**	6.80	S	7800	12000	**0.042**	**35.000**	**34.989**	**42.025**	**42.009**
	35	**48**	**17.5**	RF354818A-1	**42.5**	**50**	7.85	P	8500	13000	**0.061**	**35.000**	**34.989**	**48.025**	**48.009**
	35	**48**	**17.5**	RV354818A-4	**38.7**	**44.1**	6.90	S	8500	13000	**0.081**	**35.000**	**34.989**	**48.025**	**48.009**
36 1.4173	**36**	**41**	**20**	RS364120	**22**	**40.9**	6.35	S	7800	12000	**0.034**	**36.000**	**35.989**	**41.025**	**41.009**
	36	**42**	**17**	RS364217-K	**20.5**	**32.8**	5.05	S	7800	12000	**0.035**	**36.000**	**35.989**	**42.025**	**42.009**
	36	**43**	**22.4**	RFU364322A	**26**	**39.8**	6.30	P	7800	12000	**0.029**	**36.000**	**35.989**	**43.025**	**43.009**
37 1.4567	**37**	**42**	**22**	37R4222	**24.1**	**46.3**	7.25	S	7200	11000	**0.038**	**37.000**	**36.989**	**42.025**	**42.009**
	37	**42**	**23**	RF374223-1	**24.1**	**46.1**	7.20	P	7200	11000	**0.022**	**37.000**	**36.989**	**42.025**	**42.009**
38 1.4961	**38.02**	**42.98**	**17**	R38/17-1	**18.6**	**33.6**	5.15	S	7200	11000	**0.032**	**38.000**	**37.989**	**43.025**	**43.009**
	38	**44**	**26**	RF384426	**28.9**	**51.7**	8.15	P	7200	11000	**0.031**	**38.000**	**37.989**	**44.025**	**44.009**
	38	**44**	**33**	RP384433	**38.1**	**74**	11.5	S	7200	11000	**0.055**	**38.000**	**37.989**	**44.025**	**44.009**
	38	**44**	**39.8**	RP384440A	**43.9**	**88.7**	13.8	S	7200	11000	**0.064**	**38.000**	**37.989**	**44.025**	**44.009**
	38	**44**	**40**	WRPU384440F	**44.1**	**89.3**	14.2	S	7200	11000	**0.075**	**38.000**	**37.989**	**44.025**	**44.009**
	38	**46**	**26**	RS384626	**36.8**	**57.8**	9.10	S	7800	12000	**0.077**	**38.000**	**37.989**	**46.025**	**46.009**
39 1.5354	**39**	**44**	**43**	WRS394443	**41.3**	**94.3**	14.9	S	7200	11000	**0.075**	**39.000**	**38.989**	**44.025**	**44.009**
	39	**44**	**43.8**	39WR4444	**39.1**	**88**	13.7	S	7200	11000	**0.080**	**39.000**	**38.989**	**44.025**	**44.009**
	39	**46**	**32.8**	39R4633	**42.5**	**76.9**	12.0	S	7200	11000	**0.086**	**39.000**	**38.989**	**46.025**	**46.009**
	39	**46**	**37.8**	RSU394638A	**46.2**	**85.4**	13.3	S	7200	11000	**0.096**	**39.000**	**38.989**	**46.025**	**46.009**
	39	**46**	**44.3**	WRP394644A	**54.9**	**107**	16.8	S	7200	11000	**0.102**	**39.000**	**38.989**	**46.025**	**46.009**
	39	**55**	**20.5**	RF395521A	**56.1**	**64.2**	10.5	P	7800	12000	**0.098**	**39.000**	**38.989**	**55.029**	**55.01**
40 1.5748	**40**	**45**	**27**	RS404527	**30.3**	**63.6**	9.90	S	7200	11000	**0.049**	**40.000**	**39.989**	**45.025**	**45.009**
	40	**45**	**30**	R40/30	**30.8**	**64.9**	10.1	S	7200	11000	**0.055**	**40.000**	**39.989**	**45.025**	**45.009**
	40	**45**	**32**	R40/32A	**14.3**	**23.3**	3.60	S	7200	11000	**0.053**	**40.000**	**39.989**	**45.025**	**45.009**
	40	**47**	**20**	RS40/20	**27.7**	**44.8**	7.00	S	7200	11000	**0.054**	**40.000**	**39.989**	**47.025**	**47.009**
	40	**48**	**34**	40V4834	**50.5**	**88.3**	13.7	S	7200	11000	**0.087**	**40.000**	**39.989**	**48.025**	**48.009**
	40	**55**	**27.5**	RF405528A-1	**68.8**	**87.1**	13.8	P	7800	12000	**0.121**	**40.000**	**39.989**	**55.029**	**55.01**
	40	**55**	**30**	RF405530	**73.6**	**94.9**	15.2	P	7800	12000	**0.132**	**40.000**	**39.989**	**55.029**	**55.01**
	40	**56**	**20**	RV405620-4	**51.9**	**58.3**	9.45	S	7800	12000	**0.130**	**40.000**	**39.989**	**56.029**	**56.01**
	40	**60**	**31.5**	RF406032A	**95.2**	**112**	17.8	P	7800	12000	**0.214**	**40.000**	**39.989**	**60.029**	**60.01**
41.3 1.6260	**41.3**	**47.3**	**23.6**	RFU414724A	**27.9**	**50.8**	7.95	P	6500	10000	**0.030**	**41.300**	**41.289**	**47.325**	**47.309**
42 1.6535	**42**	**47**	**30**	RSU424730F	**32.3**	**70.4**	11.0	S	6500	10000	**0.058**	**42.000**	**41.989**	**47.025**	**47.009**

(1) Cage material: P: polymer cage, S: steel cage

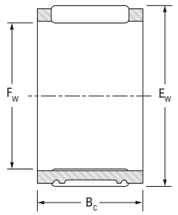
Continued on next page.

SINGLE-ROW, DOUBLE-ROW ASSEMBLIES

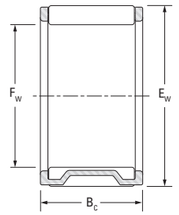
METRIC SERIES
R, RF, RFN, RP, RS, RV, V, VS, WR, WRF, WRP, WRS SERIES



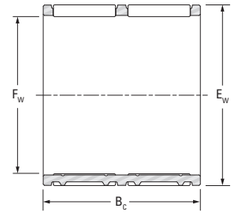
RF, RFN



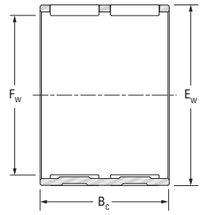
RS, R, RP



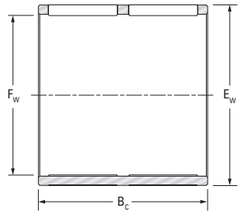
RV, V, VS



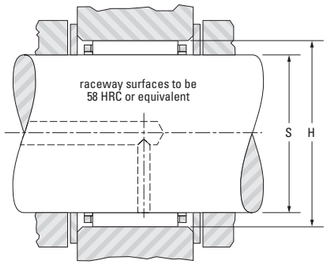
WR, WRS



WRP



WRF



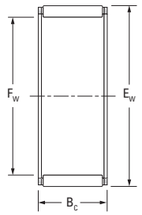
Shaft Dia.	F_w	E_w	B_c	Assembly Designation	Load Ratings		Fatigue Load Limit C_u	Cage material[1] P/S	Speed Ratings		Approx. Wt.	Mounting Dimensions			
					Dynamic	Static						S		H	
					C	C_0			Grease	Oil		Max.	Min.	Max.	Min.
mm in	mm in	mm in	mm in		kN lbf		kN		min^{-1}		kg lbs	mm in	mm in	mm in	mm in
42 1.6535	**42**	**49**	**22**	RF424922	**29.7**	**49.7**	7.95	P	6500	10000	**0.035**	**42.000**	**41.989**	**49.025**	**49.009**
43.5 1.7126	**43.5**	**50.5**	**33.8**	RF445134A	**46.5**	**89.6**	13.9	P	6500	10000	**0.059**	**43.500**	**43.489**	**50.529**	**50.51**
44 1.7323	**44**	**50**	**27.5**	44RFN5028	**36**	**72.2**	11.3	P	6500	10000	**0.041**	**44.000**	**43.989**	**50.025**	**50.009**
	44	**50**	**39**	RP445039	**46.8**	**101**	15.6	S	6500	10000	**0.070**	**44.000**	**43.989**	**50.025**	**50.009**
44.5 1.7520	**44.5**	**51.5**	**36**	RP455236A	**49.1**	**96.6**	15.0	S	6500	10000	**0.075**	**44.500**	**44.489**	**51.529**	**51.51**
	44.5	**51.5**	**41.6**	RP455242A	**54**	**109**	17.1	S	6500	10000	**0.086**	**44.500**	**44.489**	**51.529**	**51.51**
45 1.7717	**45**	**49**	**25**	RFU454925	**25.3**	**61.5**	9.70	P	6000	9300	**0.023**	**45.000**	**44.989**	**49.025**	**49.009**
	45	**50**	**17**	RS455017	**23.1**	**46.8**	7.30	S	6100	9400	**0.035**	**45.000**	**44.989**	**50.025**	**50.009**
	45	**50**	**19**	R45/19	**24.2**	**49.7**	7.80	S	6100	9400	**0.039**	**45.000**	**44.989**	**50.025**	**50.009**
	45	**50**	**24**	RS455024	**29.4**	**63.9**	10.0	S	6100	9400	**0.050**	**45.000**	**44.989**	**50.025**	**50.009**
	45	**50**	**33**	R45/33	**37.1**	**86.1**	13.3	S	6100	9400	**0.068**	**45.000**	**44.989**	**50.025**	**50.009**
	45	**52**	**22**	RS455222	**35.4**	**63.9**	10.0	S	6200	9500	**0.066**	**45.000**	**44.989**	**52.029**	**52.01**
	45	**64**	**23**	RV456423-7	**65.2**	**72.1**	11.8	S	6500	10000	**0.191**	**45.000**	**44.989**	**64.029**	**64.01**
46 1.8110	**46**	**53**	**42.6**	RPU465343A	**48.3**	**95**	14.9	S	6000	9300	**0.084**	**46.000**	**45.989**	**53.029**	**53.01**
47 1.8504	**47**	**52**	**30**	R47/30H	**36.5**	**85.4**	13.2	S	5800	8900	**0.062**	**47.000**	**46.989**	**52.029**	**52.01**
	47	**53**	**28.8**	RP475329A	**35.6**	**72.7**	11.4	S	5900	9000	**0.054**	**47.000**	**46.989**	**53.029**	**53.01**
	47	**53**	**36**	RP475336	**47.4**	**105**	16.2	S	5900	9000	**0.068**	**47.000**	**46.989**	**53.029**	**53.01**
47 1.8504	**47**	**54**	**38.6**	WRP475439A	**49.1**	**98.4**	15.5	S	5900	9100	**0.107**	**47.000**	**46.989**	**54.029**	**54.01**
47.9 1.8858	**47.9**	**52.9**	**25**	RF485325A-1	**31.2**	**70.4**	10.9	P	5700	8800	**0.033**	**47.900**	**47.889**	**52.929**	**52.91**
	47.9	**52.9**	**33.8**	RF485334A-1	**23.7**	**48.3**	7.50	P	5700	8800	**0.030**	**47.900**	**47.889**	**52.929**	**52.91**
48 1.8898	**48**	**53**	**28**	48R5328	**34.2**	**79.2**	12.3	S	5700	8700	**0.060**	**48.000**	**47.989**	**53.029**	**53.01**
	48	**54**	**20**	48R5420-1	**29.4**	**57.3**	8.90	S	5700	8800	**0.054**	**48.000**	**47.989**	**54.029**	**54.01**
	48	**54**	**39**	48R5439	**48.5**	**109**	16.8	S	5700	8800	**0.106**	**48.000**	**47.989**	**54.029**	**54.01**
49 1.9291	**49**	**56**	**44.6**	RF495645A	**61.2**	**133**	20.7	P	5700	8700	**0.087**	**49.000**	**48.989**	**56.029**	**56.01**
50 1.9685	**50**	**55**	**27**	R50/27A	**11.5**	**18.9**	2.95	S	5500	8400	**0.056**	**50.000**	**49.989**	**55.029**	**55.01**
	50	**56**	**30**	RF505630	**41.2**	**89.6**	14.0	P	5500	8500	**0.050**	**50.000**	**49.989**	**56.029**	**56.01**
	50	**56**	**40**	50WR5640	**51.2**	**119**	18.5	S	5500	8500	**0.110**	**50.000**	**49.989**	**56.029**	**56.01**
	50	**57**	**33.5**	RP505734A	**48.1**	**97.9**	15.3	S	5500	8500	**0.080**	**50.000**	**49.989**	**57.029**	**57.01**
	50	**57**	**38.9**	RS505739A	**58.4**	**126**	19.7	S	5500	8500	**0.142**	**50.000**	**49.989**	**57.029**	**57.01**
	50	**58**	**25**	RF505825	**38.5**	**66.9**	10.6	P	5600	8600	**0.054**	**50.000**	**49.989**	**58.029**	**58.01**
	50	**70**	**36**	RF507036	**115**	**149**	23.9	P	6000	9300	**0.277**	**50.000**	**49.989**	**70.029**	**70.01**
50.8 2.0000	**50.8**	**64.8**	**50**	RF516550A	**124**	**207**	32.4	P	5700	8800	**0.258**	**50.800**	**50.787**	**64.829**	**64.81**
	50.8	**64.8**	**60**	RV516560	**138**	**237**	36.7	S	5700	8800	**0.369**	**50.800**	**50.787**	**64.829**	**64.81**
51.9 2.0433	**51.9**	**57.9**	**28**	RF525828A	**40.9**	**89.9**	14.0	P	5300	8100	**0.050**	**55.500**	**55.487**	**61.529**	**61.51**

(1) Cage material: P: polymer cage, S: steel cage

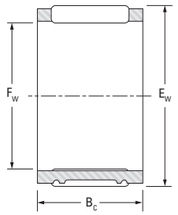
Continued on next page.

SINGLE-ROW, DOUBLE-ROW ASSEMBLIES

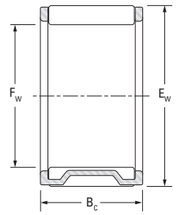
METRIC SERIES
R, RF, RFN, RP, RS, RV, V, VS, WR, WRF, WRP, WRS SERIES



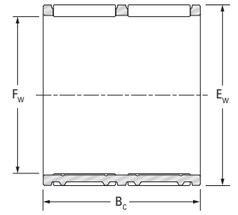
RF, RFN



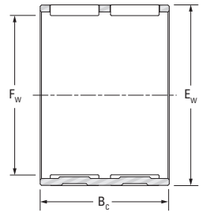
RS, R, RP



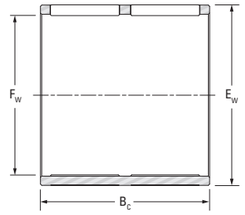
RV, V, VS



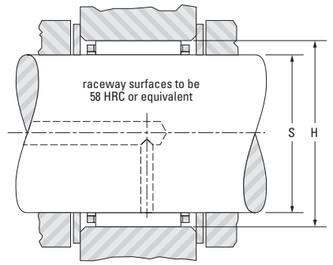
WR, WRS



WRP



WRF



Shaft Dia.	F_w	E_w	B_c	Assembly Designation	Load Ratings		Fatigue Load Limit C_u	Cage material[1] P/S	Speed Ratings		Approx. Wt.	Mounting Dimensions			
					Dynamic	Static						S		H	
					C	C_0			Grease	Oil		Max.	Min.	Max.	Min.
mm in	mm in	mm in	mm in		kN lbf		kN		min^{-1}		kg lbs	mm in	mm in	mm in	mm in
51.9 2.0433	**51.9**	**57.9**	**35.4**	RF525835A	**28.2**	**54.3**	8.45	P	5300	8100	**0.041**	**55.500**	**55.487**	**61.529**	**61.51**
53 2.0866	**53**	**58**	**25**	RF535825	**32.3**	**76**	11.9	P	5100	7900	**0.035**	**53.000**	**52.987**	**58.029**	**58.01**
54 2.1260	**54**	**60**	**36**	RP546036	**46**	**105**	16.5	S	5100	7800	**0.085**	**54.000**	**53.987**	**60.029**	**60.01**
	54	**61**	**35.8**	RFU546136A	**53.2**	**114**	17.8	P	5100	7900	**0.075**	**54.000**	**53.987**	**61.029**	**61.01**
	54	**61**	**41.3**	RF546141A	**63.5**	**143**	22.4	P	5100	7900	**0.092**	**54.000**	**53.987**	**61.029**	**61.01**
55 2.1654	**55**	**59**	**13**	55RFN5913A	**10.9**	**21.9**	3.35	P	4900	7500	**0.011**	**55.000**	**54.987**	**59.029**	**59.01**
56 2.2047	**56**	**61**	**33.5**	R56/34	**42.6**	**111**	17.2	S	4800	7400	**0.084**	**56.000**	**55.987**	**61.029**	**61.01**
	56	**63**	**47**	RPU566347	**60**	**135**	21.1	S	4900	7600	**0.119**	**56.000**	**55.987**	**63.029**	**63.01**
58 2.2835	**58**	**65**	**26.2**	58R6526	**42.2**	**87.1**	13.7	S	4700	7300	**0.099**	**58.000**	**57.987**	**65.029**	**65.01**
	58	**65**	**36.6**	58RFN6537A	**55.9**	**125**	19.5	P	4700	7300	**0.081**	**58.000**	**57.987**	**65.029**	**65.01**
	58	**65**	**36.6**	RS586537A-2	**56.7**	**127**	19.8	S	4700	7300	**0.157**	**58.000**	**57.987**	**65.029**	**65.01**
	58	**65**	**42.6**	WRP586543A	**60.1**	**137**	21.9	S	4700	7300	**0.144**	**58.000**	**57.987**	**65.029**	**65.01**
	58	**80**	**72**	RV588072	**233**	**361**	55.9	S	5200	8000	**0.889**	**58.000**	**57.987**	**80.029**	**80.01**
60 2.3622	**60**	**65**	**30**	R60/30	**40.1**	**105**	16.2	S	4500	6900	**0.081**	**60.000**	**59.987**	**65.029**	**65.01**
	60	**82**	**30**	RF608230	**120**	**155**	24.9	P	5000	7700	**0.340**	**60.000**	**59.987**	**82.034**	**82.012**
63 2.4803	**63**	**68**	**30**	R63/30	**41**	**110**	17.0	S	4300	6600	**0.083**	**63.000**	**62.987**	**68.029**	**68.01**
	63	**75**	**38.15**	RV637538-1	**121**	**240**	38.0	S	4500	6900	**0.270**	**63.000**	**62.987**	**75.029**	**75.01**

Shaft Dia.	F_w	E_w	B_c	Assembly Designation	Load Ratings		Fatigue Load Limit C_u	Cage material[1] P/S	Speed Ratings		Approx. Wt.	Mounting Dimensions			
					Dynamic	Static						S		H	
					C	C_0			Grease	Oil		Max.	Min.	Max.	Min.
mm in	mm in	mm in	mm in		kN lbf		kN		min^{-1}		kg lbs	mm in	mm in	mm in	mm in
65 2.5591	**65**	**70**	**20**	R65/20A	**12.2**	**22.3**	3.50	S	4200	6400	**0.057**	**65.000**	**64.987**	**70.029**	**70.01**
	65	**70**	**24**	R65/24A	**12.5**	**22.9**	3.60	S	4200	6400	**0.067**	**65.000**	**64.987**	**70.029**	**70.01**
68 2.6772	**68**	**73**	**31.6**	WRS687332A	**45.7**	**129**	19.8	S	4000	6100	**0.095**	**68.000**	**67.987**	**73.029**	**73.01**
70 2.7559	**70**	**76**	**20**	70R7620	**34.8**	**80.8**	12.7	S	3800	5900	**0.077**	**70.000**	**69.987**	**76.029**	**76.01**
	70	**80**	**55**	70WR8055	**103**	**225**	35.5	S	4000	6100	**0.351**	**70.000**	**69.987**	**80.029**	**80.01**
71 2.7953	**71**	**79**	**30.15**	71V7930B	**61.5**	**138**	21.4	S	3800	5900	**0.135**	**71.000**	**70.987**	**79.029**	**79.01**
73 2.8740	**73**	**79**	**20**	R73/20	**36.4**	**86.8**	13.5	S	3700	5700	**0.084**	**73.000**	**72.987**	**79.029**	**79.01**
76.2 3.0000	**76.2**	**85.5**	**31.7**	76V8632A	**76.3**	**167**	26.1	S	3600	5600	**0.177**	**76.200**	**76.187**	**85.534**	**85.512**
	76.2	**85.5**	**33.2**	RV768633A	**78.5**	**173**	27.2	S	3600	5600	**0.187**	**76.200**	**76.187**	**85.534**	**85.512**
	76.2	**85.5**	**44.2**	RV768644A-2	**95.6**	**222**	34.8	S	3600	5600	**0.235**	**76.200**	**76.187**	**85.534**	**85.512**
	76.2	**88**	**34**	RV768834A	**91.1**	**177**	27.9	S	3600	5600	**0.250**	**76.200**	**76.187**	**88.034**	**88.012**

(1) Cage material: P: polymer cage, S: steel cage

RADIAL NEEDLE ROLLER AND CAGE ASSEMBLIES FOR CONNECTING ROD APPLICATIONS

METRIC SERIES

Connecting rods have two bearing positions: the crank pin or big end, and the wrist pin or small end.

In the crank pin position there may be severe operating conditions due to centrifugal forces, internal forces, accelerations and high rotational speeds, requiring the use of special radial needle roller and cage assemblies.

Similarly, in the wrist pin position the reciprocating inertia loads and high oscillating speeds dictate the use of special cage designs.

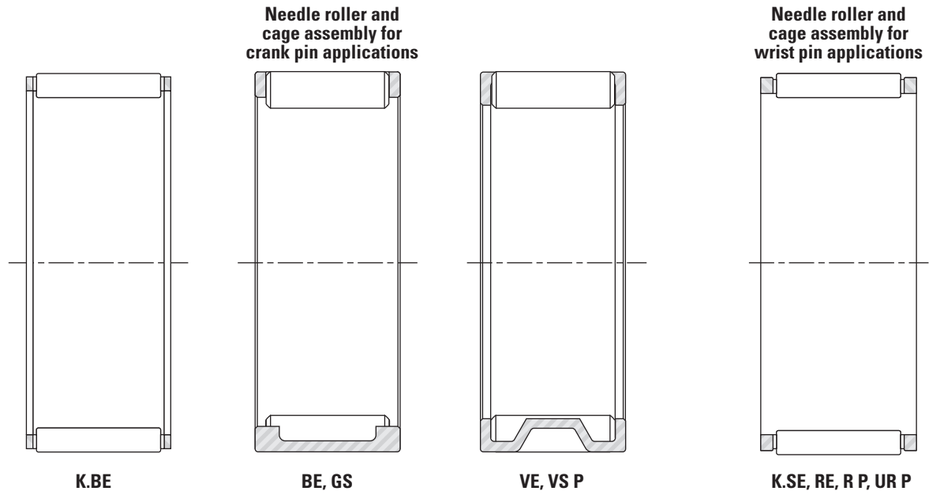


Fig. B1-3. Types of metric series radial needle roller and cage assemblies

CONSTRUCTION

METRIC SERIES RADIAL NEEDLE ROLLER AND CAGE ASSEMBLIES FOR CRANK PIN POSITIONS

Needle roller and cage assemblies for use in crank pin positions have cages with a large outside cylindrical surface to ensure optimum radial guidance in the connecting rod bore. Due to the inherent low weight and strength of the heat-treated cages, the needle roller and cage assemblies are well-suited for high-speed engine applications. When necessary, silver plating and copper plating can be applied for optimum performance during operation at high speeds.

METRIC SERIES RADIAL NEEDLE ROLLER AND CAGE ASSEMBLIES FOR WRIST PIN POSITIONS

Reciprocating inertia loads and oscillating speeds require the cages used in the wrist pin positions to be heat-treated and to guide on the wrist pin.

These cages are available in a variety of widths to allow the selection of a needle roller and cage assembly with the length of needle rollers to match the connecting rod width.

SIZE SELECTION

In most instances, selection of a suitable size of a needle roller and cage assembly for typical connecting rod positions may be based on the cylinder displacement of the engine which in turn, dictates the crank pin and wrist pin diameters.

Suggestions, based on engine displacements, are listed in the following table.

Table B1-3. Crank pin and wrist pin diameters, determined by the cylinder displacement of the engine

Cylinder displacement in cm^3								
Cylinder Displacement	>		40	60	100	150	200	300
	≤	40	60	100	150	200	300	

Diameter								
		mm in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in
Crank pin		**12/14** 0.4724/0.5512	**15/16/18** 0.5906/0.6299/0.7087	**18/20** 0.7087/0.7874	**18/20/22** 0.7087/0.7874/0.8661	**24/25/28** 0.9449/0.9843/1.1024	**28/30** 1.1024/1.1811	**35/40** 1.3780/1.5748
Wrist pin		**10/11** 0.3937/0.4331	**12/13** 0.4724/0.5118	**14/15** 0.5512/0.5906	**15/16** 0.5906/0.6299	**18** 0.7087	**20** 0.7874	**20** 0.7874

CONNECTING ROD GUIDANCE ARRANGEMENTS

End guidance of a connecting rod can be provided either at the crank pin or at the wrist pin end. Connecting-rod guidance is achieved at the crank pin end using a small clearance between the crank counterweights. Guidance at the wrist pin end is controlled by a small clearance between the piston bosses.

CRANK PIN END GUIDANCE

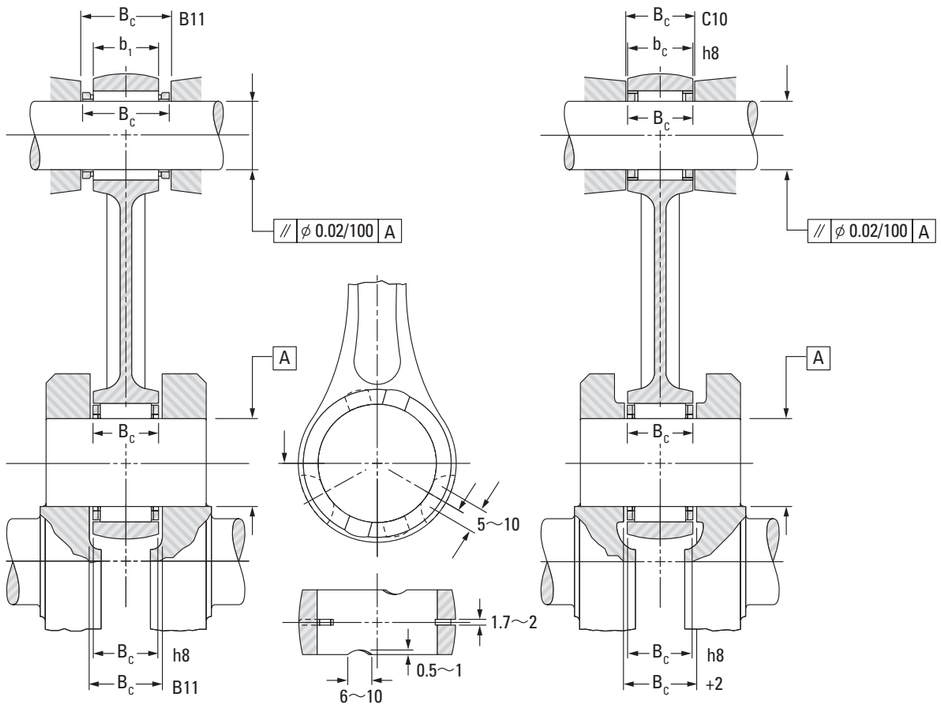
With crank pin end guidance, care must be taken that an adequate amount of lubricant is supplied to the crank pin bearing and the surfaces that guide the connecting rod. For this purpose, grooves in the connecting rod end faces, or slots in the connecting rod bore aligned with the incoming lubrication path, should be provided. Occasionally, bronze or hardened steel washers may be used for end guidance of the connecting rod.

At the wrist pin end, the needle roller and cage assembly is located axially between the piston bosses. It may be both economical and effective to machine the connecting rod at the wrist pin end and at the crank pin end to the same width. It is suggested that, at the wrist pin end, the needle roller length does not overhang the connecting rod width. Otherwise, the load rating of the needle roller and cage assembly will be reduced.

WRIST PIN END GUIDANCE

Wrist pin end will get the most effective axial guidance between the piston bosses. Grooves in the bottom of the piston bosses and a chamfer of small angle – on each side of the upper portion of the connecting rod small end – can improve the oil flow to the needle roller and cage assembly and its guiding surfaces.

The length of the needle roller and cage assembly and the connecting rod width at the crank pin end should be identical to ensure best possible radial piloting of cage in the bore of the connecting rod. The crank counterweights are recessed to allow proper axial alignment of the connecting rod. As a rule, it is not necessary to have an additional supply of lubricant. Only in engines with sparse lubrication should consideration be given to provide lubricating slots in the connecting rod bores as with crank pin end guidance.



Crank Pin End Guidance **Wrist Pin End Guidance**

Fig. B1-4. Crank pin and wrist pin end guidance

SUITABLE MATERIALS AND HEAT TREATMENT

Connecting rod crank pin end and wrist pin end bores that serve as raceways:

a case-hardening steel such as SNCM 420, 15 CrNi 6, 17 MnCr 5, or AISI 8620.

Crank pins:

a case-hardening steel such as SCM 415, 15 Cr 3, AISI 8620, or AISI 1018; a through-hardening steel such as SUJ 2m, 100 Cr 6, or AISI 52100; or a similar substance.

Wrist pins:

a case-hardening steel such as SCr 420, Ck 15, or 15 Cr 3; a through-hardening steel such as SUJ 2, 100 Cr 6, or AISI 52100; or a similar substance.

See Table B1-4 for the effective case depths of the raceways.

After hardening, the connecting rods must be stress-relieved.

FORM TOLERANCES

The recommended mounting specifications for crank pins, wrist pins, and connecting rods are listed in Table B1-4.

Table B1-4. Form tolerances

Classification		Connecting rod crank pin end and wrist pin end holes	Crank pin and wrist pin outer diameters
Surface roughness (Ra)		**0.16 a or less**	**0.1 a or less**
Hardness		**60 – 64 HRC**	
Hardening layer depth (mm) (depth to 550 HV)		**0.6 – 1.2 mm**	
Out-of-roundness (µm)	Greater than 9 and less than or equal to 18	**1.5**	**1**
	Greater than 18 and less than or equal to 30	**2**	**1.5**
	Greater than 30 and less than or equal to 40	**2.5**	**2**
Taper (µm)	Greater than 9 and less than or equal to 18	**2**	**1**
	Greater than 18 and less than or equal to 30	**3**	**2**
	Greater than 30 and less than or equal to 42	**4**	**3**
Parallelism		**0.02 mm or less per 100 mm**	

RADIAL CLEARANCE

METRIC SERIES CRANK PIN BEARINGS

The high speeds of modern production engines dictate the need for crank pin bearings with a relatively large radial clearance. As an approximation, the minimum clearance can be taken as the crank pin diameter/1000. The maximum radial clearance would be a result of the sorting plan shown in Table B1-6(1) on page B1-46.

As shown in the example of the matching scheme, the suggested mounting diameters for the crank pin position are G6 for the connecting rod bore diameters and h5 for the crank pin diameters. Axial location of the cage is shown on the crank pin end guidance arrangement.

Racing and sport engines operate at even higher speeds than production engines, requiring 50 percent larger radial clearances in the crank pin bearings. The larger radial clearances also should be used in bores of split connecting rods to avoid the danger of distortion – resulting from the unavoidable connecting rod deformation occurring in operation. Consult your representative for advice on such applications.

METRIC SERIES WRIST PIN BEARINGS

The radial clearance in wrist pin bearings should be held as small as possible. The minimum clearance should be aimed at 2 µm with the maximum clearance resulting from the proposed sorting plan in Table B1-6(2) on page B1-46. The maximum clearance should be held as close as possible to 12 µm for all wrist pin bearings based on sorting wrist pins made to a tolerance h5, small end bore diameter tolerance of K6 and needle roller grades as shown in Table B1-6(2) on page B1-46.

The recommended radial clearances for prefix BE, GS, VE, VSP, RE, RP, and URP bearings are shown in Table B1-5.

Table B1-5. Recommended radial clearances

Diameter classification		Crank pin end		Wrist pin end	
Over	Or less	Min.	Max.	Min.	Max.
mm		µm		µm	
–	10	9	25	3	14
10	18	9	25	3	14
18	30	10	25	5	17
30	40	18	33	–	–

METRIC SERIES RADIAL NEEDLE ROLLER AND CAGE ASSEMBLIES FOR CONNECTING ROD APPLICATIONS

MATCHING SCHEME FOR A CRANK PIN BEARING ARRANGEMENT
(three diameter ranges are specified for the connecting rod and crank pin)

Example: Satisfy conditions of Radial clearance 20 µm – 33 µm

Crank pin diameter	20 mm, tolerance h5
Connecting rod bore diameter	26 mm, tolerance G6
Needle roller and cage assembly	K20x26x12BE

Table B1-6(1). Radial clearance

		Connecting Rod Crank Pin End Bore Diameter 26 mm Tolerance range					
		+7 – +12		+12 – +16		+16 – +20	
		Needle Roller Tolerance	Radial Clearance	Needle Roller Tolerance	Radial Clearance	Needle Roller Tolerance	Radial Clearance
Crank Pin Diameter 20 mm Tolerance range	-3 – 0	-9 – -7	21 – 33	-6 – -4 -7 – -5	20 – 31 22 – 33	-4 – -2 -5 – -3	20 – 31 22 – 33
	-6 – -3	-7 – -5	20 – 32	-5 – -3	21 – 32	-3 – -1	21 – 32
	-9 – -6	-6 – -4	21 – 33	-3 – -1 -4 – -2	20 – 31 22 – 33	-2 – 0	22 – 33

MATCHING SCHEME FOR A WRIST PIN BEARING ARRANGEMENT
(three diameter ranges are specified for the connecting rod and wrist pin)

Example: Satisfy conditions of Radial clearance 2 µm – 16 µm

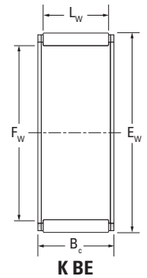
Wrist pin diameter	16 mm, tolerance h5
Connecting rod bore diameter	20 mm, tolerance K6
Needle roller and cage assembly	K16x20x20SE

Table B1-6(2). Radial clearance

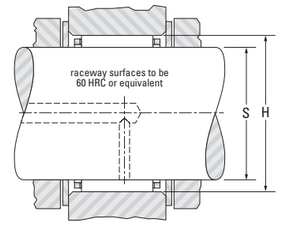
		Wrist Pin End Bore Diameter 20 mm Tolerance range					
		-11 – -6		-6 – -2		-2 – +2	
		Needle Roller Tolerance	Radial Clearance	Needle Roller Tolerance	Radial Clearance	Needle Roller Tolerance	Radial Clearance
Wrist Pin Diameter 16 mm Tolerance range	-3 – 0			-6 – -4 -7 – -5	2 – 13 4 – 15	-4 – -2 -5 – -3	2 – 13 4 – 15
	-6 – -3	-7 – -5	2 – 14	-5 – -3 -6 – -4	3 – 14 5 – 16	-3 – -1 -4 – -2	3 – 14 5 – 16
	-8 – -6	-6 – -4 -7 – -5	3 – 14 5 – 16	-3 – -1 -4 – -2	2 – 12 4 – 14	-2 – 0	4 – 10

ASSEMBLIES FOR CRANK PIN END APPLICATIONS

METRIC SERIES
K BE SERIES



K BE



Shaft Dia.	F_w	E_w	B_c -0.20 -0.008 -0.55 -0.022	L_w	Assembly Designation	Load Ratings Dynamic C	Load Ratings Static C_0	Fatigue Load Limit C_u	Approx. Wt.	Mounting Dimensions (non-high performance engines) S Max.	S Min.	H Max.	H Min.
mm in	mm in	mm in	mm in	mm in		kN lbf		kN	kg lbs	mm in	mm in	mm in	mm in
12 0.4724	**12** 0.4724	**16** 0.6299	**10** 0.394	**7.8** 0.307	K12X16X10BE	**6.21** 1400	**6.70** 1510	1.00	**0.004** 0.009	**12.000** 0.4724	**11.992** 0.4721	**16.017** 0.6306	**16.006** 0.6302
	12 0.4724	**17** 0.6693	**10** 0.394	**7.8** 0.307	K12X17X10BE	**7.32** 1650	**7.21** 1620	1.10	**0.005** 0.011	**12.000** 0.4724	**11.992** 0.4721	**17.017** 0.6700	**17.006** 0.6695
14 0.5512	**14** 0.5512	**18** 0.7087	**10** 0.394	**7.8** 0.307	K14X18X10BE	**6.89** 1550	**7.98** 1790	1.20	**0.005** 0.011	**14.000** 0.5512	**13.992** 0.5509	**18.017** 0.7093	**18.006** 0.7089
	14 0.5512	**20** 0.7874	**10** 0.394	**7.8** 0.307	K14X20X10BE	**8.90** 2000	**8.61** 1940	1.30	**0.007** 0.015	**14.000** 0.5512	**13.992** 0.5509	**20.020** 0.7882	**20.007** 0.7877
	14 0.5512	**20** 0.7874	**12** 0.472	**9.5** 0.374	K14X20X12BE	**10.50** 2360	**10.60** 2380	1.60	**0.009** 0.020	**14.000** 0.5512	**13.992** 0.5509	**20.020** 0.7882	**20.007** 0.7877
16 0.6299	**16** 0.6299	**21** 0.8268	**10** 0.394	**7.8** 0.307	K16X21X10BE	**8.17** 1840	**8.90** 2000	1.35	**0.007** 0.015	**16.000** 0.6299	**15.992** 0.6296	**21.020** 0.8276	**21.007** 0.8270
	16 0.6299	**22** 0.8661	**12** 0.472	**9.5** 0.374	K16X22X12BE	**11.20** 2520	**11.90** 2680	1.80	**0.011** 0.024	**16.000** 0.6299	**15.992** 0.6296	**22.020** 0.8669	**22.007** 0.8664
18 0.7087	**18** 0.7087	**24** 0.9449	**12** 0.472	**9.5** 0.374	K18X24X12BE	**11.80** 2650	**13.10** 2940	1.95	**0.011** 0.024	**18.000** 0.7087	**17.992** 0.7083	**24.020** 0.9457	**24.007** 0.9452
	18 0.7087	**24** 0.9449	**13** 0.512	**10.5** 0.413	WK18X24X13BE	**12.80** 2880	**14.60** 3280	2.20	**0.011** 0.024	**18.000** 0.7087	**17.992** 0.7083	**24.020** 0.9457	**24.007** 0.9452
	18 0.7087	**24** 0.9449	**15** 0.591	**11.8** 0.465	K18X24X15BE	**13.30** 2990	**15.20** 3420	2.35	**0.014** 0.031	**18.000** 0.7087	**17.992** 0.7083	**24.020** 0.9457	**24.007** 0.9452
19 0.748	**19** 0.748	**25** 0.9843	**15** 0.591	**12.5** 0.492	K19X25X15BE	**14.70** 3300	**17.60** 3960	2.70	**0.014** 0.031	**19.000** 0.7480	**18.991** 0.7477	**25.020** 0.9850	**25.007** 0.9845
20 0.7874	**20** 0.7874	**26** 1.0236	**12** 0.472	**9.8** 0.386	K20X26X12BE	**13.30** 2990	**15.80** 3550	2.40	**0.013** 0.029	**20.000** 0.7874	**19.991** 0.7870	**26.020** 1.0244	**26.007** 1.0239
	20 0.7874	**26** 1.0236	**17** 0.669	**13.8** 0.543	K20X26X17BE	**14.90** 3350	**18.20** 4090	2.85	**0.017** 0.037	**20.000** 0.7874	**19.991** 0.7870	**26.020** 1.0244	**26.007** 1.0239
22 0.8661	**22** 0.8661	**28** 1.1024	**13** 0.512	**9.8** 0.386	K22X28X13BE	**13.90** 3120	**17.10** 3840	2.60	**0.015** 0.033	**22.000** 0.8661	**21.991** 0.8658	**28.020** 1.1031	**28.007** 1.1026
	22 0.8661	**29** 1.1417	**16** 0.63	**12.8** 0.504	K22X29X16BE	**18.50** 4160	**22.30** 5010	3.45	**0.021** 0.046	**22.000** 0.8661	**21.991** 0.8658	**29.020** 1.1425	**29.007** 1.1420
24 0.9449	**24** 0.9449	**30** 1.1811	**13** 0.512	**9.8** 0.386	K24X30X13BE	**14.40** 3240	**18.40** 4140	2.80	**0.016** 0.035	**24.000** 0.9449	**23.991** 0.9445	**30.020** 1.1819	**30.007** 1.1814
	24 0.9449	**30** 1.1811	**15** 0.591	**11.8** 0.465	K24X30X15BE	**15.30** 3440	**19.70** 4430	3.05	**0.018** 0.040	**24.000** 0.9449	**23.991** 0.9445	**30.020** 1.1819	**30.007** 1.1814

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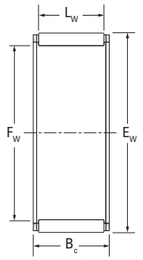
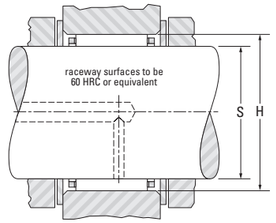
ASSEMBLIES FOR CRANK PIN END APPLICATIONS

METRIC SERIES
K BE SERIES



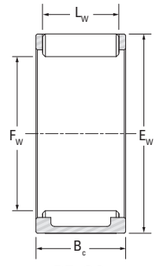
K BE



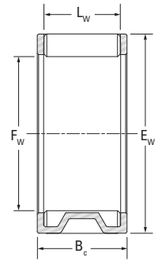
Shaft Dia.	F_w	E_w	B_c -0.20 -0.008 -0.55 -0.022	L_w	Assembly Designation	Load Ratings Dynamic C	Load Ratings Static C_0	Fatigue Load Limit C_u	Approx. Wt.	Mounting Dimensions (non-high performance engines) S Max.	S Min.	H Max.	H Min.
mm in	mm in	mm in	mm in	mm in		kN lbf		kN	kg lbs	mm in	mm in	mm in	mm in
24 0.9449	**24** 0.9449	**30** 1.1811	**17** 0.669	**13.8** 0.543	K24X30X17BE	**19.00** 4270	**26.30** 5910	4.15	**0.021** 0.040	**24.000** 0.9449	**23.991** 0.9445	**30.020** 1.1819	**30.007** 1.1814
25 0.9843	**25** 0.9843	**31** 1.2205	**19.8** 0.78	**17.8** 0.701	WK25X31X20BE	**23.30** 5240	**34.50** 7760	5.40	**0.024** 0.053	**25.000** 0.9843	**24.991** 0.9839	**31.025** 1.2215	**31.009** 1.2208
	25 0.9843	**32** 1.2598	**16** 0.63	**12.8** 0.504	K25X32X16BE	**19.20** 4320	**24.30** 5460	3.75	**0.022** 0.049	**25.000** 0.9843	**24.991** 0.9839	**32.025** 1.2608	**32.009** 1.2602
	25 0.9843	**32** 1.2598	**24** 0.945	**19.8** 0.780	K25X32X24BE	**27.50** 6180	**38.50** 8660	6.05	**0.035** 0.077	**25.000** 0.9843	**24.991** 0.9839	**32.025** 1.2608	**32.009** 1.2602
30 1.1811	**30** 1.1811	**37** 1.4567	**16** 0.63	**12.8** 0.504	K30X37X16BE	**21.60** 4860	**29.80** 6700	4.60	**0.029** 0.064	**30.000** 1.1811	**29.991** 1.1807	**37.025** 1.4577	**37.009** 1.4570
35 1.378	**35** 1.378	**42** 1.6535	**20** 0.787	**16.8** 0.661	K35X42X20BE	**29.70** 6680	**47.00** 10600	7.45	**0.039** 0.086	**35.000** 1.3780	**34.989** 1.3775	**42.025** 1.6545	**42.009** 1.6539

ASSEMBLIES FOR CRANK PIN END APPLICATIONS

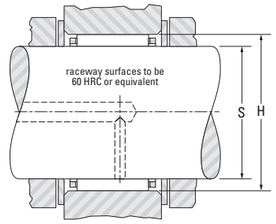
METRIC SERIES
BE, GS, VE, VS P SERIES



BE, GS



VE, VS P

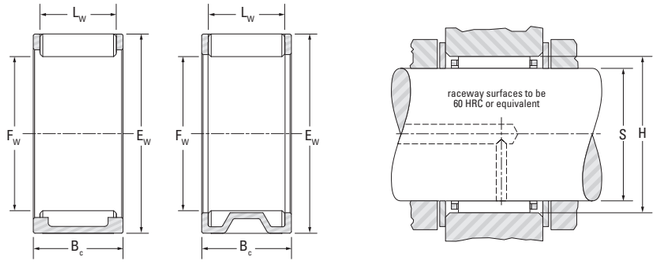


Shaft Dia.	F_w	E_w	B_c -0.20 -0.008 -0.55 -0.022	L_w	Assembly Designation	Load Ratings Dynamic C	Load Ratings Static C_0	Fatigue Load Limit C_u	Approx. Wt.	Mounting Dimensions (non-high performance engines) S Max.	S Min.	H Max.	H Min.
mm in	mm in	mm in	mm in	mm in		kN lbf		kN	kg lbs	mm in	mm in	mm in	mm in
12 0.4724	**12**	**16**	**10**	**7.4**	12VS1610P-1	**5.95**	**6.35**	0.960	**0.004**				
16 0.6299	**16**	**22**	**11.8**	**8.8**	VE162212AB1-2	**9.65**	**9.8**	1.50	**0.011**				
	16	**22**	**13.2**	**9.8**	VE162213ASB1	**10.6**	**11**	1.70	**0.012**				
17 0.6693	**17**	**23**	**14**	**10.8**	17VS2314AP	**11.2**	**12.1**	1.85	**0.013**				
20 0.7874	**20**	**26**	**13.8**	**10.8**	BE202614BSB1	**15.2**	**18.7**	2.85	**0.017**				
	20	**26**	**14**	**10.8**	20VS2614CP-2	**13.3**	**15.7**	2.40	**0.015**				
	20	**26**	**14**	**10.8**	BE202614SY1B1	**13.3**	**15.7**	2.40	**0.016**				
22 0.8661	**22**	**28**	**14**	**10.8**	22VS2814FP	**13.2**	**15.9**	2.45	**0.016**				
	22	**28**	**15.7**	**12.8**	BE222816ASB1	**17.9**	**23.7**	3.65	**0.02**				
	22	**28**	**16**	**11.8**	VS22/16KP-1	**13.8**	**16.9**	2.55	**0.018**				
	22	**29**	**16**	**11.8**	22VS2916BP	**15.7**	**18**	2.75	**0.021**				
	22	**29**	**16.8**	**12.8**	BE222917ASY1B1-2	**18.7**	**22.7**	3.45	**0.027**				
23 0.9055	**23**	**28**	**12**	**8.8**	23VS2812AP	**11.6**	**15.5**	2.30	**0.013**				
25 0.9843	**25**	**32**	**15.8**	**12.8**	BE253216ASY1B1	**20.6**	**26.6**	4.10	**0.026**				
26 1.0236	**26**	**32**	**19.8**	**15.8**	BE263220ASB1	**22.9**	**34.2**	5.45	**0.03**				
27 1.0630	**27**	**36**	**18**	**13.8**	27VS3618P	**23.4**	**27.1**	4.15	**0.042**				
	27	**36**	**20.8**	**16.8**	VE273621AB1	**29.8**	**37.1**	5.90	**0.047**				

Continued on next page.

ASSEMBLIES FOR CRANK PIN END APPLICATIONS

METRIC SERIES
BE, GS, VE, VS P SERIES

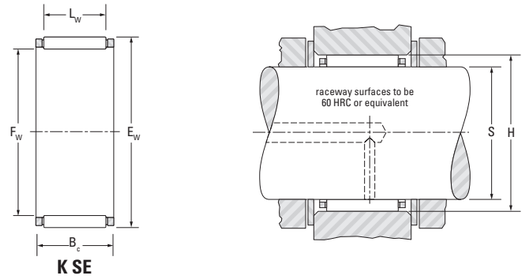


BE, GS **VE, VS P**

Shaft Dia.	F_w	E_w	B_c -0.20 -0.008 -0.55 -0.022	L_w	Assembly Designation	Load Ratings Dynamic C	Load Ratings Static C_0	Fatigue Load Limit C_u	Approx. Wt.	Mounting Dimensions (non-high performance engines) S Max.	S Min.	H Max.	H Min.
mm in	mm in	mm in	mm in	mm in		kN lbf		kN	kg lbs	mm in	mm in	mm in	mm in
30 1.1811	**30**	**37**	**16**	**12.8**	30VS3716AP-1	**20.8**	**28.3**	4.35	**0.03**				
	30	**37**	**20**	**15.8**	30VS3720P	**24.6**	**35.2**	5.50	**0.036**				
	30	**38**	**17.8**	**14.8**	VE303818AB1	**26.5**	**35.4**	5.60	**0.038**				
32 1.2598	**32**	**40**	**20**	**15.8**	VE324020SB1	**29.9**	**42.2**	6.75	**0.048**				
34 1.3386	**34**	**43**	**19.8**	**15.8**	BE344320ASB1	**34.2**	**47.2**	7.60	**0.059**				
	34	**43**	**22**	**17.8**	GS344322-1	**37.7**	**53.5**	8.45	**0.063**				
	34	**44**	**19.8**	**16.8**	BE344420ASY1B1	**38.6**	**51.5**	8.25	**0.064**				
35 1.378	**35**	**43**	**20**	**15.8**	35VS4320BP	**32**	**47.4**	7.60	**0.051**				
	35	**43**	**21.8**	**17.8**	BE354322ASB1	**36.6**	**56.4**	8.90	**0.057**				
	35	**45**	**21.8**	**17.8**	BE354522ASYB1	**43.5**	**60.7**	9.75	**0.081**				
	35	**45**	**24.8**	**20.8**	BE354525ASYB1	**48.6**	**70.0**	11.1	**0.088**				
37 1.4567	**37**	**47**	**25**	**20.8**	37VS4725P-1	**43.9**	**61.9**	9.80	**0.082**				
38 1.4961	**38**	**50**	**22.8**	**18.8**	BE385023ASY1B3-5	**51.4**	**68.2**	10.9	**0.113**				

ASSEMBLIES FOR WRIST PIN END APPLICATIONS

METRIC SERIES
K SE SERIES



K SE

Shaft Dia.	F_w	E_w	B_c -0.20 -0.008 -0.55 -0.022	L_w	Assembly Designation	Load Ratings Dynamic C	Load Ratings Static C_0	Fatigue Load Limit C_u	Approx. Wt.	Mounting Dimensions (non-high performance engines) S Max.	S Min.	H Max.	H Min.
mm in	mm in	mm in	mm in	mm in		kN lbf		kN	kg lbs	mm in	mm in	mm in	mm in
9 0.3543	**9** 0.3543	**12** 0.4724	**11.5** 0.453	**8.4** 0.331	K9X12X11,5SE	**4.23** 951	**4.53** 1020	0.690	**0.003** 0.007	**9.000** 0.3543	**8.994** 0.3541	**12.017** 0.4731	**12.006** 0.4727
	9 0.3543	**13** 0.5118	**12.5** 0.492	**9.8** 0.386	K9X13X12,5SE	**5.58** 1250	**5.41** 1220	0.820	**0.005** 0.011	**9.000** 0.3543	**8.994** 0.3541	**13.017** 0.5125	**13.006** 0.5120
10 0.3937	**10** 0.3937	**13** 0.5118	**14.5** 0.571	**11.8** 0.465	K10X13X14,5SE	**5.93** 1330	**7.20** 1620	1.10	**0.004** 0.009	**10.000** 0.3937	**9.994** 0.3935	**13.017** 0.5125	**13.006** 0.5120
	10 0.3937	**14** 0.5512	**10** 0.394	**7.0** 0.276	K10X14X10SE	**4.62** 1040	**4.36** 980	0.640	**0.004** 0.009	**10.000** 0.3937	**9.994** 0.3935	**14.017** 0.5519	**14.006** 0.5514
12 0.4724	**12** 0.4724	**15** 0.5906	**13** 0.512	**9.8** 0.386	K12X15X13SE	**6.00** 1350	**7.72** 1740	1.20	**0.004** 0.009	**12.000** 0.4724	**11.992** 0.4721	**15.017** 0.5912	**15.006** 0.5908
	12 0.4724	**15** 0.5906	**15** 0.591	**11.8** 0.465	K12X15X15SE	**6.97** 1570	**9.36** 2100	1.40	**0.005** 0.011	**12.000** 0.4724	**11.992** 0.4721	**15.017** 0.5912	**15.006** 0.5908
	12 0.4724	**15** 0.5906	**17.5** 0.689	**12.8** 0.504	K12X15X17,5SE	**7.45** 1670	**10.2** 2290	1.60	**0.006** 0.013	**12.000** 0.4724	**11.992** 0.4721	**15.017** 0.5912	**15.006** 0.5908
	12 0.4724	**16** 0.6299	**13** 0.512	**9.8** 0.386	K12X16X13SE	**6.03** 1360	**6.38** 1430	0.970	**0.006** 0.013	**12.000** 0.4724	**11.992** 0.4721	**16.017** 0.6306	**16.006** 0.6302
	12 0.4724	**17** 0.6693	**13** 0.512	**9.8** 0.386	K12X17X13SE	**7.61** 1710	**7.54** 1700	1.15	**0.007** 0.015	**12.000** 0.4724	**11.992** 0.4721	**17.017** 0.6700	**17.006** 0.6695
	12 0.4724	**17** 0.6693	**15** 0.591	**12.5** 0.492	K12X17X15SE	**9.30** 2090	**9.75** 2190	1.50	**0.007** 0.015	**12.000** 0.4724	**11.992** 0.4721	**17.017** 0.6700	**17.006** 0.6695
13 0.5118	**13** 0.5118	**16** 0.6299	**14** 0.551	**9.8** 0.386	K13X16X14SE	**5.62** 1260	**7.23** 1630	1.10	**0.005** 0.011	**13.000** 0.5118	**12.992** 0.5115	**16.017** 0.6306	**16.006** 0.6302
	13 0.5118	**17** 0.6693	**17.7** 0.697	**13.8** 0.543	K13X17X17,7SE	**9.80** 2200	**12.3** 2770	1.90	**0.008** 0.018	**13.000** 0.5118	**12.992** 0.5115	**17.017** 0.6700	**17.006** 0.6695
	13 0.5118	**18** 0.7087	**15** 0.591	**12.5** 0.492	K13X18X15SE	**9.28** 2090	**9.88** 2220	1.50	**0.008** 0.018	**13.000** 0.5118	**12.992** 0.5115	**18.017** 0.7093	**18.006** 0.7089
14 0.5512	**14** 0.5512	**18** 0.7087	**13** 0.512	**9.8** 0.386	K14X18X13SE	**7.39** 1660	**8.69** 1950	1.30	**0.007** 0.015	**14.000** 0.5512	**13.992** 0.5509	**18.017** 0.7093	**18.006** 0.7089
	14 0.5512	**18** 0.7087	**17** 0.669	**11.8** 0.465	K14X18X17SE	**8.59** 1930	**10.5** 2360	1.60	**0.009** 0.020	**14.000** 0.5512	**13.992** 0.5509	**18.017** 0.7093	**18.006** 0.7089
	14 0.5512	**18** 0.7087	**21** 0.827	**14.8** 0.583	K14X18X21SE	**10.3** 2320	**13.3** 2990	2.05	**0.011** 0.024	**14.000** 0.5512	**13.992** 0.5509	**18.017** 0.7093	**18.006** 0.7089
15 0.5906	**15** 0.5906	**19** 0.748	**17** 0.669	**11.8** 0.465	K15X19X17SE	**9.05** 2030	**11.5** 2590	1.75	**0.009** 0.020	**15.000** 0.5906	**14.992** 0.5902	**19.020** 0.7488	**19.007** 0.7483

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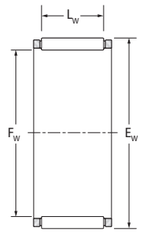
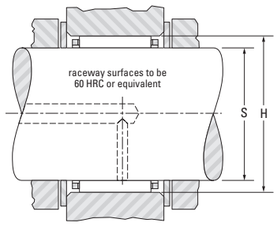
ASSEMBLIES FOR WRIST PIN END APPLICATIONS

METRIC SERIES
K SE SERIES



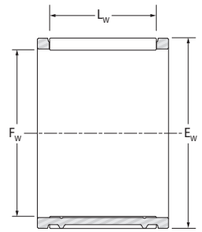
K SE



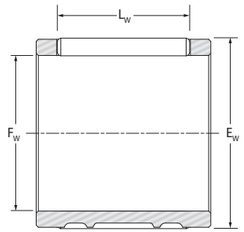
Shaft Dia.	F_w	E_w	B_c -0.20 -0.008 -0.55 -0.022	L_w	Assembly Designation	Load Ratings Dynamic C	Load Ratings Static C_0	Fatigue Load Limit C_u	Approx. Wt.	Mounting Dimensions (non-high performance engines) S Max.	S Min.	H Max.	H Min.
mm in	mm in	mm in	mm in	mm in		kN lbf		kN	kg lbs	mm in	mm in	mm in	mm in
15 0.5906	15 0.5906	19 0.748	19.5 0.768	15.8 0.622	K15X19X19,5SE	10.8 2430	14.3 3210	2.25	0.010 0.022	15.000 0.5906	14.992 0.5902	19.020 0.7488	19.007 0.7483
	15 0.5906	19 0.748	20 0.787	15.8 0.622	K15X19X20SE	10.8 2430	14.3 3210	2.25	0.010 0.022	15.000 0.5906	14.992 0.5902	19.020 0.7488	19.007 0.7483
16 0.6299	16 0.6299	20 0.7874	20 0.787	15.8 0.622	K16X20X20SE	12.0 2700	16.9 3800	2.60	0.011 0.024	16.000 0.6299	15.992 0.6296	20.020 0.7882	20.007 0.7877
	16 0.6299	20 0.7874	23 0.906	15.8 0.622	K16X20X23SE	10.7 2410	14.5 3260	2.25	0.013 0.029	16.000 0.6299	15.992 0.6296	20.020 0.7882	20.007 0.7877
18 0.7087	18 0.7087	22 0.8661	22 0.866	17.8 0.701	K18X22X22SE	14.4 3240	22.0 4950	3.45	0.016 0.035	18.000 0.7087	17.992 0.7083	22.020 0.8669	22.007 0.8664
	18 0.7087	23 0.9055	20 0.787	15.8 0.622	K18X23X20SE	13.6 3060	17.6 3960	2.80	0.015 0.033	18.000 0.7087	17.992 0.7083	23.020 0.9063	23.007 0.9058
	18 0.7087	23 0.9055	23 0.906	17.8 0.701	K18X23X23SE	15.9 3570	21.6 4860	3.35	0.018 0.040	18.000 0.7087	17.992 0.7083	23.020 0.9063	23.007 0.9058
20 0.7874	20 0.7874	24 0.9449	23 0.906	17.8 0.701	K20X24X23SE	14.8 3330	23.7 5330	3.70	0.017 0.037	20.000 0.7874	19.991 0.7870	24.020 0.9457	24.007 0.9452
	20 0.7874	25 0.9843	22 0.866	16.8 0.661	K20X25X22SE	15.9 3570	22.2 4990	3.50	0.020 0.044	20.000 0.7874	19.991 0.7870	25.020 0.9850	25.007 0.9845
	20 0.7874	25 0.9843	23 0.906	17.8 0.701	K20X25X23SE	17.5 3930	25.2 5670	3.95	0.025 0.055	20.000 0.7874	19.991 0.7870	25.020 0.9850	25.007 0.9845

ASSEMBLIES FOR WRIST PIN END APPLICATIONS

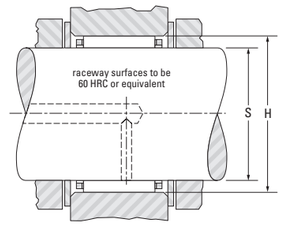
METRIC SERIES
R P, RE, UR P SERIES



R P



RE, UR P

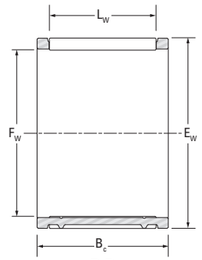


Shaft Dia.	F_w	E_w	B_c -0.20 -0.008 -0.55 -0.022	L_w	Assembly Designation	Load Ratings Dynamic C	Load Ratings Static C_0	Fatigue Load Limit C_u	Approx. Wt.	Mounting Dimensions (non-high performance engines) S Max.	S Min.	H Max.	H Min.
mm in	mm in	mm in	mm in	mm in		kN lbf		kN	kg lbs	mm in	mm in	mm in	mm in
9 0.3543	9	12	12	8.8	9R1212P	4.95	5.55	0.830	0.004				
12 0.4724	12	16	14.8	11.8	12R1615CP	8.35	9.8	1.50	0.008				
	12	16	15.4	11.8	RE121615AL1	8.35	9.8	1.50	0.008				
	12	16	16	12.8	12UR1616P	7.7	8.75	1.35	0.008				
14 0.5512	14	18	15.8	11.8	RE141816AL1	8.9	11.1	1.70	0.01				
	14	18	16.5	12.8	RE141817AL2-2	9.45	11.9	1.80	0.01				
	14	18	17.5	11.8	14R1818P	8.3	10.1	1.55	0.011				
	14	18	20	13.8	UR14/20P	8.9	11	1.70	0.012				
15 0.5906	15	19	17.3	12.8	RE151917BL3	9.9	12.9	1.95	0.011				
	15	19	20	15.8	15R1920BP-1	12.1	16.6	2.60	0.013				
	15	20	17.8	13.8	RE152018BL2	12.3	14.7	2.30	0.014				
	15	20	19.8	15.8	RE152020CL2	13.1	16	2.50	0.016				
16 0.6299	16	20	18.8	14.8	R16/18.8AP-2	11	15.1	2.35	0.013				
	16	20	19.5	13.8	R16/19.5FP	9.95	13.2	2.05	0.014				
	16	20	19.5	13.8	RE162020AL2	9.95	13.2	2.05	0.013				
	16	20	22.5	14.8	R16/22.5EP	9.85	13	2.00	0.016				
	16	21	17.5	13.8	16R2118BP-2	12.2	14.8	2.30	0.016				

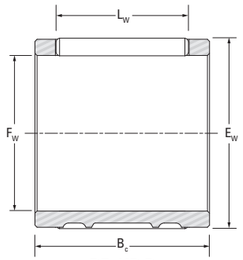
Continued on next page.

ASSEMBLIES FOR WRIST PIN END APPLICATIONS

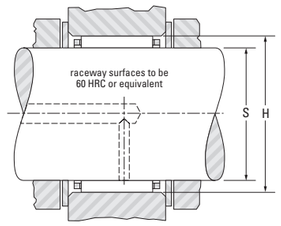
METRIC SERIES
R P, RE, UR P SERIES



R P



RE, UR P



Shaft Dia.	F_w	E_w	B_c -0.20 -0.008 -0.55 -0.022	L_w	Assembly Designation	Load Ratings Dynamic C	Load Ratings Static C_0	Fatigue Load Limit C_u	Approx. Wt.	Mounting Dimensions (non-high performance engines) S Max.	S Min.	H Max.	H Min.
mm in	mm in	mm in	mm in	mm in		kN lbf		kN	kg lbs	mm in	mm in	mm in	mm in
16 0.6299	**16**	**21**	**19.5**	**15.8**	16R2120EP-2	**13.5**	**16.9**	2.65	**0.017**				
	16	**21**	**22.5**	**16.8**	RE162123AL2	**15.4**	**20**	3.15	**0.02**				
18 0.7087	**18**	**22**	**19.65**	**13.8**	RE182220AL1	**10.9**	**15.4**	2.40	**0.015**				
	18	**22**	**22**	**15.8**	18R2222P	**12.1**	**17.6**	2.70	**0.017**				
	18	**22**	**23.6**	**17.8**	RE182224AL2	**13.3**	**20**	3.10	**0.017**				
	18	**23**	**22**	**15.8**	18R2322P	**14.2**	**18.6**	2.90	**0.021**				
	18	**23**	**23.8**	**17.8**	RE182324AL2	**16.5**	**22.7**	3.55	**0.024**				
19 0.7480	**19**	**24**	**24.8**	**18.8**	RE192425AL1	**18.3**	**26.2**	4.10	**0.026**				
20 0.7874	**20**	**24**	**13**	**9.8**	R20/13P	**9.85**	**14**	2.15	**0.01**				
	20	**25**	**13**	**9.8**	20R2513P	**11.2**	**14.1**	2.15	**0.013**				
	20	**25**	**21.8**	**16.8**	RE202522AL2	**17.6**	**25.3**	4.00	**0.024**				
	20	**25**	**23**	**18.8**	RE202523L1	**19.1**	**28.2**	4.40	**0.024**				
	20	**25**	**24**	**17.8**	RE202524L2-1	**16.3**	**23**	3.60	**0.026**				
	20	**25**	**27.8**	**21.8**	RE202528AL1	**21.7**	**33.2**	5.15	**0.03**				

RADIAL NEEDLE ROLLER AND CAGE ASSEMBLIES

INCH SERIES

Inch series radial needle roller and cage assemblies are available in a variety of sizes and designs. This catalog includes the most popular, standardized designs.

REFERENCE STANDARDS:

- **ANSI/ABMA 18.2** – needle roller bearings – radial, inch design.

Before selecting specific inch series radial needle roller and cage assemblies, the engineering section should be reviewed.

WJ

WJC

Fig. B1-5 . Types of inch series radial needle roller and cage assemblies

There are two primary constructions of inch series needle roller and cage assemblies. WJ assemblies are heavy-duty compared to WJC assemblies due to the nature of the roller diameter.

CONSTRUCTION

Radial needle roller and cage assemblies have a steel cage that provides both inward and outward retention for the needle rollers. The designs provide maximum cage strength consistent with the inherent high load-ratings of needle roller bearings.

Accurate guidance of the needle rollers by the cage bars allows for operation at high speeds. Needle roller and cage assemblies have either one or two rows of needle rollers.

Also available (by request) are needle roller and cage assemblies using molded, one-piece glass-reinforced engineered polymer cages. These operate well at temperatures up to 250° F (120° C) over extended periods. However, care should be exercised when bearings are lubricated with oils containing additives, as service life may be reduced if the operating temperature exceeds 212° F (100° C). At such high temperatures, oil can deteriorate with time and it is suggested that oil change intervals are observed.

Needle rollers with relieved ends – used in these assemblies are made of high carbon chrome steel through-hardened, ground and lapped to close tolerances for diameter and roundness. See the engineering section for further discussion of relieved end rollers.

DIMENSIONAL ACCURACY

The nominal inch assemblies, WJ and WJC, contain needle rollers manufactured to only one diameter grade. Within any one assembly, the needle rollers have a total diameter tolerance of 0.0001 in (0.003 mm).

The limit to precision of the radial clearance of mounted needle roller and cage assemblies is the capability of the user to hold close tolerances on the inner and outer raceways.

The tolerance of the overall width of these assemblies is given in the bearing tables of this section.

MOUNTING DIMENSIONS

The needle roller and cage assembly normally uses the shaft and housing as the inner and outer raceways. To realize full bearing load rating and life, the shaft and housing must have the correct geometric and metallurgical characteristics.

The tables of dimensions for these assemblies list the suggested diameters for the shaft when used as the inner raceway. These are consistent with ISO h5 shaft raceway tolerances. Additional design details for shafts used as inner raceways can be found in the engineering section.

Since the housing normally serves as the outer raceway, it should be of sufficient cross section to maintain adequate roundness and running clearance under load. The tables of dimensions

B

also list the suggested diameters for the housings when used as outer raceways. These are consistent with ISO G6 housing bore tolerances. Additional design details for housings used as outer raceways can be found in the engineering section.

The suggested mounting diameter tolerances for these needle roller and cage assemblies will provide correct running clearance for most applications.

The needle roller and cage assembly must be axially located by shoulders or other suitable means. End locating surfaces should be hardened to minimize wear. For satisfactory operation, minimum axial clearance should be 0.008 in (0.203 mm). When using type WJ assembly, fillets adjacent to the assembly must not exceed 0.03 in (0.762 mm) radius. When it is necessary to use fillets adjacent to WJC assembly, please consult your representative for suggestions.

LUBRICATION

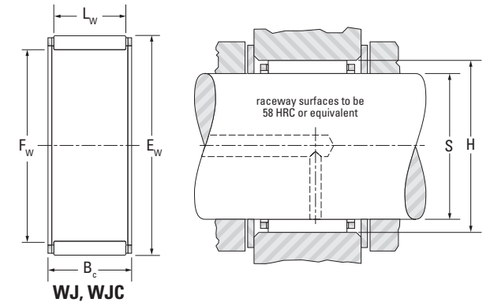
Oil is the preferred lubricant for most applications. In critical applications involving high speeds, ample oil flow must be provided. Where assemblies are subjected to high centrifugal forces, such as in epicyclic gearing, or inertia forces, as in the small end of a connecting rod, the contact pressure between the cage and the raceway guiding surface becomes critical. The allowable contact pressure depends on a combination of the induced force and the relative velocity between the cage and the raceway and the rate of lubricant flow. Consult your representative when cages will be subjected to high induced forces.

SPECIAL DESIGNS

Needle roller and cage assemblies made to special dimensions or configurations, such as those that are split to assemble around a one-piece crankshaft, can be made available on special order where quantities permit. Special plated cages to enhance life under conditions of high induced forces can also be made available.

SINGLE-ROW ASSEMBLIES

INCH SERIES



WJ, WJC

Shaft Dia.	F_w	E_w	B_c	Assembly Designation	Load Ratings		Fatigue Load Limit C_u	Speed Ratings		Mounting Dimensions				Approx. Wt.
					Dynamic	Static				S (ISO h5)		H (ISO G6)		
			+0 -0.38 +0 -0.015		C	C_0		Grease	Oil	Max.	Min.	Max.	Min.	
in	mm in	mm in	mm in		kN lbf		kN	min^{-1}		mm in	mm in	mm in	mm in	kg lbs
3/8	**9.525** 0.3750	**12.700** 0.5000	**9.53** 0.375	WJC-060806	**3.87** 870	**4.00** 900	0.600	24000	37000	**9.525** 0.3750	**9.520** 0.3748	**12.715** 0.5006	**12.705** 0.5002	**0.003** 0.006
1/2	**12.700** 0.5000	**15.875** 0.6250	**12.70** 0.500	WJC-081008	**6.23** 1400	**8.01** 1800	1.65	23000	35000	**12.700** 0.5000	**12.692** 0.4997	**15.890** 0.6256	**15.880** 0.6252	**0.005** 0.010
9/16	**14.288** 0.5625	**17.463** 0.6875	**12.70** 0.500	WJC-091108	**6.81** 1530	**9.25** 2080	1.40	22000	34000	**14.288** 0.5625	**14.280** 0.5622	**17.478** 0.6881	**17.468** 0.6877	**0.006** 0.013
5/8	**15.875** 0.6250	**19.050** 0.7500	**12.70** 0.500	WJC-101208	**7.03** 1580	**9.96** 2240	1.50	18000	27000	**15.875** 0.6250	**15.867** 0.6247	**19.070** 0.7508	**19.058** 0.7503	**0.006** 0.013
	15.875 0.6250	**22.225** 0.8750	**15.88** 0.625	WJ-101410	**15.6** 3510	**17.8** 3990	2.80	19000	29000	**15.875** 0.6250	**15.867** 0.6247	**22.245** 0.8758	**22.233** 0.8753	**0.012** 0.027
	15.875 0.6250	**22.225** 0.8750	**22.23** 0.875	WJ-101414	**21.3** 4780	**26.4** 5940	4.10	19000	29000	**15.875** 0.6250	**15.867** 0.6247	**22.245** 0.8758	**22.233** 0.8753	**0.017** 0.038
3/4	**19.050** 0.7500	**25.400** 1.0000	**25.40** 1.000	WJ-121616	**26.8** 6020	**37.2** 8370	5.80	16000	24000	**19.050** 0.7500	**19.040** 0.7496	**25.420** 1.0008	**25.408** 1.0003	**0.023** 0.051
13/16	**20.638** 0.8125	**26.988** 1.0625	**22.23** 0.875	WJ-131714	**25.1** 5650	**35.0** 7880	5.50	14000	22000	**20.638** 0.8125	**20.627** 0.8121	**27.008** 1.0633	**26.995** 1.0628	**0.021** 0.046
7/8	**22.225** 0.8750	**28.575** 1.1250	**25.40** 1.000	WJ-141816	**29.2** 6570	**43.5** 9770	6.75	13000	20000	**22.225** 0.8750	**22.215** 0.8746	**28.595** 1.1258	**28.583** 1.1253	**0.026** 0.058
1	**25.400** 1.0000	**33.338** 1.3125	**19.05** 0.750	WJ-162112	**28.1** 6320	**37.1** 8340	5.90	12000	18000	**25.400** 1.0000	**25.390** 0.9996	**33.363** 1.3135	**33.348** 1.3129	**0.029** 0.063
	25.400 1.0000	**33.338** 1.3125	**25.40** 1.000	WJ-162116	**36.8** 8270	**52.5** 11800	8.20	12000	18000	**25.400** 1.0000	**25.390** 0.9996	**33.363** 1.3135	**33.348** 1.3129	**0.038** 0.084
	25.400 1.0000	**33.338** 1.3125	**31.75** 1.250	WJ-162120	**44.5** 10000	**67.2** 15100	10.5	12000	18000	**25.400** 1.0000	**25.390** 0.9996	**33.363** 1.3135	**33.348** 1.3129	**0.048** 0.105
1 1/8	**28.575** 1.1250	**38.100** 1.5000	**25.40** 1.000	WJ-182416	**42.4** 9520	**57.8** 13000	9.05	10000	16000	**28.575** 1.1250	**28.565** 1.1246	**38.125** 1.5010	**38.110** 1.5004	**0.041** 0.090
	28.575 1.1250	**38.100** 1.5000	**31.75** 1.250	WJ-182420	**52** 11700	**74.7** 16800	11.7	10000	16000	**28.575** 1.1250	**28.565** 1.1246	**38.125** 1.5010	**38.110** 1.5004	**0.065** 0.143
1 1/4	**31.750** 1.2500	**41.275** 1.6250	**19.05** 0.750	WJ-202612	**33.4** 7520	**43.7** 9830	7.05	9300	14000	**31.750** 1.2500	**31.740** 1.2496	**41.300** 1.6260	**41.285** 1.6254	**0.043** 0.094
	31.750 1.2500	**41.275** 1.6250	**25.40** 1.000	WJ-202616	**44.1** 9910	**62.3** 14000	9.80	9300	14000	**31.750** 1.2500	**31.740** 1.2496	**41.300** 1.6260	**41.285** 1.6254	**0.061** 0.134
	31.750 1.2500	**41.275** 1.6250	**31.75** 1.250	WJ-202620	**53.8** 12100	**81.0** 18200	12.6	9300	14000	**31.750** 1.2500	**31.740** 1.2496	**41.300** 1.6260	**41.285** 1.6254	**0.071** 0.156

· Load ratings are based on a minimum raceway hardness of 58 HRC or equivalent.
· Minimum axial clearance should be 0.02 mm (0.008 in).

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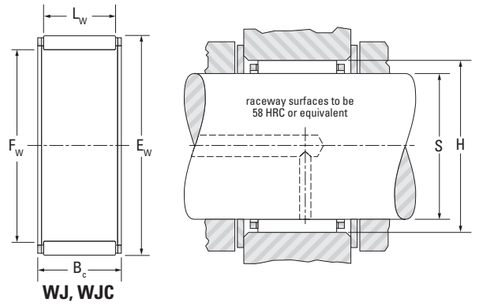
SINGLE-ROW ASSEMBLIES

INCH SERIES



WJ, WJC

Shaft Dia.	F_w	E_w	B_c	Assembly Designation	Load Ratings		Fatigue Load Limit C_u	Speed Ratings		Mounting Dimensions				Approx. Wt.
			+0 +0 -0.38 -0.015		Dynamic	Static				S (ISO h5)		H (ISO G6)		
					C	C_0		Grease	Oil	Max.	Min.	Max.	Min.	
in	mm in	mm in	mm in		kN lbf		kN	min^{-1}		mm in	mm in	mm in	mm in	kg lbs
1¼	**31.750** 1.2500	**41.275** 1.6250	**38.10** 1.500	WJ-202624	**63.6** 14300	**99.6** 22400	15.6	9300	14000	**31.750** 1.2500	**31.740** 1.2496	**41.300** 1.6260	**41.285** 1.6254	**0.085** 0.188
1⅜	**34.925** 1.3750	**44.450** 1.7500	**25.40** 1.000	WJ-222816	**45.8** 10300	**67.2** 15100	10.5	8300	13000	**34.925** 1.3750	**34.915** 1.3746	**44.475** 1.7510	**44.460** 1.7504	**0.067** 0.147
	34.925 1.3750	**44.450** 1.7500	**31.75** 1.250	WJ-222820	**56.0** 12600	**87.2** 19600	13.6	8300	13000	**34.925** 1.3750	**34.915** 1.3746	**44.475** 1.7510	**44.460** 1.7504	**0.077** 0.170
1½	**38.100** 1.5000	**47.625** 1.8750	**25.40** 1.000	WJ-243016	**47.2** 10600	**71.6** 16100	11.3	7600	12000	**38.100** 1.5000	**38.090** 1.4996	**47.650** 1.8760	**47.635** 1.8754	**0.078** 0.172
	38.100 1.5000	**47.625** 1.8750	**31.75** 1.250	WJ-243020	**57.8** 13000	**93.0** 20900	14.5	7600	12000	**38.100** 1.5000	**38.090** 1.4996	**47.650** 1.8760	**47.635** 1.8754	**0.083** 0.184
	38.100 1.5000	**47.625** 1.8750	**38.10** 1.500	WJ-243024	**68.1** 15300	**114.8** 25800	18.0	7600	12000	**38.100** 1.5000	**38.090** 1.4996	**47.650** 1.8760	**47.635** 1.8754	**0.100** 0.220
	38.100 1.5000	**47.625** 1.8750	**44.45** 1.750	WJ-243028	**77.4** 17400	**135.7** 30500	21.2	7600	12000	**38.100** 1.5000	**38.090** 1.4996	**47.650** 1.8760	**47.635** 1.8754	**0.134** 0.295
1¾	**44.450** 1.7500	**53.975** 2.1250	**19.05** 0.750	WJ-283412	**39.5** 8870	**59.6** 13400	9.60	6400	9900	**44.450** 1.7500	**44.440** 1.7496	**54.003** 2.1261	**53.985** 2.1254	**0.058** 0.127
	44.450 1.7500	**53.975** 2.1250	**25.40** 1.000	WJ-283416	**52.0** 11700	**85.0** 19100	13.4	6400	9900	**44.450** 1.7500	**44.440** 1.7496	**54.003** 2.1261	**53.985** 2.1254	**0.084** 0.185
	44.450 1.7500	**53.975** 2.1250	**38.10** 1.500	WJ-283424	**74.7** 16800	**136** 30600	21.3	6400	9900	**44.450** 1.7500	**44.440** 1.7496	**54.003** 2.1261	**53.985** 2.1254	**0.115** 0.253
2	**50.800** 2.0000	**60.325** 2.3750	**19.05** 0.750	WJ-323812	**42.8** 9610	**69** 15500	11.1	5600	8600	**50.800** 2.0000	**50.787** 1.9995	**60.353** 2.3761	**60.335** 2.3754	**0.065** 0.143
	50.800 2.0000	**60.325** 2.3750	**25.40** 1.000	WJ-323816	**56.5** 12700	**98** 22100	15.5	5600	8600	**50.800** 2.0000	**50.787** 1.9995	**60.353** 2.3761	**60.335** 2.3754	**0.105** 0.231
	50.800 2.0000	**60.325** 2.3750	**31.75** 1.250	WJ-323820	**69.0** 15500	**127** 28700	20.0	5600	8600	**50.800** 2.0000	**50.787** 1.9995	**60.353** 2.3761	**60.335** 2.3754	**0.108** 0.238
	50.800 2.0000	**60.325** 2.3750	**38.10** 1.500	WJ-323824	**81.0** 18200	**157** 35300	24.6	5600	8600	**50.800** 2.0000	**50.787** 1.9995	**60.353** 2.3761	**60.335** 2.3754	**0.130** 0.286
2 1/16	**52.388** 2.0625	**61.913** 2.4375	**25.40** 1.000	WJ-333916	**57.8** 13000	**102** 23100	16.2	5400	8300	**52.388** 2.0625	**52.375** 2.0620	**61.940** 2.4386	**61.923** 2.4379	**0.099** 0.218
2⅛	**53.975** 2.1250	**63.500** 2.5000	**25.40** 1.000	WJ-344016	**52.5** 11800	**92.08** 20700	14.6	5200	8000	**53.975** 2.1250	**53.962** 2.1245	**63.528** 2.5011	**63.510** 2.5004	**0.089** 0.196
	53.975 2.1250	**63.500** 2.5000	**38.10** 1.500	WJ-344024	**78.3** 17600	**153** 34500	24.0	5200	8000	**53.975** 2.1250	**53.962** 2.1245	**63.528** 2.5011	**63.510** 2.5004	**0.137** 0.302
2 3/16	**55.563** 2.1875	**65.088** 2.5625	**19.05** .750	WJ-354112	**44.5** 10000	**75.17** 16900	12.2	5000	7800	**55.563** 2.1875	**55.550** 2.1870	**65.115** 2.5636	**65.098** 2.5629	**0.070** 0.155
	55.563 2.1875	**65.088** 2.5625	**25.40** 1.000	WJ-354116	**57.8** 13000	**107** 24100	16.9	5000	7800	**55.563** 2.1875	**55.550** 2.1870	**65.115** 2.5636	**65.098** 2.5629	**0.094** 0.207
2¼	**57.150** 2.2500	**66.675** 2.6250	**25.40** 1.000	WJ-364216	**53.8** 12100	**96.08** 21600	15.2	4900	7500	**57.150** 2.2500	**57.137** 2.2495	**66.703** 2.6261	**66.685** 2.6254	**0.096** 0.212
	57.150 2.2500	**66.675** 2.6250	**31.75** 1.250	WJ-364220	**67.6** 15200	**128** 28900	20.1	4900	7500	**57.150** 2.2500	**57.137** 2.2495	**66.703** 2.6261	**66.685** 2.6254	**0.120** 0.265
2⅜	**60.325** 2.3750	**69.850** 2.7500	**38.10** 1.500	WJ-384424	**81.4** 18300	**167** 37600	26.1	4600	7100	**60.325** 2.3750	**60.312** 2.3745	**69.878** 2.7511	**69.860** 2.7504	**0.151** 0.334
2½	**63.500** 2.5000	**73.025** 2.8750	**25.40** 1.000	WJ-404616	**55.6** 12500	**104** 23400	16.5	4400	6700	**63.500** 2.5000	**63.487** 2.4995	**73.053** 2.8761	**73.035** 2.8754	**0.106** 0.234
	63.500 2.5000	**73.025** 2.8750	**31.75** 1.250	WJ-404620	**69.8** 15700	**139** 31400	21.8	4400	6700	**63.500** 2.5000	**63.487** 2.4995	**73.053** 2.8761	**73.035** 2.8754	**0.132** 0.292
	63.500 2.5000	**73.025** 2.8750	**38.10** 1.500	WJ-404624	**83.2** 18700	**173** 39100	27.2	4400	6700	**63.500** 2.5000	**63.487** 2.4995	**73.053** 2.8761	**73.035** 2.8754	**0.179** 0.395
2¾	**69.850** 2.7500	**79.375** 3.1250	**25.40** 1.000	WJ-445016	**57.8** 13000	**112.54** 25300	17.8	4000	6100	**69.850** 2.7500	**69.837** 2.7495	**79.403** 3.1261	**79.385** 3.1254	**0.116** 0.256
3	**76.200** 3.0000	**85.725** 3.3750	**25.40** 1.000	WJ-485416	**59.6** 13400	**120.55** 27100	19.1	3600	5600	**76.200** 3.0000	**76.187** 2.9995	**85.761** 3.3764	**85.738** 3.3755	**0.126** 0.278
	76.200 3.0000	**85.725** 3.3750	**38.10** 1.500	WJ-485424	**85.4** 19200	**191.72** 43100	29.9	3600	5600	**76.200** 3.0000	**76.187** 2.9995	**85.761** 3.3764	**85.738** 3.3755	**0.189** 0.416
3¼	**82.550** 3.2500	**92.075** 3.6250	**25.40** 1.000	WJ-525816	**61.4** 13800	**128.55** 28900	20.4	3300	5100	**82.550** 3.2500	**82.535** 3.2494	**92.111** 3.6264	**92.088** 3.6255	**0.136** 0.299
	82.550 3.2500	**92.075** 3.6250	**38.10** 1.500	WJ-525824	**88.1** 19800	**204.62** 46000	31.9	3300	5100	**82.550** 3.2500	**82.535** 3.2494	**92.111** 3.6264	**92.088** 3.6255	**0.220** 0.486
3½	**88.900** 3.5000	**98.425** 3.8750	**25.40** 1.000	WJ-566216	**63.2** 14200	**136.56** 30700	21.7	3100	4700	**88.900** 3.5000	**88.885** 3.4994	**98.461** 3.8764	**98.438** 3.8755	**0.146** 0.321
	88.900 3.5000	**101.600** 4.0000	**25.40** 1.000	WJ-566416	**79.6** 17900	**150.35** 33800	23.9	3100	4800	**88.900** 3.5000	**88.885** 3.4994	**101.636** 4.0014	**101.613** 4.0005	**0.197** 0.435
	88.900 3.5000	**101.600** 4.0000	**38.10** 1.500	WJ-566424	**113** 25600	**237.53** 53400	37.4	3100	4800	**88.900** 3.5000	**88.885** 3.4994	**101.636** 4.0014	**101.613** 4.0005	**0.296** 0.653
4	**101.600** 4.0000	**114.300** 4.5000	**25.40** 1.000	WJ-647216	**83.6** 18800	**166.59** 37450	30.9	2700	4200	**101.600** 4.0000	**101.585** 3.9994	**114.336** 4.5014	**114.313** 4.5005	**0.224** 0.493
	101.600 4.0000	**114.300** 4.5000	**38.10** 1.500	WJ-647224	**119** 26800	**263.33** 59200	40.6	2700	4200	**101.600** 4.0000	**101.585** 3.9994	**114.336** 4.5014	**114.313** 4.5005	**0.335** 0.739
5	**127.000** 5.0000	**152.400** 6.0000	**38.10** 1.500	WJ-809624	**211** 47600	**365.20** 82100	51.9	2200	3400	**127.000** 5.0000	**126.982** 4.9993	**152.438** 6.0015	**152.415** 6.0006	**1.018** 2.244

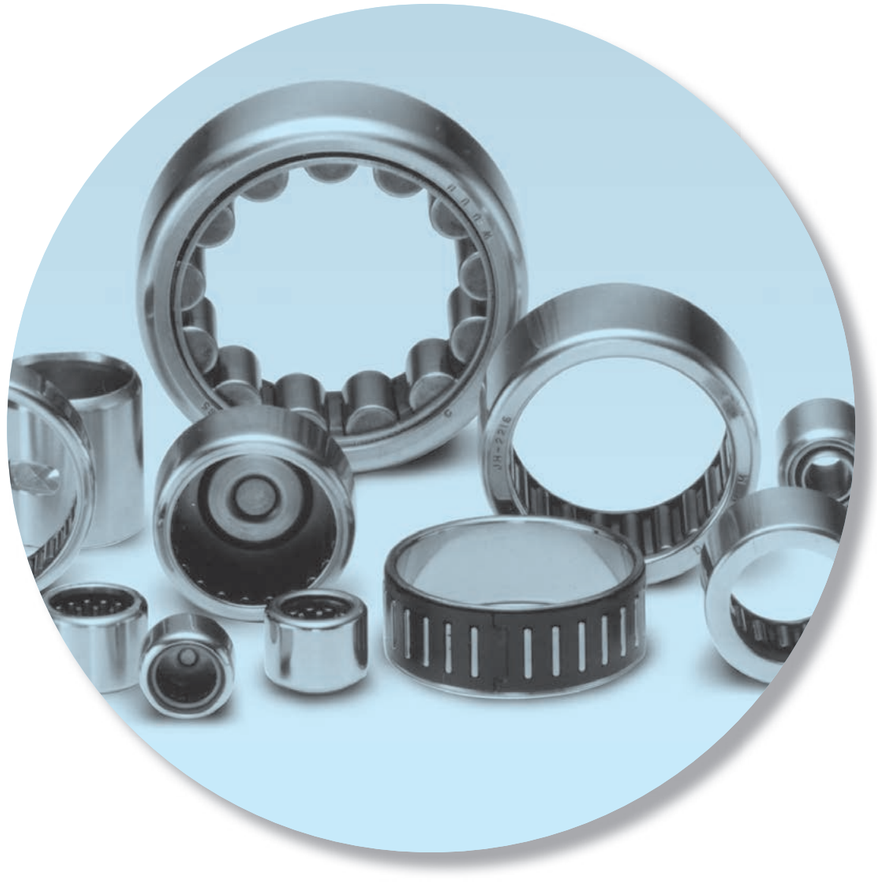
· Load ratings are based on a minimum raceway hardness of 58 HRC or equivalent.
· Minimum axial clearance should be 0.02 mm (0.008 in).

NOTES

DRAWN CUP NEEDLE ROLLER BEARINGS

Overview: Drawn cup needle roller bearings support radial loads and reduce friction between rotating components, with a drawn outer shell serving as a raceway for the rollers. The small cross section of the drawn cup bearing provides high load-carrying capability with minimum required space. Drawn cup bearings are easily installed with a press fit in the housing.

- **Catalog range:** 3 mm – 139.7 mm (0.1181 in – 5.5000 in) bore.
- **Markets:** Transmissions, transfer cases, engines, valve trains, steering and braking systems, axle supports, outboard engines, power tools, copiers, fax machines, paper-moving equipment and appliances.
- **Features:** Available in two basic designs: full complement and caged.
- **Benefits:** Full complement bearings handle high radial load-carrying capability. Caged bearings provide high speed and maximum lubricant-retention capability.



Drawn Cup Needle Roller Bearings – Metric Nominal Dimensions

Prefix
HK drawn cup bearing, caged, open ends
BK drawn cup bearing, caged, closed end

Width
12 = 12 mm

HK **10** **12** **AS1**

Needle roller complement bore diameter
10 = 10 mm

Suffix (1)
RS lip contact seal on one side of the bearing
.2RS lip contact seal on each side of the bearing
AS1 lubricating hole

(1) These suffixes only apply to the HK and BK Series bearings.

Prefix
BTM, BHTM, BKM, BHKM, BSM drawn cup bearing, caged, open ends
BM, BHM, YM drawn cup bearing, full complement, open ends

Width
10 = 10 mm

BTM **17** **10** **UU**

Suffix
UU lip contact seal on each side of the bearing
J bearing designed according to ISO standards

Needle roller complement bore diameter
17 = 17 mm

Prefix
BTM, BHTM, BKM, BHKM, BSM drawn cup bearing, caged, open ends
BM, BHM, YM drawn cup bearing, full complement, open ends

Width
12 = 12 mm

17 **BKM** **23** **12** **UU**

BKM **17** **23** **12** **UU**

Needle roller complement bore diameter
17 = 17 mm

Outer diameter
23 = 23 mm

Suffix
UU lip contact seal on each side of the bearing
J bearing designed according to ISO standards

Inner Rings – Metric Nominal Dimensions

Prefix
JR inner ring
JRZ inner ring without mounting chamfers

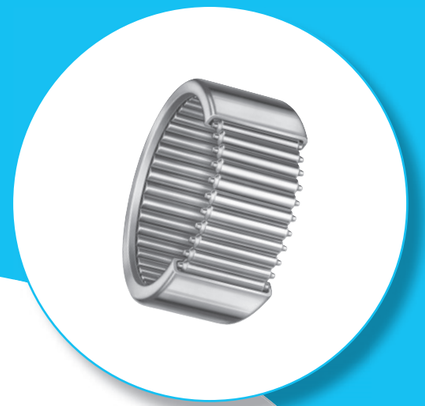
Outer diameter
14 = 14 mm

Suffix
JS1 lubricating hole

JR **10** x **14** x **12** **JS1**

Bore diameter
10 = 10 mm

Width
12 = 12 mm



Drawn Cup Needle Roller Bearings – Inch Nominal Dimensions

Prefix
J, JH, JP, BT drawn cup bearing, caged, open ends
MJ, MJH drawn cup bearing, caged, closed end
JT drawn cup bearing, caged, one seal, open ends
JTT drawn cup bearing, caged, two seals, open ends
B, BH, Y drawn cup bearing, full complement, open ends
GB, GBH drawn cup bearing, full complement, open ends, extra precision
M, MH drawn cup bearing, full complement, closed end

Suffix 1
1 closed end
blank open ends

MJH - **18** **16** **1** - **OH**

Needle roller complement bore diameter
18 = $^{18}/_{16}$ = 1 $^{1}/_{8}$ in

Width
16 = $^{16}/_{16}$ = 1 in

Suffixes 2
OH, 2OH, OHE, GF Oil hole(s) or grease fitting, closed end
AS, NS, NSN, P Corrosion resistant coating
S, S2S, Z1S, Z1Y Corrosion resistant stainless
D, R Increased performance
F Plastic cage
T1, T2, T6 Sealed

Inner Rings (with four-digit number) Inch Nominal Dimensions

Prefix
IR regular width (for use with drawn cup bearings only)
IRA extended width (for use with drawn cup bearings only)

IR - **14** **16**

Bore diameter
14 = $^{14}/_{16}$ = $^{7}/_{8}$ in

Width (IR series only)
16 = $^{16}/_{16}$ = 1 in

Drawn Cup Needle Roller Bearings

DRAWN CUP NEEDLE ROLLER BEARINGS

METRIC SERIES

When a rolling bearing is needed for a compact and economic design and where it is not practical to harden and grind the housing bore, or where the housing materials are of low rigidity such as cast iron, aluminum or even plastics – drawn cup needle roller bearings should be considered.

REFERENCE STANDARDS ARE:

- **ISO 3245** – rolling bearings – needle roller bearings, drawn cup, without inner ring, boundary dimensions and tolerances.
- **ANSI/ABMA 18.1** – needle roller bearings – radial, metric design.
- **DIN 618** – needle roller bearings with cage – drawn cups with open end, drawn cup with closed end.
- **JIS B 1536** – rolling bearings – needle roller bearings – boundary dimensions and tolerances.

Before selecting specific drawn cup needle roller bearings, please review the engineering section of this catalog.

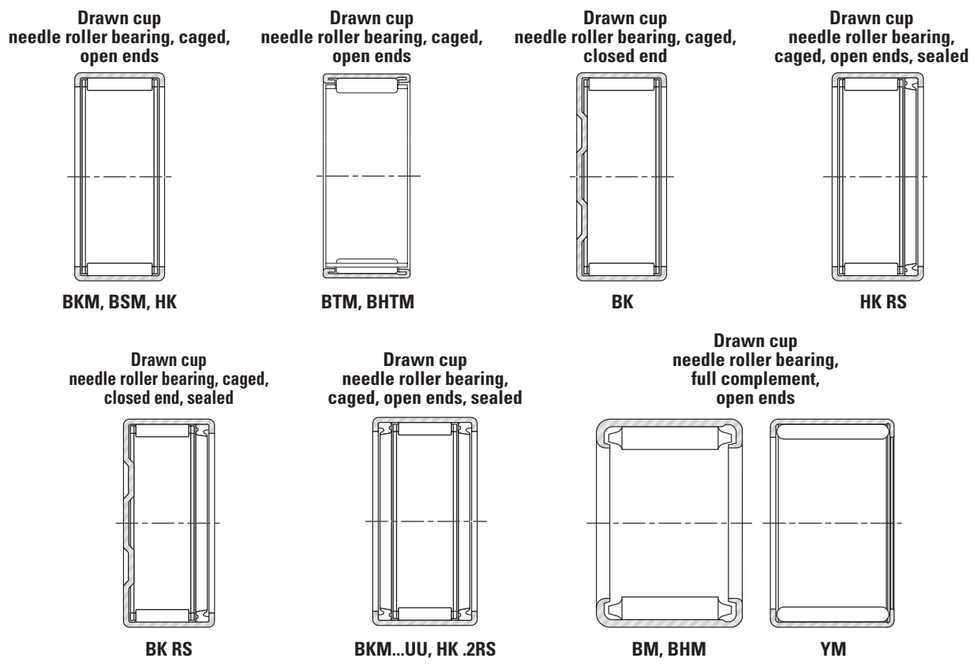


Fig. B2-1. Types of metric series drawn cup needle roller bearings

CONSTRUCTION

The prefix letters in metric series drawn cup bearing designations denote whether the bearings are made with a full complement of needle rollers or caged needle rollers. The use of a full complement of needle rollers is indicated by the prefix code letters **BM**, **BHM**, or **YM** and for use of caged needle rollers by the prefix code letters **HK**, **BKM**, **BTM**, **BHTM**, **BSM** or **BK**.

The outer ring, in the form of a cup, is accurately drawn and no subsequent machining is performed. Drawn cup needle roller bearings of series **HK**, **BKM**, **BTM**, **BHTM**, **BSM**, **BM**, **BHM** and **YM** have open ends. The **HK** and **BKM** series also are available with one seal, **HK RS**, and with two seals, **HK 2RS** and **BKM UU**. The stamped lip of a drawn cup needle roller bearing of series **HK RS** is at the seal end.

Drawn cup needle roller bearings of series **BK** is closed at one end. They are used for shaft-end mounting. The open end is typically not sealed.

The one-piece steel cage used in **HK**, **BKM** and **BK** series drawn cup bearings is designed to provide rigidity and minimize wear. This cage design separates the needle roller guiding and retention functions.

Drawn cup needle roller bearings also are available with two needle roller and cage assemblies. They have a lubricating hole in the outer ring. Metric series drawn cup bearings with one needle roller and cage assembly may be made available on request with a lubricating hole, indicated by suffix **AS1** and **JS1**.

SEALED BEARINGS

The HK and BKM series drawn cup bearings are offered with integral seals. The tables of dimensions on pages B-2-24 to B-2-26, indicate those sizes available with lip contact seals. The seal lip design achieves a light and constant contact with the inner raceway throughout the range of mounted bearing clearances, thereby ensuring positive sealing and low frictional drag.

Sealed drawn cup needle roller bearings are intended to retain grease or non-pressurized oil within a bearing while also preventing contaminants from entering the raceway area.

Details of shaft design for sealed bearings are given in the engineering section of this catalog.

The standard lip contact seals are compatible with common lubricating oils and petroleum based fuels; but, they are adversely affected by certain fire-resistant hydraulic fluids and most common solvents. Sealed drawn cup bearings are normally filled with a high-quality lithium soap-based general purpose grease. The seal material and grease properties limit the bearing operating temperature between -30˚ C and +100˚ C (-22˚ F and + 212˚ F).

If the operating temperature must be outside of the range for the seals mentioned here, or if the seals are exposed to unusual fluids, please consult your representative.

BEARING MOUNTING FITS AND INTERNAL CLEARANCE

Drawn cup needle roller bearings are manufactured to a degree of precision that will satisfy the radial clearance requirements of most applications. The total radial clearance for an installed drawn cup bearing results from the buildup of manufacturing tolerances of the housing bore, the inner raceway diameter and the bearing, as well as the minimum radial clearance required for the application (reference Table B2-1 on page B-2-8).

For metric series caged drawn cup needle roller bearings requiring close control of radial internal clearance, the suggested housing bore tolerance is N6 and h5 tolerance for the inner raceway diameter. When such exacting close control of radial internal clearance is not required, the user may select N7 housing bore and h6 inner raceway diameter tolerances.

For metric series full complement drawn cup bearings requiring close control of radial internal clearance, the suggested housing bore tolerance is H6 and h5 tolerance for the inner raceway diameter. When such exacting close control of radial internal clearance is not required, the user may select H7 housing bore and h6 inner raceway diameter tolerances.

TOLERANCES FOR HOUSING MATERIALS OF LOW RIGIDITY

The suggested housing bore tolerance for metric series caged drawn cup bearings used in housings made from materials of low rigidity or steel housings of small section is R6. To maintain normal radial internal clearance, the inner raceway diameter tolerance should be h5. When such exacting close control of radial internal clearance is not required, the user may select R7 housing bore and h6 inner raceway diameter tolerances.

The suggested housing bore tolerance for metric series full complement drawn cup bearings used in housings made from materials of low rigidity or steel housings of small section is M6. To maintain normal radial internal clearance, the inner raceway diameter tolerance should be h5. When such exacting close control of radial internal clearance is not required, the user may select M7 housing bore and h6 inner raceway diameter tolerances.

OUTER RING ROTATION

For metric series caged drawn cup bearing applications where the outer ring rotates with respect to the load, it is suggested that both the housing bore and the inner raceway diameter be reduced using R6 and f5 tolerance practice respectively. The user may select R7 housing bore and f6 inner raceway diameter tolerance when such exacting close control of radial internal clearance is not required.

For metric series full complement drawn cup bearings applications where the outer ring rotates with respect to the load, it is suggested that both the housing bore and the inner raceway diameter tolerance be reduced using is M6 and f5 tolerance practice respectively. The user may select M7 housing bore and f6 inner raceway diameter tolerances when such exacting close control of radial internal clearance is not required.

OSCILLATING MOTION

Metric series drawn cup needle roller bearing applications involving oscillating motion may require reduced radial internal clearances. This reduction may be accomplished by increasing the inner raceway diameter using j5 tolerance. When such exacting close control of radial clearance is not required, the user may select j6 inner raceway diameter tolerances.

Table B2-1. Metric mounting fits

Bearing type	Operating condition	Shaft fit (recommended internal radial clearances)	Housing fit (recommended internal radial clearances)
HK, BK, HKRS, HK.2RS, BTM, BSM, BKM (caged)	One piece heavy section steel or cast iron housing	h5 (h6)	N6 (N7)
	Housing material of low rigidity	h5 (h6)	R6 (R7)
	Outer ring rotation (one piece heavy section steel or cast iron housing)	f5 (f6)	R6 (R7)
	Oscillating motion	j5 (j6)	(1)
BM, BHM, YM (full complement)	One piece heavy section steel or cast iron housing	h5 (h6)	H6 (H7)
	Housing material of low rigidity	h5 (h6)	M6 (M7)
	Outer ring rotation (one piece heavy section steel or cast iron housing)	f5 (f6)	M6 (M7)
	Oscillating motion	j5 (j6)	(1)

(1) Tolerance dependent on housing design.

INNER RINGS

When it becomes impractical to meet the shaft raceway design requirements (hardness, case depth, surface finish, etc.) outlined in the engineering section of this catalog, standard inner rings may be used with metric series drawn cup bearings. It is suggested that when metric series inner rings are used with metric series drawn cup bearings, they should be mounted with a loose transition fit on the shaft using g5 shaft diameter tolerance. The inner ring should be end-clamped against a shoulder. If a tight transition fit must be used (shaft diameter tolerance h5) to keep the inner ring from rotating relative to the shaft, the inner ring outer diameter, as mounted, must not exceed the raceway diameter required by the drawn cup bearing for the particular application. In case the outer diameter of the inner ring, when mounted on the shaft, exceeds the required raceway diameter for the matching drawn cup bearing, it should be ground to proper diameter while mounted on the shaft. When such exacting close control of radial internal clearance is not required the user may select g6 or h5 shaft diameter tolerances.

LOAD RATING FACTORS

DYNAMIC LOADS

Drawn cup needle roller bearings can accommodate only radial loads.

$P = F_r$

P = The maximum dynamic radial load that may be applied to a drawn cup bearing based on the dynamic load rating, C_r given in the bearing tables. This load should be $\leq C_r/3$.

STATIC LOADS

$$f_0 = \frac{C_0}{P_0}$$

f_0 = static load safety factor

C_0 = basic static load rating (kN)

P_0 = maximum applied static load (kN)

To ensure satisfactory operation of drawn cup needle roller bearings, under all types of conditions, the static load safety factor f_0 should be ≥ 3.

INSPECTION OF DRAWN CUP NEEDLE ROLLER BEARINGS

Although the bearing cup is accurately drawn from strip steel, because of its fairly thin section, it may go out-of-round during heat treatment. When the bearing is pressed into a true round housing, or ring gage of correct size and wall thickness, it becomes round and is sized properly. *For this reason, it is incorrect to inspect an unmounted drawn cup bearing by measuring the outer diameter.* The correct method for inspecting the bearing size is to:

1. Press the bearing into a ring gage of proper size.
2. Plug the bearing bore with the appropriate “go” and “no go” gages, or measure it with a tapered arbor (lathe mandrel).

- HK and BK series

The "go" gage size is the minimum needle roller complement bore diameter.

The "no go" gage size is larger than the maximum needle roller complement bore diameter by 0.002 mm (0.0001 in). (Table B2-2)

- BTM, BHTM, BSM, BKM, BM and YM series

The inspection gage (ring gage and plug gage) sizes are listed in Table B2-3.

NOTE

SPECIAL BEARINGS. There are bearings available with other cage designs, and materials such as reinforced engineered polymer for use where operating conditions permit.

Table B2-2. Caged bearing gage sizes

Nominal bore diameter	Ring gage(1)	Needle roller complement bore diameter	
		Max.	Min.
mm in	mm in	mm in	mm in
3.000 0.1181	6.484 0.2553	3.024 0.1191	3.006 0.1183
4.000 0.1575	7.984 0.3143	4.028 0.1586	4.010 0.1579
5.000 0.1969	8.984 0.3537	5.028 0.1980	5.010 0.1972
6.000 0.2362	9.984 0.3931	6.028 0.2373	6.010 0.2366
7.000 0.2756	10.980 0.4323	7.031 0.2768	7.013 0.2761
8.000 0.3150	11.980 0.4717	8.031 0.3162	8.013 0.3155
9.000 0.3543	12.980 0.5110	9.031 0.3555	9.013 0.3548
10.000 0.3937	13.980 0.5504	10.031 0.3949	10.013 0.3942
12.000 0.4724	15.980 0.6291	12.034 0.4738	12.016 0.4731
12.000 0.4724	17.980 0.7079	12.034 0.4738	12.016 0.4731
13.000 0.5118	18.976 0.7471	13.034 0.5131	13.016 0.5124
14.000 0.5512	19.976 0.7865	14.034 0.5525	14.016 0.5518
15.000 0.5906	20.976 0.8258	15.034 0.5919	15.016 0.5912
16.000 0.6299	21.976 0.8652	16.034 0.6313	16.016 0.6306
17.000 0.6693	22.976 0.9046	17.034 0.6706	17.016 0.6699
18.000 0.7087	23.976 0.9439	18.034 0.7100	18.016 0.7093
20.000 0.7874	25.976 1.0227	20.041 0.7890	20.020 0.7882
22.000 0.8661	27.976 1.1014	22.041 0.8678	22.020 0.8669
25.000 0.9843	31.972 1.2587	25.041 0.9859	25.020 0.9850
28.000 1.1024	34.972 1.3769	28.041 1.1040	28.020 1.1031
30.000 1.1811	36.972 1.4556	30.041 1.1827	30.020 1.1819
35.000 1.3780	41.972 1.6524	35.050 1.3799	35.025 1.3789
40.000 1.5750	46.972 1.8493	40.050 1.5768	40.025 1.5758
45.000 1.7717	51.967 2.0459	45.050 1.7736	45.025 1.7726
50.000 1.9685	57.967 2.2822	50.050 1.9705	50.025 1.9695
60.000 2.3622	67.967 2.6759	60.060 2.3646	60.030 2.3634

(1) The ring gage sizes are in accordance with ISO N6 lower limit.

Table B2-3. Needle roller bearing gage sizes (metric series)

Needle roller complement bore diameter Fw nominal size	Ring gage	Plug gage	
		Go	No go
mm	mm	mm	mm
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 14.995	8.031	8.056
9	12.995 15.995	9.031	9.056
10	13.995 16.995	10.031	10.056
12	15.995 17.995 18.993	12.031	12.056
13	18.993	13.034	13.059
14	18.993 19.993 21.993	14.034	14.059
15	19.993 20.993 21.993	15.034	15.059
16	21.993 23.993	16.034	16.059
17	21.972 22.972 23.972	17.013	17.038
18	23.972 24.972	18.013	18.038
19	26.972	19.013	19.038
20	25.972 26.972	20.013	20.038
22	27.972 28.972 29.972	22.013	22.038
24	29.972 30.967 34.967	24.013	24.038
25	31.967 32.967	25.013	25.038
26	33.967	26.013	26.038
28	33.967 34.967 36.967	28.013	28.038
30	36.967 37.967 39.967	30.013	30.038
32	37.967 39.967 41.967	32.013	32.038
35	41.967 44.967	35.013	35.038
36	41.967 43.967 47.967	36.013	36.038
37	42.967 46.967	37.013	37.038
38	47.967	38.013	38.038
40	46.967 49.967	40.013	40.043
45	51.961 54.961	45.013	45.043
50	57.961 61.961	50.013	50.043
55	62.961	55.013	55.051

INSTALLATION PROCEDURES

GENERAL INSTALLATION REQUIREMENTS

- A drawn cup needle roller bearing must be pressed into its housing.
- An installation tool, similar to the ones illustrated must be used in conjunction with a standard press.
- The bearing must not be hammered into its housing, even in conjunction with the proper assembly mandrel.
- The bearing must not be pressed tightly against a shoulder in the housing.
- If it is necessary to use a shouldered housing, the depth of the housing bore must be sufficient to ensure that the housing shoulder fillet, as well as the shoulder face, clears the bearing.
- The installation tool must be coaxial with the housing bore.

INSTALLATION OF OPEN ENDS CAGED BEARINGS

It is advisable to utilize a positive stop on the press tool to locate the bearing properly in the housing. The assembly tool should have a leader or a pilot, as shown, to aid in starting the bearing true in the housing. The "O" ring shown on the drawing may be used to assist in holding the bearing on the installation tool. The bearing should be installed with the stamped end (the end with the identification markings) against the angled shoulder of the pressing tool.

A – 0.40 mm (0.016 in) less than housing bore
B – 0.08 mm (0.003 in) less than shaft diameter
C – distance bearing will be inset into housing, minimum of 0.20 mm (0.008 in)
D – pilot length should be length of bearing less 0.80 mm (0.030 in)
E – approximately $\frac{1}{2}$ D

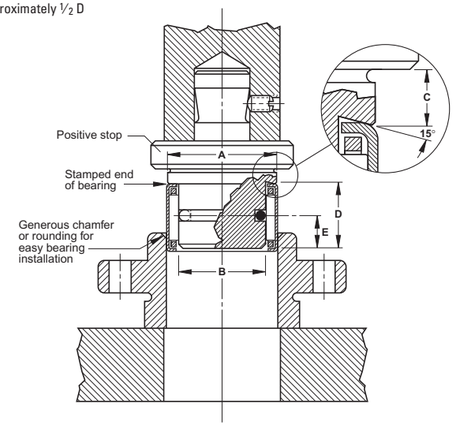


Fig. B2-2. Installation of open ends caged bearings

INSTALLATION OF CLOSED END CAGED BEARINGS

Bearing can be piloted from below for installation.

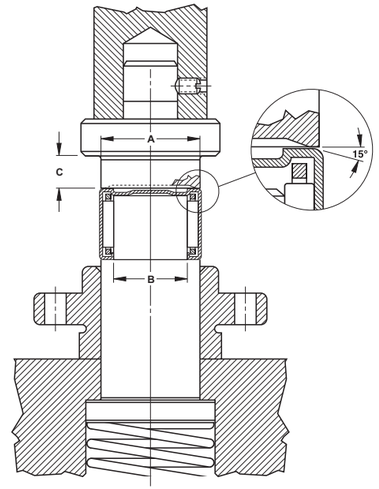


Fig. B2-3. Installation of closed end caged bearings

EXTRACTION FROM A STRAIGHT HOUSING (CAGED AND FULL COMPLEMENT BEARINGS)

Bearing can be extracted by pushing it through the housing. After extraction, the drawn cup needle roller bearing should not be reused.

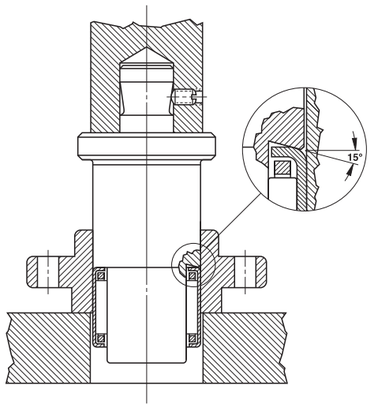


Fig. B2-4. Extraction from a straight housing

INSTALLATION OF OPEN ENDS FULL COMPLEMENT BEARINGS

It is advisable to utilize a positive stop on the press tool to locate the bearing properly in the housing. The assembly tool should have a leader or a pilot, as shown, to aid in starting the bearing true in the housing. The ball detent shown on the drawing is used to assist in aligning the rollers of a full complement bearing during installation and to hold the bearing on the installation tool. The bearing should be installed with the marked end (the end with identification markings) against the angled shoulder of the pressing tool.

A – 0.40 mm (0.016 in) less than housing bore
B – 0.08 mm (0.003 in) less than shaft diameter
C – distance bearing will be inset into housing, minimum of 0.20 mm (0.008 in)
D – pilot length should be length of bearing less 0.80 mm (0.030 in)
E – approximately 1⁄2 D

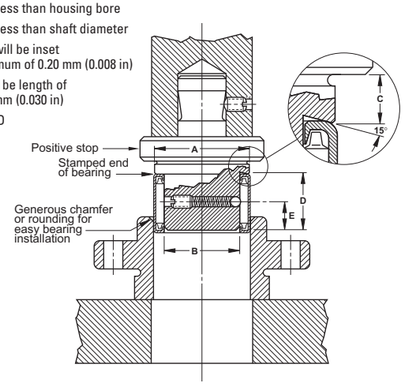


Fig. B2-5. Installation of open ends full complement bearings

INSTALLATION OF CLOSED END FULL COMPLEMENT BEARINGS

The installation tool combines all the features of the tool used to install open end bearings, but the pilot is spring loaded and is part of the press bed.

The angled shoulder of the pressing tool should bear against the closed end with the bearing held on the pilot to aid in starting the bearing true in the housing.

A – 0.40 mm (0.016 in) less than housing bore
B – 0.08 mm (0.003 in) less than shaft diameter
C – distance bearing will be inset into housing, minimum of 0.20 mm (0.008 in)

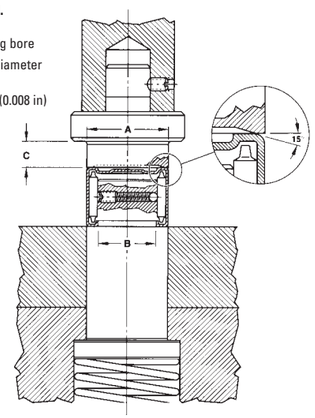


Fig. B2-6. Installation of closed end full complement bearings

EXTRACTION FROM A SHOULDERED OR DEAD END HOUSING (CAGED AND FULL COMPLEMENT BEARINGS) (with space between the bearing and the housing shoulder)

Bearings may be extracted from shouldered or dead end housings with a common bearing puller tool as shown. This type of tool is slotted in two places at right angles to form four prongs. The four puller prongs are pressed together and inserted into the space between the end of the bearing and the shoulder. The prongs are forced outward by inserting the expansion rod, and then the bearing is extracted. Do not reuse the bearing after extraction.

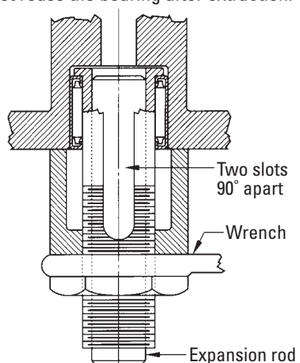


Fig. B2-7. Extraction from a shouldered or dead end housing

EXTRACTION FROM A SHOULDERED HOUSING (CAGED AND FULL COMPLEMENT BEARINGS) (with bearing pressed up close to the shoulder)

The tool to be used, as shown, is of a similar type described for a shouldered or dead end housing, but the rollers must first be removed from the bearing.

The four segment puller jaws are collapsed and slipped into the empty cup. The jaws are then forced outward into the cup bore by means of the tapered expansion rod. The jaws should bear on the lip as near as possible to the cup bore. The cup is then pressed out from the top.

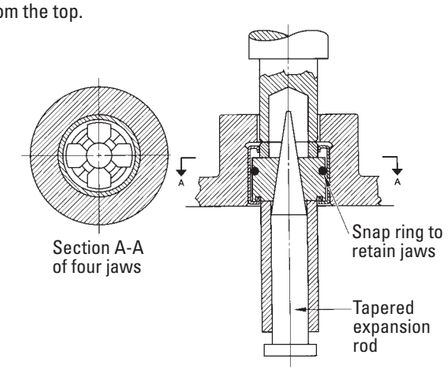
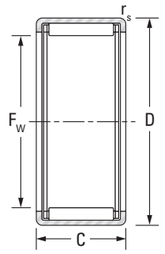


Fig. B2-8. Extraction from a shouldered housing

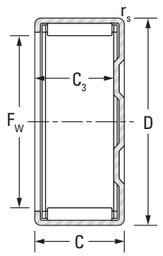
NOTES

DRAWN CUP NEEDLE ROLLER BEARINGS CAGED, OPEN ENDS, CLOSED ONE END

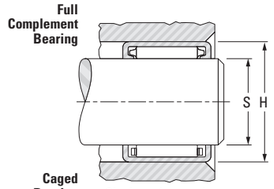
METRIC SERIES
HK, BK SERIES



HK



BK



Shaft Dia.	F_w	D	C +0 -0.3 +0.000 -0.012	$C_{3\ min.}$	$r_{s\ min.}$	Bearing Designation		Load Ratings Dynamic C	Load Ratings Static C_0	Fatigue Load Limit C_u	Speed Ratings Grease	Speed Ratings Oil	Approx. Wt.	Mounting Dimensions Shaft(h5) Max.	Mounting Dimensions Shaft(h5) Min.	Mounting Dimensions Housing(N6) Max.	Mounting Dimensions Housing(N6) Min.	Inspection gage	Mounting inner ring (pages B-2-28 to B-2-37)
						Open Ends	Closed One End												
mm in	mm in	mm in	mm in	mm in	mm in			kN lbf		kN	min^{-1}		kg lbs	mm in	mm in	mm in	mm in		
3 0.1181	**3** 0.1181	**6.5** 0.2559	**6** 0.236	**5.20** 0.205	**0.30** 0.012	—	BK0306	**1.20** 270	**0.78** 180	0.130	30000	46000	**0.001** 0.002	**3.000** 0.1181	**2.996** 0.118	**6.493** 0.2556	**6.484** 0.2553	Table B2-2	
	3 0.1181	**6.5** 0.2559	**6** 0.236	—	**0.30** 0.012	HK0306	—	**1.20** 270	**0.78** 180	0.130	30000	46000	**0.001** 0.002	**3.000** 0.1181	**2.996** 0.118	**6.493** 0.2556	**6.484** 0.2553	Table B2-2	
4 0.1575	**4** 0.1575	**8** 0.3150	**8** 0.315	**6.40** 0.252	**0.40** 0.016	—	BK0408	**1.88** 423	**1.38** 310	0.200	25000	39000	**0.002** 0.004	**4.000** 0.1575	**3.995** 0.1573	**7.993** 0.3147	**7.984** 0.3143	Table B2-2	
	4 0.1575	**8** 0.3150	**8** 0.315	—	**0.40** 0.016	HK0408	—	**1.88** 420	**1.38** 310	0.200	25000	39000	**0.002** 0.004	**4.000** 0.1575	**3.995** 0.1573	**7.993** 0.3147	**7.984** 0.3143	Table B2-2	
5 0.1969	**5** 0.1969	**9** 0.3543	**9** 0.354	**7.40** 0.291	**0.40** 0.016	—	BK0509	**2.52** 570	**2.07** 470	0.320	23000	36000	**0.002** 0.004	**5.000** 0.1969	**4.995** 0.1967	**8.993** 0.3541	**8.984** 0.3537	Table B2-2	
	5 0.1969	**9** 0.3543	**9** 0.354	—	**0.40** 0.016	HK0509	—	**2.52** 570	**2.07** 470	0.320	23000	36000	**0.002** 0.004	**5.000** 0.1969	**4.995** 0.1967	**8.993** 0.3541	**8.984** 0.3537	Table B2-2	
6 0.2362	**6** 0.2362	**10** 0.3937	**8** 0.315	**6.40** 0.252	**0.40** 0.016	—	BK0608	**2.34** 530	**1.95** 440	0.290	22000	33000	**0.002** 0.004	**6.000** 0.2362	**5.995** 0.236	**9.993** 0.3934	**9.984** 0.3931	Table B2-2	
	6 0.2362	**10** 0.3937	**8** 0.315	—	**0.40** 0.016	HK0608	—	**2.34** 530	**1.95** 440	0.290	22000	33000	**0.002** 0.004	**6.000** 0.2362	**5.995** 0.236	**9.993** 0.3934	**9.984** 0.3931	Table B2-2	
	6 0.2362	**10** 0.3937	**9** 0.354	**7.40** 0.291	**0.40** 0.016	—	BK0609	**3.14** 710	**2.85** 640	0.290	22000	33000	**0.003** 0.007	**6.000** 0.2362	**5.995** 0.236	**9.993** 0.3934	**9.984** 0.3931	Table B2-2	
	6 0.2362	**10** 0.3937	**9** 0.354	—	**0.40** 0.016	HK0609	—	**3.14** 710	**2.85** 640	0.290	22000	33000	**0.002** 0.004	**6.000** 0.2362	**5.995** 0.236	**9.993** 0.3934	**9.984** 0.3931	Table B2-2	
7 0.2756	**7** 0.2756	**11** 0.4331	**9** 0.354	**7.40** 0.291	**0.40** 0.016	—	BK0709	**3.23** 730	**3.05** 690	0.470	21000	32000	**0.003** 0.007	**7.000** 0.2756	**6.994** 0.2754	**10.991** 0.4327	**10.980** 0.4323	Table B2-2	
	7 0.2756	**11** 0.4331	**9** 0.354	—	**0.40** 0.016	HK0709	—	**3.23** 730	**3.05** 690	0.470	21000	32000	**0.003** 0.007	**7.000** 0.2756	**6.994** 0.2754	**10.991** 0.4327	**10.980** 0.4323	Table B2-2	
8 0.3150	**8** 0.3150	**12** 0.4724	**8** 0.315	**6.40** 0.252	**0.40** 0.016	—	BK0808	**2.90** 650	**2.73** 610	0.400	20000	31000	**0.003** 0.007	**8.000** 0.315	**7.994** 0.3147	**11.991** 0.4721	**11.980** 0.4717	Table B2-2	
	8 0.3150	**12** 0.4724	**8** 0.315	—	**0.40** 0.016	HK0808	—	**2.90** 650	**2.73** 610	0.400	20000	31000	**0.003** 0.007	**8.000** 0.315	**7.994** 0.3147	**11.991** 0.4721	**11.980** 0.4717	Table B2-2	
	8 0.3150	**12** 0.4724	**10** 0.394	**8.40** 0.331	**0.40** 0.016	—	BK0810	**3.95** 890	**4.07** 920	0.600	20000	31000	**0.004** 0.009	**8.000** 0.315	**7.994** 0.3147	**11.991** 0.4721	**11.980** 0.4717	Table B2-2	JR5x8x12
	8 0.3150	**12** 0.4724	**10** 0.394	—	**0.40** 0.016	HK0810	—	**3.95** 890	**4.07** 920	0.600	20000	31000	**0.004** 0.009	**8.000** 0.315	**7.994** 0.3147	**11.991** 0.4721	**11.980** 0.4717	Table B2-2	JR5x8x12
9 0.3543	**9** 0.3543	**13** 0.5118	**10** 0.394	**8.40** 0.331	**0.40** 0.016	—	BK0910	**4.57** 1030	**5.07** 1140	0.770	19000	30000	**0.004** 0.009	**9.000** 0.3543	**8.994** 0.3541	**12.991** 0.5115	**12.980** 0.5110	Table B2-2	JR6x9x12

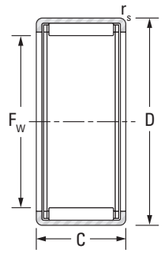
(1) Drawn cup needle roller bearings with two needle roller and cage assemblies and one lubricating hole.

Shaft Dia.	F_w	D	C +0 -0.3 +0.000 -0.012	$C_{3\ min.}$	$r_{s\ min.}$	Bearing Designation		Load Ratings Dynamic C	Load Ratings Static C_0	Fatigue Load Limit C_u	Speed Ratings Grease	Speed Ratings Oil	Approx. Wt.	Mounting Dimensions Shaft(h5) Max.	Mounting Dimensions Shaft(h5) Min.	Mounting Dimensions Housing(N6) Max.	Mounting Dimensions Housing(N6) Min.	Inspection gage	Mounting inner ring (pages B-2-28 to B-2-37)
						Open Ends	Closed One End												
mm in	mm in	mm in	mm in	mm in	mm in			kN lbf		kN	min^{-1}		kg lbs	mm in	mm in	mm in	mm in		
9 0.3543	**9** 0.3543	**13** 0.5118	**10** 0.394	—	**0.40** 0.016	HK0910	—	**4.57** 1030	**5.07** 1140	0.770	19000	30000	**0.004** 0.009	**9.000** 0.3543	**8.994** 0.3541	**12.991** 0.5115	**12.980** 0.5110	Table B2-2	JR6x9x12
	9 0.3543	**13** 0.5118	**12** 0.472	**10.40** 0.409	**0.40** 0.016	—	BK0912	**5.65** 1270	**6.65** 1490	1.00	19000	30000	**0.005** 0.011	**9.000** 0.3543	**8.994** 0.3541	**12.991** 0.5115	**12.980** 0.5110	Table B2-2	JR6x9x12
	9 0.3543	**13** 0.5118	**12** 0.472	—	**0.40** 0.016	HK0912	—	**5.65** 1270	**6.65** 1490	1.00	19000	30000	**0.005** 0.011	**9.000** 0.3543	**8.994** 0.3541	**12.991** 0.5115	**12.980** 0.5110	Table B2-2	JR6x9x12
10 0.3937	**10** 0.3937	**14** 0.5512	**10** 0.394	**8.40** 0.331	**0.40** 0.016	—	BK1010	**4.78** 1070	**5.51** 1240	0.840	19000	29000	**0.004** 0.009	**10.000** 0.3937	**9.994** 0.3935	**13.991** 0.5508	**13.980** 0.5504	Table B2-2	JR7x10x10,5
	10 0.3937	**14** 0.5512	**10** 0.394	—	**0.40** 0.016	HK1010	—	**4.78** 1070	**5.51** 1240	0.840	19000	29000	**0.004** 0.009	**10.000** 0.3937	**9.994** 0.3935	**13.991** 0.5508	**13.980** 0.5504	Table B2-2	JR7x10x10,5
	10 0.3937	**14** 0.5512	**12** 0.472	**10.40** 0.409	**0.40** 0.016	—	BK1012	**5.90** 1330	**7.23** 1630	1.10	19000	29000	**0.006** 0.013	**10.000** 0.3937	**9.994** 0.3935	**13.991** 0.5508	**13.980** 0.5504	Table B2-2	JR7x10x12
	10 0.3937	**14** 0.5512	**12** 0.472	—	**0.40** 0.016	HK1012	—	**5.90** 1330	**7.23** 1630	1.10	19000	29000	**0.005** 0.011	**10.000** 0.3937	**9.994** 0.3935	**13.991** 0.5508	**13.980** 0.5504	Table B2-2	JR7x10x12
	10 0.3937	**14** 0.5512	**15** 0.591	**13.40** 0.528	**0.40** 0.016	—	BK1015	**7.49** 1680	**9.81** 2210	1.50	19000	29000	**0.006** 0.013	**10.000** 0.3937	**9.994** 0.3935	**13.991** 0.5508	**13.980** 0.5504	Table B2-2	JR7x10x16
	10 0.3937	**14** 0.5512	**15** 0.591	—	**0.40** 0.016	HK1015	—	**7.49** 1680	**9.81** 2210	1.50	19000	29000	**0.006** 0.013	**10.000** 0.3937	**9.994** 0.3935	**13.991** 0.5508	**13.980** 0.5504	Table B2-2	JR7x10x16
12 0.4724	**12** 0.4724	**16** 0.6299	**10** 0.394	**8.40** 0.331	**0.40** 0.016	—	BK1210	**5.24** 1180	**6.55** 1470	0.890	18000	28000	**0.006** 0.013	**12.000** 0.4724	**11.992** 0.4721	**15.991** 0.6296	**15.980** 0.6291	Table B2-2	JR8x12x10,5
	12 0.4724	**16** 0.6299	**10** 0.394	—	**0.40** 0.016	HK1210	—	**5.24** 1180	**6.55** 1470	0.890	18000	28000	**0.006** 0.013	**12.000** 0.4724	**11.992** 0.4721	**15.991** 0.6296	**15.980** 0.6291	Table B2-2	JR8x12x10,5
	12 0.4724	**18** 0.7087	**12** 0.472	**9.30** 0.366	**1** 0.039	—	BK1212	**6.61** 1490	**7.29** 1640	1.10	14000	22000	**0.012** 0.026	**12.000** 0.4724	**11.992** 0.4721	**17.991** 0.7083	**17.980** 0.7079	Table B2-2	JR8x12x12,5
	12 0.4724	**18** 0.7087	**12** 0.472	—	**1** 0.039	HK1212	—	**6.61** 1490	**7.29** 1640	1.10	14000	22000	**0.01** 0.022	**12.000** 0.4724	**11.992** 0.4721	**17.991** 0.7083	**17.980** 0.7079	Table B2-2	JR8x12x12,5
13 0.5118	**13** 0.5118	**19** 0.7480	**12** 0.472	**9.30** 0.366	**1** 0.039	—	BK1312	**6.92** 1560	**7.89** 1770	1.20	14000	22000	**0.012** 0.026	**13.000** 0.5118	**12.992** 0.5115	**18.989** 0.7476	**18.976** 0.7471	Table B2-2	JR10x13x12,5
	13 0.5118	**19** 0.7480	**12** 0.472	—	**1** 0.039	HK1312	—	**6.92** 1560	**7.89** 1770	1.20	14000	22000	**0.01** 0.022	**13.000** 0.5118	**12.992** 0.5115	**18.989** 0.7476	**18.976** 0.7471	Table B2-2	JR10x13x12,5
14 0.5512	**14** 0.5512	**20** 0.7874	**12** 0.472	**9.30** 0.366	**1** 0.039	—	BK1412	**7.21** 1620	**8.50** 1910	1.30	14000	21000	**0.014** 0.031	**14.000** 0.5512	**13.992** 0.5509	**19.989** 0.7870	**19.976** 0.7865	Table B2-2	JR10x14x12
	14 0.5512	**20** 0.7874	**12** 0.472	—	**1** 0.039	HK1412	—	**7.21** 1620	**8.50** 1910	1.30	14000	21000	**0.011** 0.024	**14.000** 0.5512	**13.992** 0.5509	**19.989** 0.7870	**19.976** 0.7865	Table B2-2	JR10x14x12
15 0.5906	**15** 0.5906	**21** 0.8268	**12** 0.472	**9.30** 0.366	**1** 0.039	—	BK1512	**7.49** 1680	**9.11** 2050	1.40	14000	21000	**0.015** 0.033	**15.000** 0.5906	**14.992** 0.5902	**20.989** 0.8263	**20.976** 0.8258	Table B2-2	JR12x15x12,5
	15 0.5906	**21** 0.8268	**12** 0.472	—	**1** 0.039	HK1512	—	**7.49** 1680	**9.11** 2050	1.40	14000	21000	**0.012** 0.026	**15.000** 0.5906	**14.992** 0.5902	**20.989** 0.8263	**20.976** 0.8258	Table B2-2	JR12x15x12,5
	15 0.5906	**21** 0.8268	**16** 0.630	**13.30** 0.524	**1** 0.039	—	BK1516	**10.7** 2410	**14.4** 3240	2.20	14000	21000	**0.019** 0.042	**15.000** 0.5906	**14.992** 0.5902	**20.989** 0.8263	**20.976** 0.8258	Table B2-2	JR12x15x16,5
	15 0.5906	**21** 0.8268	**16** 0.630	—	**1** 0.039	HK1516	—	**10.7** 2410	**14.4** 3240	2.20	14000	21000	**0.018** 0.040	**15.000** 0.5906	**14.992** 0.5902	**20.989** 0.8263	**20.976** 0.8258	Table B2-2	JR12x15x16,5
	15 0.5906	**21** 0.8268	**22** 0.866	**19.30** 0.760	**1** 0.039	—	BK1522(1)	**13.5** 3030	**19.4** 4360	2.95	14000	21000	**0.022** 0.049	**15.000** 0.5906	**14.992** 0.5902	**20.989** 0.8263	**20.976** 0.8258	Table B2-2	JR12x15x22,5
	15 0.5906	**21** 0.8268	**22** 0.866	—	**1** 0.039	HK1522(1)	—	**13.5** 3030	**19.4** 4360	2.95	14000	21000	**0.024** 0.053	**15.000** 0.5906	**14.992** 0.5902	**20.989** 0.8263	**20.976** 0.8258	Table B2-2	JR12x15x22,5
16 0.6299	**16** 0.6299	**22** 0.8661	**12** 0.472	**9.30** 0.366	**1** 0.039	—	BK1612	**7.76** 1740	**9.72** 2190	1.50	14000	21000	**0.016** 0.035	**16.000** 0.6299	**15.992** 0.6296	**21.989** 0.8657	**21.976** 0.8652	Table B2-2	JR12x16x12

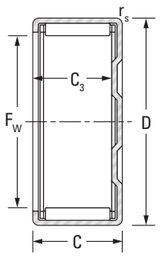
Continued on next page.

DRAWN CUP NEEDLE ROLLER BEARINGS CAGED, OPEN ENDS, CLOSED ONE END

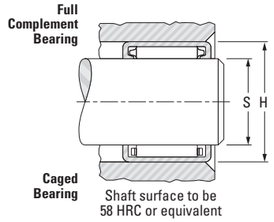
METRIC SERIES
HK, BK SERIES



HK



BK



Shaft Dia.	F_w	D	C +0 -0.3 +0.000 -0.012	$C_{3\ min.}$	$r_{s\ min.}$	Bearing Designation		Load Ratings Dynamic C	Load Ratings Static C_0	Fatigue Load Limit C_u	Speed Ratings Grease	Speed Ratings Oil	Approx. Wt.	Mounting Dimensions Shaft(h5) Max.	Mounting Dimensions Shaft(h5) Min.	Mounting Dimensions Housing(N6) Max.	Mounting Dimensions Housing(N6) Min.	Inspection gage	Mounting inner ring (pages B-2-28 to B-2-37)
						Open Ends	Closed One End												
mm in	mm in	mm in	mm in	mm in	mm in			kN lbf		kN	min^{-1}		kg lbs	mm in	mm in	mm in	mm in		
16 0.6299	**16** 0.6299	**22** 0.8661	**12** 0.472	— 	**1** 0.039	HK1612	—	**7.76** 1740	**9.72** 2190	1.50	14000	21000	**0.012** 0.026	**16.000** 0.6299	**15.992** 0.6296	**21.989** 0.8657	**21.976** 0.8652	Table B2-2	JR12x16x12
	16 0.6299	**22** 0.8661	**16** 0.630	**13.30** 0.524	**1** 0.039	—	BK1616	**11.1** 2500	**15.3** 3440	2.35	14000	21000	**0.02** 0.044	**16.000** 0.6299	**15.992** 0.6296	**21.989** 0.8657	**21.976** 0.8652	Table B2-2	JR12x16x16
	16 0.6299	**22** 0.8661	**16** 0.630	— 	**1** 0.039	HK1616	—	**11.1** 2500	**15.3** 3440	2.35	14000	21000	**0.016** 0.035	**16.000** 0.6299	**15.992** 0.6296	**21.989** 0.8657	**21.976** 0.8652	Table B2-2	JR12x16x16
	16 0.6299	**22** 0.8661	**22** 0.866	**19.30** 0.760	**1** 0.039	—	BK1622(1)	**13.4** 3010	**19.5** 4380	2.95	14000	21000	**0.028** 0.062	**16.000** 0.6299	**15.992** 0.6296	**21.989** 0.8657	**21.976** 0.8652	Table B2-2	JR12x16x22
	16 0.6299	**22** 0.8661	**22** 0.866	— 	**1** 0.039	HK1622(1)	—	**13.4** 3010	**19.5** 4380	2.95	14000	21000	**0.022** 0.049	**16.000** 0.6299	**15.992** 0.6296	**21.989** 0.8657	**21.976** 0.8652	Table B2-2	JR12x16x22
17 0.6693	**17** 0.6693	**23** 0.9055	**12** 0.472	**9.30** 0.366	**1** 0.039	—	BK1712	**8.12** 1830	**10.4** 2340	1.60	13000	20000	**0.018** 0.040	**17.000** 0.6693	**16.992** 0.6690	**22.989** 0.9051	**22.976** 0.9046	Table B2-2	
	17 0.6693	**23** 0.9055	**12** 0.472	— 	**1** 0.039	HK1712	—	**8.12** 1830	**10.4** 2340	1.60	13000	20000	**0.013** 0.029	**17.000** 0.6693	**16.992** 0.6690	**22.989** 0.9051	**22.976** 0.9046	Table B2-2	
18 0.7087	**18** 0.7087	**24** 0.9449	**12** 0.472	**9.30** 0.366	**1** 0.039	—	BK1812	**8.41** 1890	**11.1** 2500	1.70	12000	18000	**0.017** 0.037	**18.000** 0.7087	**17.992** 0.7083	**23.989** 0.9444	**23.976** 0.9439	Table B2-2	
	18 0.7087	**24** 0.9449	**12** 0.472	— 	**1** 0.039	HK1812	—	**8.41** 1890	**11.1** 2500	1.70	12000	18000	**0.015** 0.033	**18.000** 0.7087	**17.992** 0.7083	**23.989** 0.9444	**23.976** 0.9439	Table B2-2	
	18 0.7087	**24** 0.9449	**16** 0.630	**13.30** 0.524	**1** 0.039	—	BK1816	**11.6** 2610	**16.8** 3780	2.55	12000	18000	**0.022** 0.049	**18.000** 0.7087	**17.992** 0.7083	**23.989** 0.9444	**23.976** 0.9439	Table B2-2	JR15x18x16,5
	18 0.7087	**24** 0.9449	**16** 0.630	— 	**1** 0.039	HK1816	—	**11.6** 2610	**16.8** 3780	2.55	12000	18000	**0.018** 0.040	**18.000** 0.7087	**17.992** 0.7083	**23.989** 0.9444	**23.976** 0.9439	Table B2-2	JR15x18x16,5
20 0.7874	**20** 0.7874	**26** 1.0236	**12** 0.472	**9.3** 0.366	**1** 0.039	—	BK2012	**8.97** 2020	**12.5** 2810	1.90	11000	16000	**0.017** 0.037	**20.000** 0.7874	**19.991** 0.7870	**25.989** 1.0232	**25.976** 1.0227	Table B2-2	JR15x20x12
	20 0.7874	**26** 1.0236	**12** 0.472	— 	**1** 0.039	HK2012	—	**8.97** 2020	**12.5** 2810	1.90	11000	16000	**0.015** 0.033	**20.000** 0.7874	**19.991** 0.7870	**25.989** 1.0232	**25.976** 1.0227	Table B2-2	JR15x20x12
	20 0.7874	**26** 1.0236	**16** 0.630	**13.3** 0.524	**1** 0.039	—	BK2016	**12.4** 2790	**18.9** 4250	2.85	11000	16000	**0.024** 0.053	**20.000** 0.7874	**19.991** 0.7870	**25.989** 1.0232	**25.976** 1.0227	Table B2-2	JR17x20x16,5
	20 0.7874	**26** 1.0236	**16** 0.630	— 	**1** 0.039	HK2016	—	**12.4** 2790	**18.9** 4250	2.85	11000	16000	**0.022** 0.049	**20.000** 0.7874	**19.991** 0.7870	**25.989** 1.0232	**25.976** 1.0227	Table B2-2	JR17x20x16,5
	20 0.7874	**26** 1.0236	**20** 0.787	**17.3** 0.681	**1** 0.039	—	BK2020	**15.5** 3480	**25.3** 5690	3.95	11000	16000	**0.027** 0.060	**20.000** 0.7874	**19.991** 0.7870	**25.989** 1.0232	**25.976** 1.0227	Table B2-2	JR17x20x20,5
	20 0.7874	**26** 1.0236	**20** 0.787	— 	**1** 0.039	HK2020	—	**15.5** 3480	**25.3** 5690	3.95	11000	16000	**0.025** 0.055	**20.000** 0.7874	**19.991** 0.7870	**25.989** 1.0232	**25.976** 1.0227	Table B2-2	JR17x20x20,5

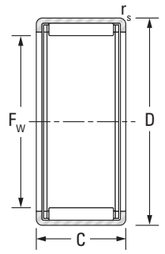
(1) Drawn cup needle roller bearings with two needle roller and cage assemblies and one lubricating hole.

Shaft Dia.	F_w	D	C +0 -0.3 +0.000 -0.012	$C_{3\ min.}$	$r_{s\ min.}$	Bearing Designation		Load Ratings Dynamic C	Load Ratings Static C_0	Fatigue Load Limit C_u	Speed Ratings Grease	Speed Ratings Oil	Approx. Wt.	Mounting Dimensions Shaft(h5) Max.	Mounting Dimensions Shaft(h5) Min.	Mounting Dimensions Housing(N6) Max.	Mounting Dimensions Housing(N6) Min.	Inspection gage	Mounting inner ring (pages B-2-28 to B-2-37)
						Open Ends	Closed One End												
mm in	mm in	mm in	mm in	mm in	mm in			kN lbf		kN	min^{-1}		kg lbs	mm in	mm in	mm in	mm in		
20 0.7874	**20** 0.7874	**26** 1.0236	**30** 1.181	**27.3** 1.075	**1** 0.039	—	BK2030(1)	**21.2** 4770	**37.8** 8500	5.75	11000	16000	**0.043** 0.095	**20.000** 0.7874	**19.991** 0.7870	**25.989** 1.0232	**25.976** 1.0227	Table B2-2	JR17x20x30,5
	20 0.7874	**26** 1.0236	**30** 1.181	— 	**1** 0.039	HK2030(1)	—	**21.2** 4770	**37.8** 8500	5.75	11000	16000	**0.041** 0.090	**20.000** 0.7874	**19.991** 0.7870	**25.989** 1.0232	**25.976** 1.0227	Table B2-2	JR17x20x30,5
22 0.8661	**22** 0.8661	**28** 1.1024	**10** 0.394	— 	**1** 0.039	HK2210	—	**7.06** 1590	**9.49** 2130	1.45	9600	15000	**0.013** 0.029	**22.000** 0.8661	**21.991** 0.8658	**27.989** 1.1019	**27.976** 1.1014	Table B2-2	
	22 0.8661	**28** 1.1024	**12** 0.472	**9.3** 0.366	**1** 0.039	—	BK2212	**9.81** 2210	**14.5** 3260	2.20	9600	15000	**0.02** 0.044	**22.000** 0.8661	**21.991** 0.8658	**27.989** 1.1019	**27.976** 1.1014	Table B2-2	JR17x22x13
	22 0.8661	**28** 1.1024	**12** 0.472	— 	**1** 0.039	HK2212	—	**9.81** 2210	**14.5** 3260	2.20	9600	15000	**0.015** 0.033	**22.000** 0.8661	**21.991** 0.8658	**27.989** 1.1019	**27.976** 1.1014	Table B2-2	JR17x22x13
	22 0.8661	**28** 1.1024	**16** 0.630	**13.3** 0.524	**1** 0.039	—	BK2216	**13.1** 2940	**20.9** 4700	3.20	9600	15000	**0.027** 0.060	**22.000** 0.8661	**21.991** 0.8658	**27.989** 1.1019	**27.976** 1.1014	Table B2-2	JR17x22x16
	22 0.8661	**28** 1.1024	**16** 0.630	— 	**1** 0.039	HK2216	—	**13.1** 2940	**20.9** 4700	3.20	9600	15000	**0.022** 0.049	**22.000** 0.8661	**21.991** 0.8658	**27.989** 1.1019	**27.976** 1.1014	Table B2-2	JR17x22x16
	22 0.8661	**28** 1.1024	**20** 0.787	**17.3** 0.681	**1** 0.039	—	BK2220	**15.3** 3440	**25.5** 5730	4.00	9600	15000	**0.028** 0.062	**22.000** 0.8661	**21.991** 0.8658	**27.989** 1.1019	**27.976** 1.1014	Table B2-2	JR17x22x23
	22 0.8661	**28** 1.1024	**20** 0.787	— 	**1** 0.039	HK2220	—	**15.3** 3440	**25.5** 5730	4.00	9600	15000	**0.026** 0.057	**22.000** 0.8661	**21.991** 0.8658	**27.989** 1.1019	**27.976** 1.1014	Table B2-2	JR17x22x23
25 0.9843	**25** 0.9843	**32** 1.2598	**12** 0.472	**9.30** 0.366	**1** 0.039	—	BK2512	**10.9** 2450	**14.7** 3300	2.25	8500	13000	**0.025** 0.055	**25.000** 0.9843	**24.991** 0.9839	**31.988** 1.2594	**31.972** 1.2587	Table B2-2	
	25 0.9843	**32** 1.2598	**12** 0.472	— 	**1** 0.039	HK2512	—	**10.9** 2450	**14.7** 3300	2.25	8500	13000	**0.021** 0.046	**25.000** 0.9843	**24.991** 0.9839	**31.988** 1.2594	**31.972** 1.2587	Table B2-2	
	25 0.9843	**32** 1.2598	**16** 0.630	**13.3** 0.524	**1** 0.039	—	BK2516	**15.6** 3510	**23.5** 5280	3.55	8500	13000	**0.031** 0.068	**25.000** 0.9843	**24.991** 0.9839	**31.988** 1.2594	**31.972** 1.2587	Table B2-2	JR20x25x17
	25 0.9843	**32** 1.2598	**16** 0.630	— 	**1** 0.039	HK2516	—	**15.6** 3510	**23.5** 5280	3.55	8500	13000	**0.028** 0.062	**25.000** 0.9843	**24.991** 0.9839	**31.988** 1.2594	**31.972** 1.2587	Table B2-2	JR20x25x17
	25 0.9843	**32** 1.2598	**20** 0.787	**17.3** 0.681	**1** 0.039	—	BK2520	**20.6** 4630	**33.4** 7510	5.30	8500	13000	**0.043** 0.095	**25.000** 0.9843	**24.991** 0.9839	**31.988** 1.2594	**31.972** 1.2587	Table B2-2	JR20x25x20,5
	25 0.9843	**32** 1.2598	**20** 0.787	— 	**1** 0.039	HK2520	—	**20.6** 4630	**33.4** 7510	5.30	8500	13000	**0.040** 0.088	**25.000** 0.9843	**24.991** 0.9839	**31.988** 1.2594	**31.972** 1.2587	Table B2-2	JR20x25x20,5
	25 0.9843	**32** 1.2598	**26** 1.024	**23.3** 0.917	**1** 0.039	—	BK2526	**25.7** 5780	**44.4** 9980	6.95	8500	13000	**0.051** 0.112	**25.000** 0.9843	**24.991** 0.9839	**31.988** 1.2594	**31.972** 1.2587	Table B2-2	JR20x25x26,5
	25 0.9843	**32** 1.2598	**26** 1.024	— 	**1** 0.039	HK2526	—	**25.7** 5780	**44.4** 9980	6.95	8500	13000	**0.046** 0.101	**25.000** 0.9843	**24.991** 0.9839	**31.988** 1.2594	**31.972** 1.2587	Table B2-2	JR20x25x26,5
	25 0.9843	**32** 1.2598	**38** 1.496	**35.3** 1.390	**1** 0.039	—	BK2538(1)	**35.3** 7940	**66.9** 15000	10.6	8500	13000	**0.077** 0.170	**25.000** 0.9843	**24.991** 0.9839	**31.988** 1.2594	**31.972** 1.2587	Table B2-2	JR20x25x38,5
	25 0.9843	**32** 1.2598	**38** 1.496	— 	**1** 0.039	HK2538(1)	—	**35.3** 7940	**66.9** 15000	10.6	8500	13000	**0.068** 0.150	**25.000** 0.9843	**24.991** 0.9839	**31.988** 1.2594	**31.972** 1.2587	Table B2-2	JR20x25x38,5
28 1.1024	**28** 1.1024	**35** 1.3780	**16** 0.630	— 	**1** 0.039	HK2816	—	**17.4** 3910	**28.1** 6320	3.85	7500	12000	**0.032** 0.071	**28.000** 1.1024	**27.991** 1.1020	**34.988** 1.3775	**34.972** 1.3769	Table B2-2	JR22x28x17
	28 1.1024	**35** 1.3780	**20** 0.787	**17.3** 0.681	**1** 0.039	—	BK2820	**20.9** 4700	**35.3** 7940	5.60	7500	12000	**0.047** 0.104	**28.000** 1.1024	**27.991** 1.1020	**34.988** 1.3775	**34.972** 1.3769	Table B2-2	JR22x28x20,5
	28 1.1024	**35** 1.3780	**20** 0.787	— 	**1** 0.039	HK2820	—	**20.9** 4700	**35.3** 7940	5.60	7500	12000	**0.040** 0.088	**28.000** 1.1024	**27.991** 1.1020	**34.988** 1.3775	**34.972** 1.3769	Table B2-2	JR22x28x20,5
30 1.1811	**30** 1.1811	**37** 1.4567	**12** 0.472	**9.3** 0.366	**1** 0.039	—	BK3012	**12.0** 2700	**17.7** 3980	2.90	7000	11000	**0.031** 0.068	**30.000** 1.1811	**29.991** 1.1807	**36.988** 1.4562	**36.972** 1.4556	Table B2-2	
	30 1.1811	**37** 1.4567	**12** 0.472	— 	**1** 0.039	HK3012	—	**12.0** 2700	**17.7** 3980	2.70	7000	11000	**0.024** 0.053	**30.000** 1.1811	**29.991** 1.1807	**36.988** 1.4562	**36.972** 1.4556	Table B2-2	

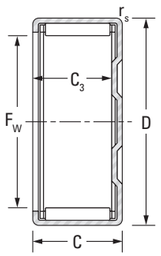
Continued on next page.

DRAWN CUP NEEDLE ROLLER BEARINGS CAGED, OPEN ENDS, CLOSED ONE END

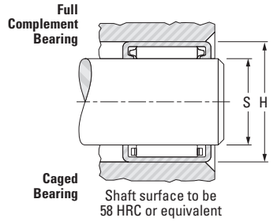
METRIC SERIES
HK, BK SERIES



HK



BK



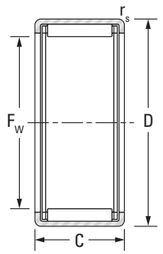
Shaft Dia.	F_w	D	C +0 -0.3 +0.000 -0.012	$C_{3\ min.}$	$r_{s\ min.}$	Bearing Designation		Load Ratings Dynamic C	Load Ratings Static C_0	Fatigue Load Limit C_u	Speed Ratings Grease	Speed Ratings Oil	Approx. Wt.	Mounting Dimensions Shaft(h5) Max.	Shaft(h5) Min.	Housing(N6) Max.	Housing(N6) Min.	Inspection gage	Mounting inner ring (pages B-2-28 to B-2-37)
						Open Ends	Closed One End												
mm in	mm in	mm in	mm in	mm in	mm in			kN lbf		kN	min^{-1}		kg lbs	mm in	mm in	mm in	mm in		
30 1.1811	**30** 1.1811	**37** 1.4567	**16** 0.630	**13.30** 0.524	**1** 0.039	—	BK3016	**16.8** 3780	**27.3** 6140	4.20	7000	11000	**0.041** 0.090	**30.000** 1.1811	**29.991** 1.1807	**36.988** 1.4562	**36.972** 1.4556	Table B2-2	JR25x30x17
	30 1.1811	**37** 1.4567	**16** 0.630	—	**1** 0.039	HK3016	—	**16.8** 3780	**27.3** 6140	4.20	7000	11000	**0.032** 0.071	**30.000** 1.1811	**29.991** 1.1807	**36.988** 1.4562	**36.972** 1.4556	Table B2-2	JR25x30x17
	30 1.1811	**37** 1.4567	**20** 0.787	**17.3** 0.681	**1** 0.039	—	BK3020	**22.4** 5040	**39.6** 8900	6.25	7000	11000	**0.053** 0.117	**30.000** 1.1811	**29.991** 1.1807	**36.988** 1.4562	**36.972** 1.4556	Table B2-2	JR25x30x20,5
	30 1.1811	**37** 1.4567	**20** 0.787	—	**1** 0.039	HK3020	—	**22.4** 5040	**39.6** 8900	6.25	7000	11000	**0.042** 0.093	**30.000** 1.1811	**29.991** 1.1807	**36.988** 1.4562	**36.972** 1.4556	Table B2-2	JR25x30x20,5
	30 1.1811	**37** 1.4567	**26** 1.024	**23.3** 0.917	**1** 0.039	—	BK3026	**27.4** 6160	**51.2** 11500	7.95	7000	11000	**0.067** 0.148	**30.000** 1.1811	**29.991** 1.1807	**36.988** 1.4562	**36.972** 1.4556	Table B2-2	JR25x30x26,5
	30 1.1811	**37** 1.4567	**26** 1.024	—	**1** 0.039	HK3026	—	**27.4** 6160	**51.2** 11500	7.95	7000	11000	**0.054** 0.119	**30.000** 1.1811	**29.991** 1.1807	**36.988** 1.4562	**36.972** 1.4556	Table B2-2	JR25x30x26,5
	30 1.1811	**37** 1.4567	**38** 1.496	**35.3** 1.390	**1** 0.039	—	BK3038(1)	**38.4** 8630	**79.2** 17800	12.5	7000	11000	**0.093** 0.205	**30.000** 1.1811	**29.991** 1.1807	**36.988** 1.4562	**36.972** 1.4556	Table B2-2	JR25x30x38,5
	30 1.1811	**37** 1.4567	**38** 1.496	—	**1** 0.039	HK3038(1)	—	**38.4** 8630	**79.2** 17800	12.5	7000	11000	**0.075** 0.165	**30.000** 1.1811	**29.991** 1.1807	**36.988** 1.4562	**36.972** 1.4556	Table B2-2	JR25x30x38,5
35 1.3780	**35** 1.3780	**42** 1.6535	**12** 0.472	—	**1** 0.039	HK3512	—	**12.3** 2770	**19.2** 4320	2.90	5900	9100	**0.028** 0.062	**35.000** 1.3780	**34.989** 1.3775	**41.988** 1.6531	**41.972** 1.6524	Table B2-2	
	35 1.3780	**42** 1.6535	**16** 0.630	—	**1** 0.039	HK3516	—	**18.7** 4200	**33.0** 7420	4.60	5900	9100	**0.037** 0.082	**35.000** 1.3780	**34.989** 1.3775	**41.988** 1.6531	**41.972** 1.6524	Table B2-2	JR30x35x17
	35 1.3780	**42** 1.6535	**20** 0.787	**17.3** 0.681	**1** 0.039	—	BK3520	**24.5** 5510	**46.8** 10520	7.40	5900	9100	**0.065** 0.143	**35.000** 1.3780	**34.989** 1.3775	**41.988** 1.6531	**41.972** 1.6524	Table B2-2	JR30x35x20,5
	35 1.3780	**42** 1.6535	**20** 0.787	—	**1** 0.039	HK3520	—	**24.5** 5510	**46.8** 10500	7.40	5900	9100	**0.049** 0.108	**35.000** 1.3780	**34.989** 1.3775	**41.988** 1.6531	**41.972** 1.6524	Table B2-2	JR30x35x20,5
40 1.5748	**40** 1.5748	**47** 1.8504	**12** 0.472	—	**1** 0.039	HK4012	—	**13.4** 3010	**22.4** 5040	3.40	5200	7900	**0.033** 0.073	**40.000** 1.5748	**39.989** 1.5744	**46.988** 1.8499	**46.972** 1.8493	Table B2-2	
	40 1.5748	**47** 1.8504	**16** 0.630	—	**1** 0.039	HK4016	—	**18.9** 4250	**34.8** 7820	5.35	5200	7900	**0.042** 0.093	**40.000** 1.5748	**39.989** 1.5744	**46.988** 1.8499	**46.972** 1.8493	Table B2-2	JR35x40x17
	40 1.5748	**47** 1.8504	**20** 0.787	**17.3** 0.681	**1** 0.039	—	BK4020	**25.1** 5640	**50.4** 11330	8.00	5200	7900	**0.070** 0.154	**40.000** 1.5748	**39.989** 1.5744	**46.988** 1.8499	**46.972** 1.8493	Table B2-2	JR35x40x20,5
	40 1.5748	**47** 1.8504	**20** 0.787	—	**1** 0.039	HK4020	—	**25.1** 5640	**50.4** 11330	8.00	5200	7900	**0.060** 0.132	**40.000** 1.5748	**39.989** 1.5744	**46.988** 1.8499	**46.972** 1.8493	Table B2-2	JR35x40x20,5
45 1.7717	**45** 1.7717	**52** 2.0472	**12** 0.472	—	**1** 0.039	HK4512	—	**14.1** 3170	**24.8** 5580	3.75	4600	7000	**0.036** 0.079	**45.000** 1.7717	**44.989** 1.7712	**51.986** 2.0467	**51.967** 2.0459	Table B2-2	

(1) Drawn cup needle roller bearings with two needle roller and cage assemblies and one lubricating hole.

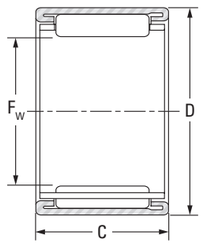
Shaft Dia.	F_w	D	C +0 -0.3 +0.000 -0.012	$C_{3\ min.}$	$r_{s\ min.}$	Bearing Designation		Load Ratings Dynamic C	Load Ratings Static C_0	Fatigue Load Limit C_u	Speed Ratings Grease	Speed Ratings Oil	Approx. Wt.	Mounting Dimensions Shaft(h5) Max.	Shaft(h5) Min.	Housing(N6) Max.	Housing(N6) Min.	Inspection gage	Mounting inner ring (pages B-2-28 to B-2-37)
						Open Ends	Closed One End												
mm in	mm in	mm in	mm in	mm in	mm in			kN lbf		kN	min^{-1}		kg lbs	mm in	mm in	mm in	mm in		
45 1.7717	**45** 1.7717	**52** 2.0472	**16** 0.630	—	**1** 0.039	HK4516	—	**19.8** 4450	**38.5** 8660	5.95	4600	7000	**0.048** 0.106	**45.000** 1.7717	**44.989** 1.7712	**51.986** 2.0467	**51.967** 2.0459	Table B2-2	JR40x45x17
	45 1.7717	**52** 2.0472	**20** 0.787	**17.3** 0.681	**1** 0.039	—	BK4520	**27.2** 6110	**58.2** 13100	8.80	4600	7000	**0.079** 0.174	**45.000** 1.7717	**44.989** 1.7712	**51.986** 2.0467	**51.967** 2.0459	Table B2-2	JR40x45x20,5
	45 1.7717	**52** 2.0472	**20** 0.787	—	**1** 0.039	HK4520	—	**27.2** 6110	**58.2** 13100	8.80	4600	7000	**0.059** 0.130	**45.000** 1.7717	**44.989** 1.7712	**51.986** 2.0467	**51.967** 2.0459	Table B2-2	JR40x45x20,5
50 1.9685	**50** 1.9685	**58** 2.2835	**12** 0.472	—	**1** 0.039	HK5012	—	**17.0** 3820	**28.7** 6450	4.40	4100	6300	**0.045** 0.099	**50.000** 1.9685	**49.989** 1.9681	**57.986** 2.2829	**57.967** 2.2822	Table B2-2	
	50 1.9685	**58** 2.2835	**20** 0.787	—	**1** 0.039	HK5020	—	**30.9** 6950	**62.2** 14000	8.80	4100	6300	**0.072** 0.159	**50.000** 1.9685	**49.989** 1.9681	**57.986** 2.2829	**57.967** 2.2822	Table B2-2	JR45x50x20
	50 1.9685	**58** 2.2835	**25** 0.984	—	**1** 0.039	HK5025	—	**35.5** 7980	**74.1** 16700	11.7	4100	6300	**0.092** 0.203	**50.000** 1.9685	**49.989** 1.9681	**57.986** 2.2829	**57.967** 2.2822	Table B2-2	JR45x50x25,5
55 2.1654	**55** 2.1654	**63** 2.4803	**20** 0.787	—	**1** 0.039	HK5520	—	**31.0** 6970	**64.4** 14480	10.0	3700	5700	**0.079** 0.174	**55.000** 2.1654	**54.987** 2.1648	**62.986** 2.4798	**62.967** 2.4790	Table B2-2	
60 2.3622	**60** 2.3622	**68** 2.6772	**12** 0.472	—	**1** 0.039	HK6012	—	**18.6** 6110	**34.4** 13100	5.25	3400	5200	**0.060** 0.132	**60.000** 2.3622	**59.987** 2.3617	**67.986** 2.6766	**67.967** 2.6759	Table B2-2	
	60 2.3622	**68** 2.6772	**20** 0.787	—	**1** 0.039	HK6020	—	**35.6** 8000	**79.5** 17870	10.9	3400	5200	**0.090** 0.198	**60.000** 2.3622	**59.987** 2.3617	**67.986** 2.6766	**67.967** 2.6759	Table B2-2	

DRAWN CUP NEEDLE ROLLER BEARINGS CAGED, OPEN ENDS

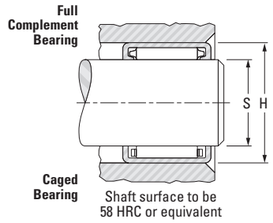
METRIC SERIES
BSM, BKM, BTM, BHTM SERIES



BSM, BKM



BTM, BHTM



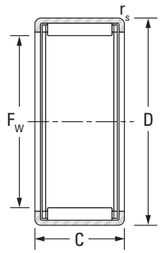
Shaft Dia.	F_w	D	C +0 -0.3 +0.000 -0.012	$C_{3\ min.}$	$r_{s\ min.}$	Bearing Designation	Load Ratings		Fatigue Load Limit C_u	Speed Ratings		Approx. Wt.	Mounting Dimensions				Inspection gage	Mounting inner ring (pages B-2-28 to B-2-37)
							Dynamic	Static					Shaft(h5)		Housing(N6)			
						Open Ends	C	C_0		Grease	Oil		Max.	Min.	Max.	Min.		
mm in	mm in	mm in	mm in	mm in	mm in		kN lbf		kN	min^{-1}		kg lbs	mm in	mm in	mm in	mm in		
6 0.2362	6	10	9	—	—	6BTM109	2.65 600	2.40 540	0.350	23000	36000	0.003	6.000	5.995	9.993	9.984	Table B2-3	—
8 0.3150	8	12	10	—	—	8BTM1210	3.55 800	3.85 870	0.580	21000	33000	0.004	8.000	7.994	11.991	11.98	Table B2-3	—
	8	15	15	—	—	BHTM815	7.55 1700	6.55 1470	1.00	13000	20000	0.009	8.000	7.994	14.991	14.98	Table B2-3	—
9 0.3543	9	13	10	—	—	9BTM1310A	3.80 850	4.25 960	0.630	21000	32000	0.004	9.000	8.994	12.991	12.98	Table B2-3	—
9.8 0.3858	9.8	13.8	10	—	—	BTM101410A	3.75 840	4.25 960	0.640	21000	32000	0.004	9.800	9.794	13.791	13.78	Table B2-3	—
10 0.3937	10	14	10	—	—	10BTM1410	3.95 890	4.60 1030	0.690	20000	31000	0.004	10.000	9.994	13.991	13.98	Table B2-3	—
	10	17	20	—	—	BHTM1020	11.9 2680	12.6 2830	1.95	12000	19000	0.015	10.000	9.994	16.991	16.98	Table B2-3	—
12 0.4724	12	16	10	—	—	12BTM1610	4.45 1000	5.60 1260	0.860	20000	30000	0.005	12.000	11.992	15.991	15.98	Table B2-3	—
	12	18	12	—	—	12BTM1812	6.55 1470	6.70 1510	1.00	14000	21000	0.009	12.000	11.992	17.991	17.98	Table B2-3	—
13 0.5118	13	17	15	—	—	BKM131715J	5.65 1270	7.85 1760	1.20	20000	30000	0.007	13.000	12.992	16.991	16.98	Table B2-3	—
	13	19	14	—	—	BKM131914J	8.60 1930	9.95 2240	1.50	14000	21000	0.011	13.000	12.992	18.989	18.976	Table B2-3	—
	13	20	12	—	—	13BTM2012J	8.25 1860	8.40 1890	1.30	12000	18000	0.012	13.000	12.992	19.989	19.976	Table B2-3	—
	13	21	14	—	—	BKM132114BJ	10.8 2430	10.5 2360	1.60	10000	16000	0.015	13.000	12.992	20.989	20.976	Table B2-3	—
13.5 0.5315	13.5	19	12	—	—	BTM141912A	6.70 1510	7.60 1710	1.15	14000	22000	0.010	13.500	13.492	18.989	18.976	Table B2-3	—
14 0.5512	14	19	16	—	—	14BTM1916B-1	8.80 1980	11.9 2680	1.80	16000	24000	0.011	14.000	13.992	18.989	18.976	Table B2-3	—
	14	20	12	—	—	14BTM2012	6.95 1560	7.50 1690	1.15	13000	20000	0.010	14.000	13.992	19.989	19.976	Table B2-3	—
14.5 0.5709	14.5	19.5	13.5	—	—	BTM152014A	8.35 1880	10.9 2450	1.65	15000	23000	0.009	14.500	14.492	19.489	19.476	Table B2-3	—

Shaft Dia.	F_w	D	C +0 -0.3 +0.000 -0.012	$C_{3\ min.}$	$r_{s\ min.}$	Bearing Designation	Load Ratings		Fatigue Load Limit C_u	Speed Ratings		Approx. Wt.	Mounting Dimensions				Inspection gage	Mounting inner ring (pages B-2-28 to B-2-37)
							Dynamic	Static					Shaft(h5)		Housing(N6)			
						Open Ends	C	C_0		Grease	Oil		Max.	Min.	Max.	Min.		
mm in	mm in	mm in	mm in	mm in	mm in		kN lbf		kN	min^{-1}		kg lbs	mm in	mm in	mm in	mm in		
14.975 0.5896	14.975	21	10	—	—	BTM152110JA	5.80 1300	6.25 1410	0.950	13000	20000	0.009	14.975	14.967	20.989	20.976	Table B2-3	—
15 0.5906	15	20	16	—	—	15BTM2016C-2	9.05 2030	12.6 2830	1.90	15000	23000	0.012	15.000	14.992	19.989	19.976	Table B2-3	—
	15	21	16	—	—	15BTM2116	10.8 2430	13.6 3060	2.05	12000	19000	0.014	15.000	14.992	20.989	20.976	Table B2-3	—
	15	21	22	—	—	15BTM2122	14.3 3220	19.5 4380	3.05	12000	19000	0.020	15.000	14.992	20.989	20.976	Table B2-3	—
	15	22	15	—	—	BHTM1515-1	11.9 2680	13.3 2990	2.05	10000	16000	0.015	15.000	14.992	21.989	21.976	Table B2-3	—
17 0.6693	17	21.5	15	—	—	17BTM2215	6.80 1530	9.60 2160	1.45	12000	19000	0.010	17.000	16.992	21.489	21.476	Table B2-3	—
	17	23	12	—	—	BTM172312	8.45 1900	10.2 2290	1.55	13000	20000	0.012	17.000	16.992	22.989	22.976	Table B2-3	—
	17	24	15	—	—	BHTM1715-1	12.4 2790	14.8 3330	2.25	13000	20000	0.017	17.000	16.992	23.989	23.976	Table B2-3	—
	17	24	20	—	—	BHTM1720-1	16.8 3780	21.9 4920	3.40	13000	20000	0.023	17.000	16.992	23.989	23.976	Table B2-3	—
	17	25	15	—	—	BTM172515	13.2 2970	14.9 3350	2.25	13000	20000	0.020	17.000	16.992	24.989	24.976	Table B2-3	—
18 0.7087	18	24	11.6	—	—	18BTM2412	8.75 1970	10.9 2450	1.65	12000	18000	0.012	18.000	17.992	23.989	23.976	Table B2-3	—
	18	24	16	—	—	BTM182416	12.3 2770	16.8 3780	2.55	12000	18000	0.017	18.000	17.992	23.989	23.976	Table B2-3	—
	18	25	20	—	—	BTM1820	16.7 3750	22.0 4950	3.50	12000	19000	0.024	18.000	17.992	24.989	24.976	Table B2-3	—
	18	25	20	—	—	BTM182520	16.8 3780	22.1 4970	3.45	12000	19000	0.024	18.000	17.992	24.989	24.976	Table B2-3	—
20 0.7874	20	26	16	—	—	BTM202616	13.3 2990	19.6 4410	3.00	10000	16000	0.019	20.000	19.991	25.989	25.976	Table B2-3	—
	20	27	20	—	—	BTM202720-2	19.6 4410	27.6 6200	4.35	11000	17000	0.027	20.000	19.991	26.989	26.976	Table B2-3	—
	20	27	25	—	—	BTM2025	24.3 5460	36.4 8180	5.70	11000	17000	0.033	20.000	19.991	26.989	26.976	Table B2-3	—
	20	27	30	—	—	BTM202730	28.1 6320	43.8 9850	6.80	11000	17000	0.040	20.000	19.991	26.989	26.976	Table B2-3	—
21.6 0.8504	21.6	26.645	12.4	—	—	BTM222712A	9.15 2060	13.9 3130	2.10	9800	15000	0.012	21.600	21.591	26.634	26.621	Table B2-3	—
22 0.8661	22	28	12	—	—	22BTM2812	10.0 2250	13.5 3040	2.05	9800	15000	0.014	22.000	21.991	27.989	27.976	Table B2-3	—
24 0.9449	24	30	13	—	—	BTM243013J	10.5 2360	15.7 3530	2.35	9100	14000	0.018	24.000	23.991	29.989	29.976	Table B2-3	—
25 0.9843	25	31	19	—	—	25BTM3119A	17.9 4020	30.1 6770	4.65	8500	13000	0.026	25.000	24.991	30.988	30.972	Table B2-3	—
	25	32	12	—	—	BTM2512	10.2 2290	12.8 2880	1.95	8500	13000	0.019	25.000	24.991	31.988	31.972	Table B2-3	—
	25	33	20	—	—	BHTM2520-1	21.3 4790	29.7 6680	4.60	8500	13000	0.037	25.000	24.991	32.988	32.972	Table B2-3	—

Continued on next page.

DRAWN CUP NEEDLE ROLLER BEARINGS CAGED, OPEN ENDS

METRIC SERIES
BSM, BKM, BTM, BHTM SERIES



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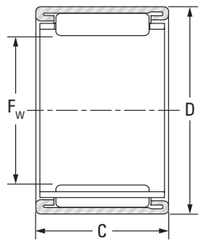

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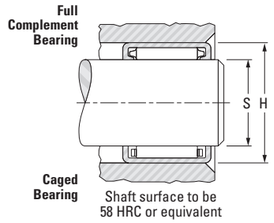
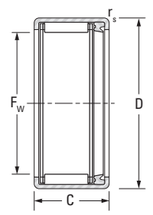


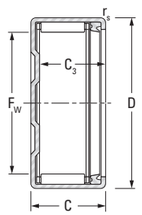
Shaft Dia.	F_w	D	C +0 -0.3 +0.000 -0.012	$C_{3\ min.}$	$r_{s\ min.}$	Bearing Designation	Load Ratings		Fatigue Load Limit C_u	Speed Ratings		Approx. Wt.	Mounting Dimensions				Inspection gage	Mounting inner ring (pages B-2-28 to B-2-37)
							Dynamic	Static					Shaft(h5)		Housing(N6)			
						Open Ends	C	C_0		Grease	Oil		Max.	Min.	Max.	Min.		
mm in	mm in	mm in	mm in	mm in	mm in		kN lbf		kN	min^{-1}		kg lbs	mm in	mm in	mm in	mm in		
25 0.9843	25	33	30	—	—	BHTM2530-1	31.0 6970	48.0 10790	7.55	8500	13000	0.054	25.000	24.991	32.988	32.972	Table B2-3	—
25.8 1.0157	25.8	33	16	—	—	BTM263316A	15.7 3530	22.4 5040	3.40	8500	13000	0.028	25.800	25.791	32.988	32.972	Table B2-3	—
26 1.0236	26	31.4	12	—	—	BKM263112A	9.45 2120	14.5 3260	2.20	7800	12000	0.014	26.000	25.991	31.388	31.372	Table B2-3	—
28 1.1024	28	33	12	—	—	BTM283312J	9.50 2140	15.8 3550	2.40	7200	11000	0.015	28.000	27.991	32.988	32.972	Table B2-3	—
	28	35	20	—	—	28BTM3520	21.1 4740	33.4 7510	5.20	7800	12000	0.035	28.000	27.991	34.988	34.972	Table B2-3	—
	28	36	20.75	—	—	BTM283621JA	25.3 5690	39.3 8840	6.15	7800	12000	0.044	28.000	27.991	35.988	35.972	Table B2-3	—
	28	37	20	—	—	BTM283720	24.2 5440	33.5 7530	5.30	7800	12000	0.046	28.000	27.991	36.988	36.972	Table B2-3	—
	28	37	30	—	—	BHTM2830	36.3 8160	56.5 12700	8.75	7800	12000	0.069	28.000	27.991	36.988	36.972	Table B2-3	—
30 1.1811	30	37	12	—	—	BTM303712	13.3 2990	18.8 4230	2.90	7200	11000	0.022	30.000	29.991	36.988	36.972	Table B2-3	—
	30	37	16	—	—	30BTM3716BM	18.8 4230	29.3 6590	4.45	7200	11000	0.030	30.000	29.991	36.988	36.972	Table B2-3	—
	30	37	20	—	—	30BTM3720	22.7 5100	40.1 9010	6.35	7200	11000	0.040	30.000	29.991	36.988	36.972	Table B2-3	—
	30	40	25	—	—	BHTM3025-1	32.7 7350	46.8 10520	7.35	7200	11000	0.069	30.000	29.991	39.988	39.972	Table B2-3	—
	30	40	30	—	—	BHTM3030-1A	39.2 8810	59.0 13260	9.15	7200	11000	0.083	30.000	29.991	39.988	39.972	Table B2-3	—
31 1.2205	31	39	17.8	—	—	31BTM3918A	22.9 5150	34.8 7820	5.50	7200	11000	0.039	31.000	30.989	38.988	38.972	Table B2-3	—
32 1.2598	32	38	11	—	—	32BTM3811A	5.40 1210	6.75 1520	1.05	6500	10000	0.017	32.000	31.989	37.988	37.972	Table B2-3	—
	32	42	20	—	—	BHTM3220A	26.1 5870	35.1 7890	5.60	6500	10000	0.058	32.000	31.989	41.988	41.972	Table B2-3	—
	32	42	30	—	—	BHTM3230	40.5 9100	61.9 13920	9.65	6500	10000	0.086	32.000	31.989	41.988	41.972	Table B2-3	—
33.5 1.3189	33.5	40	17	—	—	BTM344017A	18.5 4160	33.5 7530	5.25	6200	9500	0.034	33.500	33.489	39.988	39.972	Table B2-3	—
35 1.3780	35	42	16	—	—	BTM3516	20.3 4560	34.7 7800	5.35	6000	9200	0.035	35.000	34.989	41.988	41.972	Table B2-3	—
	35	45	20	—	—	BHTM3520	28.8 6470	41.7 9370	6.60	6100	9400	0.065	35.000	34.989	44.988	44.972	Table B2-3	—
	35	45	30	—	—	BHTM3530	43.8 9850	71.5 16070	11.2	6100	9400	0.096	35.000	34.989	44.988	44.972	Table B2-3	—
37 1.4567	37	43	12	—	—	37BTM4312A	8.80 1980	13.6 3060	2.05	5600	8600	0.022	37.000	36.989	42.988	42.972	Table B2-3	—
38 1.4961	38	45	12	—	—	BTM384512A	14.2 3190	23.3 5240	3.55	5500	8400	0.029	38.000	37.989	44.988	44.972	Table B2-3	—
	38	48	30	—	—	BTM3830PL	45.6 10250	76.5 17200	11.9	5600	8600	0.102	38.000	37.989	47.988	47.972	Table B2-3	—
40 1.5748	40	51	30	—	—	40BTM5130J	48.6 10930	77.5 17420	12.1	5400	8300	0.112	40.000	39.989	50.986	50.967	Table B2-3	—
41.5 1.6339	41.5	46.5	8.5	—	—	BTM424709AJ	7.75 1740	13.9 3120	2.10	4900	7500	0.015	41.500	41.489	46.488	46.472	Table B2-3	—
42 1.6535	42	53	30	—	—	BTM425330J	51.0 11470	85.0 19110	13.3	5100	7800	0.121	42.000	41.989	52.986	52.967	Table B2-3	—
43.52 1.7134	43.52	48.52	14	—	—	44BTM4914A	13.3 2990	29.0 6520	4.35	4700	7200	0.027	43.520	43.509	48.508	48.492	Table B2-3	—
45 1.7717	45	52	12	—	—	45BTM5212A	15.2 3420	27.3 6140	4.15	4600	7000	0.034	45.000	44.989	51.986	51.967	Table B2-3	—
48 1.8898	48	56	30	—	—	BTM485630J	45.4 10210	100 22480	15.6	4300	6600	0.103	48.000	47.989	55.986	55.967	Table B2-3	—
50 1.9685	50	58	20	—	—	50BTM5820J	31.7 7130	61.9 13920	9.65	4200	6400	0.068	50.000	49.989	57.986	57.967	Table B2-3	—
	50	62	25	—	—	BTM5025	49.3 11080	79.5 17870	12.7	4200	6500	0.125	50.000	49.989	61.986	61.967	Table B2-3	—
55 2.1654	55	63	20	—	—	55BTM6320	32.5 7310	66.0 14840	10.3	3700	5700	0.073	55.000	54.987	62.986	62.967	Table B2-3	—
55.254 2.1754	55.254	60.3	14	—	—	BSM5514BJ-2	16.7 3750	41.0 9220	6.30	3600	5600	0.035	55.254	55.241	60.286	60.267	Table B2-3	—
64 2.5197	64	73.178	21.1	—	—	64BTM7321A	40.3 9060	84.9 19090	13.5	3200	4900	0.110	64.000	63.987	73.164	73.145	Table B2-3	—

DRAWN CUP NEEDLE ROLLER BEARINGS SEALED

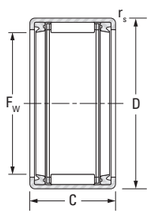
METRIC SERIES
HK RS, BK RS,
HK.2RS SERIES



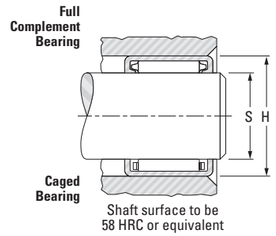
HK RS



BK RS



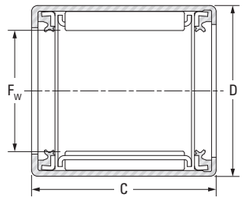
HK.2RS



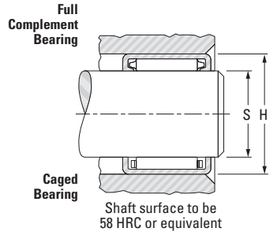
Shaft Dia.	F_w	D	C +0 -0.3 +0.000 -0.012	$C_{3\ min.}$	$r_{s\ min.}$	Bearing Designation		Load Ratings Dynamic C	Load Ratings Static C_0	Fatigue Load Limit C_u	Speed Rating Grease	Approx. Wt.	Mounting Dimensions Shaft(h5) Max.	Mounting Dimensions Shaft(h5) Min.	Mounting Dimensions Housing(N6) Max.	Mounting Dimensions Housing(N6) Min.	Inspection gage	Mounting inner ring (pages B-2-28 to B-2-37)
						Open Ends	Closed One End											
mm in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in			**kN** lbf		kN	min^{-1}	**kg** lbs	**mm** in	**mm** in	**mm** in	**mm** in		
8 0.3150	**8** 0.3150	**12** 0.4724	**10** 0.394	—	**0.4** 0.016	HK0810RS	—	**2.90** 650	**2.73** 610	0.400	20000	**0.004** 0.009	**8.000** 0.3150	**7.994** 0.3147	**11.991** 0.4721	**11.980** 0.4717	Table B2-2	
10 0.3937	**10** 0.3937	**14** 0.5512	**12** 0.472	—	**0.4** 0.016	HK1012RS	—	**4.78** 1070	**5.51** 1240	0.840	19000	**0.006** 0.013	**10.000** 0.3937	**9.994** 0.3935	**13.991** 0.5508	**13.980** 0.5504	Table B2-2	
12 0.4724	**12** 0.4724	**18** 0.7087	**14** 0.551	—	**1** 0.039	HK1214RS	—	**6.61** 1490	**7.29** 1640	1.10	14000	**0.013** 0.029	**12.000** 0.4724	**11.992** 0.4721	**17.991** 0.7083	**17.980** 0.7079	Table B2-2	
	12 0.4724	**18** 0.7087	**16** 0.630	—	**1** 0.039	HK1216.2RS	—	**6.87** 1540	**7.65** 1720	1.15	14000	**0.016** 0.035	**12.000** 0.4724	**11.992** 0.4721	**17.991** 0.7083	**17.980** 0.7079	Table B2-2	
14 0.5512	**14** 0.5512	**20** 0.7874	**14** 0.551	**11.6** 0.457	**1** 0.039	—	BK1414RS	**7.17** 1610	**8.41** 1890	1.30	14000	**0.014** 0.031	**14.000** 0.5512	**13.992** 0.5509	**19.989** 0.7870	**19.976** 0.7865	Table B2-2	
	14 0.5512	**20** 0.7874	**14** 0.551	—	**1** 0.039	HK1414RS	—	**7.17** 1610	**8.41** 1890	1.30	14000	**0.015** 0.033	**14.000** 0.5512	**13.992** 0.5509	**19.989** 0.7870	**19.976** 0.7865	Table B2-2	JR10x14x16
	14 0.5512	**20** 0.7874	**16** 0.630	—	**1** 0.039	HK1416.2RS	—	**7.17** 1610	**8.41** 1890	1.30	14000	**0.014** 0.031	**14.000** 0.5512	**13.992** 0.5509	**19.989** 0.7870	**19.976** 0.7865	Table B2-2	JR10x14x20
15 0.5906	**15** 0.5906	**21** 0.8268	**14** 0.551	**11.3** 0.445	**1** 0.039	—	BK1514RS	**7.87** 1770	**9.69** 2180	1.45	13000	**0.017** 0.037	**15.000** 0.5906	**14.992** 0.5902	**20.989** 0.8263	**20.976** 0.8258	Table B2-2	JR12x15x16,5
	15 0.5906	**21** 0.8268	**14** 0.551	—	**1** 0.039	HK1514RS	—	**7.87** 1770	**9.69** 2180	1.45	13000	**0.016** 0.035	**15.000** 0.5906	**14.992** 0.5902	**20.989** 0.8263	**20.976** 0.8258	Table B2-2	JR12x15x16,5
	15 0.5906	**21** 0.8268	**16** 0.630	—	**1** 0.039	HK1516.2RS	—	**7.87** 1770	**9.69** 2180	1.45	13000	**0.019** 0.042	**15.000** 0.5906	**14.992** 0.5902	**20.989** 0.8263	**20.976** 0.8258	Table B2-2	JR12x15x16,5
16 0.6299	**16** 0.6299	**22** 0.8661	**14** 0.551	—	**1** 0.039	HK1614RS	—	**7.76** 1740	**9.76** 2190	1.50	12000	**0.014** 0.031	**16.000** 0.6299	**15.992** 0.6296	**21.989** 0.8657	**21.976** 0.8652	Table B2-2	JR12x16x16
	16 0.6299	**22** 0.8661	**16** 0.630	—	**1** 0.039	HK1616.2RS	—	**7.82** 1760	**9.76** 2190	1.50	12000	**0.015** 0.033	**16.000** 0.6299	**15.992** 0.6296	**21.989** 0.8657	**21.976** 0.8652	Table B2-2	JR12x16x20
18 0.7087	**18** 0.7087	**24** 0.9449	**14** 0.551	—	**1** 0.039	HK1814RS	—	**8.41** 1890	**11.10** 2500	1.70	11000	**0.018** 0.040	**18.000** 0.7087	**17.992** 0.7083	**23.989** 0.9444	**23.976** 0.9439	Table B2-2	JR15x18x16,5
	18 0.7087	**24** 0.9449	**16** 0.630	—	**1** 0.039	HK1816.2RS	—	**8.41** 1890	**11.10** 2500	1.70	11000	**0.017** 0.037	**18.000** 0.7087	**17.992** 0.7083	**23.989** 0.9444	**23.976** 0.9439	Table B2-2	JR15x18x16,5
20 0.7874	**20** 0.7874	**26** 1.0236	**16** 0.630	—	**1** 0.039	HK2016.2RS	—	**8.97** 2020	**12.50** 2810	1.90	9700	**0.023** 0.051	**20.000** 0.7874	**19.991** 0.7870	**25.989** 1.0232	**25.976** 1.0227	Table B2-2	JR17x20x16,5
	20 0.7874	**26** 1.0236	**18** 0.709	—	**1** 0.039	HK2018RS	—	**12.40** 2790	**18.90** 4250	2.85	9700	**0.025** 0.055	**20.000** 0.7874	**19.991** 0.7870	**25.989** 1.0232	**25.976** 1.0227	Table B2-2	JR17x20x20,5
	20 0.7874	**26** 1.0236	**20** 0.787	—	**1** 0.039	HK2020.2RS	—	**12.40** 2790	**18.90** 4250	2.85	9700	**0.028** 0.062	**20.000** 0.7874	**19.991** 0.7870	**25.989** 1.0232	**25.976** 1.0227	Table B2-2	JR17x20x20,5
22 0.8661	**22** 0.8661	**28** 1.1024	**16** 0.630	—	**1** 0.039	HK2216.2RS	—	**9.81** 2210	**14.50** 3260	2.20	8800	**0.025** 0.055	**22.000** 0.8661	**21.991** 0.8658	**27.989** 1.1019	**27.976** 1.1014	Table B2-2	
	22 0.8661	**28** 1.1024	**18** 0.709	—	**1** 0.039	HK2218RS	—	**13.10** 2950	**20.90** 4700	3.20	8800	**0.027** 0.060	**22.000** 0.8661	**21.991** 0.8658	**27.989** 1.1019	**27.976** 1.1014	Table B2-2	JR17x22x23
	22 0.8661	**28** 1.1024	**20** 0.787	—	**1** 0.039	HK2220.2RS	—	**13.10** 2950	**20.90** 4700	3.20	8800	**0.026** 0.057	**22.000** 0.8661	**21.991** 0.8658	**27.989** 1.1019	**27.976** 1.1014	Table B2-2	JR17x22x23
25 0.9843	**25** 0.9843	**32** 1.2598	**16** 0.630	—	**1** 0.039	HK2516.2RS	—	**11.10** 2500	**15.10** 3390	2.30	7800	**0.030** 0.066	**25.000** 0.9843	**24.991** 0.9839	**31.988** 1.2594	**31.972** 1.2587	Table B2-2	JR20x25x17
	25 0.9843	**32** 1.2598	**18** 0.709	—	**1** 0.039	HK2518RS	—	**15.6** 3510	**24.60** 5530	3.80	7800	**0.034** 0.075	**25.000** 0.9843	**24.991** 0.9839	**31.988** 1.2594	**31.972** 1.2587	Table B2-2	JR20x25x20,5
	25 0.9843	**32** 1.2598	**20** 0.787	—	**1** 0.039	HK2520.2RS	—	**16.20** 3640	**24.60** 5530	3.80	7800	**0.033** 0.073	**25.000** 0.9843	**24.991** 0.9839	**31.988** 1.2594	**31.972** 1.2587	Table B2-2	JR20x25x20,5
	25 0.9843	**32** 1.2598	**22** 0.866	—	**1** 0.039	HK2522RS	—	**20.60** 4630	**33.40** 7510	5.30	7800	**0.042** 0.093	**25.000** 0.9843	**24.991** 0.9839	**31.988** 1.2594	**31.972** 1.2587	Table B2-2	JR20x25x26
	25 0.9843	**32** 1.2598	**24** 0.945	—	**1** 0.039	HK2524.2RS	—	**20.6** 4630	**33.4** 7510	5.30	7800	**0.047** 0.104	**25.000** 0.9843	**24.991** 0.9839	**31.988** 1.2594	**31.972** 1.2587	Table B2-2	JR20x25x26
28 1.1024	**28** 1.1024	**35** 1.3780	**20** 0.787	—	**1** 0.039	HK2820.2RS	—	**15.9** 3570	**24.9** 5600	3.85	6900	**0.042** 0.093	**28.000** 1.1024	**27.991** 1.1020	**34.988** 1.3775	**34.972** 1.3769	Table B2-2	JR22x28x20,5
30 1.1811	**30** 1.1811	**37** 1.4567	**16** 0.63	—	**1** 0.039	HK3016.2RS	—	**11.6** 2610	**16.8** 3780	2.55	6500	**0.030** 0.066	**30.000** 1.1811	**29.991** 1.1807	**36.988** 1.4562	**36.972** 1.4556	Table B2-2	JR25x30x17
	30 1.1811	**37** 1.4567	**18** 0.709	—	**1** 0.039	HK3018RS	—	**16.8** 3780	**27.3** 6140	4.20	6500	**0.042** 0.093	**30.000** 1.1811	**29.991** 1.1807	**36.988** 1.4562	**36.972** 1.4556	Table B2-2	JR25x30x20,5
	30 1.1811	**37** 1.4567	**20** 0.787	—	**1** 0.039	HK3020.2RS	—	**16.8** 3780	**27.3** 6140	4.20	6500	**0.040** 0.088	**30.000** 1.1811	**29.991** 1.1807	**36.988** 1.4562	**36.972** 1.4556	Table B2-2	JR25x30x20,5
	30 1.1811	**37** 1.4567	**22** 0.866	—	**1** 0.039	HK3022RS	—	**22.4** 5040	**39.6** 8900	6.25	6500	**0.051** 0.112	**30.000** 1.1811	**29.991** 1.1807	**36.988** 1.4562	**36.972** 1.4556	Table B2-2	JR25x30x26
	30 1.1811	**37** 1.4567	**24** 0.945	—	**1** 0.039	HK3024.2RS	—	**22.4** 5040	**39.6** 8900	6.25	6500	**0.057** 0.126	**30.000** 1.1811	**29.991** 1.1807	**36.988** 1.4562	**36.972** 1.4556	Table B2-2	JR25x30x26
35 1.3780	**35** 1.3780	**42** 1.6535	**16** 0.630	—	**1** 0.039	HK3516.2RS	—	**13.4** 3010	**21.4** 4810	3.25	5500	**0.047** 0.104	**35.000** 1.3780	**34.989** 1.3775	**41.988** 1.6531	**41.972** 1.6524	Table B2-2	JR30x35x17
	35 1.3780	**42** 1.6535	**18** 0.709	—	**1** 0.039	HK3518RS	—	**17.4** 3910	**29.9** 6720	4.60	5500	**0.054** 0.119	**35.000** 1.3780	**34.989** 1.3775	**41.988** 1.6531	**41.972** 1.6524	Table B2-2	JR30x35x20,5
	35 1.3780	**42** 1.6535	**20** 0.787	—	**1** 0.039	HK3520.2RS	—	**17.4** 3910	**29.9** 6720	4.60	5500	**0.044** 0.097	**35.000** 1.3780	**34.989** 1.3775	**41.988** 1.6531	**41.972** 1.6524	Table B2-2	JR30x35x20,5
40 1.5748	**40** 1.5748	**47** 1.8504	**16** 0.630	—	**1** 0.039	HK4016.2RS	—	**13.4** 3010	**22.4** 5040	3.40	4900	**0.037** 0.082	**40.000** 1.5748	**39.989** 1.5744	**46.988** 1.8499	**46.972** 1.8493	Table B2-2	JR35x40x20
	40 1.5748	**47** 1.8504	**18** 0.709	—	**1** 0.039	HK4018RS	—	**18.9** 4250	**34.8** 7820	5.35	4900	**0.057** 0.126	**40.000** 1.5748	**39.989** 1.5744	**46.988** 1.8499	**46.972** 1.8493	Table B2-2	JR35x40x20,5
	40 1.5748	**47** 1.8504	**20** 0.787	—	**1** 0.039	HK4020.2RS	—	**18.9** 4250	**34.8** 7820	5.35	4900	**0.053** 0.117	**40.000** 1.5748	**39.989** 1.5744	**46.988** 1.8499	**46.972** 1.8493	Table B2-2	JR35x40x20,5
45 1.7717	**45** 1.7717	**52** 2.0472	**18** 0.709	—	**1** 0.039	HK4518RS	—	**19.8** 4450	**38.5** 8660	5.95	4300	**0.064** 0.141	**45.000** 1.7717	**44.989** 1.7712	**51.986** 2.0467	**51.967** 2.0459	Table B2-2	JR40x45x20,5
	45 1.7717	**52** 2.0472	**20** 0.787	—	**1** 0.039	HK4520.2RS	—	**19.8** 4450	**38.5** 8660	5.95	4300	**0.055** 0.121	**45.000** 1.7717	**44.989** 1.7712	**51.986** 2.0467	**51.967** 2.0459	Table B2-2	JR40x45x20,5
50 1.9685	**50** 1.9685	**58** 2.2835	**22** 0.866	—	**1** 0.039	HK5022RS	—	**28.8** 6470	**56.6** 12700	8.80	3900	**0.097** 0.214	**50.000** 1.9685	**49.989** 1.9681	**57.986** 2.2829	**57.967** 2.2822	Table B2-2	JR45x50x25,5
	50 1.9685	**58** 2.2835	**24** 0.945	—	**1** 0.039	HK5024.2RS	—	**28.8** 6470	**56.6** 12700	8.80	3900	**0.083** 0.183	**50.000** 1.9685	**49.989** 1.9681	**57.986** 2.2829	**57.967** 2.2822	Table B2-2	JR45x50x25,5

DRAWN CUP NEEDLE ROLLER BEARINGS SEALED

METRIC SERIES
BKM UU, BHKM UU SERIES



BKM UU, BHKM UU



Shaft Dia.	F_w	D	C +0 -0.3 +0.000 -0.012	$C_{3\ min.}$	$r_{s\ min.}$	Bearing Designation	Load Ratings Dynamic C	Load Ratings Static C_0	Fatigue Load Limit C_u	Speed Rating	Approx. Wt.	Mounting Dimensions Shaft (h5) Max.	Shaft (h5) Min.	Housing (N6) Max.	Housing (N6) Min.	Inspection gage	Mounting inner ring (pages B-2-28 to B-2-37)
						Open Ends				Grease							
mm in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in		**kN** lbf		kN	min^{-1}	**kg** lbs	**mm** in	**mm** in	**mm** in	**mm** in		
17 0.6693	**17**	**24**	**26**	—	—	BHKM1726JUU	**17.6** 3960	**23.3** 5240	3.65	13000	**0.029**	**17.000**	**16.992**	**23.989**	**23.976**	Table B2-3	—
20 0.7874	**20**	**27**	**26**	—	—	BKM2026JUU	**20.5** 4610	**29.2** 6560	4.60	11000	**0.033**	**20.000**	**19.991**	**26.989**	**26.976**	Table B2-3	—
	20	**27**	**30**	—	—	BKM2030JUU	**24.3** 5460	**36.4** 8180	5.70	11000	**0.038**	**20.000**	**19.991**	**26.989**	**26.976**	Table B2-3	—
	20	**27**	**35**	—	—	BKM2035JUU	**28.9** 6500	**45.4** 10210	7.05	11000	**0.045**	**20.000**	**19.991**	**26.989**	**26.976**	Table B2-3	—

INNER RINGS

METRIC SERIES

When it is impractical to meet the shaft raceway design requirements (hardness, surface finish, case depth, etc.) outlined in the engineering section of this catalog, standard inner rings may be used.

Inner rings are made of rolling bearing steel and after hardening, their bores, raceways and end surfaces are ground. Metric series inner rings may be used to provide inner raceway surfaces for metric series radial needle roller and cage assemblies, metric series needle roller bearings and metric series drawn cup needle roller bearings. The extended inner rings are suitable for use with bearings containing lip contact seals and for applications in which axial movement may be present.

CONSTRUCTION

Metric series inner rings are available in four basic designs and differ only by the chamfers at the ends of the raceway surfaces, the lubricant access holes and the raceway profile. Inner rings of series JR have chamfers to assist in bearing installation but are without lubricating holes. Inner rings of series JR.JS1 have bearing installation chamfers and lubricating holes (bore diameters 5 to 180 mm [0.1969 in to 7.0866 in]). Inner rings of series JRZ.JS1 are without installation chamfers, allowing for maximum possible raceway contact.

DIMENSIONAL ACCURACY

The tolerances of size, form, and runout for metric series inner rings meet the requirements of ISO normal tolerance class for radial bearings (see the engineering section). Most metric series inner rings are produced with outside diameter raceway tolerance in accordance with h5 which, in most cases, is suitable for combining the metric series needle roller bearings to give the normal clearance class, and for use with drawn cup bearings. Other raceway tolerances may also be found on inner rings for combining with needle roller bearings to give one of the clearance requirements.

MOUNTING OF INNER RINGS

Inner rings may be mounted on the shaft with either a loose transition fit or an interference fit. These fits used in conjunction with the proper fit of the bearing outer ring, will provide the correct operating clearances for most applications.

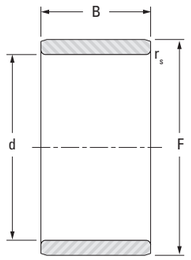
Regardless of the fit of the inner ring on the shaft, the inner ring should be axially located by shaft shoulders or other positive means. The shaft shoulder diameter adjacent to the inner ring must not exceed the inner ring outside diameter (per suggestions on pages B-4-9 and B-4-10 of the metric series needle roller bearing section).

When metric series inner rings are to be used with the metric series needle roller bearings, appropriate shaft tolerances should be selected from Table B4-3 on page B-4-9 in the metric series needle roll bearing section. When Metric series inner rings are to be used with drawn cup bearings the suggested shaft tolerances are given in the “Inner ring” discussion on page B-2-8 of the “metric series drawn cup needle roller bearings” section of this catalog.

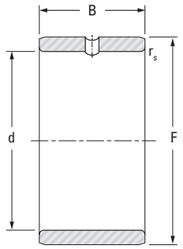
INCH SERIES INNER RINGS

Inch series inner rings for use with inch series drawn cup bearings are tabulated on page B-2-68 of this catalog.

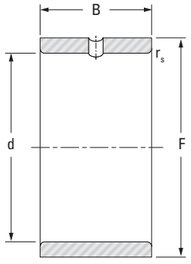
INNER RINGS



JR



JR.JS1

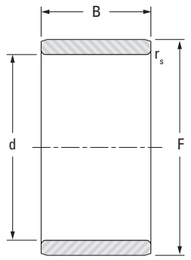


JRZ.JS1

Shaft Dia.	d	F (1)	B	$r_{s\ min.}$	Inner Ring Designation	Approx. Wt.
mm in	mm in	mm in	mm in	mm in		kg lbs
5 0.1969	**5** 0.1969	**8** 0.3150	**8** 0.3150	**0.3** 0.01	JR5x8x8JS1	**0.002** 0.004
	5 0.1969	**8** 0.3150	**12** 0.4724	**0.3** 0.01	JR5x8x12	**0.003** 0.007
	5 0.1969	**8** 0.3150	**16** 0.630	**0.3** 0.01	JR5x8x16	**0.004** 0.009
6 0.2362	**6** 0.2362	**9** 0.3543	**8** 0.315	**0.3** 0.01	JR6x9x8JS1	**0.002** 0.004
	6 0.2362	**9** 0.3543	**12** 0.4724	**0.3** 0.01	JR6x9x12	**0.003** 0.007
	6 0.2362	**9** 0.3543	**16** 0.630	**0.3** 0.01	JR6x9x16	**0.004** 0.009
	6 0.2362	**10** 0.3937	**10** 0.394	**0.3** 0.01	JR6x10x10	**0.004** 0.009
	6 0.2362	**10** 0.3937	**10** 0.394	**0.3** 0.01	JR6x10x10JS1	**0.004** 0.009
	6 0.2362	**10** 0.3937	**12** 0.4724	**0.3** 0.01	JRZ6x10x12JS1	**0.005** 0.011
7 0.2756	**7** 0.2756	**10** 0.3937	**10.5** 0.413	**0.3** 0.01	JR7x10x10,5	**0.003** 0.007
	7 0.2756	**10** 0.3937	**12** 0.4724	**0.3** 0.01	JR7x10x12	**0.004** 0.009
	7 0.2756	**10** 0.3937	**16** 0.630	**0.3** 0.01	JR7x10x16	**0.005** 0.011
8 0.3150	**8** 0.3150	**12** 0.4724	**10** 0.394	**0.3** 0.01	JR8x12x10	**0.005** 0.011
	8 0.3150	**12** 0.4724	**10** 0.394	**0.3** 0.01	JR8x12x10JS1	**0.005** 0.011
	8 0.3150	**12** 0.4724	**10.5** 0.413	**0.3** 0.01	JR8x12x10,5	**0.005** 0.011
	8 0.3150	**12** 0.4724	**12** 0.472	**0.3** 0.01	JRZ8xl2x12JS1	**0.006** 0.013
	8 0.3150	**12** 0.4724	**12.5** 0.492	**0.3** 0.01	JR8x12x12,5	**0.006** 0.013
9 0.3543	**9** 0.3543	**12** 0.4724	**12** 0.4724	**0.3** 0.01	JR9x12x12	**0.005** 0.011
	9 0.3543	**12** 0.4724	**16** 0.630	**0.3** 0.01	JR9x12x16	**0.006** 0.013
10 0.3937	**10** 0.3937	**13** 0.5118	**12.5** 0.492	**0.3** 0.01	JR10x13x12,5	**0.005** 0.011
	10 0.3937	**14** 0.5512	**11** 0.433	**0.3** 0.01	JR10x14x11JS1	**0.007** 0.015
	10 0.3937	**14** 0.5512	**12** 0.4724	**0.3** 0.01	JR10x14x12	**0.007** 0.015
	10 0.3937	**14** 0.5512	**12** 0.4724	**0.3** 0.01	JR10x14x12JS1	**0.007** 0.015
	10 0.3937	**14** 0.5512	**13** 0.512	**0.3** 0.01	JR10x14x13	**0.007** 0.015

(1) Inner rings for metric full complement needle roller bearings are produced with outside diameter tolerance g5.

INNER RINGS



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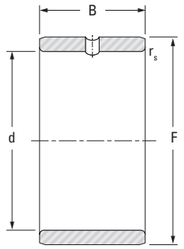
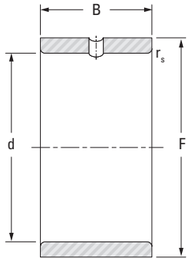


JR.JS1



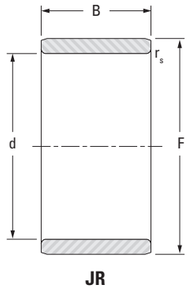
JRZ.JS1

Shaft Dia.	d	F (1)	B	$r_{s\ min.}$	Inner Ring Designation	Approx. Wt.
mm in	mm in	mm in	mm in	mm in		kg lbs
10 0.3937	**10** 0.3937	**14** 0.5512	**14** 0.551	**0.3** 0.01	JRZ10x14x14JS1	**0.008** 0.018
	10 0.3937	**14** 0.5512	**16** 0.630	**0.3** 0.01	JR10x14x16	**0.009** 0.020
	10 0.3937	**14** 0.5512	**20** 0.787	**0.3** 0.01	JR10x14x20	**0.012** 0.026
12 0.4724	**12** 0.4724	**15** 0.5906	**12.5** 0.492	**0.3** 0.01	JR12x15x12,5	**0.006** 0.013
	12 0.4724	**15** 0.5906	**16** 0.630	**0.3** 0.01	JR12x15x16	**0.008** 0.018
	12 0.4724	**15** 0.5906	**16.5** 0.650	**0.3** 0.01	JR12x15x16,5	**0.008** 0.018
	12 0.4724	**15** 0.5906	**18.5** 0.728	**0.3** 0.01	JR12x15x18,5	**0.009** 0.020
	12 0.4724	**15** 0.5906	**22.5** 0.886	**0.3** 0.01	JR12x15x22,5	**0.011** 0.024
	12 0.4724	**16** 0.6299	**12** 0.472	**0.3** 0.01	JR12x16x12	**0.008** 0.018
	12 0.4724	**16** 0.6299	**12** 0.472	**0.3** 0.01	JR12x16x12JS1	**0.008** 0.018
	12 0.4724	**16** 0.6299	**13** 0.512	**0.3** 0.01	JR12x16x13	**0.008** 0.018
	12 0.4724	**16** 0.6299	**14** 0.551	**0.3** 0.01	JRZ12x16x14JS1	**0.010** 0.022
	12 0.4724	**16** 0.6299	**16** 0.630	**0.3** 0.01	JR12x16x16	**0.011** 0.024
	12 0.4724	**16** 0.6299	**20** 0.787	**0.3** 0.01	JR12x16x20	**0.014** 0.031
	12 0.4724	**16** 0.6299	**22** 0.866	**0.3** 0.01	JR12x16x22	**0.015** 0.033
14 0.5512	**14** 0.5512	**17** 0.6693	**17** 0.669	**0.3** 0.01	JR14x17x17	**0.009** 0.020
15 0.5906	**15** 0.5906	**18** 0.7087	**16.5** 0.650	**0.3** 0.01	JR15x18x16,5	**0.010** 0.022
	15 0.5906	**19** 0.7480	**16** 0.630	**0.3** 0.01	JR15x19x16	**0.013** 0.029
	15 0.5906	**19** 0.7480	**20** 0.787	**0.3** 0.01	JR15x19x20	**0.017** 0.037
	15 0.5906	**20** 0.7874	**12** 0.472	**0.3** 0.01	JR15x20x12	**0.012** 0.026
	15 0.5906	**20** 0.7874	**12** 0.472	**0.3** 0.01	JR15x20x12JS1	**0.012** 0.026
	15 0.5906	**20** 0.7874	**13** 0.512	**0.3** 0.01	JR15x20x13	**0.014** 0.031
	15 0.5906	**20** 0.7874	**14** 0.551	**0.3** 0.01	JRZ15x20x14JS1	**0.015** 0.033
	15 0.5906	**20** 0.7874	**16** 0.630	**0.3** 0.01	JR15x20x16	**0.017** 0.037

(1) Inner rings for metric full complement needle roller bearings are produced with outside diameter tolerance g5.

Continued on next page.

INNER RINGS



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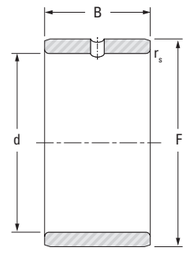
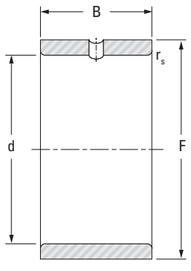


JR.JS1

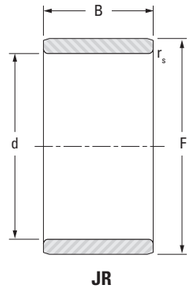


JRZ.JS1

Shaft Dia.	d	F (1)	B	$r_{s\ min.}$	Inner Ring Designation	Approx. Wt.
mm in	**mm** in	**mm** in	**mm** in	**mm** in		**kg** lbs
15 0.5906	**15** 0.5906	**20** 0.7874	**23** 0.906	**0.3** 0.01	JR15x20x23	**0.025** 0.055
	15 0.5906	**20** 0.7874	**26** 1.024	**0.3** 0.01	JR15x20x26	**0.028** 0.062
17 0.6693	**17** 0.6693	**20** 0.7874	**16.5** 0.650	**0.3** 0.01	JR17x20x16,5	**0.011** 0.024
	17 0.6693	**20** 0.7874	**20** 0.787	**0.3** 0.01	JR17x20x20	**0.014** 0.031
	17 0.6693	**20** 0.7874	**20.5** 0.807	**0.3** 0.01	JR17x20x20,5	**0.014** 0.031
	17 0.6693	**20** 0.7874	**30.5** 1.201	**0.3** 0.01	JR17x20x30,5	**0.021** 0.046
	17 0.6693	**21** 0.8268	**16** 0.630	**0.3** 0.01	JR17x21x16	**0.015** 0.033
	17 0.6693	**21** 0.8268	**20** 0.787	**0.3** 0.01	JR17x21x20	**0.019** 0.042
	17 0.6693	**22** 0.8661	**13** 0.512	**0.3** 0.01	JR17x22x13	**0.015** 0.033
	17 0.6693	**22** 0.8661	**16** 0.630	**0.3** 0.01	JR17x22x16	**0.019** 0.042
	17 0.6693	**22** 0.8661	**16** 0.630	**0.3** 0.01	JR17x22x16JS1	**0.019** 0.042
	17 0.6693	**22** 0.8661	**16** 0.630	**0.3** 0.01	JRZ17x22x16JS1	**0.019** 0.042
	17 0.6693	**22** 0.8661	**23** 0.906	**0.3** 0.01	JR17x22x23	**0.028** 0.062
	17 0.6693	**22** 0.8661	**26** 1.024	**0.3** 0.01	JR17x22x26	**0.031** 0.068
	17 0.6693	**22** 0.8661	**32** 1.260	**0.3** 0.01	JR17x22x32	**0.038** 0.084
20 0.7874	**20** 0.7874	**24** 0.9449	**16** 0.630	**0.3** 0.01	JR20x24x16	**0.018** 0.040
	20 0.7874	**24** 0.9449	**20** 0.787	**0.3** 0.01	JR20x24x20	**0.022** 0.049
	20 0.7874	**25** 0.9843	**16** 0.630	**0.3** 0.01	JR20x25x16	**0.022** 0.049
	20 0.7874	**25** 0.9843	**16** 0.630	**0.3** 0.01	JR20x25x16JS1	**0.022** 0.049
	20 0.7874	**25** 0.9843	**17** 0.669	**0.3** 0.01	JR20x25x17	**0.023** 0.051
	20 0.7874	**25** 0.9843	**18** 0.709	**0.3** 0.01	JRZ20x25x18JS1	**0.025** 0.055
	20 0.7874	**25** 0.9843	**20** 0.787	**0.3** 0.01	JR20x25x20	**0.028** 0.062
	20 0.7874	**25** 0.9843	**20.5** 0.807	**0.3** 0.01	JR20x25x20,5	**0.029** 0.064
	20 0.7874	**25** 0.9843	**26** 1.024	**0.3** 0.01	JR20x25x26	**0.036** 0.079

(1) Inner rings for metric full complement needle roller bearings are produced with outside diameter tolerance g5.

INNER RINGS



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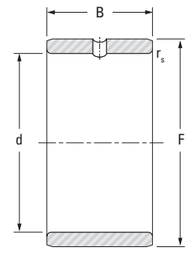
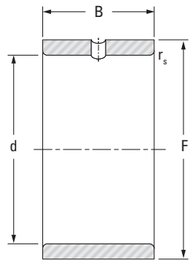


JR.JS1



JRZ.JS1

Shaft Dia.	d	F (1)	B	$r_{s\ min.}$	Inner Ring Designation	Approx. Wt.
mm in	**mm** in	**mm** in	**mm** in	**mm** in		**kg** lbs
20 0.7874	**20** 0.7874	**25** 0.9843	**26.5** 1.043	**0.3** 0.01	JR20x25x26,5	**0.037** 0.082
	20 0.7874	**25** 0.9843	**30** 1.181	**0.3** 0.01	JR20x25x30	**0.042** 0.093
	20 0.7874	**25** 0.9843	**32** 1.260	**0.3** 0.01	JR20x25x32	**0.044** 0.097
	20 0.7874	**25** 0.9843	**38.5** 1.516	**0.3** 0.01	JR20x25x38,5	**0.054** 0.119
22 0.8661	**22** 0.8661	**26** 1.0236	**16** 0.630	**0.3** 0.01	JR22x26x16	**0.019** 0.042
	22 0.8661	**26** 1.0236	**20** 0.787	**0.3** 0.01	JR22x26x20	**0.023** 0.051
	22 0.8661	**28** 1.1024	**17** 0.669	**0.3** 0.01	JR22x28x17	**0.030** 0.066
	22 0.8661	**28** 1.1024	**20.5** 0.807	**0.3** 0.01	JR22x28x20,5	**0.038** 0.084
	22 0.8661	**28** 1.1024	**30** 1.181	**0.3** 0.01	JR22x28x30	**0.056** 0.123
25 0.9843	**25** 0.9843	**29** 1.1417	**20** 0.787	**0.3** 0.01	JR25x29x20	**0.027** 0.060
	25 0.9843	**29** 1.1417	**30** 1.181	**0.3** 0.01	JR25x29x30	**0.040** 0.088
	25 0.9843	**30** 1.1811	**16** 0.630	**0.3** 0.01	JR25x30x16	**0.027** 0.060
	25 0.9843	**30** 1.1811	**16** 0.630	**0.3** 0.01	JR25x30x16JS1	**0.027** 0.060
	25 0.9843	**30** 1.1811	**17** 0.669	**0.3** 0.01	JR25x30x17	**0.028** 0.062
	25 0.9843	**30** 1.1811	**18** 0.709	**0.3** 0.01	JRZ25x30x18JS1	**0.031** 0.068
	25 0.9843	**30** 1.1811	**20** 0.787	**0.3** 0.01	JR25x30x20	**0.034** 0.075
	25 0.9843	**30** 1.1811	**20.5** 0.807	**0.3** 0.01	JR25x30x20,5	**0.035** 0.077
	25 0.9843	**30** 1.1811	**26** 1.024	**0.3** 0.01	JR25x30x26	**0.044** 0.097
	25 0.9843	**30** 1.1811	**26.5** 1.043	**0.3** 0.01	JR25x30x26,5	**0.045** 0.099
	25 0.9843	**30** 1.1811	**30** 1.181	**0.3** 0.01	JR25x30x30	**0.051** 0.112
	25 0.9843	**30** 1.1811	**32** 1.260	**0.3** 0.01	JR25x30x32	**0.054** 0.119
	25 0.9843	**30** 1.1811	**38.5** 1.516	**0.3** 0.01	JR25x30x38,5	**0.066** 0.146
28 1.1024	**28** 1.1024	**32** 1.2598	**17** 0.669	**0.3** 0.01	JR28x32x17	**0.028** 0.062
	28 1.1024	**32** 1.2598	**20** 0.787	**0.3** 0.01	JR28x32x20	**0.030** 0.066

(1) Inner rings for metric full complement needle roller bearings are produced with outside diameter tolerance g5.

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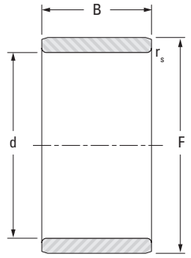
INNER RINGS



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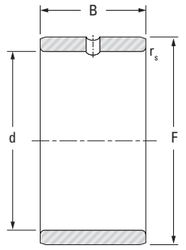
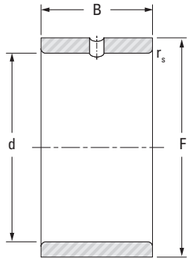


JR.JS1

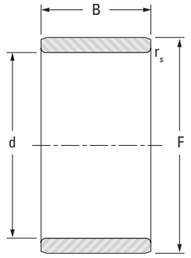


JRZ.JS1

Shaft Dia.	d	F (1)	B	$r_{s\ min.}$	Inner Ring Designation	Approx. Wt.
mm in	**mm** in	**mm** in	**mm** in	**mm** in		**kg** lbs
28 1.1024	**28** 1.1024	**32** 1.2598	**30** 1.181	**0.3** 0.01	JR28x32x30	**0.044** 0.097
30 1.1811	**30** 1.1811	**35** 1.3780	**16** 0.630	**0.3** 0.01	JR30x35x16	**0.031** 0.068
	30 1.1811	**35** 1.3780	**17** 0.669	**0.3** 0.01	JR30x35x17	**0.033** 0.073
	30 1.1811	**35** 1.3780	**18** 0.709	**0.3** 0.01	JRZ30x35x18JS1	**0.036** 0.079
	30 1.1811	**35** 1.3780	**20** 0.787	**0.3** 0.01	JR30x35x20	**0.039** 0.086
	30 1.1811	**35** 1.3780	**20** 0.787	**0.3** 0.01	JRZ30x35x20JS1	**0.039** 0.086
	30 1.1811	**35** 1.3780	**20.5** 0.807	**0.3** 0.01	JR30x35x20,5	**0.040** 0.088
	30 1.1811	**35** 1.3780	**26** 1.024	**0.3** 0.01	JR30x35x26	**0.054** 0.119
	30 1.1811	**35** 1.3780	**30** 1.181	**0.3** 0.01	JR30x35x30	**0.057** 0.126
	30 1.1811	**35** 1.3780	**32** 1.260	**0.3** 0.01	JR30x35x32	**0.062** 0.137
	30 1.1811	**38** 1.4961	**20** 0.787	**0.6** 0.02	JR30x38x20JS1	**0.067** 0.148
32 1.2598	**32** 1.2598	**37** 1.4567	**20** 0.787	**0.3** 0.01	JR32x37x20	**0.043** 0.095
	32 1.2598	**37** 1.4567	**30** 1.181	**0.3** 0.01	JR32x37x30	**0.064** 0.141
	32 1.2598	**40** 1.5748	**20** 0.787	**0.6** 0.02	JR32x40x20	**0.069** 0.152
	32 1.2598	**40** 1.5748	**36** 1.417	**0.6** 0.02	JR32x40x36	**0.128** 0.282
35 1.3780	**35** 1.3780	**40** 1.5748	**17** 0.669	**0.3** 0.01	JR35x40x17	**0.040** 0.088
	35 1.3780	**40** 1.5748	**20** 0.787	**0.3** 0.01	JR35x40x20	**0.046** 0.101
	35 1.3780	**40** 1.5748	**20.5** 0.807	**0.3** 0.01	JR35x40x20,5	**0.049** 0.108
	35 1.3780	**40** 1.5748	**22** 0.866	**0.3** 0.01	JR35x40x22	**0.052** 0.115
	35 1.3780	**40** 1.5748	**30** 1.181	**0.3** 0.01	JR35x40x30	**0.071** 0.157
	35 1.3780	**40** 1.5748	**34** 1.339	**0.3** 0.01	JR35x40x34	**0.080** 0.176
	35 1.3780	**40** 1.5748	**40** 1.575	**0.3** 0.01	JR35x40x40	**0.094** 0.207
	35 1.3780	**42** 1.6535	**20** 0.787	**0.6** 0.02	JR35x42x20	**0.065** 0.143
	35 1.3780	**42** 1.6535	**20** 0.787	**0.6** 0.02	JR35x42x20JS1	**0.065** 0.143

(1) Inner rings for metric full complement needle roller bearings are produced with outside diameter tolerance g5.

INNER RINGS



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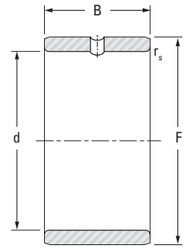
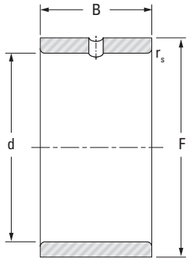


JR.JS1



JRZ.JS1

Shaft Dia.	d	F (1)	B	$r_{s\ min.}$	Inner Ring Designation	Approx. Wt.
mm in	**mm** in	**mm** in	**mm** in	**mm** in		**kg** lbs
35 1.3780	**35** 1.3780	**42** 1.6535	**23** 0.906	**0.6** 0.02	JRZ35x42x23JS1	**0.074** 0.163
	35 1.3780	**42** 1.6535	**36** 1.417	**0.6** 0.02	JR35x42x36	**0.122** 0.269
	35 1.3780	**44** 1.7323	**22** 0.866	**0.6** 0.02	JR35x44x22	**0.097** 0.214
38 1.4961	**38** 1.4961	**43** 1.6929	**20** 0.787	**0.3** 0.01	JR38x43x20	**0.050** 0.110
	38 1.4961	**43** 1.6929	**30** 1.181	**0.3** 0.01	JR38x43x30	**0.075** 0.165
40 1.5748	**40** 1.5748	**45** 1.7717	**17** 0.669	**0.3** 0.01	JR40x45x17	**0.044** 0.097
	40 1.5748	**45** 1.7717	**20** 0.787	**0.3** 0.01	JR40x45x20	**0.052** 0.115
	40 1.5748	**45** 1.7717	**20.5** 0.807	**0.3** 0.01	JR40x45x20,5	**0.054** 0.119
	40 1.5748	**45** 1.7717	**30** 1.181	**0.3** 0.01	JR40x45x30	**0.078** 0.172
	40 1.5748	**45** 1.7717	**34** 1.339	**0.3** 0.01	JR40x45x34	**0.089** 0.196
	40 1.5748	**45** 1.7717	**40** 1.575	**0.3** 0.01	JR40x45x40	**0.115** 0.254
	40 1.5748	**48** 1.8898	**22** 0.866	**0.6** 0.02	JR40x48x22	**0.094** 0.207
	40 1.5748	**48** 1.8898	**23** 0.906	**0.6** 0.02	JRZ40x48x23JS1	**0.100** 0.220
	40 1.5748	**48** 1.8898	**40** 1.575	**0.6** 0.02	JR40x48x40	**0.173** 0.381
	40 1.5748	**50** 1.9685	**20** 0.787	**1** 0.04	JR40x50x20	**0.110** 0.243
42 1.6535	**42** 1.6535	**47** 1.8504	**20** 0.787	**0.3** 0.01	JR42x47x20	**0.055** 0.121
	42 1.6535	**47** 1.8504	**30** 1.181	**0.3** 0.01	JR42x47x30	**0.083** 0.183
45 1.7717	**45** 1.7717	**50** 1.9685	**20** 0.787	**0.3** 0.01	JR45x50x20	**0.058** 0.128
	45 1.7717	**50** 1.9685	**25** 0.984	**0.6** 0.02	JR45x50x25	**0.073** 0.161
	45 1.7717	**50** 1.9685	**25.5** 1.004	**0.3** 0.01	JR45x50x25,5	**0.075** 0.165
	45 1.7717	**50** 1.9685	**35** 1.378	**0.6** 0.02	JR45x50x35	**0.103** 0.227
	45 1.7717	**50** 1.9685	**40** 1.575	**0.3** 0.01	JR45x50x40	**0.117** 0.258
	45 1.7717	**52** 2.0472	**22** 0.866	**0.6** 0.02	JR45x52x22	**0.090** 0.198
	45 1.7717	**52** 2.0472	**23** 0.906	**0.6** 0.02	JR45x52x23	**0.096** 0.212

(1) Inner rings for metric full complement needle roller bearings are produced with outside diameter tolerance g5.

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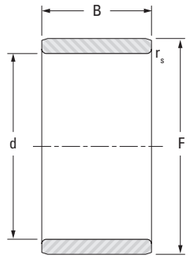
INNER RINGS



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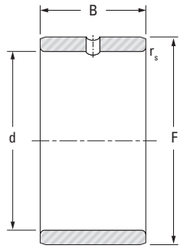
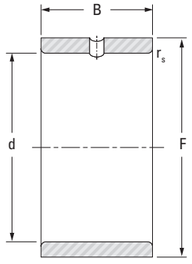


JR.JS1

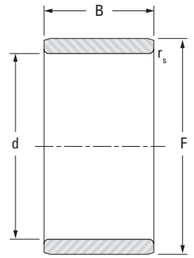


JRZ.JS1

Shaft Dia.	d	F (1)	B	$r_{s\ min.}$	Inner Ring Designation	Approx. Wt.
mm in	**mm** in	**mm** in	**mm** in	**mm** in		**kg** lbs
45 1.7717	**45** 1.7717	**52** 2.0472	**23** 0.906	**0.6** 0.02	JRZ45x52x23JS1	**0.096** 0.212
	45 1.7717	**52** 2.0472	**40** 1.575	**0.6** 0.02	JR45x52x40	**0.167** 0.368
	45 1.7717	**55** 2.1654	**20** 0.787	**1** 0.04	JR45x55x20	**0.133** 0.293
	45 1.7717	**55** 2.1654	**20** 0.787	**1** 0.04	JR45x55x20JS1	**0.133** 0.293
	45 1.7717	**55** 2.1654	**22** 0.866	**1** 0.04	JR45x55x22	**0.135** 0.298
	45 1.7717	**55** 2.1654	**40** 1.575	**1** 0.04	JR45x55x40	**0.247** 0.545
50 1.9685	**50** 1.9685	**55** 2.1654	**20** 0.787	**0.3** 0.01	JR50x55x20	**0.065** 0.143
	50 1.9685	**55** 2.1654	**25** 0.984	**0.6** 0.02	JR50x55x25	**0.081** 0.179
	50 1.9685	**55** 2.1654	**35** 1.378	**0.6** 0.02	JR50x55x35	**0.113** 0.249
	50 1.9685	**55** 2.1654	**40** 1.575	**0.3** 0.01	JR50x55x40	**0.130** 0.287
	50 1.9685	**58** 2.2835	**22** 0.866	**0.6** 0.02	JR50x58x22	**0.117** 0.258
	50 1.9685	**58** 2.2835	**23** 0.906	**0.6** 0.02	JRZ50x58x23JS1	**0.122** 0.269
	50 1.9685	**58** 2.2835	**40** 1.575	**0.6** 0.02	JR50x58x40	**0.213** 0.470
	50 1.9685	**60** 2.3622	**20** 0.787	**1** 0.04	JR50x60x20	**0.155** 0.342
	50 1.9685	**60** 2.3622	**20** 0.787	**1** 0.04	JR50x60x20JS1	**0.155** 0.342
	50 1.9685	**60** 2.3622	**25** 0.984	**1** 0.04	JR50x60x25	**0.170** 0.375
	50 1.9685	**60** 2.3622	**40** 1.575	**1** 0.04	JR50x60x40	**0.310** 0.683
55 2.1654	**55** 2.1654	**60** 2.3622	**25** 0.984	**0.6** 0.02	JR55x60x25	**0.088** 0.194
	55 2.1654	**60** 2.3622	**35** 1.378	**0.6** 0.02	JR55x60x35	**0.124** 0.273
	55 2.1654	**63** 2.4803	**25** 0.984	**1** 0.04	JR55x63x25	**0.141** 0.311
	55 2.1654	**63** 2.4803	**45** 1.772	**1** 0.04	JR55x63x45	**0.286** 0.631
	55 2.1654	**65** 2.5591	**30** 1.181	**1** 0.04	JR55x65x30	**0.222** 0.489
	55 2.1654	**65** 2.5591	**60** 2.362	**1** 0.04	JR55x65x60	**0.444** 0.979
60 2.3622	**60** 2.3622	**68** 2.6772	**25** 0.984	**0.6** 0.02	JR60x68x25	**0.153** 0.337

(1) Inner rings for metric full complement needle roller bearings are produced with outside diameter tolerance g5.

INNER RINGS



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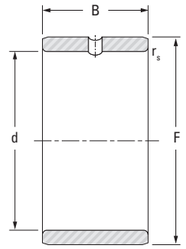
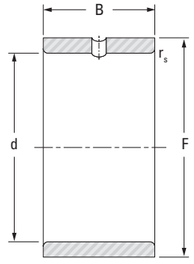


JR.JS1



JRZ.JS1

Shaft Dia.	d	F (1)	B	$r_{s\ min.}$	Inner Ring Designation	Approx. Wt.
mm in	**mm** in	**mm** in	**mm** in	**mm** in		**kg** lbs
60 2.3622	**60** 2.3622	**68** 2.6772	**35** 1.378	**0.6** 0.02	JR60x68x35	**0.220** 0.485
	60 2.3622	**68** 2.6772	**45** 1.772	**1** 0.04	JR60x68x45	**0.284** 0.626
	60 2.3622	**70** 2.7559	**25** 0.984	**1** 0.04	JR60x70x25	**0.200** 0.441
	60 2.3622	**70** 2.7559	**30** 1.181	**1** 0.04	JR60x70x30	**0.240** 0.529
	60 2.3622	**70** 2.7559	**60** 2.362	**1** 0.04	JR60x70x60	**0.480** 1.058
65 2.5591	**65** 2.5591	**72** 2.8346	**25** 0.984	**1** 0.04	JR65x72x25	**0.143** 0.315
	65 2.5591	**72** 2.8346	**45** 1.772	**1** 0.04	JR65x72x45	**0.266** 0.586
	65 2.5591	**73** 2.8740	**25** 0.984	**0.6** 0.02	JR65x73x25	**0.170** 0.375
	65 2.5591	**73** 2.8740	**35** 1.378	**0.6** 0.02	JR65x73x35	**0.240** 0.529
	65 2.5591	**75** 2.9528	**28** 1.102	**1** 0.04	JR65x75x28	**0.240** 0.529
	65 2.5591	**75** 2.9528	**30** 1.181	**1** 0.04	JR65x75x30	**0.260** 0.573
	65 2.5591	**75** 2.9528	**60** 2.362	**1** 0.04	JR65x75x60	**0.520** 1.146
70 2.7559	**70** 2.7559	**80** 3.1496	**25** 0.984	**1** 0.04	JR70x80x25	**0.230** 0.507
	70 2.7559	**80** 3.1496	**30** 1.181	**1** 0.04	JR70x80x30	**0.270** 0.595
	70 2.7559	**80** 3.1496	**35** 1.378	**1** 0.04	JR70x80x35	**0.320** 0.705
	70 2.7559	**80** 3.1496	**54** 2.126	**1** 0.04	JR70x80x54	**0.500** 1.102
	70 2.7559	**80** 3.1496	**60** 2.362	**1** 0.04	JR70x80x60	**0.556** 1.226
75 2.9528	**75** 2.9528	**85** 3.3465	**25** 0.984	**1** 0.04	JR75x85x25	**0.240** 0.529
	75 2.9528	**85** 3.3465	**30** 1.181	**1** 0.04	JR75x85x30	**0.289** 0.637
	75 2.9528	**85** 3.3465	**35** 1.378	**1** 0.04	JR75x85x35	**0.338** 0.745
	75 2.9528	**85** 3.3465	**54** 2.126	**1** 0.04	JR75x85x54	**0.530** 1.168
80 3.1496	**80** 3.1496	**90** 3.5433	**25** 0.984	**1** 0.04	JR80x90x25	**0.260** 0.573
	80 3.1496	**90** 3.5433	**30** 1.181	**1** 0.04	JR80x90x30	**0.306** 0.675
	80 3.1496	**90** 3.5433	**35** 1.378	**1** 0.04	JR80x90x35	**0.355** 0.783

(1) Inner rings for metric full complement needle roller bearings are produced with outside diameter tolerance g5.

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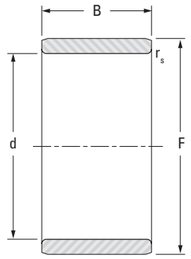
INNER RINGS



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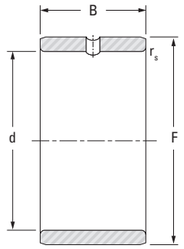

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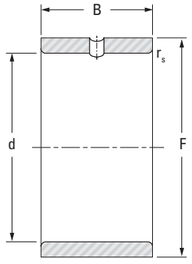
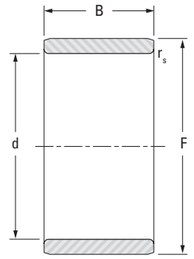


JRZ.JS1

Shaft Dia.	d	F (1)	B	$r_{s\ min.}$	Inner Ring Designation	Approx. Wt.
mm in	**mm** in	**mm** in	**mm** in	**mm** in		**kg** lbs
80 3.1496	**80** 3.1496	**90** 3.5433	**54** 2.126	**1** 0.04	JR80x90x54	**0.565** 1.246
85 3.3465	**85** 3.3465	**95** 3.7402	**26** 1.024	**1** 0.04	JR85x95x26	**0.290** 0.639
	85 3.3465	**95** 3.7402	**30** 1.181	**1** 0.04	JR85x95x30	**0.334** 0.736
	85 3.3465	**95** 3.7402	**36** 1.417	**1** 0.04	JR85x95x36	**0.397** 0.875
	85 3.3465	**100** 3.9370	**35** 1.378	**1.1** 0.04	JR85x100x35	**0.595** 1.312
	85 3.3465	**100** 3.9370	**63** 2.480	**1.1** 0.04	JR85x100x63	**1.080** 2.381
90 3.5433	**90** 3.5433	**100** 3.9370	**26** 1.024	**1** 0.04	JR90x100x26	**0.300** 0.661
	90 3.5433	**100** 3.9370	**30** 1.181	**1** 0.04	JR90x100x30	**0.350** 0.772
	90 3.5433	**100** 3.9370	**36** 1.417	**1** 0.04	JR90x100x36	**0.422** 0.930
	90 3.5433	**105** 4.1339	**32** 1.260	**1.1** 0.04	JR90x105x32	**0.580** 1.279
	90 3.5433	**105** 4.1339	**35** 1.378	**1.1** 0.04	JR90x105x35	**0.624** 1.376
	90 3.5433	**105** 4.1339	**63** 2.480	**1.1** 0.04	JR90x105x63	**1.140** 2.513
95 3.7402	**95** 3.7402	**105** 4.1339	**26** 1.024	**1** 0.04	JR95x105x26	**0.310** 0.683
	95 3.7402	**105** 4.1339	**36** 1.417	**1** 0.04	JR95x105x36	**0.430** 0.948
	95 3.7402	**110** 4.3307	**35** 1.378	**1.1** 0.04	JR95x110x35	**0.653** 1.440
	95 3.7402	**110** 4.3307	**63** 2.480	**1.1** 0.04	JR95x110x63	**1.200** 2.646
100 3.9370	**100** 3.9370	**110** 4.3307	**30** 1.181	**1.1** 0.04	JR100x110x30	**0.384** 0.847
	100 3.9370	**110** 4.3307	**40** 1.575	**1.1** 0.04	JR100x110x40	**0.510** 1.124
	100 3.9370	**115** 4.5276	**40** 1.575	**1.1** 0.04	JR100x115x40	**0.790** 1.742
110 4.3307	**110** 4.3307	**120** 4.7244	**30** 1.181	**1** 0.04	JR110x120x30	**0.425** 0.937
	110 4.3307	**125** 4.9213	**40** 1.575	**1.1** 0.04	JR110x125x40	**0.870** 1.918
120 4.7244	**120** 4.7244	**130** 5.1181	**30** 1.181	**1** 0.04	JR120x130x30	**0.460** 1.014
	120 4.7244	**135** 5.3150	**45** 1.772	**1.1** 0.04	JR120x135x45	**1.060** 2.337
130 5.1181	**130** 5.1181	**145** 5.7087	**35** 1.378	**1.1** 0.04	JR130x145x35	**0.890** 1.962

(1) Inner rings for metric full complement needle roller bearings are produced with outside diameter tolerance g5.

INNER RINGS



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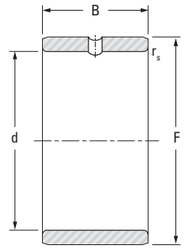

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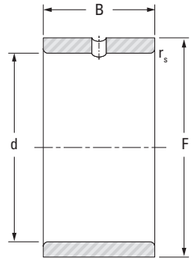


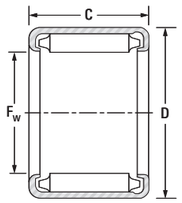
JRZ.JS1

Shaft Dia.	d	F (1)	B	$r_{s\ min.}$	Inner Ring Designation	Approx. Wt.
mm in	**mm** in	**mm** in	**mm** in	**mm** in		**kg** lbs
130 5.1181	**130** 5.1181	**150** 5.9055	**50** 1.969	**1.5** 0.06	JR130x150x50	**1.730** 3.814
140 5.5118	**140** 5.5118	**155** 6.1024	**35** 1.378	**1.1** 0.04	JR140x155x35	**0.955** 2.105
	140 5.5118	**160** 6.2992	**50** 1.969	**1.5** 0.06	JR140x160x50	**1.860** 4.101
150 5.9055	**150** 5.9055	**165** 6.4961	**40** 1.575	**1.1** 0.04	JR150x165x40	**1.170** 2.579
160 6.2992	**160** 6.2992	**175** 6.8898	**40** 1.575	**1.1** 0.04	JR160x175x40	**1.240** 2.734
170 6.6929	**170** 6.6929	**185** 7.2835	**45** 1.772	**1.1** 0.04	JR170x185x45	**1.480** 3.263
180 7.0866	**180** 7.0866	**195** 7.6772	**45** 1.772	**1.1** 0.04	JR180x195x45	**1.560** 3.439

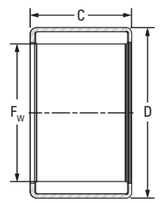
(1) Inner rings for metric full complement needle roller bearings are produced with outside diameter tolerance g5.

DRAWN CUP NEEDLE ROLLER BEARINGS
FULL COMPLEMENT
OPEN ENDS

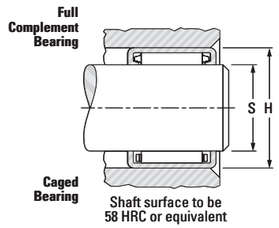
METRIC SERIES
BM, BHM, YM SERIES



BM, BHM



YM



Shaft surface to be 58 HRC or equivalent

Shaft Dia.	F_w	D	C +0 -0.3 +0.000 -0.012	$C_{3\ min.}$	Bearing Designation	Load Ratings Dynamic	Load Ratings Static	Fatigue Load Limit	Approx. Wt.	Mounting Dimensions Shaft(h5) Max.	Shaft(h5) Min.	Housing(H6) Max.	Housing(H6) Min.	Inspection gage
					Open Ends	C	C_0	C_u						
mm in	mm in	mm in	mm in	mm in		kN lbf		kN	kg lbs	mm in	mm in	mm in	mm in	
3.5 0.1378	**3.5**	**8**	**11**	—	YM040811A	**4.50** 1010	**4.20** 940	0.62	**0.003**	**3.500**	**3.495**	**8.009**	**8.000**	Table B2-3
6.13 0.2413	**6.13**	**11**	**9.7**	—	6YM1110BM	**5.20** 1170	**5.80** 1300	0.88	**0.004**	**6.130**	**6.124**	**11.011**	**11.000**	Table B2-3
8 0.3150	**8**	**12**	**10**	—	YM081210	**6.70** 1510	**8.80** 1980	1.35	**0.004**	**8.000**	**7.994**	**12.011**	**12.000**	Table B2-3
	8	**13**	**10**	—	YM081310AM	**6.20** 1390	**7.70** 1730	1.15	**0.006**	**8.000**	**7.994**	**13.011**	**13.000**	Table B2-3
10 0.3937	**10**	**14**	**10**	—	10BM1410	**7.20** 1620	**9.50** 2140	1.45	**0.004**	**10.000**	**9.994**	**14.011**	**14.000**	Table B2-3
12 0.4724	**12**	**18**	**12**	—	12BM1812	**10.7** 2410	**12.8** 2880	1.90	**0.010**	**12.000**	**11.992**	**18.011**	**18.000**	Table B2-3
14 0.5512	**14**	**20**	**12**	—	14BM2012	**11.6** 2610	**14.8** 3330	2.25	**0.011**	**14.000**	**13.992**	**20.013**	**20.000**	Table B2-3
15 0.5906	**15**	**21**	**10**	—	15BM2110	**9.75** 2190	**12.0** 2700	1.85	**0.009**	**15.000**	**14.992**	**21.013**	**21.000**	Table B2-3
	15	**21**	**12**	—	15BM2112	**12.3** 2770	**16.1** 3620	2.45	**0.012**	**15.000**	**14.992**	**21.013**	**21.000**	Table B2-3
	15	**21**	**16**	—	15BM2116	**16.9** 3800	**24.4** 5490	3.70	**0.016**	**15.000**	**14.992**	**21.013**	**21.000**	Table B2-3
16 0.6299	**16**	**22**	**12**	—	16BM2212	**12.9** 2900	**17.3** 3890	2.65	**0.012**	**16.000**	**15.992**	**22.013**	**22.000**	Table B2-3
17 0.6693	**17**	**23**	**12**	—	17BM2312	**13.0** 2920	**18.2** 4090	2.70	**0.013**	**17.000**	**16.992**	**23.013**	**23.000**	Table B2-3
	17	**24**	**12**	—	YM172412-1	**16.3** 3660	**21.5** 4830	3.25	**0.016**	**17.000**	**16.992**	**24.013**	**24.000**	Table B2-3
	17	**24**	**17**	—	BM172417-1	**20.1** 4520	**28.2** 6340	4.30	**0.023**	**17.000**	**16.992**	**24.013**	**24.000**	Table B2-3
	17	**24**	**20**	—	BHM1720A	**23.9** 5370	**35.1** 7890	5.55	**0.026**	**17.000**	**16.992**	**24.013**	**24.000**	Table B2-3
	17	**24**	**25**	—	BHM1725	**29.9** 6720	**46.9** 10540	7.30	**0.034**	**17.000**	**16.992**	**24.013**	**24.000**	Table B2-3
18 0.7087	**18**	**24**	**16**	—	18BM2416	**18.9** 4250	**29.4** 6610	4.45	**0.018**	**18.000**	**17.992**	**24.013**	**24.000**	Table B2-3
20 0.7874	**20**	**26**	**14**	—	YM202614	**19.0** 4270	**31.4** 7060	4.75	**0.019**	**20.000**	**19.991**	**26.013**	**26.000**	Table B2-3
	20	**26**	**16**	—	20BM2616	**18.7** 4200	**31.7** 7130	4.85	**0.021**	**20.000**	**19.991**	**26.013**	**26.000**	Table B2-3
20 0.7874	**20**	**26**	**20**	—	20BM2620	**23.6** 5310	**42.7** 9600	6.70	**0.026**	**20.000**	**19.991**	**26.013**	**26.000**	Table B2-3
	20	**27**	**15**	—	BM2015	**19.6** 4410	**28.0** 6290	4.25	**0.022**	**20.000**	**19.991**	**27.013**	**27.000**	Table B2-3
	20	**27**	**26**	—	BM2026	**34.7** 7800	**58.3** 13110	9.10	**0.040**	**20.000**	**19.991**	**27.013**	**27.000**	Table B2-3
21 0.8268	**21**	**27**	**20**	—	21YM2720J	**25.6** 5750	**47.6** 10700	7.45	**0.029**	**21.000**	**20.991**	**27.013**	**27.000**	Table B2-3
22 0.8661	**22**	**29**	**25**	—	BM222925	**33.5** 7530	**60.1** 13510	9.40	**0.043**	**22.000**	**21.991**	**29.013**	**29.000**	Table B2-3
25 0.9843	**25**	**32**	**16**	—	BM2516	**23.6** 5310	**38.3** 8610	5.85	**0.028**	**25.000**	**24.991**	**32.016**	**32.000**	Table B2-3
	25	**32**	**20**	—	BM2520	**30.0** 6740	**52.0** 11690	8.15	**0.036**	**25.000**	**24.991**	**32.016**	**32.000**	Table B2-3
	25	**32**	**26**	—	BM2526	**38.9** 8740	**72.7** 16340	11.4	**0.048**	**25.000**	**24.991**	**32.016**	**32.000**	Table B2-3
	25	**33**	**25**	—	BHM2525	**39.3** 8830	**66.6** 14970	10.4	**0.053**	**25.000**	**24.991**	**33.016**	**33.000**	Table B2-3
28 1.1024	**28**	**34**	**17**	—	BM2817	**26.0** 5840	**50.0** 11240	7.80	**0.029**	**28.000**	**27.991**	**34.016**	**34.000**	Table B2-3
	28	**34**	**24**	—	BM2824	**36.3** 8160	**77.1** 17330	12.1	**0.042**	**28.000**	**27.991**	**34.016**	**34.000**	Table B2-3
	28	**37**	**30**	—	28BHM3730	**54.8** 12320	**95.1** 21380	14.9	**0.080**	**28.000**	**27.991**	**37.016**	**37.000**	Table B2-3
	28	**39**	**30**	—	BM283930A	**55.8** 12540	**86.3** 19400	13.5	**0.101**	**28.000**	**27.991**	**39.016**	**39.000**	Table B2-3
30 1.1811	**30**	**37**	**20**	—	30BM3720	**33.6** 7550	**62.9** 14140	10.0	**0.042**	**30.000**	**29.991**	**37.016**	**37.000**	Table B2-3
	30	**37**	**26**	—	30BM3726	**43.6** 9800	**87.7** 19710	13.7	**0.056**	**30.000**	**29.991**	**37.016**	**37.000**	Table B2-3
34 1.3386	**34**	**42**	**25**	—	34YM4225L	**46.3** 10410	**94.1** 21150	14.7	**0.075**	**34.000**	**33.989**	**42.016**	**42.000**	Table B2-3
38 1.4961	**38**	**48**	**20**	—	YM3820PL	**48.1** 10810	**83.3** 18730	13.3	**0.082**	**38.000**	**37.989**	**48.016**	**48.000**	Table B2-3
40 1.5748	**40**	**53**	**20**	—	YM405320JM	**59.6** 13400	**89.9** 20210	14.4	**0.116**	**40.000**	**39.989**	**53.019**	**53.000**	Table B2-3

Note) · For information on the speed ratings, contact JTEKT.

DRAWN CUP NEEDLE ROLLER BEARINGS

INCH SERIES

When a rolling bearing is needed for a compact and economical design, where it is not practical to harden and grind the housing bore, or where the housing materials are of low rigidity such as cast iron, aluminum or even plastics – drawn cup needle roller bearings should be considered.

REFERENCE STANDARDS

- **ANSI/ABMA 18.2** – needle roller bearings - radial, inch design.
- **JIS B 1536** – rolling bearings – needle roller bearings – boundary dimensions and tolerances.

Y

B

M

Full complement bearings

J

JTT

BT

Caged bearings

Fig. B2-9. Types of inch series drawn cup needle roller bearings

CONSTRUCTION

FULL COMPLEMENT BEARINGS

The original drawn cup needle roller bearing employs a full complement of needle rollers. The full complement drawn cup bearing combines maximum load-carrying capability with the advantages of the drawn outer ring.

The inward turned lips of the cup are used to mechanically retain the full complement of needle rollers, providing their positive radial retention – even though it may be necessary to remove the shaft repeatedly during servicing of the mechanism employing the bearing.

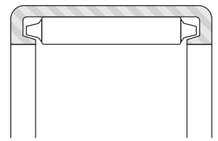


Fig. B2-10. Full complement bearing

CAGED BEARINGS

The one-piece steel cage, used in most caged drawn cup bearings, is designed to provide rigidity and minimize wear. This cage design separates the roller guiding and roller retainment functions. The portions of the cage that retain the rollers cannot contact the rollers while the bearing is operating. Thus, there is no wear which might affect roller retention.

The cage contacts the rollers only near their ends at the roller pitch line, so accurate guidance is achieved with least effort. Pitch line guidance at the ends of the rollers prevents skewing and assures roller stability, with little stress on the cage itself. The design minimizes the contact area and force required for roller guidance, and thus minimizes drag between cage and rollers.

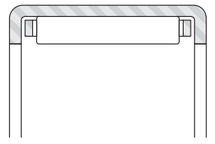


Fig. B2-11. Caged bearing

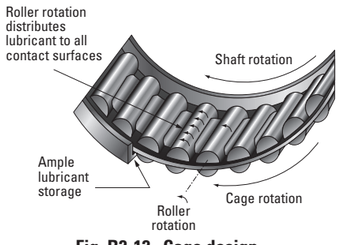


Fig. B2-12. Cage design

The same design feature that assures no contact between roller retention bars and rollers while the bearing is operating, also provides ample clearance along the length of the roller to enhance the circulation of lubricant.

There are bearings with other cage designs. Bearings with engineered polymer cages are for use where operating conditions permit. Before applying bearings with engineered polymer cages, please consult your representative.

SEALED BEARINGS

Drawn cup caged needle roller bearings are offered with integral seals. The tables of dimensions on pages B-2-66 and B-2-67 indicate those sizes available with lip contact seals. The seal lip design achieves a light and constant contact with the shaft throughout the range of mounting bearing clearances thereby ensuring positive sealing and low frictional drag.

Sealed drawn cup bearings are intended to retain grease or non-pressurized oil within a bearing while also preventing contaminants from entering the raceway area.

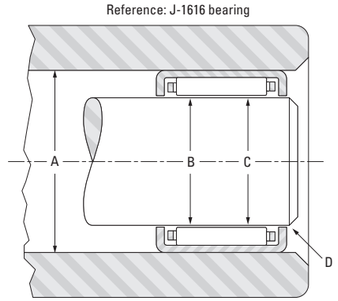
Details of shaft design for sealed bearings are given in the engineering section.

The standard lip contact seals are compatible with common lubricating oils and petroleum based fuels. But they are adversely affected by certain fire-resistant hydraulic fluids and most common solvents.

If the operating temperature must be outside of the specified range, or if the seals are exposed to unusual fluids, please consult your representative.

DIMENSIONAL ACCURACY AND MOUNTING DIMENSIONS

MANUFACTURING TOLERANCES AND RESULTING CLEARANCES



A. Housing bore tolerance 0.025 mm (0.0010in)
B. Manufacturing tolerance for bearing 0.023 mm (0.0009 in)
C. Shaft diameter tolerance 0.013 mm (0.0005 in)
D. Min. Initial radial clearance 0.013 mm (0.0005 in)

Fig. B2-13. Manufacturing tolerances and resulting clearances

BEARING MOUNTING FITS AND RADIAL INTERNAL CLEARANCE

Drawn cup bearings are manufactured to a degree of precision that will satisfy the radial clearance requirements of most applications. The total radial clearance of an installed drawn cup bearing results from the buildup of manufacturing tolerances of the housing bore, inner raceway O.D., and the bearing – as well as the minimum radial clearance required for the application.

For bearings of nominal inch dimensions, the suggested mounting dimensions will provide correct running clearance for most applications. Closer control of radial clearance would be governed by the user's capability of holding housing and shaft raceway dimensional tolerances tighter than the limits shown in the bearing tables.

The drawing illustrates the manufacturing tolerances and resulting clearances applying to medium size drawn cup bearings, in rotating applications, when using the suggested tabulated mounting dimensions.

Radial clearance in a mounted bearing may be more closely controlled by reducing the manufacturing tolerances of the housing bore and inner raceway diameter. Where extremely close control of radial clearance is required for bearings of nominal inch dimensions, extra-precision full complement bearings are available (see page B-2-57).

TOLERANCES FOR HOUSING MATERIALS OF LOW RIGIDITY

For housing materials of low rigidity, or steel housings of small section, it is suggested that for initial trial the housing bore diameters given in the bearing tables be reduced by the amounts shown in Table B2-4. To maintain normal radial internal clearance, the inner raceway diameter tolerance given in the bearing tables should be used.

Table B2-4. Low Rigidity Housing Bore

Nom. housing bore				Subtract	
Over	Incl.	Over	Incl.		
mm		in		mm	in
0.0	**9.5**	0.00	0.38	**0.010**	0.0004
9.5	**25.4**	0.38	1.00	**0.015**	0.0006
25.4	**50.8**	1.00	2.00	**0.025**	0.0010
50.8	**76.2**	2.00	3.00	**0.030**	0.0012
76.2	**152.4**	3.00	6.00	**0.036**	0.0014

OUTER RING ROTATION

For applications where the outer ring rotates with respect to the load, it is suggested that both the housing bore and inner raceway diameter be reduced. Bearings of nominal inch dimensions should have the housing bore and inner raceway diameters reduced by 0.013 mm (0.0005 in)

OSCILLATING MOTION

Applications involving oscillating motion often require reduced radial clearances. This reduction is accomplished by increasing the shaft raceway diameters as shown in Table B2-5.

Table B2-5. Nominal inch bearing oscillating shaft size

Shaft size		Add	
mm	in	mm	in
2.38 to 4.76	0.094 to 0.188	**0.008**	0.0003
6.35 to 47.62	0.250 to 1.875	**0.013**	0.0005
50.8 to 139.70	2.000 to 5.500	**0.015**	0.0006

For information on fits to housing materials of low rigidity and on fits during outer ring rotation and during oscillation rotation, contact JTEKT.

INNER RINGS

Where it becomes impractical to meet the shaft raceway design requirements (hardness, case depth, surface finish, etc.) outlined in the engineering section, standard inner rings for drawn cup bearings are available. These are tabulated on pages B-2-68 to B-2-70 of the drawn cup section.

Inner rings for drawn cup bearings are designed to be a loose transition fit on the shaft and should be clamped against a shoulder. If a tight transition fit must be used to keep the inner ring from rotating relative to the shaft, the inner ring O.D., as mounted, must not exceed the raceway diameters required by the drawn cup bearing for the particular application.

LOAD RATING FACTORS

Dynamic Loads

Drawn cup needle roller bearings can accommodate only radial loads.

$P = F_r$

P = The maximum dynamic radial load that may be applied to a drawn cup bearing based on the dynamic load rating, C_r given in the bearing tables. This load should be $\leq C_r/3$.

Static Loads

$$f_0 = \frac{C_0}{P_0}$$

f_0 = static load safety factor

C_0 = basic static load rating

P_0 = maximum applied static load

To ensure satisfactory operation of drawn cup needle roller bearings under all types of conditions the static load safety factor f_0 should be ≥ 3.

INSPECTION PROCEDURES

Although the bearing cup (outer ring) is accurately drawn from strip steel it may go out of round during heat treatment. When the bearing is pressed into a true, round housing or ring gage of correct size and wall thickness, it becomes round and is sized properly. For this reason, it is incorrect to inspect an unmounted drawn cup bearing by measuring the O.D. The correct method for inspecting the bearing size is to:

1. Press the bearing into a ring gage of proper size.
2. Plug the bearing bore with the appropriate "go" and "no go" gages.

Tables B2-6 and B2-7 starting on page B-2-44 provide the correct ring and plug gage diameters for inspecting drawn cup needle roller bearings.

When the letter **H** appears in the columns headed "Bearing Bore Designation" and "Nominal Shaft Diameter" in Table B2-6, the gage sizes listed are for the larger cross section bearings, which include **H** in their bearing designation prefix.

Example

Find the ring gage and plug gage dimensions for a BH-68 bearing.

The nominal bore diameter (F_w) for this bearing, as shown in the table of dimensions on page B-2-49, is 9.525 mm (0.3750 in). Since the letter H appears in the bearing designation, the following information will be found opposite H6 9.525 mm (0.3750 in) in Table B2-6 on page B-2-44.

	in
ring gage	0.6255
diameter under needle rollers, min.	0.3765
diameter under needle rollers, max.	0.3774

The "go" plug gage is the same size as the minimum needle roller complement bore diameter and the "no go" plug gage size is 0.002 mm (0.0001 in) larger than the maximum bore diameter. Therefore the correct ring and plug gage dimensions are:

	in
ring gage	0.6255
plug gage, "go"	0.3765
plug gage, "no go"	0.3775

These same gage dimensions also apply to JH-68.

Table B2-6 applies to the Y, B, M, J and JTT series. Table B2-7 applies to the BT.

Table B2-6. Ring and plug gage dimensions

Bearing bore designation	Nominal shaft diameter	Nominal. bore diameter	Ring gage	Needle roller complement bore diameter	
				Max.	Min.
	mm in	mm in	mm in	mm in	mm in
2	**3.175** 1/8	**3.175** 0.1250	**6.363** 0.2505	**3.218** 0.1267	**3.195** 0.1258
2 1/2	**3.970** 5/32	**3.967** 0.1562	**7.155** 0.2817	**4.013** 0.1580	**3.99** 0.1571
3	**4.763** 3/16	**4.763** 0.1875	**8.730** 0.3437	**4.806** 0.1892	**4.783** 0.1883
4	**6.350** 1/4	**6.350** 0.2500	**11.125** 0.4380	**6.411** 0.2524	**6.388** 0.2515
5	**7.938** 5/16	**7.938** 0.3125	**12.713** 0.5005	**7.998** 0.3149	**7.976** 0.3140
H 5	**H 7.938** H 5/16	**7.938** 0.3125	**14.300** 0.5630	**7.998** 0.3149	**7.976** 0.3140
6	**9.525** 3/8	**9.525** 0.3750	**14.300** 0.5630	**9.586** 0.3774	**9.563** 0.3765
H 6	**H 9.525** H 3/8	**9.525** 0.3750	**15.888** 0.6255	**9.586** 0.3774	**9.563** 0.3765
7	**11.113** 7/16	**11.113** 0.4375	**15.888** 0.6255	**11.174** 0.4399	**11.151** 0.4390
H 7	**H 11.113** H 7/16	**11.113** 0.4375	**17.475** 0.6880	**11.174** 0.4399	**11.151** 0.4390
8	**12.700** 1/2	**12.700** 0.5000	**17.475** 0.6880	**12.761** 0.5024	**12.738** 0.5015
H 8	**H12.700** H 1/2	**12.700** 0.5000	**19.063** 0.7505	**12.761** 0.5024	**12.738** 0.5015
9	**14.288** 9/16	**14.288** 0.5625	**19.063** 0.7505	**14.349** 0.5649	**14.326** 0.5640
H 9	**H 14.288** H 9/16	**14.288** 0.5625	**20.650** 0.8130	**14.349** 0.5649	**14.326** 0.5640
10	**15.875** 5/8	**15.875** 0.6250	**20.650** 0.8130	**14.349** 0.6274	**15.913** 0.6265
H 10	**H 15.875** H 5/8	**15.875** 0.6250	**22.238** 0.8755	**14.349** 0.6274	**15.913** 0.6265
11	**17.463** 11/16	**17.463** 0.6875	**22.238** 0.8755	**17.524** 0.6899	**17.501** 0.6890
H 11	**H 17.463** H 11/16	**17.463** 0.6875	**23.825** 0.9380	**17.524** 0.6899	**17.501** 0.6890
12	**19.050** 3/4	**19.050** 0.7500	**25.387** 0.9995	**19.086** 0.7514	**19.063** 0.7505
H 12	**H 19.050** H 3/4	**19.050** 0.7500	**26.975** 1.0620	**19.086** 0.7514	**19.063** 0.7505
13	**20.638** 13/16	**20.638** 0.8125	**26.975** 1.0620	**20.673** 0.8139	**20.650** 0.8130
H 13	**H 20.638** H 13/16	**20.638** 0.8125	**28.562** 1.1245	**20.673** 0.8139	**20.650** 0.8130
14	**22.225** 7/8	**22.225** 0.8750	**28.562** 1.1245	**22.261** 0.8764	**22.238** 0.8755
H 14	**H 22.225** H 7/8	**22.225** 0.8750	**30.150** 1.1870	**22.261** 0.8764	**22.238** 0.8755

Bearing bore designation	Nominal shaft diameter	Nominal. bore diameter	Ring gage	Needle roller complement bore diameter	
				Max.	Min.
	mm in	mm in	mm in	mm in	mm in
15	**23.813** 15/16	**23.813** 0.9375	**30.150** 1.1870	**23.848** 0.9389	**23.825** 0.9380
16	**25.400** 1	**25.400** 1.0000	**31.737** 1.2495	**25.436** 1.0014	**25.413** 1.0005
H 16	**H 25.400** H 1	**25.400** 1.0000	**33.325** 1.3120	**25.436** 1.0014	**25.413** 1.0005
17	**26.988** 1 1/16	**26.988** 1.0625	**33.325** 1.3120	**27.023** 1.0639	**27.000** 1.0630
18	**28.575** 1 1/8	**28.575** 1.1250	**34.912** 1.3745	**28.611** 1.1264	**28.588** 1.1255
H 18	**H 28.575** H 1 1/8	**28.575** 1.1250	**38.087** 1.4995	**28.611** 1.1264	**28.588** 1.1255
19	**30.163** 1 3/16	**30.163** 1.1875	**38.087** 1.4995	**30.198** 1.1889	**30.175** 1.1880
20	**31.750** 1 1/4	**31.750** 1.2500	**38.087** 1.4995	**31.786** 1.2514	**31.763** 1.2505
H 20	**H 31.750** H 1 1/4	**31.750** 1.2500	**41.262** 1.6245	**31.786** 1.2514	**31.763** 1.2505
21	**33.338** 1 5/16	**33.338** 1.3125	**41.262** 1.6245	**33.376** 1.3140	**33.350** 1.3130
22	**34.925** 1 3/8	**34.925** 1.3750	**41.262** 1.6245	**34.963** 1.3765	**34.938** 1.3755
H 22	**H 34.925** H1 3/8	**34.925** 1.3750	**44.437** 1.7495	**34.963** 1.3765	**34.938** 1.3755
24	**38.100** 1 1/2	**38.100** 1.5000	**47.612** 1.8745	**38.141** 1.5016	**38.113** 1.5005
26	**41.275** 1 5/8	**41.275** 1.6250	**50.787** 1.9995	**41.316** 1.6266	**41.288** 1.6255
28	**44.450** 1 3/4	**44.450** 1.7500	**53.962** 2.1245	**44.493** 1.7517	**44.463** 1.7505
30	**47.625** 1 7/8	**47.625** 1.8750	**57.137** 2.2495	**47.668** 1.8767	**47.638** 1.8755
32	**50.800** 2	**50.800** 2.0000	**60.312** 2.3745	**50.846** 2.0018	**50.815** 2.0006
H 33	**H 52.388** H 2 1/16	**52.388** 2.0625	**64.280** 2.5307	**52.436** 2.0644	**52.400** 2.0630
34	**53.975** 2 1/8	**53.975** 2.1250	**63.487** 2.4995	**54.026** 2.1270	**53.990** 2.1256
36	**57.150** 2 1/4	**57.150** 2.2500	**66.662** 2.6245	**57.201** 2.2520	**57.165** 2.2506
42	**66.675** 2 5/8	**66.675** 2.6250	**76.187** 2.9995	**66.736** 2.6274	**66.700** 2.6260
44	**69.850** 2 3/4	**69.850** 2.7500	**79.362** 3.1245	**69.911** 2.7524	**69.875** 2.7510
56	**88.900** 3 1/2	**88.900** 3.5000	**101.587** 3.9995	**88.961** 3.5024	**88.925** 3.5010
88	**139.700** 5 1/2	**139.700** 5.5000	**152.375** 5.9990	**139.774** 5.5029	**139.725** 5.5010

Bearing bore should be checked with “go” and “no go” plug gages. The “go” gage size is the minimum needle roller complement bore diameter. The “no go” gage size is larger than the maximum needle roller complement bore diameter by 0.0001 in

Table B2-7. Ring and plug gage dimensions[1)]

Needle roller complement bore diameter F_w nominal size	Ring gage	Plug gage	
		Go	No go
mm (in)	mm	mm	mm
4.762(3/16)	8.730	4.783	4.808
6.350(1/4)	11.125	6.388	6.413
7.938(5/16)	12.713 14.300	7.976	8.001
9.525(3/8)	14.300 15.888	9.563	9.588
11.112(7/16)	15.888 17.475	11.151	11.176
12.700(1/2)	17.475 19.063	12.738	12.763
14.288(9/16)	19.063 20.650	14.326	14.351
15.875(5/8)	20.650 22.237	15.913	15.938
17.462(11/16)	22.237 23.825	17.501	17.526
19.050(3/4)	25.387	19.063	19.088
20.638(13/16)	26.975 28.562	20.650	20.675
22.225(7/8)	28.562 30.150	22.238	22.263
23.812(15/16)	30.150	23.825	23.850
25.400(1)	31.737 33.325	25.413	25.438

Needle roller complement bore diameter F_w nominal size	Ring gage	Plug gage	
		Go	No go
mm (in)	mm	mm	mm
26.988(1 1/16)	33.325	27.000	27.025
28.575(1 1/8)	34.912 38.087	28.588	28.613
30.162(1 3/16)	38.087	30.175	30.200
31.750(1 1/4)	38.087 41.262	31.763	31.788
33.338(1 5/16)	41.262	33.350	33.378
34.925(1 3/8)	41.262 44.437	34.938	34.966
38.100(1 1/2)	47.612	38.113	38.143
41.275(1 5/8)	50.787	41.288	41.318
44.450(1 3/4)	53.962	44.463	44.496
47.625(1 7/8)	57.137	47.638	47.671
50.800(2)	60.312	50.815	50.848
52.388(2 1/16)	64.280	52.413	52.451
53.975(2 1/8)	63.487	53.990	54.028
57.150(2 1/4)	66.662	57.165	57.203
63.500(2 1/2)	73.139	63.515	63.553
66.675(2 5/8)	76.187	66.700	66.738
69.850(2 3/4)	79.362	69.875	69.913
88.900(3 1/2)	101.587	88.925	88.963

1) These values apply to the needle roller bearings of the BT series with inch nominal dimensions.

INSTALLATION OF DRAWN CUP NEEDLE ROLLER BEARINGS

GENERAL INSTALLATION REQUIREMENTS

- A drawn cup needle roller bearing must be pressed into its housing.
- An installation tool, similar to the ones shown, must be used in conjunction with a standard press.
- The bearing must not be hammered into its housing – even in conjunction with the proper assembly mandrel.
- The bearing must not be pressed tightly against a shoulder in the housing.
- If it is necessary to use a shouldered housing, the depth of the housing bore must be sufficient to ensure the housing shoulder fillet, and the shoulder face, clear the bearing.
- The installation tool must be coaxial with the housing bore.

INSTALLATION OF OPEN END BEARINGS

It is advisable to utilize a positive stop on the press tool to locate the bearing properly in the housing. The assembly tool should have a leader or a pilot, as shown, to aid in starting the bearing true in the housing. The ball detent shown on the drawing is used to assist in aligning the rollers of a full complement bearing during installation and to hold the bearing on the installation tool. A caged-type drawn cup bearing does not require a ball detent to align its rollers. The ball detent may still be used to hold the bearing on the installation tool or an "O" ring may be used as shown in the drawing on this page. The bearing should be installed with the marked end (the end with identification markings) against the angled shoulder of the pressing tool.

A – 0.40 mm (0.016 in) less than housing bore
B – 0.08 mm (0.003 in) less than shaft diameter
C – distance bearing will be inset into housing, minimum of 0.20 mm (0.008 in)
D – pilot length should be length of bearing less 0.80 mm (0.030 in)
E – approximately 1/2 D

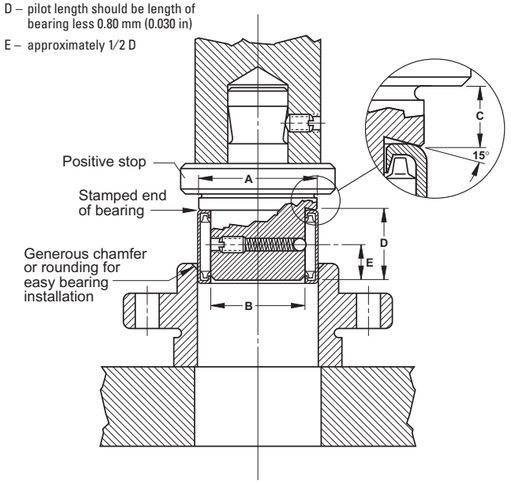


Fig. B2-14. Installation of open ends full complement bearings

A – 0.40 mm (0.016 in) less than housing bore
B – 0.08 mm (0.003 in) less than shaft diameter
C – distance bearing will be inset into housing, minimum of 0.20 mm (0.008 in)
D – pilot length should be length of bearing less 0.80 mm (0.030 in)
E – approximately ½ D

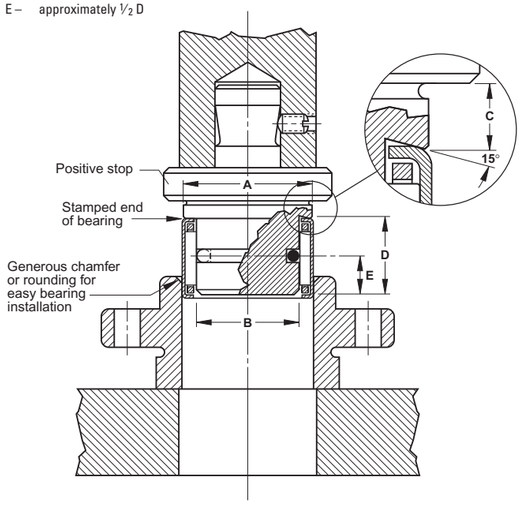


Fig. B2-15. Installation of open ends caged bearings

INSTALLATION OF CLOSED END BEARINGS

The installation tool combines all the features of the tool used to install open end bearings. But the pilot is spring loaded and is part of the press bed.

The angled shoulder of the pressing tool should bear against the closed end, with the bearing held on the pilot, to aid in starting the bearing true in the housing.

A – 0.40 mm (0.016 in) less than housing bore
B – 0.08 mm (0.003 in) less than shaft diameter
C – distance bearing will be inset into housing, minimum of 0.20 mm (0.008 in)

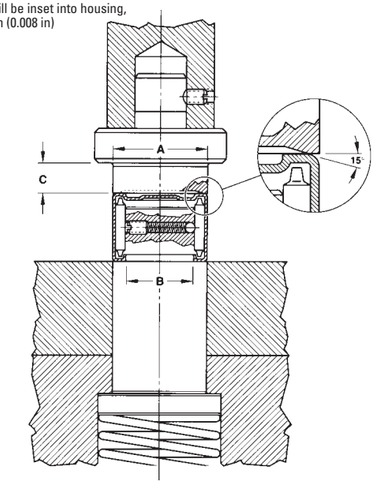


Fig. B2-16. Installation of closed end bearings

EXTRACTION OF DRAWN CUP NEEDLE ROLLER BEARINGS

The need to extract a drawn cup needle roller bearing does not arise often. Standard extractor tools may be purchased from a reputable manufacturer. Customers may produce the special extraction tools at their own facilities. After extraction, the drawn cup needle roller bearing should not be reused.

EXTRACTION FROM A STRAIGHT HOUSING

When it is necessary to extract a drawn cup needle roller bearing from a straight housing, a similar tool to the installation tool – but without the stop – may be used. To avoid damage to the bearing, pressure should be applied against the marked end of the bearing, just as it is done at installation.

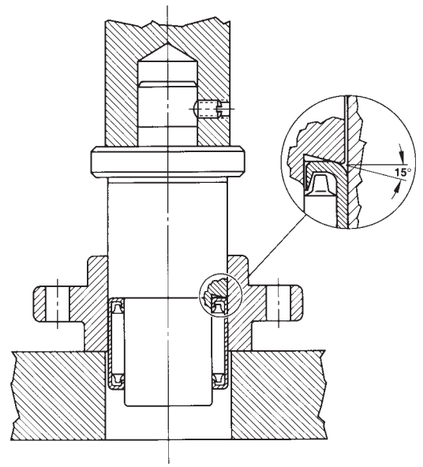


Fig. B2-17. Extraction from a straight housing

EXTRACTION FROM A SHOULDERED HOUSING

(with bearing pressed up close to the shoulder)

The tool to be used, as shown, is of a similar type described for a shouldered or dead end housing. But the rollers must first be removed from the bearing.

The four segment puller jaws are collapsed and slipped into the empty cup. The jaws are then forced outward into the cup bore, by means of the tapered expansion rod. The jaws should bear on the lip as near as possible to the cup bore. The cup is then pressed out from the top.

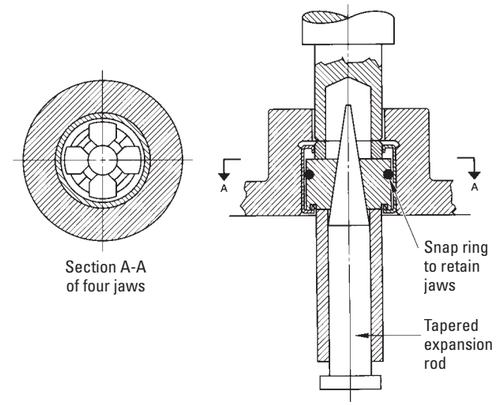


Fig. B2-18. Extraction from a shouldered housing

EXTRACTION FROM A SHOULDERED OR DEAD END HOUSING

(with space between the bearing and the housing shoulder)

Bearings may be extracted from shouldered or dead end housings with a common bearing puller tool as shown. This type of tool is slotted in two places, at right angles, to form four prongs. The four puller prongs are pressed together and inserted into the space between the end of the bearing and the shoulder. The prongs are forced outward by inserting the expansion rod, and then the bearing is extracted. Do not reuse the bearing after extraction.

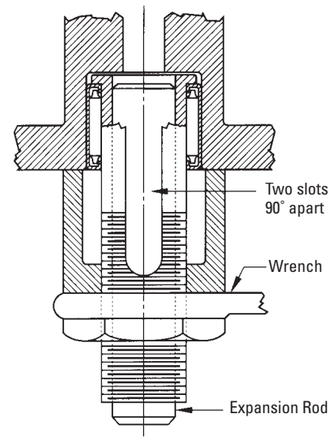
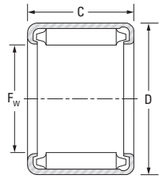


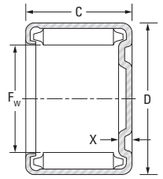
Fig. B2-19. Extraction from a shouldered or dead end housing

FULL COMPLEMENT BEARINGS
OPEN ENDS, CLOSED ONE END

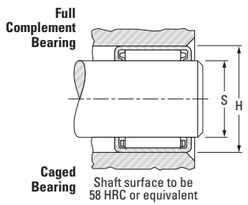
INCH SERIES
B, BH, NB, NBH, M- 1, MH- 1 SERIES



B, BH, NB, NBH



M- 1, MH- 1



Shaft Dia.	F_w	D	C +0 -0.3 +0.000 -0.012	$X_{max.}$	Bearing Designation		Load Ratings Dynamic	Load Ratings Static	Fatigue Load Limit C_u	Approx. Wt.		Mounting Dimensions Shaft		Mounting Dimensions Housing		Inspection gage	Mounting inner ring (pages B-2-68 to B-2-70)
					Open Ends	Closed One End	C	C_0		Open Ends	Closed One End	Max.	Min.	Max.	Min.		
in	mm in	mm in	mm in	mm in			kN lbf		kN	kg lbs		mm in	mm in	mm in	mm in		
1/8	**3.175** 0.1250	**6.350** 0.2500	**6.35** 0.250	—	B-24	—	**1.73** 390	**1.65** 370	0.24	**0.001** 0.002	—	**3.175** 0.1250	**3.167** 0.1247	**6.363** 0.2505	**6.350** 0.2500	Table B2-6	
5/32	**3.970** 0.1563	**7.142** 0.2812	**6.35** 0.250	—	B-2 1/2 4	—	**2.00** 450	**2.00** 450	0.31	**0.001** 0.002	—	**3.970** 0.1563	**3.962** 0.1560	**7.155** 0.2817	**7.142** 0.2812	Table B2-6	
	3.970 0.1563	**7.142** 0.2812	**7.92** 0.312	—	B-2 1/2 5	—	**2.58** 580	**2.80** 630	0.42	**0.001** 0.003	—	**3.970** 0.1563	**3.962** 0.1560	**7.155** 0.2817	**7.142** 0.2812	Table B2-6	
3/16	**4.763** 0.1875	**8.733** 0.3438	**6.35** 0.250	**1.78** 0.070	B-34	M-341	**2.20** 490	**2.12** 480	0.36	**0.001** 0.003	**0.002** 0.004	**4.763** 0.1875	**4.755** 0.1872	**8.730** 0.3437	**8.717** 0.3432	Table B2-6	
	4.763 0.1875	**8.733** 0.3438	**9.53** 0.375	**1.78** 0.070	B-36	M-361	**3.78** 850	**4.23** 950	0.64	**0.002** 0.005	**0.003** 0.006	**4.763** 0.1875	**4.755** 0.1872	**8.730** 0.3437	**8.717** 0.3432	Table B2-6	
1/4	**6.350** 0.2500	**11.113** 0.4375	**6.35** 0.250	**2.03** 0.080	B-44	M-441	**2.74** 620	**2.63** 590	0.45	**0.002** 0.005	**0.003** 0.006	**6.350** 0.2500	**6.337** 0.2495	**11.125** 0.4380	**11.100** 0.4370	Table B2-6	
	6.350 0.2500	**11.113** 0.4375	**7.92** 0.312	**2.03** 0.080	B-45	M-451	**3.55** 800	**3.68** 830	0.56	**0.003** 0.007	**0.004** 0.008	**6.350** 0.2500	**6.337** 0.2495	**11.125** 0.4380	**11.100** 0.4370	Table B2-6	
	6.350 0.2500	**11.113** 0.4375	**9.53** 0.375	—	B-46	—	**4.55** 1020	**5.06** 1140	0.77	**0.004** 0.008	—	**6.350** 0.2500	**6.337** 0.2495	**11.125** 0.4380	**11.100** 0.4370	Table B2-6	
	6.350 0.2500	**11.113** 0.4375	**11.13** 0.438	**2.03** 0.080	B-47	M-471	**5.51** 1240	**6.46** 1450	0.98	**0.004** 0.009	**0.005** 0.011	**6.350** 0.2500	**6.337** 0.2495	**11.125** 0.4380	**11.100** 0.4370	Table B2-6	
5/16	**7.938** 0.3125	**12.700** 0.5000	**7.92** 0.312	**2.03** 0.080	B-55	M-551	**4.08** 920	**4.60** 1030	0.70	**0.004** 0.008	**0.004** 0.009	**7.938** 0.3125	**7.925** 0.3120	**12.713** 0.5005	**12.687** 0.4995	Table B2-6	
	7.938 0.3125	**12.700** 0.5000	**9.53** 0.375	—	B-56	—	**5.23** 1180	**6.33** 1420	0.97	**0.005** 0.010	—	**7.938** 0.3125	**7.925** 0.3120	**12.713** 0.5005	**12.687** 0.4995	Table B2-6	
	7.938 0.3125	**12.700** 0.5000	**11.13** 0.438	**2.03** 0.080	B-57	M-571	**6.33** 1420	**8.09** 1820	1.20	**0.005** 0.011	**0.006** 0.013	**7.938** 0.3125	**7.925** 0.3120	**12.713** 0.5005	**12.687** 0.4995	Table B2-6	
	7.938 0.3125	**12.700** 0.5000	**14.27** 0.562	—	B-59	—	**8.37** 1880	**11.6** 2600	1.75	**0.006** 0.014	—	**7.938** 0.3125	**7.925** 0.3120	**12.713** 0.5005	**12.687** 0.4995	Table B2-6	
	7.938 0.3125	**14.288** 0.5625	**11.13** 0.438	**2.29** 0.090	BH-57	MH-571	**7.01** 1580	**7.33** 1650	1.10	**0.007** 0.016	**0.008** 0.018	**7.938** 0.3125	**7.925** 0.3120	**14.300** 0.5630	**14.275** 0.5620	Table B2-6	
	7.938 0.3125	**14.288** 0.5625	**14.27** 0.562	—	BH-59	—	**9.46** 2130	**10.8** 2420	1.65	**0.009** 0.020	—	**7.938** 0.3125	**7.925** 0.3120	**14.300** 0.5630	**14.275** 0.5620	Table B2-6	
21/64	**8.331** 0.3280	**14.288** 0.5625	**12.70** 0.500	—	NB-3	—	**8.10** 1820	**9.56** 2150	1.45	**0.008** 0.018	—	**8.331** 0.3280	**8.319** 0.3275	**14.300** 0.5630	**14.275** 0.5620	Table B2-6	
3/8	**9.525** 0.3750	**14.288** 0.5625	**7.92** 0.312	**2.03** 0.080	B-65	M-651	**4.55** 1020	**5.53** 1240	0.84	**0.004** 0.009	**0.005** 0.010	**9.525** 0.3750	**9.512** 0.3745	**14.300** 0.5630	**14.275** 0.5620	Table B2-6	IRA-3
	9.525 0.3750	**14.288** 0.5625	**9.53** 0.375	**2.03** 0.080	B-66	M-661	**5.83** 1310	**7.61** 1710	1.15	**0.005** 0.011	**0.005** 0.012	**9.525** 0.3750	**9.512** 0.3745	**14.300** 0.5630	**14.275** 0.5620	Table B2-6	IRA-3
	9.525 0.3750	**14.288** 0.5625	**11.13** 0.438	—	B-67	—	**7.06** 1590	**9.72** 2190	1.45	**0.006** 0.013	—	**9.525** 0.3750	**9.512** 0.3745	**14.300** 0.5630	**14.275** 0.5620	Table B2-6	IRA-3
	9.525 0.3750	**14.288** 0.5625	**12.70** 0.500	**2.03** 0.080	B-68	M-681	**8.21** 1850	**11.8** 2650	1.80	**0.007** 0.015	**0.008** 0.017	**9.525** 0.3750	**9.512** 0.3745	**14.300** 0.5630	**14.275** 0.5620	Table B2-6	IRA-3
	9.525 0.3750	**14.288** 0.5625	**14.27** 0.562	—	B-69	—	**9.33** 2100	**13.9** 3130	2.10	**0.007** 0.016	—	**9.525** 0.3750	**9.512** 0.3745	**14.300** 0.5630	**14.275** 0.5620	Table B2-6	
	9.525 0.3750	**14.288** 0.5625	**15.88** 0.625	**2.03** 0.080	B-610	M-6101	**10.4** 2340	**16.0** 3590	2.40	**0.008** 0.018	**0.010** 0.021	**9.525** 0.3750	**9.512** 0.3745	**14.300** 0.5630	**14.275** 0.5620	Table B2-6	
	9.525 0.3750	**15.875** 0.6250	**12.70** 0.500	—	BH-68	—	**9.35** 2100	**10.9** 2460	1.65	**0.010** 0.021	—	**9.525** 0.3750	**9.512** 0.3745	**15.888** 0.6255	**15.862** 0.6245	Table B2-6	IRA-3
7/16	**11.113** 0.4375	**15.875** 0.6250	**9.53** 0.375	—	B-76	—	**6.37** 1430	**8.88** 2000	1.35	**0.005** 0.012	—	**11.113** 0.4375	**11.100** 0.4370	**15.888** 0.6255	**15.862** 0.6245	Table B2-6	IRA-4
	11.113 0.4375	**15.875** 0.6250	**11.13** 0.438	—	B-77	—	**7.71** 1730	**11.3** 2550	1.70	**0.007** 0.015	—	**11.113** 0.4375	**11.100** 0.4370	**15.888** 0.6255	**15.862** 0.6245	Table B2-6	IRA-4
	11.113 0.4375	**15.875** 0.6250	**12.70** 0.500	**2.03** 0.080	B-78	M-781	**8.97** 2020	**13.8** 3100	2.10	**0.008** 0.017	**0.009** 0.019	**11.113** 0.4375	**11.100** 0.4370	**15.888** 0.6255	**15.862** 0.6245	Table B2-6	IRA-4
	11.113 0.4375	**15.875** 0.6250	**15.88** 0.625	—	B-710	—	**11.4** 2560	**18.7** 4200	2.80	**0.010** 0.021	—	**11.113** 0.4375	**11.100** 0.4370	**15.888** 0.6255	**15.862** 0.6245	Table B2-6	
	11.113 0.4375	**17.463** 0.6875	**12.70** 0.500	—	BH-78	—	**10.3** 2320	**12.8** 2870	1.95	**0.010** 0.023	—	**11.113** 0.4375	**11.100** 0.4370	**17.475** 0.6880	**17.450** 0.6870	Table B2-6	IRA-4
0.439	**11.151** 0.439	**15.908** 0.6263	**12.70** 0.500	—	NB-38		**9.00** 2020	**13.8** 3100	2.10	**0.032** 0.071	—	**11.151** 0.4390	**11.143** 0.4387	**15.908** 0.6263	**15.9** 0.6260	Table B2-6	
1/2	**12.700** 0.5000	**17.463** 0.6875	**7.92** 0.312	**2.03** 0.080	B-85	M-851	**5.36** 1200	**7.38** 1660	1.15	**0.005** 0.012	**0.006** 0.014	**12.700** 0.5000	**12.687** 0.4995	**17.475** 0.6880	**17.450** 0.6870	Table B2-6	IRA-5
	12.700 0.5000	**17.463** 0.6875	**9.53** 0.375	**2.03** 0.080	B-86	M-861	**6.87** 1540	**10.2** 2290	1.55	**0.006** 0.014	**0.007** 0.016	**12.700** 0.5000	**12.687** 0.4995	**17.475** 0.6880	**17.450** 0.6870	Table B2-6	IRA-5
	12.700 0.5000	**17.463** 0.6875	**11.13** 0.438	**2.03** 0.080	B-87	M-871	**8.31** 1870	**13.0** 2920	1.95	**0.007** 0.016	**0.008** 0.018	**12.700** 0.5000	**12.687** 0.4995	**17.475** 0.6880	**17.450** 0.6870	Table B2-6	IRA-5
	12.700 0.5000	**17.463** 0.6875	**12.70** 0.500	**2.03** 0.080	B-88	—	**9.63** 2160	**15.7** 3530	2.40	**0.009** 0.019	**0.010** 0.021	**12.700** 0.5000	**12.687** 0.4995	**17.475** 0.6880	**17.450** 0.6870	Table B2-6	IRA-5
	12.700 0.5000	**17.463** 0.6875	**12.70** 0.500	**2.03** 0.080	—	M-881	**9.66** 2170	**15.8** 3550	2.40	—	**0.010** 0.021	**12.700** 0.5000	**12.687** 0.4995	**17.475** 0.6880	**17.450** 0.6870	Table B2-6	
	12.700 0.5000	**17.463** 0.6875	**15.88** 0.625	**2.03** 0.080	B-810	M-8101	**12.2** 2750	**21.3** 4800	3.20	**0.010** 0.023	**0.012** 0.026	**12.700** 0.5000	**12.687** 0.4995	**17.475** 0.6880	**17.450** 0.6870	Table B2-6	
	12.700 0.5000	**17.463** 0.6875	**19.05** 0.750	**2.03** 0.080	B-812	M-8121	**14.7** 3300	**26.9** 6050	4.20	**0.013** 0.028	**0.014** 0.031	**12.700** 0.5000	**12.687** 0.4995	**17.475** 0.6880	**17.450** 0.6870	Table B2-6	
	12.700 0.5000	**19.050** 0.7500	**11.13** 0.438	—	BH-87	—	**9.46** 2130	**11.8** 2650	1.80	**0.010** 0.023	—	**12.700** 0.5000	**12.687** 0.4995	**19.063** 0.7505	**19.037** 0.7495	Table B2-6	IRA-5
	12.700 0.5000	**19.050** 0.7500	**12.70** 0.500	—	BH-88	—	**11.2** 2510	**14.6** 3280	2.20	**0.012** 0.026	—	**12.700** 0.5000	**12.687** 0.4995	**19.063** 0.7505	**19.037** 0.7495	Table B2-6	IRA-5
	12.700 0.5000	**19.050** 0.7500	**15.88** 0.625	—	BH-810	—	**14.4** 3230	**20.2** 4540	3.05	**0.015** 0.033	—	**12.700** 0.5000	**12.687** 0.4995	**19.063** 0.7505	**19.037** 0.7495	Table B2-6	
	12.700 0.5000	**19.050** 0.7500	**19.05** 0.750	**2.29** 0.090	BH-812	MH-8121	**17.4** 3910	**25.8** 5790	3.95	**0.018** 0.039	**0.020** 0.044	**12.700** 0.5000	**12.687** 0.4995	**19.063** 0.7505	**19.037** 0.7495	Table B2-6	
9/16	**14.288** 0.5625	**19.050** 0.7500	**7.92** 0.312	**2.03** 0.080	B-95	M-951	**5.72** 1290	**8.31** 1870	1.25	**0.006** 0.013	**0.006** 0.014	**14.288** 0.5625	**14.275** 0.5620	**19.063** 0.7505	**19.037** 0.7495	Table B2-6	IR-68
	14.288 0.5625	**19.050** 0.7500	**9.53** 0.375	**2.03** 0.080	B-96	M-961	**7.33** 1650	**11.4** 2570	1.75	**0.007** 0.015	**0.008** 0.018	**14.288** 0.5625	**14.275** 0.5620	**19.063** 0.7505	**19.037** 0.7495	Table B2-6	IR-68
	14.288 0.5625	**19.050** 0.7500	**11.13** 0.438	**2.03** 0.080	B-97	M-971	**8.87** 1990	**14.6** 3280	2.20	**0.008** 0.018	**0.010** 0.021	**14.288** 0.5625	**14.275** 0.5620	**19.063** 0.7505	**19.037** 0.7495	Table B2-6	IR-68
	14.288 0.5625	**19.050** 0.7500	**12.70** 0.500	**2.03** 0.080	B-98	M-981	**10.3** 2320	**17.7** 3990	2.70	**0.009** 0.020	**0.010** 0.023	**14.288** 0.5625	**14.275** 0.5620	**19.063** 0.7505	**19.037** 0.7495	Table B2-6	IR-68
	14.288 0.5625	**19.050** 0.7500	**15.88** 0.625	**2.03** 0.080	B-910	M-9101	**13.1** 2940	**24.0** 5400	3.60	**0.012** 0.026	**0.013** 0.029	**14.288** 0.5625	**14.275** 0.5620	**19.063** 0.7505	**19.037** 0.7495	Table B2-6	IR-612[1]

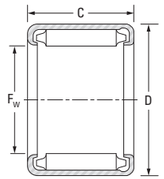
Note) · For information on the speed ratings, contact JTEKT.

(1) IRA inner ring provides additional length if required.

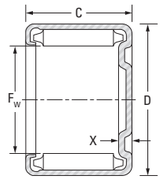
Continued on next page.

FULL COMPLEMENT BEARINGS
OPEN ENDS, CLOSED ONE END

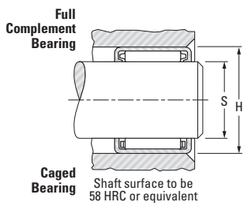
INCH SERIES
B, BH, NB, NBH, M- 1, MH- 1 SERIES



B, BH, NB, NBH



M- 1, MH- 1



Shaft Dia.	F_w	D	C +0 -0.3 +0.000 -0.012	$X_{max.}$	Bearing Designation		Load Ratings Dynamic	Load Ratings Static	Fatigue Load Limit C_u	Approx. Wt.		Mounting Dimensions Shaft		Mounting Dimensions Housing		Inspection gage	Mounting inner ring (pages B-2-68 to B-2-70)
					Open Ends	Closed One End	C	C_0	C_u	Open Ends	Closed One End	Max.	Min.	Max.	Min.		
in	mm in	mm in	mm in	mm in			kN lbf		kN	kg lbs		mm in	mm in	mm in	mm in		
9/16	14.288 0.5625	19.050 0.7500	19.05 0.750	2.03 0.080	B-912	M-9121	15.6 3510	30.3 6820	4.70	0.014 0.031	0.015 0.034	14.288 0.5625	14.275 0.5620	19.063 0.7505	19.037 0.7495	Table B2-6	IR-612(1)
	14.288 0.5625	20.638 0.8125	12.70 0.500	—	BH-98	—	12.0 2690	16.4 3690	2.50	0.013 0.029	—	14.288 0.5625	14.275 0.5620	20.650 0.8130	20.625 0.8120	Table B2-6	IR-68
	14.288 0.5625	20.638 0.8125	15.88 0.625	—	BH-910	—	15.4 3460	22.7 5110	3.45	0.016 0.036	—	14.288 0.5625	14.275 0.5620	20.650 0.8130	20.625 0.8120	Table B2-6	IR-612(1)
	14.288 0.5625	20.638 0.8125	19.05 0.750	—	BH-912	—	18.6 4190	29.0 6520	4.45	0.020 0.043	—	14.288 0.5625	14.275 0.5620	20.650 0.8130	20.625 0.8120	Table B2-6	IR-612(1)
5/8	15.875 0.6250	20.638 0.8125	7.92 0.312	2.03 0.080	B-105	M-1051	6.05 1360	9.24 2080	1.40	0.006 0.014	0.007 0.016	15.875 0.6250	15.862 0.6245	20.650 0.8130	20.625 0.8120	Table B2-6	IR-68-1
	15.875 0.6250	20.638 0.8125	11.13 0.438	2.03 0.080	B-107	M-1071	9.39 2110	16.2 3650	2.45	0.009 0.020	0.010 0.022	15.875 0.6250	15.862 0.6245	20.650 0.8130	20.625 0.8120	Table B2-6	IR-68-1
	15.875 0.6250	20.638 0.8125	12.70 0.500	2.03 0.080	B-108	M-1081	10.9 2450	19.7 4430	3.00	0.010 0.022	0.012 0.026	15.875 0.6250	15.862 0.6245	20.650 0.8130	20.625 0.8120	Table B2-6	IR-68-1
	15.875 0.6250	20.638 0.8125	15.88 0.625	2.03 0.080	B-1010	M-10101	13.80 3110	26.7 6000	4.00	0.013 0.028	0.015 0.032	15.875 0.6250	15.862 0.6245	20.650 0.8130	20.625 0.8120	Table B2-6	IR-612-1
	15.875 0.6250	20.638 0.8125	19.05 0.750	2.03 0.080	B-1012	M-10121	16.6 3720	33.7 7580	5.25	0.015 0.034	0.017 0.038	15.875 0.6250	15.862 0.6245	20.650 0.8130	20.625 0.8120	Table B2-6	IR-612-1
	15.875 0.6250	22.212 0.8745	12.70 0.500	2.29 0.090	BH-108	MH-1081	12.7 2860	18.3 4110	2.75	0.014 0.031	0.016 0.035	15.875 0.6250	15.862 0.6245	22.238 0.8755	22.212 0.8745	Table B2-6	IR-68-1
	15.875 0.6250	22.212 0.8745	15.88 0.625	—	BH-1010	—	16.4 3680	25.3 5680	3.85	0.018 0.039	—	15.875 0.6250	15.862 0.6245	22.238 0.8755	22.212 0.8745	Table B2-6	IR-612-1
	15.875 0.6250	22.212 0.8745	19.05 0.750	—	BH-1012	—	19.8 4450	32.3 7250	4.95	0.021 0.047	—	15.875 0.6250	15.862 0.6245	22.238 0.8755	22.212 0.8745	Table B2-6	IR-612-1
	15.875 0.6250	22.212 0.8745	25.40 1.000	—	BH-1016	—	26.2 5890	46.2 10390	7.10	0.028 0.062	—	15.875 0.6250	15.862 0.6245	22.238 0.8755	22.212 0.8745	Table B2-6	
11/16	17.463 0.6875	22.212 0.8745	9.53 0.375	2.03 0.080	B-116	M-1161	8.17 1840	14.0 3140	2.15	0.008 0.018	0.009 0.020	17.463 0.6875	17.450 0.6870	22.238 0.8755	22.212 0.8745	Table B2-6	
	17.463 0.6875	22.212 0.8745	12.70 0.500	2.03 0.080	B-118	M-1181	11.5 2580	21.7 4880	3.30	0.011 0.024	0.012 0.027	17.463 0.6875	17.450 0.6870	22.238 0.8755	22.212 0.8745	Table B2-6	
	17.463 0.6875	22.212 0.8745	15.88 0.625	2.03 0.080	B-1110	M-11101	14.6 3270	29.4 6610	4.40	0.014 0.030	0.015 0.034	17.463 0.6875	17.450 0.6870	22.238 0.8755	22.212 0.8745	Table B2-6	
	17.463 0.6875	22.212 0.8745	19.05 0.750	2.03 0.080	B-1112	M-11121	17.4 3920	37.1 8340	5.75	0.016 0.036	0.019 0.041	17.463 0.6875	17.450 0.6870	22.238 0.8755	22.212 0.8745	Table B2-6	
	17.463 0.6875	23.813 0.9375	11.13 0.438	—	BH-117	—	11.4 2560	16.2 3650	2.45	0.014 0.030	—	17.463 0.6875	17.450 0.6870	23.825 0.9380	23.800 0.9370	Table B2-6	
	17.463 0.6875	23.813 0.9375	15.88 0.625	2.29 0.090	BH-1110	MH-11101	17.3 3890	27.8 6250	4.25	0.019 0.042	0.021 0.047	17.463 0.6875	17.450 0.6870	23.825 0.9380	23.800 0.9370	Table B2-6	

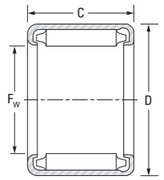
Note) · For information on the speed ratings, contact JTEKT. (1) IRA inner ring provides additional length if required.

Shaft Dia.	F_w	D	C +0 -0.3 +0.000 -0.012	$X_{max.}$	Bearing Designation		Load Ratings Dynamic	Load Ratings Static	Fatigue Load Limit C_u	Approx. Wt.		Mounting Dimensions Shaft		Mounting Dimensions Housing		Inspection gage	Mounting inner ring (pages B-2-68 to B-2-70)
					Open Ends	Closed One End	C	C_0	C_u	Open Ends	Closed One End	Max.	Min.	Max.	Min.		
in	mm in	mm in	mm in	mm in			kN lbf		kN	kg lbs		mm in	mm in	mm in	mm in		
11/16	17.463 0.6875	23.813 0.9375	19.05 0.750	—	BH-1112	—	20.9 4700	35.5 7980	5.45	0.023 0.051	—	17.463 0.6875	17.450 0.6870	23.825 0.9380	23.800 0.9370	Table B2-6	
3/4	19.050 0.7500	25.400 1.0000	9.53 0.375	2.29 0.090	B-126	M-1261	9.70 2180	13.6 3050	2.10	0.012 0.027	0.014 0.031	19.050 0.7500	19.037 0.7495	25.413 1.0005	25.387 0.9995	Table B2-6	IR-88
	19.050 0.7500	25.400 1.0000	12.70 0.500	2.29 0.090	B-128	M-1281	14.1 3170	22.0 4940	3.30	0.016 0.036	0.019 0.041	19.050 0.7500	19.037 0.7495	25.413 1.0005	25.387 0.9995	Table B2-6	IR-88
	19.050 0.7500	25.400 1.0000	15.88 0.625	2.29 0.090	B-1210	M-12101	18.1 4070	30.4 6830	4.60	0.020 0.045	0.024 0.052	19.050 0.7500	19.037 0.7495	25.413 1.0005	25.387 0.9995	Table B2-6	IR-812(1)
	19.050 0.7500	25.400 1.0000	19.05 0.750	2.29 0.090	B-1212	M-12121	21.9 4930	38.7 8710	5.95	0.024 0.054	0.028 0.062	19.050 0.7500	19.037 0.7495	25.413 1.0005	25.387 0.9995	Table B2-6	IR-812(1)
13/16	20.638 0.8125	26.988 1.0625	9.53 0.375	—	B-136	—	10.1 2280	14.7 3300	2.25	0.013 0.029	—	20.638 0.8125	20.625 0.8120	27.000 1.0630	26.975 1.0620	Table B2-6	
	20.638 0.8125	26.988 1.0625	12.70 0.500	2.29 0.090	B-138	M-1381	14.7 3300	23.8 5350	3.60	0.018 0.039	0.020 0.044	20.638 0.8125	20.625 0.8120	27.000 1.0630	26.975 1.0620	Table B2-6	
	20.638 0.8125	26.988 1.0625	22.23 0.875	2.29 0.090	B-1314	M-13141	26.7 6010	51.1 11490	7.90	0.031 0.068	0.035 0.077	20.638 0.8125	20.625 0.8120	27.000 1.0630	26.975 1.0620	Table B2-6	
	20.638 0.8125	26.988 1.0625	25.40 1.000	2.29 0.090	B-1316	M-13161	30.3 6820	60.2 13530	9.25	0.035 0.078	0.040 0.088	20.638 0.8125	20.625 0.8120	27.000 1.0630	26.975 1.0620	Table B2-6	
	20.638 0.8125	26.988 1.0625	31.75 1.250	—	B-1320	—	37.3 8380	78.4 17620	12.0	0.044 0.098	—	20.638 0.8125	20.625 0.8120	27.000 1.0630	26.975 1.0620	Table B2-6	
	20.638 0.8125	28.575 1.1250	12.70 0.500	2.79 0.110	BH-138	MH-1381	14.8 3330	20.8 4680	3.10	0.023 0.050	0.026 0.057	20.638 0.8125	20.625 0.8120	28.588 1.1255	28.562 1.1245	Table B2-6	
	20.638 0.8125	28.575 1.1250	15.88 0.625	2.79 0.110	BH-1310	MH-13101	19.7 4430	29.9 6720	4.50	0.029 0.063	0.032 0.071	20.638 0.8125	20.625 0.8120	28.588 1.1255	28.562 1.1245	Table B2-6	
	20.638 0.8125	28.575 1.1250	19.05 0.750	2.79 0.110	BH-1312	MH-13121	24.2 5440	39.0 8760	6.10	0.034 0.076	0.039 0.086	20.638 0.8125	20.625 0.8120	28.588 1.1255	28.562 1.1245	Table B2-6	
7/8	22.225 0.8750	28.575 1.1250	9.53 0.375	2.29 0.090	B-146	M-1461	10.6 2380	15.8 3560	2.45	0.014 0.031	0.016 0.035	22.225 0.8750	22.212 0.8745	28.588 1.1255	28.562 1.1245	Table B2-6	
	22.225 0.8750	28.575 1.1250	12.70 0.500	2.29 0.090	B-148	M-1481	15.4 3450	25.6 5760	3.85	0.019 0.042	0.022 0.048	22.225 0.8750	22.212 0.8745	28.588 1.1255	28.562 1.1245	Table B2-6	IR-1012(1)
	22.225 0.8750	28.575 1.1250	19.05 0.750	2.29 0.090	B-1412	M-14121	23.9 5370	45.2 10160	6.95	0.028 0.062	0.032 0.070	22.225 0.8750	22.212 0.8745	28.588 1.1255	28.562 1.1245	Table B2-6	IR-1012(1)
	22.225 0.8750	28.575 1.1250	25.40 1.000	2.29 0.090	B-1416	M-14161	31.6 7100	64.8 14570	10.0	0.038 0.083	0.043 0.094	22.225 0.8750	22.212 0.8745	28.588 1.1255	28.562 1.1245	Table B2-6	IR-1016
	22.225 0.8750	28.575 1.1250	28.58 1.125	—	B-1418	—	35.2 7920	74.6 16770	11.4	0.043 0.094	—	22.225 0.8750	22.212 0.8745	28.588 1.1255	28.562 1.1245	Table B2-6	
	22.225 0.8750	30.163 1.1875	15.88 0.625	2.79 0.110	BH-1410	MH-14101	20.3 4570	32.2 7240	4.85	0.030 0.067	0.035 0.076	22.225 0.8750	22.212 0.8745	30.175 1.1880	30.150 1.1870	Table B2-6	IR-1012(1)
	22.225 0.8750	30.163 1.1875	19.05 0.750	2.79 0.110	BH-1412	MH-14121	25.0 5620	42.0 9440	6.55	0.036 0.080	0.041 0.091	22.225 0.8750	22.212 0.8745	30.175 1.1880	30.150 1.1870	Table B2-6	IR-1012(1)
	22.225 0.8750	30.163 1.1875	25.40 1.000	—	BH-1416	—	33.7 7570	61.6 13850	9.60	0.049 0.107	—	22.225 0.8750	22.212 0.8745	30.175 1.1880	30.150 1.1870	Table B2-6	IR-1016
15/16	23.813 0.9375	30.163 1.1875	12.70 0.500	—	B-158	—	15.9 3580	27.5 6180	4.15	0.020 0.044	—	23.813 0.9375	23.800 0.9370	30.175 1.1880	30.150 1.1870	Table B2-6	
	23.813 0.9375	30.163 1.1875	25.40 1.000	2.29 0.090	B-1516	M-15161	32.8 7370	69.5 15620	10.7	0.040 0.088	0.045 0.100	23.813 0.9375	23.800 0.9370	30.175 1.1880	30.150 1.1870	Table B2-6	
1	25.400 1.0000	31.750 1.2500	9.53 0.375	—	B-166	—	11.3 2550	18.1 4070	2.80	0.016 0.035	—	25.400 1.0000	25.387 0.9995	31.763 1.2505	31.737 1.2495	Table B2-6	IR-128
	25.400 1.0000	31.750 1.2500	11.13 0.438	2.29 0.090	B-167	M-1671	14.0 3140	23.7 5320	3.60	0.019 0.041	0.021 0.046	25.400 1.0000	25.387 0.9995	31.763 1.2505	31.737 1.2495	Table B2-6	IR-128
	25.400 1.0000	31.750 1.2500	12.70 0.5000	2.29 0.090	B-168	M-1681	16.5 3710	29.3 6590	4.45	0.021 0.047	0.024 0.053	25.400 1.0000	25.387 0.9995	31.763 1.2505	31.737 1.2495	Table B2-6	IR-128

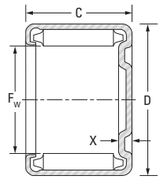
Continued on next page.

FULL COMPLEMENT BEARINGS
OPEN ENDS, CLOSED ONE END

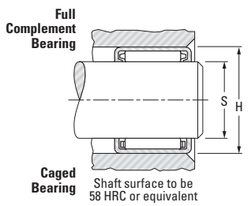
INCH SERIES
B, BH, NB, NBH, M- 1, MH- 1 SERIES



B, BH, NB, NBH



M- 1, MH- 1



Shaft Dia.	F_w	D	C +0 -0.3 +0.000 -0.012	$X_{max.}$	Bearing Designation		Load Ratings Dynamic	Load Ratings Static	Fatigue Load Limit C_u	Approx. Wt.		Mounting Dimensions Shaft		Mounting Dimensions Housing		Inspection gage	Mounting inner ring (pages B-2-68 to B-2-70)
					Open Ends	Closed One End	C	C_0		Open Ends	Closed One End	Max.	Min.	Max.	Min.		
in	mm in	mm in	mm in	mm in			kN lbf		kN	kg lbs		mm in	mm in	mm in	mm in		
1	**25.400** 1.0000	**31.750** 1.2500	**15.88** 0.625	**2.29** 0.090	B-1610	M-16101	**21.2** 4770	**40.5** 9110	6.15	**0.026** 0.058	**0.030** 0.066	**25.400** 1.0000	**25.387** 0.9995	**31.763** 1.2505	**31.737** 1.2495	Table B2-6	IR-1212
	25.400 1.0000	**31.750** 1.2500	**19.05** 0.750	**2.29** 0.090	B-1612	M-16121	**25.7** 5770	**51.7** 11620	7.95	**0.032** 0.070	**0.036** 0.080	**25.400** 1.0000	**25.387** 0.9995	**31.763** 1.2505	**31.737** 1.2495	Table B2-6	IR-1212
	25.400 1.0000	**31.750** 1.2500	**25.40** 1.000	**2.29** 0.090	B-1616	M-16161	**34.0** 7640	**74.1** 16660	11.4	**0.043** 0.094	**0.048** 0.106	**25.400** 1.0000	**25.387** 0.9995	**31.763** 1.2505	**31.737** 1.2495	Table B2-6	IR-1216(1)
	25.400 1.0000	**33.338** 1.3125	**12.70** 0.500	**2.79** 0.110	BH-168	MH-1681	**16.6** 3740	**25.6** 5760	3.80	**0.027** 0.060	**0.031** 0.068	**25.400** 1.0000	**25.387** 0.9995	**33.350** 1.3130	**33.325** 1.3120	Table B2-6	IR-128
	25.400 1.0000	**33.338** 1.3125	**15.88** 0.625	—	BH-1610	—	**22.0** 4950	**36.8** 8280	5.50	**0.034** 0.075	—	**25.400** 1.0000	**25.387** 0.9995	**33.350** 1.3130	**33.325** 1.3120	Table B2-6	IR-1212
	25.400 1.0000	**33.338** 1.3125	**19.05** 0.750	**2.79** 0.110	BH-1612	MH-16121	**27.1** 6090	**48.0** 10800	7.45	**0.041** 0.090	**0.046** 0.102	**25.400** 1.0000	**25.387** 0.9995	**33.350** 1.3130	**33.325** 1.3120	Table B2-6	IR-1212
	25.400 1.0000	**33.338** 1.3125	**22.23** 0.875	—	BH-1614	—	**31.9** 7170	**59.2** 13300	9.15	**0.048** 0.105	—	**25.400** 1.0000	**25.387** 0.9995	**33.350** 1.3130	**33.325** 1.3120	Table B2-6	IR-1216(1)
	25.400 1.0000	**33.338** 1.3125	**25.40** 1.000	**2.79** 0.110	BH-1616	MH-16161	**36.5** 8200	**70.4** 15830	10.9	**0.054** 0.120	**0.062** 0.136	**25.400** 1.0000	**25.387** 0.9995	**33.350** 1.3130	**33.325** 1.3120	Table B2-6	IR-1216(1)
	25.400 1.0000	**33.338** 1.3125	**31.75** 1.250	—	BH-1620	—	**45.2** 10160	**92.8** 20860	14.2	**0.068** 0.150	—	**25.400** 1.0000	**25.387** 0.9995	**33.350** 1.3130	**33.325** 1.3120	Table B2-6	IR-1220
	25.400 1.0000	**33.338** 1.3125	**38.10** 1.500	**2.79** 0.110	BH-1624	MH-16241	**53.5** 12030	**115** 25900	17.7	**0.082** 0.180	**0.093** 0.204	**25.400** 1.0000	**25.387** 0.9995	**33.350** 1.3130	**33.325** 1.3120	Table B2-6	IR-1224
1 1/16	**26.988** 1.0625	**33.338** 1.3125	**15.88** 0.625	**2.29** 0.090	B-1710	M-17101	**21.9** 4930	**43.1** 9680	6.55	**0.028** 0.062	**0.032** 0.070	**26.988** 1.0625	**26.975** 1.0620	**33.350** 1.3130	**33.325** 1.3120	Table B2-6	
	26.988 1.0625	**34.925** 1.3750	**19.05** 0.750	—	BH-1712	—	**29.5** 6630	**52.4** 11780	8.05	**0.035** 0.078	—	**26.988** 1.0625	**26.975** 1.0620	**34.938** 1.3755	**34.912** 1.3745	Table B2-6	
1 1/8	**28.575** 1.1250	**34.925** 1.3750	**9.53** 0.375	**2.29** 0.090	B-186	M-1861	**12.1** 2720	**20.4** 4580	3.10	**0.018** 0.039	**0.020** 0.044	**28.575** 1.1250	**28.562** 1.1245	**34.938** 1.3755	**34.912** 1.3745	Table B2-6	IR-1416(1)
	28.575 1.1250	**34.925** 1.3750	**12.70** 0.500	**2.29** 0.090	B-188	M-1881	**17.6** 3950	**33.0** 7420	4.95	**0.024** 0.052	**0.027** 0.059	**28.575** 1.1250	**28.562** 1.1245	**34.938** 1.3755	**34.912** 1.3745	Table B2-6	IR-1416(1)
	28.575 1.1250	**34.925** 1.3750	**15.88** 0.625	—	B-1810	—	**22.6** 5080	**45.6** 10250	6.90	**0.029** 0.065	—	**28.575** 1.1250	**28.562** 1.1245	**34.938** 1.3755	**34.912** 1.3745	Table B2-6	IR-1416(1)
	28.575 1.1250	**34.925** 1.3750	**19.05** 0.750	**2.29** 0.090	B-1812	M-18121	**27.3** 6140	**58.2** 13080	8.90	**0.035** 0.078	**0.040** 0.088	**28.575** 1.1250	**28.562** 1.1245	**34.938** 1.3755	**34.912** 1.3745	Table B2-6	IR-1416(1)
	28.575 1.1250	**34.925** 1.3750	**25.40** 1.000	**2.29** 0.090	B-1816	M-18161	**36.1** 8120	**83.4** 18750	12.8	**0.047** 0.104	**0.054** 0.118	**28.575** 1.1250	**28.562** 1.1245	**34.938** 1.3755	**34.912** 1.3745	Table B2-6	IR-1416(1)
	28.575 1.1250	**38.100** 1.5000	**19.05** 0.750	**3.05** 0.120	BH-1812	MH-18121	**31.5** 7090	**52.9** 11900	8.30	**0.056** 0.123	**0.063** 0.138	**28.575** 1.1250	**28.562** 1.1245	**38.113** 1.5005	**38.087** 1.4995	Table B2-6	IR-1416(1)
	28.575 1.1250	**38.100** 1.5000	**25.40** 1.000	**3.05** 0.120	BH-1816	MH-18161	**42.5** 9560	**77.8** 17500	12.0	**0.074** 0.164	**0.084** 0.186	**28.575** 1.1250	**28.562** 1.1245	**38.113** 1.5005	**38.087** 1.4995	Table B2-6	IR-1416(1)
1 1/4	**31.750** 1.2500	**38.100** 1.5000	**12.70** 0.500	**2.29** 0.090	B-208	M-2081	**18.6** 4170	**36.7** 8250	5.50	**0.026** 0.057	**0.029** 0.065	**31.750** 1.2500	**31.737** 1.2495	**38.113** 1.5005	**38.087** 1.4995	Table B2-6	IR-1612
	31.750 1.2500	**38.100** 1.5000	**15.88** 0.625	**2.29** 0.090	B-2010	M-20101	**23.9** 5370	**50.7** 11400	7.70	**0.032** 0.071	**0.044** 0.097	**31.750** 1.2500	**31.737** 1.2495	**38.113** 1.5005	**38.087** 1.4995	Table B2-6	IR-1612
	31.750 1.2500	**38.100** 1.5000	**19.05** 0.750	**2.29** 0.090	B-2012	M-20121	**28.9** 6490	**64.7** 14540	9.90	**0.039** 0.086	**0.045** 0.099	**31.750** 1.2500	**31.737** 1.2495	**38.113** 1.5005	**38.087** 1.4995	Table B2-6	IR-1612
	31.750 1.2500	**38.100** 1.5000	**25.40** 1.000	**2.29** 0.090	B-2016	M-20161	**38.2** 8590	**92.7** 20840	14.2	**0.052** 0.114	**0.059** 0.130	**31.750** 1.2500	**31.737** 1.2495	**38.113** 1.5005	**38.087** 1.4995	Table B2-6	IR-1616(1)
	31.750 1.2500	**38.100** 1.5000	**31.75** 1.250	**2.29** 0.090	B-2020	M-20201	**46.9** 10540	**121** 27200	18.4	**0.065** 0.143	**0.073** 0.162	**31.750** 1.2500	**31.737** 1.2495	**38.113** 1.5005	**38.087** 1.4995	Table B2-6	
	31.750 1.2500	**41.275** 1.6250	**12.70** 0.500	**3.05** 0.120	BH-208	MH-2081	**19.7** 4420	**30.0** 6750	4.50	**0.041** 0.090	**0.046** 0.102	**31.750** 1.2500	**31.737** 1.2495	**41.288** 1.6255	**41.262** 1.6245	Table B2-6	IR-1612
	31.750 1.2500	**41.275** 1.6250	**19.05** 0.750	**3.05** 0.120	BH-2012	MH-20121	**33.1** 7440	**58.6** 13170	9.10	**0.061** 0.135	**0.069** 0.153	**31.750** 1.2500	**31.737** 1.2495	**41.288** 1.6255	**41.262** 1.6245	Table B2-6	IR-1612
	31.750 1.2500	**41.275** 1.6250	**25.40** 1.000	**3.05** 0.120	BH-2016	MH-20161	**44.9** 10100	**86.6** 19470	13.4	**0.081** 0.179	**0.092** 0.203	**31.750** 1.2500	**31.737** 1.2495	**41.288** 1.6255	**41.262** 1.6245	Table B2-6	IR-1616(1)
	31.750 1.2500	**41.275** 1.6250	**31.75** 1.250	**3.05** 0.120	BH-2020	MH-20201	**55.9** 12570	**115** 25800	17.6	**0.102** 0.224	**0.115** 0.254	**31.750** 1.2500	**31.737** 1.2495	**41.288** 1.6255	**41.262** 1.6245	Table B2-6	
1 5/16	**33.338** 1.3125	**41.275** 1.6250	**12.70** 0.500	**2.79** 0.110	B-218	M-2181	**19.3** 4330	**33.7** 7570	5.00	**0.034** 0.076	**0.039** 0.086	**33.338** 1.3125	**33.325** 1.3120	**41.288** 1.6255	**41.262** 1.6245	Table B2-6	
	33.338 1.3125	**41.275** 1.6250	**15.88** 0.625	**2.79** 0.110	B-2110	M-21101	**25.5** 5740	**48.4** 10880	7.25	**0.043** 0.095	**0.049** 0.108	**33.338** 1.3125	**33.325** 1.3120	**41.288** 1.6255	**41.262** 1.6245	Table B2-6	
	33.338 1.3125	**41.275** 1.6250	**31.75** 1.250	—	B-2120	—	**52.6** 11820	**123** 27650	18.8	**0.087** 0.191	—	**33.338** 1.3125	**33.325** 1.3120	**41.288** 1.6255	**41.262** 1.6245	Table B2-6	
1 3/8	**34.925** 1.3750	**41.275** 1.6250	**12.70** 0.500	**2.29** 0.090	B-228	M-2281	**19.5** 4390	**40.3** 9060	6.05	**0.028** 0.062	**0.032** 0.070	**34.925** 1.3750	**34.912** 1.3745	**41.288** 1.6255	**41.262** 1.6245	Table B2-6	IR-1812
	34.925 1.3750	**41.275** 1.6250	**19.05** 0.750	**2.29** 0.090	B-2212	M-22121	**30.4** 6830	**71.2** 16000	10.9	**0.043** 0.094	**0.049** 0.107	**34.925** 1.3750	**34.912** 1.3745	**41.288** 1.6255	**41.262** 1.6245	Table B2-6	IR-1812
	34.925 1.3750	**41.275** 1.6250	**25.40** 1.000	**2.29** 0.090	B-2216	M-22161	**40.2** 9030	**102** 22900	15.7	**0.057** 0.125	**0.064** 0.142	**34.925** 1.3750	**34.912** 1.3745	**41.288** 1.6255	**41.262** 1.6245	Table B2-6	IR-1816
	34.925 1.3750	**41.275** 1.6250	**31.75** 1.250	**2.29** 0.090	B-2220	M-22201	**49.3** 11080	**133** 29900	20.3	**0.071** 0.156	**0.080** 0.177	**34.925** 1.3750	**34.912** 1.3745	**41.288** 1.6255	**41.262** 1.6245	Table B2-6	IR-1820
	34.925 1.3750	**44.450** 1.7500	**12.70** 0.500	—	BH-228	—	**21.2** 4770	**33.5** 7540	5.15	**0.044** 0.098	—	**34.925** 1.3750	**34.912** 1.3745	**44.463** 1.7505	**44.437** 1.7495	Table B2-6	IR-1812
	34.925 1.3750	**44.450** 1.7500	**15.88** 0.625	—	BH-2210	—	**28.5** 6410	**48.9** 11000	7.45	**0.055** 0.122	—	**34.925** 1.3750	**34.912** 1.3745	**44.463** 1.7505	**44.437** 1.7495	Table B2-6	IR-1812
	34.925 1.3750	**44.450** 1.7500	**19.05** 0.750	**3.05** 0.120	BH-2212	MH-22121	**35.3** 7930	**64.3** 14450	10.0	**0.066** 0.146	**0.075** 0.165	**34.925** 1.3750	**34.912** 1.3745	**44.463** 1.7505	**44.437** 1.7495	Table B2-6	IR-1812
	34.925 1.3750	**44.450** 1.7500	**25.40** 1.000	**3.05** 0.120	BH-2216	MH-22161	**47.6** 10700	**94.8** 21300	14.7	**0.088** 0.195	**0.100** 0.221	**34.925** 1.3750	**34.912** 1.3745	**44.463** 1.7505	**44.437** 1.7495	Table B2-6	IR-1816
	34.925 1.3750	**44.450** 1.7500	**31.75** 1.250	—	BH-2220	—	**59.4** 13350	**126** 28300	19.4	**0.111** 0.244	**0.125** 0.276	**34.925** 1.3750	**34.912** 1.3745	**44.463** 1.7505	**44.437** 1.7495	Table B2-6	IR-1820
1 1/2	**38.100** 1.5000	**47.625** 1.8750	**12.70** 0.500	**3.05** 0.120	B-248	M-2481	**22.3** 5020	**37.1** 8340	5.60	**0.048** 0.105	**0.054** 0.119	**38.100** 1.5000	**38.087** 1.4995	**47.638** 1.8755	**47.612** 1.8745	Table B2-6	IR-1916
	38.100 1.5000	**47.625** 1.8750	**15.88** 0.625	**3.05** 0.120	B-2410	M-24101	**29.9** 6720	**53.9** 12120	8.10	**0.060** 0.132	**0.068** 0.150	**38.100** 1.5000	**38.087** 1.4995	**47.638** 1.8755	**47.612** 1.8745	Table B2-6	IR-1916

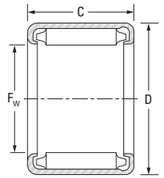
Note) · For information on the speed ratings, contact JTEKT.

(1) IRA inner ring provides additional length if required.

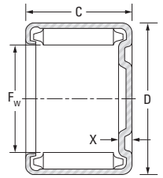
Continued on next page.

FULL COMPLEMENT BEARINGS
OPEN ENDS, CLOSED ONE END

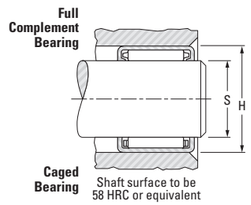
INCH SERIES
B, BH, NB, NBH, M- 1, MH- 1 SERIES



B, BH, NB, NBH



M- 1, MH- 1



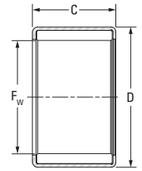
Shaft Dia.	F_w	D	C +0 -0.3 +0.000 -0.012	$X_{max.}$	Bearing Designation		Load Ratings Dynamic	Load Ratings Static	Fatigue Load Limit C_u	Approx. Wt.		Mounting Dimensions Shaft		Mounting Dimensions Housing		Inspection gage	Mounting inner ring (pages B-2-68 to B-2-70)
					Open Ends	Closed One End	C	C_0		Open Ends	Closed One End	Max.	Min.	Max.	Min.		
in	mm in	mm in	mm in	mm in			kN lbf		kN	kg lbs		mm in	mm in	mm in	mm in		
1 1/2	38.100 1.5000	47.625 1.8750	19.05 0.750	3.05 0.120	B-2412	M-24121	36.9 8290	70.7 15900	11.1	0.072 0.158	0.081 0.179	38.100 1.5000	38.087 1.4995	47.638 1.8755	47.612 1.8745	Table B2-6	IR-1916
	38.100 1.5000	47.625 1.8750	22.23 0.875	3.05 0.120	B-2414	M-24141	43.5 9780	87.5 19670	13.6	0.083 0.184	0.095 0.209	38.100 1.5000	38.087 1.4995	47.638 1.8755	47.612 1.8745	Table B2-6	IR-1916
	38.100 1.5000	47.625 1.8750	25.40 1.000	3.05 0.120	B-2416	M-24161	49.7 11170	104 23380	16.1	0.096 0.211	0.108 0.239	38.100 1.5000	38.087 1.4995	47.638 1.8755	47.612 1.8745	Table B2-6	IR-1916
	38.100 1.5000	47.625 1.8750	31.75 1.250	3.05 0.120	B-2420	M-24201	62.0 13940	138 31000	21.2	0.119 0.263	0.135 0.298	38.100 1.5000	38.087 1.4995	47.638 1.8755	47.612 1.8745	Table B2-6	IR-1920
1 5/8	41.275 1.6250	50.800 2.0000	12.70 0.500	—	B-268	—	22.7 5100	39.2 8820	5.85	0.051 0.113	—	41.275 1.6250	41.262 1.6245	50.813 2.0005	50.787 1.9995	Table B2-6	IR-2020(1)
	41.275 1.6250	50.800 2.0000	15.88 0.625	3.05 0.120	B-2610	M-26101	30.6 6890	57.4 12900	8.60	0.064 0.141	0.073 0.160	41.275 1.6250	41.262 1.6245	50.813 2.0005	50.787 1.9995	Table B2-6	IR-2020(1)
	41.275 1.6250	50.800 2.0000	25.40 1.000	—	B-2616	—	51.4 11550	112 25200	17.4	0.103 0.226	—	41.275 1.6250	41.262 1.6245	50.813 2.0005	50.787 1.9995	Table B2-6	IR-2020(1)
	41.275 1.6250	50.800 2.0000	31.75 1.250	3.05 0.120	B-2620	M-26201	64.0 14400	148 33270	22.9	0.128 0.282	0.145 0.320	41.275 1.6250	41.262 1.6245	50.813 2.0005	50.787 1.9995	Table B2-6	IR-2220(1)
1 3/4	44.450 1.7500	53.975 2.1250	19.05 0.750	3.05 0.120	B-2812	M-28121	39.3 8830	81.5 18320	12.8	0.082 0.181	0.093 0.205	44.450 1.7500	44.437 1.7495	53.988 2.1255	53.962 2.1245	Table B2-6	IR-2316
	44.450 1.7500	53.975 2.1250	25.40 1.000	3.05 0.120	B-2816	M-28161	53.3 11980	121 27100	18.8	0.110 0.242	0.124 0.274	44.450 1.7500	44.437 1.7495	53.988 2.1255	53.962 2.1245	Table B2-6	IR-2316
	44.450 1.7500	53.975 2.1250	31.75 1.250	—	B-2820	—	66.4 14930	160 36000	24.7	0.137 0.302	—	44.450 1.7500	44.437 1.7495	53.988 2.1255	53.962 2.1245	Table B2-6	IR-2324
	44.450 1.7500	53.975 2.1250	38.10 1.500	3.05 0.120	B-2824	M-26241	78.7 17700	199 44800	30.5	0.165 0.363	0.186 0.411	44.450 1.7500	44.437 1.7495	53.988 2.1255	53.962 2.1245	Table B2-6	IR-2324
1 7/8	47.625 1.8750	57.150 2.2500	12.70 0.500	3.05 0.120	B-308	M-3081	25.1 5650	46.4 10430	7.00	0.059 0.129	0.066 0.146	47.625 1.8750	47.612 1.8745	57.163 2.2505	57.137 2.2495	Table B2-6	
	47.625 1.8750	57.150 2.2500	15.888 0.625	—	B-3010	—	33.6 7550	67.4 15150	10.2	0.073 0.161	—	47.625 1.8750	47.612 1.8745	57.163 2.2505	57.137 2.2495	Table B2-6	
	47.625 1.8750	57.150 2.2500	19.05 0.750	—	B-3012	—	41.5 9330	88.4 19870	13.9	0.088 0.193	—	47.625 1.8750	47.612 1.8745	57.163 2.2505	57.137 2.2495	Table B2-6	
	47.625 1.8750	57.150 2.2500	25.40 1.000	3.05 0.120	B-3016	M-30161	56.0 12600	130 29200	20.1	0.117 0.258	0.132 0.292	47.625 1.8750	47.612 1.8745	57.163 2.2505	57.137 2.2495	Table B2-6	
2	50.800 2.0000	60.325 2.3750	12.70 0.500	3.05 0.120	B-328	M-3281	25.4 5710	48.2 10840	7.20	0.062 0.136	0.070 0.154	50.800 2.0000	50.785 1.9994	60.338 2.3755	60.312 2.3745	Table B2-6	
	50.800 2.0000	60.325 2.3750	15.88 0.625	—	B-3210	—	34.2 7680	70.7 15900	10.6	0.078 0.171	—	50.800 2.0000	50.785 1.9994	60.338 2.3755	60.312 2.3745	Table B2-6	
	50.800 2.0000	60.325 2.3750	22.23 0.875	—	B-3214	—	50.1 11260	116 26080	18.0	0.108 0.239	—	50.800 2.0000	50.785 1.9994	60.338 2.3755	60.312 2.3745	Table B2-6	

Note) · For information on the speed ratings, contact JTEKT. (1) IRA inner ring provides additional length if required.

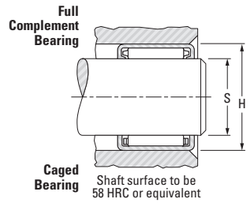
Shaft Dia.	F_w	D	C +0 -0.3 +0.000 -0.012	$X_{max.}$	Bearing Designation		Load Ratings Dynamic	Load Ratings Static	Fatigue Load Limit C_u	Approx. Wt.		Mounting Dimensions Shaft		Mounting Dimensions Housing		Inspection gage	Mounting inner ring (pages B-2-68 to B-2-70)
					Open Ends	Closed One End	C	C_0		Open Ends	Closed One End	Max.	Min.	Max.	Min.		
in	mm in	mm in	mm in	mm in			kN lbf		kN	kg lbs		mm in	mm in	mm in	mm in		
2	50.800 2.0000	60.325 2.3750	25.40 1.000	3.05 0.120	B-3216	M-32161	57.5 12930	138 31000	21.5	0.124 0.273	0.140 0.309	50.800 2.0000	50.785 1.9994	60.338 2.3755	60.312 2.3745	Table B2-6	
	50.800 2.0000	60.325 2.3750	31.75 1.250	3.05 0.120	B-3220	M-32201	71.5 16070	183 41100	28.3	0.155 0.341	0.175 0.386	50.800 2.0000	50.785 1.9994	60.338 2.3755	60.312 2.3745	Table B2-6	
	50.800 2.0000	60.325 2.3750	38.10 1.500	3.05 0.120	B-3224	M-32241	84.8 19060	228 51200	34.9	0.186 0.410	0.211 0.465	50.800 2.0000	50.785 1.9994	60.338 2.3755	60.312 2.3745	Table B2-6	
	50.800 2.0000	60.325 2.3750	44.45 1.750	3.05 0.120	B-3228	M-32281	97.6 21940	272 61150	41.9	0.217 0.478	0.245 0.541	50.800 2.0000	50.785 1.9994	60.338 2.3755	60.312 2.3745	Table B2-6	
2 1/16	52.388 2.0625	64.292 2.5312	19.05 0.750	—	BH-3312	—	46.1 10360	86.9 19540	13.4	0.122 0.269	—	52.388 2.0625	52.372 2.0619	64.305 2.5317	64.280 2.5307	Table B2-6	IR-2916
	52.388 2.0625	64.292 2.5312	25.40 1.000	3.56 0.140	BH-3316	MH-33161	64.2 14430	133 29900	20.7	0.162 0.358	0.184 0.406	52.388 2.0625	52.372 2.0619	64.305 2.5317	64.280 2.5307	Table B2-6	IR-2916
	52.388 2.0625	64.292 2.5312	38.10 1.500	3.56 0.140	BH-3324	MH-33241	96.8 21760	226 50700	34.8	0.244 0.537	0.276 0.609	52.388 2.0625	52.372 2.0619	64.305 2.5317	64.280 2.5307	Table B2-6	IR-2924
2 1/8	53.975 2.1250	63.500 2.5000	12.70 0.500	—	B-348	—	26.1 5870	51.3 11530	7.65	0.065 0.144	—	53.975 2.1250	53.960 2.1244	63.513 2.5005	63.487 2.4995	Table B2-6	IR-3024
	53.975 2.1250	63.500 2.5000	19.05 0.750	—	B-3412	—	43.6 9790	99.0 22260	15.5	0.098 0.216	—	53.975 2.1250	53.960 2.1244	63.513 2.5005	63.487 2.4995	Table B2-6	IR-3024
	53.975 2.1250	63.500 2.5000	25.40 1.000	3.05 0.120	B-3416	M-34161	59.1 13290	147 33000	22.8	0.131 0.289	0.148 0.327	53.975 2.1250	53.960 2.1244	63.513 2.5005	63.487 2.4995	Table B2-6	IR-3024
	53.975 2.1250	63.500 2.5000	31.75 1.250	—	B-3420	—	73.6 16550	194 43700	30.1	0.164 0.361	—	53.975 2.1250	53.960 2.1244	63.513 2.5005	63.487 2.4995	Table B2-6	IR-3024
	53.975 2.1250	63.500 2.5000	38.10 1.500	3.05 0.120	B-3424	M-34241	87.3 19630	242 54400	37.1	0.196 0.433	0.223 0.491	53.975 2.1250	53.960 2.1244	63.513 2.5005	63.487 2.4995	Table B2-6	IR-3024
2 1/4	57.150 2.2500	66.675 2.6250	19.05 0.750	3.30 0.130	B-3612	M-36121	46 10340	105 23700	16.5	0.103 0.228	0.117 0.258	57.150 2.2500	57.135 2.2494	66.688 2.6255	66.662 2.6245	Table B2-6	
	57.150 2.2500	66.675 2.6250	25.40 1.000	—	B-3616	—	62.3 14010	155.6 35000	24.2	0.138 0.304	—	57.150 2.2500	57.135 2.2494	66.688 2.6255	66.662 2.6245	Table B2-6	
	57.150 2.2500	66.675 2.6250	31.75 1.250	—	B-3620	—	77.5 17420	206 46400	31.8	0.172 0.380	—	57.150 2.2500	57.135 2.2494	66.688 2.6255	66.662 2.6245	Table B2-6	
	57.150 2.2500	66.675 2.6250	38.10 1.500	3.30 0.130	B-3624	M-36241	91.9 20660	257 57700	39.6	0.207 0.456	0.235 0.517	57.150 2.2500	57.135 2.2494	66.688 2.6255	66.662 2.6245	Table B2-6	
2 1/2	63.500 2.5000	73.020 2.8750	19.05 0.750	—	NB-4012	—	48.1 10800	117 26300	18.4	0.116 0.255	—	63.500 2.5000	63.485 2.4994	73.165 2.8805	73.139 2.8795	Table B2-6	
	63.500 2.5000	73.020 2.8750	28.58 1.125	—	NB-4018	—	73.3 16500	201 45200	31.2	0.174 0.383	—	63.500 2.5000	63.485 2.4994	73.165 2.8805	73.139 2.8795	Table B2-6	
	63.500 2.5000	73.020 2.8750	38.10 1.500	—	NB-4024	—	96.2 21600	285 64100	44.5	0.231 0.508	—	63.500 2.5000	63.485 2.4994	73.165 2.8805	73.139 2.8795	Table B2-6	
2 5/8	66.675 2.6250	76.200 3.0000	25.40 1.000	3.30 0.130	B-4216	M-42161	66.7 15000	182 40900	23.9	0.159 0.351	0.181 0.398	66.675 2.6250	66.660 2.6244	76.213 3.0005	76.187 2.9995	Table B2-6	
2 3/4	69.850 2.7500	79.375 3.1250	15.88 0.625	—	B-4410	—	41.0 9210	98.0 22000	14.9	0.104 0.229	—	69.850 2.7500	69.835 2.7494	79.388 3.1255	79.362 3.1245	Table B2-6	IR-4016
	69.850 2.7500	79.375 3.1250	19.050 0.7500	—	B-4412	—	50.7 11400	129 29000	20.1	0.124 0.274	—	69.850 2.7500	69.835 2.7494	79.388 3.1255	79.362 3.1245	Table B2-6	IR-4016
	69.850 2.7500	79.375 3.1250	25.40 1.000	—	B-4416	—	68.8 15470	191 42940	29.5	0.166 0.366	—	69.850 2.7500	69.835 2.7494	79.388 3.1255	79.362 3.1245	Table B2-6	IR-4016
	69.850 2.7500	79.375 3.1250	31.75 1.250	3.30 0.130	B-4420	M-44201	85.5 19220	252 56700	38.9	0.208 0.458	0.235 0.519	69.850 2.7500	69.835 2.7494	79.388 3.1255	79.362 3.1245	Table B2-6	
3	76.200 3.0000	88.900 3.5000	19.05 0.750	—	NBH-4812	—	59.3 13300	127 28600	19.7	0.186 0.409	—	76.200 3.0000	76.185 2.9994	89.040 3.5055	89.014 3.5045	Table B2-6	
	76.200 3.0000	88.900 3.5000	38.10 1.500	—	NBH-4824	—	124 27900	329 74000	51.4	0.372 0.818	—	76.200 3.0000	76.185 2.9994	89.040 3.5055	89.014 3.5045	Table B2-6	
3 1/2	88.900 3.5000	101.600 4.0000	19.05 0.750	—	B-5612	—	65.1 14630	150 33700	22.9	0.212 0.468	—	88.900 3.5000	88.885 3.4994	101.613 4.0005	101.587 3.9995	Table B2-6	
5 1/2	139.700 5.5000	152.400 6.0000	19.05 0.750	—	B-8812	—	76.8 17260	231 52000	31.6	0.325 0.717	—	139.700 5.5000	139.682 5.4993	152.425 6.0010	152.375 5.9990	Table B2-6	

FULL COMPLEMENT BEARINGS
OPEN ENDS

INCH SERIES
Y SERIES



Y



Shaft Dia.	F_w	D	C	$X_{max.}$	Bearing Designation	Load Ratings		Fatigue Load Limit	Approx. Wt.	Mounting Dimensions				Inspection gage
			+0 +0.000 -0.3 -0.012			Dynamic	Static			Shaft		Housing		
					Open Ends	C	C_0	C_u	Open Ends	Max.	Min.	Max.	Min.	
in	mm in	mm in	mm in	mm in		kN lbf		kN	kg lbs	mm in	mm in	mm in	mm in	
5/32	**3.970** 0.1563	**7.142** 0.2812	**3.96** 0.156	—	Y-2 1/2 2 1/2	**1.29** 290	**1.14** 260	—	**0.001** 0.002	**3.970** 0.1563	**3.962** 0.1560	**7.155** 0.2817	**7.142** 0.2812	Table B2-6
3/8	**9.525** 0.3750	**14.288** 0.5625	**9.53** 0.375	—	Y-66	**6.67** 1500	**9.04** 2030	1.45	**0.005** 0.011	**9.525** 0.3750	**9.512** 0.3745	**14.300** 0.5630	**14.275** 0.5620	Table B2-6
	9.525 0.3750	**14.288** 0.5625	**19.05** 0.750	—	Y-612	**13.2** 2970	**21.6** 4860	3.5	**0.010** 0.022	**9.525** 0.3750	**9.512** 0.3745	**14.300** 0.5630	**14.275** 0.5620	Table B2-6
7/16	**11.113** 0.4375	**15.875** 0.625	**9.53** 0.375	—	Y-76	**7.29** 1640	**10.6** 2380	1.7	**0.005** 0.012	**11.113** 0.4375	**11.100** 0.4370	**15.888** 0.6255	**15.862** 0.6245	Table B2-6
9/16	**14.288** 0.5625	**19.050** 0.7500	**9.53** 0.375	—	Y-96	**8.38** 1880	**13.6** 3060	2.2	**0.007** 0.015	**14.288** 0.5625	**14.275** 0.5620	**19.063** 0.7505	**19.037** 0.7495	Table B2-6
	14.288 0.5625	**19.050** 0.7500	**12.70** 0.500	—	Y-98	**11.3** 2540	**19.9** 4470	3.2	**0.009** 0.020	**14.288** 0.5625	**14.275** 0.5620	**19.063** 0.7505	**19.037** 0.7495	Table B2-6
	14.288 0.5625	**19.050** 0.7500	**15.88** 0.625	—	Y-910	**14.0** 3150	**26.2** 5890	4.2	**0.012** 0.026	**14.288** 0.5625	**14.275** 0.5620	**19.063** 0.7505	**19.037** 0.7495	Table B2-6
	14.288 0.5625	**19.050** 0.7500	**19.05** 0.750	—	Y-912	**16.5** 3710	**32.5** 7310	5.25	**0.014** 0.031	**14.288** 0.5625	**14.275** 0.5620	**19.063** 0.7505	**19.037** 0.7495	Table B2-6
5/8	**15.875** 0.6250	**20.638** 0.8125	**15.88** 0.625	—	Y-1010	**14.8** 3330	**29.2** 6560	4.7	**0.013** 0.029	**15.875** 0.6250	**15.862** 0.6245	**20.650** 0.8130	**20.625** 0.8120	Table B2-6
11/16	**17.463** 0.6875	**22.212** 0.8745	**6.35** 0.250	—	Y-114	**5.76** 1290	**8.92** 2010	1.55	**0.005** 0.012	**17.463** 0.6875	**17.450** 0.6870	**22.238** 0.8755	**22.212** 0.8745	Table B2-6

Note) · For information on the speed ratings, contact JTEKT.

EXTRA-PRECISION BEARINGS

INCH SERIES

Open-end full-complement mechanically retained drawn cup needle roller bearings, manufactured to inch standards, are offered with extra-precision specifications. The manufacturing tolerance of these bearings is one-third that of the standard precision bearings. In production operations, using closer tolerances on shaft and housing, they will assemble with consistently lower radial internal clearances than can be expected with the standard precision series bearings.

Extra-precision bearings are suitable for those applications requiring close control of radial play and eccentricity. They are also preferred when two bearings are mounted adjacent to each other because greater accuracy in manufacture will provide better load distribution between the bearings.

Nominal dimensions, load ratings, speed ratings and other general specifications for extra-precision bearings are the same as for the corresponding “B” or “BH” sizes of drawn cup needle roller bearings. Consequently, the data on pages B-2-48 to B-2-55 can be used in bearing size selection.

When ordering an extra-precision bearing, add the prefix letter “G” to the bearing designation. For example, after following the size selection procedure outlined in the engineering section, bearing B-1212 is selected – but extra-precision tolerances are required. These are designated by ordering a GB-1212 bearing.

To realize the advantages of the expected closer radial internal clearance of the extra-precision bearing, the user must have the capability of producing housing bore and shaft raceway diameters to the close tolerances indicated by the bearing tables on page B-2-59.

The resulting total radial internal clearance, within the installed GB-1212 extra-precision drawn cup needle roller bearing, will lie in the range from 0.005 mm to 0.030 mm (0.0002 in to 0.0012 in)

Inspection dimensions for the extra-precision bearings are given in table on page B-2-58. Note that these bearings must be inspected while mounted in the specified ring gage. Bearing bores are checked with “go” and “no go” plug gages. The “go” gage size is the minimum diameter inside the needle rollers. The “no go” gage size is 0.002 mm (0.0001 in) larger than the maximum diameter inside the needle rollers.

Procedures for selecting ring and plug gage dimensions are the same as for those involving standard precision needle roller bearings – except that the ring gage diameters and diameters inside the needle rollers must be drawn from the table on page B-2-58.

Table B2-8. Inspection for extra-precision drawn cup needle roller bearings – inch series

Nominal shaft diameter	Gaging		
	Ring gage	Diameter inside needle rollers	
		Max.	Min.
mm in	mm in	mm in	mm in
3.175 1/8	**6.281** 0.2473	**3.200** 0.1260	**3.190** 0.1256
3.970 5/32	**7.074** 0.2785	**3.995** 0.1573	**3.985** 0.1569
4.763 3/16	**8.611** 0.3390	**4.788** 0.1885	**4.777** 0.1881
6.350 1/4	**10.993** 0.4328	**6.375** 0.2510	**6.365** 0.2506
7.938 5/16	**12.581** 0.4953	**7.963** 0.3135	**7.953** 0.3131
H 7.938 H 5/16	**14.168** 0.5578	**7.963** 0.3135	**7.953** 0.3131
9.525 3/8	**14.168** 0.5578	**9.550** 0.3760	**9.540** 0.3756
H 9.525 H 3/8	**15.756** 0.6203	**9.550** 0.3760	**9.540** 0.3756
11.113 7/16	**15.756** 0.6203	**11.138** 0.4385	**11.127** 0.4381
H 11.113 H 7/16	**17.343** 0.6828	**11.138** 0.4385	**11.127** 0.4381
12.700 1/2	**17.343** 0.6828	**12.725** 0.5010	**12.715** 0.5006
H 12.700 H 1/2	**18.931** 0.7453	**12.725** 0.5010	**12.715** 0.5006
14.288 9/16	**18.931** 0.7453	**14.313** 0.5635	**14.303** 0.5631
H 14.288 H 9/16	**20.518** 0.8078	**14.313** 0.5635	**14.303** 0.5631
15.875 5/8	**20.518** 0.8078	**15.900** 0.6260	**15.890** 0.6256
H 15.875 H 5/8	**22.106** 0.8703	**15.900** 0.6260	**15.890** 0.6256
17.463 11/16	**22.106** 0.8703	**17.488** 0.6885	**17.478** 0.6881
H 17.463 H 11/16	**23.693** 0.9328	**17.488** 0.6885	**17.478** 0.6881
19.050 3/4	**25.273** 0.9950	**19.068** 0.7507	**19.058** 0.7503
H 19.050 H 3/4	**26.861** 1.0575	**19.068** 0.7507	**19.058** 0.7503
20.638 13/16	**26.861** 1.0575	**20.655** 0.8132	**20.645** 0.8128
H 20.638 H 13/16	**28.448** 1.1200	**20.655** 0.8132	**20.645** 0.8128
22.225 7/8	**28.448** 1.1200	**22.243** 0.8757	**22.233** 0.8753
H 22.225 H 7/8	**30.036** 1.1825	**22.243** 0.8757	**22.233** 0.8753

Nominal shaft diameter	Gaging		
	Ring gage	Diameter inside needle rollers	
		Max.	Min.
mm in	mm in	mm in	mm in
23.813 15/16	**30.036** 1.1825	**23.830** 0.9382	**23.820** 0.9378
25.400 1	**31.623** 1.2450	**25.418** 1.0007	**25.408** 1.0003
H 25.400 H 1	**33.211** 1.3075	**25.418** 1.0007	**25.408** 1.0003
26.988 1 1/16	**33.211** 1.3075	**27.005** 1.0632	**26.995** 1.0628
28.575 1 1/8	**34.798** 1.3700	**28.593** 1.1257	**28.583** 1.1253
H 28.575 H 1 1/8	**37.973** 1.4950	**28.593** 1.1257	**28.583** 1.1253
30.163 1 3/16	**37.973** 1.4950	**30.180** 1.1882	**30.170** 1.1878
31.750 1 1/4	**37.973** 1.4950	**31.768** 1.2507	**31.758** 1.2503
H 31.750 H 1 1/4	**41.148** 1.6200	**31.768** 1.2507	**31.758** 1.2503
33.338 1 5/16	**41.148** 1.6200	**33.355** 1.3132	**33.345** 1.3128
34.925 1 3/8	**41.148** 1.6200	**34.943** 1.3757	**34.933** 1.3753
H 34.925 H 1 3/8	**44.323** 1.7450	**34.943** 1.3757	**34.933** 1.3753
38.100 1 1/2	**47.498** 1.8700	**38.120** 1.5008	**38.108** 1.5003
41.275 1 5/8	**50.673** 1.9950	**41.295** 1.6258	**41.283** 1.6253
44.450 1 3/4	**53.848** 2.1200	**44.470** 1.7508	**44.458** 1.7503
47.625 1 7/8	**57.023** 2.2450	**47.645** 1.8758	**47.633** 1.8753
50.800 2	**60.198** 2.3700	**50.820** 2.0008	**50.808** 2.0003
H 52.388 H 2 1/16	**64.166** 2.5262	**52.408** 2.0633	**52.395** 2.0628
53.975 2 1/8	**63.373** 2.4950	**53.995** 2.1258	**53.983** 2.1253
57.150 2 1/4	**66.548** 2.6200	**57.170** 2.2508	**57.158** 2.2503
66.675 2 5/8	**76.073** 2.9950	**66.700** 2.6260	**66.685** 2.6254
69.850 2 3/4	**79.248** 3.1200	**69.875** 2.7510	**69.860** 2.7504
88.900 3 1/2	**101.473** 3.9950	**88.925** 3.5010	**88.710** 3.5004

Table B2-9. Mounting dimensions for extra-precision drawn cup needle roller bearings – inch series

Bearing bore designation	Mounting					
	Nominal bore	Nominal O.D.	Shaft raceway diameter		Housing bore	
			Max.	Min.	Max.	Min.
	mm in	mm in	mm in	mm in	mm in	mm in
GB-2	**3.175** 0.1250	**6.350** 0.2500	**3.178** 0.1251	**3.170** 0.1248	**6.281** 0.2473	**6.274** 0.2470
GB-2 1/2	**3.967** 0.1562	**7.142** 0.2812	**3.973** 0.1564	**3.965** 0.1561	**7.074** 0.2785	**7.066** 0.2782
GB-3	**4.763** 0.1875	**8.733** 0.3438	**4.765** 0.1876	**4.757** 0.1873	**8.611** 0.3390	**8.603** 0.3387
GB-4	**6.350** 0.2500	**11.113** 0.4375	**6.353** 0.2501	**6.345** 0.2498	**10.993** 0.4328	**10.986** 0.4325
GB-5	**7.938** 0.3125	**12.700** 0.5000	**7.940** 0.3126	**7.932** 0.3123	**12.581** 0.4953	**12.573** 0.4950
GBH-5	**7.938** 0.3125	**14.288** 0.5625	**7.940** 0.3126	**7.932** 0.3123	**14.168** 0.5578	**14.161** 0.5575
GB-6	**9.525** 0.3750	**14.288** 0.5625	**9.528** 0.3751	**9.520** 0.3748	**14.168** 0.5578	**14.161** 0.5575
GBH-6	**9.525** 0.3750	**15.875** 0.6250	**9.528** 0.3751	**9.520** 0.3748	**15.756** 0.6203	**15.748** 0.6200
GB-7	**11.113** 0.4375	**15.875** 0.6250	**11.115** 0.4376	**11.107** 0.4373	**15.756** 0.6203	**15.748** 0.6200
GBH-7	**11.113** 0.4375	**17.463** 0.6875	**11.115** 0.4376	**11.107** 0.4373	**17.343** 0.6828	**17.336** 0.6825
GB-8	**12.700** 0.5000	**17.463** 0.6875	**12.703** 0.5001	**12.695** 0.4998	**17.343** 0.6828	**17.336** 0.6825
GBH-8	**12.700** 0.5000	**19.050** 0.7500	**12.703** 0.5001	**12.695** 0.4998	**18.931** 0.7453	**18.923** 0.7450
GB-9	**14.288** 0.5625	**19.050** 0.7500	**14.290** 0.5626	**14.282** 0.5623	**18.931** 0.7453	**18.923** 0.7450
GBH-9	**14.288** 0.5625	**20.638** 0.8125	**14.290** 0.5626	**14.282** 0.5623	**20.518** 0.8078	**20.511** 0.8075
GB-10	**15.875** 0.6250	**20.638** 0.8125	**14.878** 0.6251	**15.870** 0.6248	**20.518** 0.8078	**20.511** 0.8075
GBH-10	**15.875** 0.6250	**22.225** 0.8750	**14.878** 0.6251	**15.870** 0.6248	**22.106** 0.8703	**22.098** 0.8700
GB-11	**17.463** 0.6875	**22.225** 0.8750	**17.465** 0.6876	**17.457** 0.6873	**22.106** 0.8703	**22.098** 0.8700
GBH-11	**17.463** 0.6875	**23.813** 0.9375	**17.465** 0.6876	**17.457** 0.6873	**23.693** 0.9328	**23.686** 0.9325
GB-12	**19.050** 0.7500	**25.400** 1.0000	**19.053** 0.7501	**19.045** 0.7498	**25.281** 0.9953	**25.273** 0.9950
GBH-12	**19.050** 0.7500	**26.988** 1.0625	**19.053** 0.7501	**19.045** 0.7498	**26.868** 1.0578	**26.861** 1.0575
GB-13	**20.638** 0.8125	**26.988** 1.0625	**20.640** 0.8126	**20.632** 0.8123	**26.868** 1.0578	**26.861** 1.0575
GBH-13	**20.638** 0.8125	**28.575** 1.1250	**20.640** 0.8126	**20.632** 0.8123	**28.456** 1.1203	**28.448** 1.1200
GB-14	**22.225** 0.8750	**28.575** 1.1250	**22.228** 0.8751	**22.220** 0.8748	**28.456** 1.1203	**28.448** 1.1200
GBH-14	**22.225** 0.8750	**30.163** 1.1875	**22.228** 0.8751	**22.220** 0.8748	**30.046** 1.1829	**30.036** 1.1825

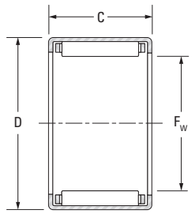
Bearing bore designation	Mounting					
	Nominal bore	Nominal O.D.	Shaft raceway diameter		Housing bore	
			Max.	Min.	Max.	Min.
	mm in	mm in	mm in	mm in	mm in	mm in
GB-15	**23.813** 0.9375	**30.163** 1.1875	**23.815** 0.9376	**23.807** 0.9373	**30.046** 1.1829	**30.036** 1.1825
GB-16	**25.400** 1.0000	**31.750** 1.2500	**25.403** 1.0001	**25.395** 0.9998	**31.633** 1.2454	**31.623** 1.2450
GBH-16	**25.400** 1.0000	**33.338** 1.3125	**25.403** 1.0001	**25.395** 0.9998	**33.221** 1.3079	**33.211** 1.3075
GB-17	**26.988** 1.0625	**33.338** 1.3125	**26.990** 1.0626	**26.982** 1.0623	**33.221** 1.3079	**33.211** 1.3075
GB-18	**28.575** 1.1250	**34.925** 1.3750	**28.578** 1.1251	**28.570** 1.1248	**34.808** 1.3704	**34.798** 1.3700
GBH-18	**28.575** 1.1250	**38.100** 1.5000	**28.578** 1.1251	**28.570** 1.1248	**37.986** 1.4955	**37.973** 1.4950
GB-19	**30.163** 1.1875	**38.100** 1.5000	**30.165** 1.1876	**30.157** 1.1873	**37.986** 1.4955	**37.973** 1.4950
GB-20	**31.750** 1.2500	**38.100** 1.5000	**31.753** 1.2501	**31.745** 1.2498	**37.986** 1.4955	**37.973** 1.4950
GBH-20	**31.750** 1.2500	**41.275** 1.6250	**31.753** 1.2501	**31.745** 1.2498	**41.161** 1.6205	**41.148** 1.6200
GB-21	**33.338** 1.3125	**41.275** 1.6250	**33.340** 1.3126	**33.332** 1.3123	**41.161** 1.6205	**41.148** 1.6200
GB-22	**34.925** 1.3750	**41.275** 1.6250	**34.925** 1.3750	**34.917** 1.3747	**41.161** 1.6205	**41.148** 1.6200
GBH-22	**34.925** 1.3750	**44.450** 1.7500	**34.925** 1.3750	**34.917** 1.3747	**44.336** 1.7455	**44.323** 1.7450
GB-24	**38.100** 1.5000	**47.625** 1.8750	**38.100** 1.5000	**38.092** 1.4997	**47.511** 1.8705	**47.498** 1.8700
GB-26	**41.275** 1.6250	**50.800** 2.0000	**41.275** 1.6250	**41.267** 1.6247	**50.686** 1.9955	**50.673** 1.9950
GB-28	**44.450** 1.7500	**53.975** 2.1250	**44.450** 1.7500	**44.442** 1.7497	**53.861** 2.1205	**53.848** 2.1200
GB-30	**47.625** 1.8750	**57.150** 2.2500	**47.625** 1.8750	**47.617** 1.8747	**57.036** 2.2455	**57.023** 2.2450
GB-32	**50.800** 2.0000	**60.325** 2.3750	**50.800** 2.0000	**50.792** 1.9997	**60.211** 2.3705	**60.198** 2.3700
GBH-33	**52.388** 2.0625	**64.293** 2.5312	**52.385** 2.0624	**52.377** 2.0621	**64.178** 2.5267	**64.166** 2.5262
GB-34	**53.975** 2.1250	**63.500** 2.5000	**53.973** 2.1249	**53.965** 2.1246	**63.386** 2.4955	**63.373** 2.4950
GB-36	**57.150** 2.2500	**66.675** 2.6250	**57.148** 2.2499	**57.140** 2.2496	**66.561** 2.6205	**66.548** 2.6200
GB-42	**66.675** 2.6250	**76.200** 3.0000	**66.670** 2.6248	**66.662** 2.6245	**76.088** 2.9956	**76.073** 2.9950
GB-44	**69.850** 2.7500	**79.375** 3.1250	**69.845** 2.7498	**69.837** 2.7495	**79.263** 3.1206	**79.248** 3.1200
GB-56	**88.900** 3.5000	**101.600** 4.0000	**88.895** 3.4998	**88.887** 3.4995	**101.488** 3.9956	**101.473** 3.9950

NOTE

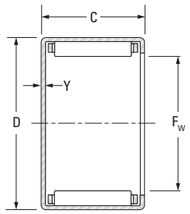
Check for availability as not every size may be in production.

CAGED BEARINGS – OPEN ENDS, CLOSED ONE END

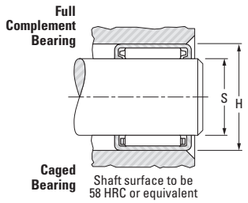
INCH SERIES
J, JH, MJ- 1, MJH- 1 SERIES



J, JH



MJ- 1, MJH- 1



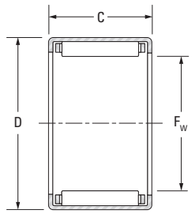
Shaft Dia.	F_w	D	C +0 +0.000 -0.3 -0.012	Y max.	Bearing Designation		Load Ratings Dynamic	Load Ratings Static	Fatigue Load Limit C_u	Speed Ratings Grease	Speed Ratings Oil	Approx. Wt. Open Ends	Approx. Wt. Closed One End	Mounting Dimensions Shaft Max.	Mounting Dimensions Shaft Min.	Mounting Dimensions Housing Max.	Mounting Dimensions Housing Min.	Inspection gage	Mounting inner ring (pages B-2-68 to B-2-70)
					Open Ends	Closed One End	C	C_0											
in	mm in	mm in	mm in	mm in			kN lbf		kN	min^{-1}		kg lbs		mm in	mm in	mm in	mm in		
1/8	**3.175** 0.1250	**6.350** 0.2500	**4.78** 0.188	—	JP-23-F	—	**0.90** 200	**0.61** 140	0.100	33000	51000	**0.001** 0.001	—	**3.175** 0.1250	**3.167** 0.1247	**6.363** 0.2505	**6.350** 0.2500	Table B2-6	
	3.175 0.1250	**6.350** 0.2500	**6.35** 0.250	—	JP-24-F	—	**1.33** 300	**1.01** 230	0.150	33000	51000	**0.001** 0.001	—	**3.175** 0.1250	**3.167** 0.1247	**6.363** 0.2505	**6.350** 0.2500	Table B2-6	
5/32	**3.970** 0.1563	**7.142** 0.2812	**4.78** 0.188	—	JP-2 1/2 3F	—	**0.91** 200	**0.62** 140	0.110	31000	47000	**0.001** 0.001	—	**3.970** 0.1563	**3.962** 0.1560	**7.155** 0.2817	**7.142** 0.2812	Table B2-6	
3/16	**4.763** 0.1875	**8.733** 0.3438	**4.77** 0.188	—	JP-33-F	—	**1.07** 240	**0.73** 160	0.120	25000	38000	**0.001** 0.002	—	**4.763** 0.1875	**4.755** 0.1872	**8.730** 0.3437	**8.717** 0.3432	Table B2-6	
	4.763 0.1875	**8.733** 0.3438	**6.35** 0.250	—	JP-34-F	—	**1.72** 390	**1.34** 300	0.200	25000	38000	**0.001** 0.002	—	**4.763** 0.1875	**4.755** 0.1872	**8.730** 0.3437	**8.717** 0.3432	Table B2-6	
	4.763 0.1875	**8.733** 0.3438	**9.53** 0.375	**1.02** 0.040	J-36	MJ-361	**2.28** 510	**1.92** 430	0.290	25000	38000	**0.002** 0.004	**0.002** 0.005	**4.763** 0.1875	**4.755** 0.1872	**8.730** 0.3437	**8.717** 0.3432	Table B2-6	
1/4	**6.350** 0.2500	**11.113** 0.4375	**7.92** 0.312	**1.02** 0.040	J-45	MJ-451	**2.21** 500	**1.74** 390	0.300	20000	30000	**0.003** 0.006	**0.003** 0.007	**6.350** 0.2500	**6.337** 0.2495	**11.125** 0.4380	**11.100** 0.4370	Table B2-6	
	6.350 0.2500	**11.113** 0.4375	**11.13** 0.438	**1.02** 0.040	J-47	MJ-471	**3.40** 760	**3.01** 680	0.450	20000	30000	**0.004** 0.008	**0.004** 0.009	**6.350** 0.2500	**6.337** 0.2495	**11.125** 0.4380	**11.100** 0.4370	Table B2-6	
5/16	**7.938** 0.3125	**12.700** 0.5000	**7.92** 0.312	—	J-55	—	**2.40** 540	**2.01** 450	0.340	18000	28000	**0.003** 0.007	—	**7.938** 0.3125	**7.925** 0.3120	**12.713** 0.5005	**12.687** 0.4995	Table B2-6	
	7.938 0.3125	**12.700** 0.5000	**11.13** 0.438	**1.02** 0.040	J-57	MJ-571	**4.03** 910	**3.92** 880	0.590	18000	28000	**0.004** 0.009	**0.005** 0.011	**7.938** 0.3125	**7.925** 0.3120	**12.713** 0.5005	**12.687** 0.4995	Table B2-6	
	7.938 0.3125	**14.288** 0.5625	**11.13** 0.438	**1.02** 0.040	JH-57	MJH-571	**4.65** 1050	**3.76** 850	0.570	14000	22000	**0.006** 0.013	**0.007** 0.016	**7.938** 0.3125	**7.925** 0.3120	**14.300** 0.5630	**14.275** 0.5620	Table B2-6	
3/8	**9.525** 0.3750	**14.288** 0.5625	**7.92** 0.312	**1.02** 0.040	J-65	MJ-651	**2.73** 610	**2.49** 560	0.430	18000	27000	**0.004** 0.008	**0.004** 0.009	**9.525** 0.3750	**9.512** 0.3745	**14.300** 0.5630	**14.275** 0.5620	Table B2-6	IRA-3
	9.525 0.3750	**14.288** 0.5625	**9.53** 0.375	**1.02** 0.040	J-66	MJ-661	**3.53** 790	**3.46** 780	0.530	18000	27000	**0.004** 0.009	**0.005** 0.010	**9.525** 0.3750	**9.512** 0.3745	**14.300** 0.5630	**14.275** 0.5620	Table B2-6	IRA-3
	9.525 0.3750	**14.288** 0.5625	**12.70** 0.500	**1.02** 0.040	J-68	MJ-681	**5.22** 1170	**5.72** 1290	0.860	18000	27000	**0.005** 0.012	**0.006** 0.013	**9.525** 0.3750	**9.512** 0.3745	**14.300** 0.5630	**14.275** 0.5620	Table B2-6	IRA-3
	9.525 0.3750	**15.875** 0.6250	**12.70** 0.500	—	JH-68	—	**6.59** 1480	**6.08** 1370	0.920	13000	20000	**0.008** 0.017	—	**9.525** 0.3750	**9.512** 0.3745	**15.888** 0.6255	**15.862** 0.6245	Table B2-6	IRA-3
7/16	**11.113** 0.4375	**15.875** 0.6250	**12.70** 0.500	**1.02** 0.040	J-78	MJ-781	**6.34** 1430	**7.67** 1720	1.15	17000	26000	**0.006** 0.014	**0.007** 0.016	**11.113** 0.4375	**11.100** 0.4370	**15.888** 0.6255	**15.862** 0.6245	Table B2-6	
	11.113 0.4375	**17.463** 0.6875	**12.70** 0.500	—	JH-78	—	**7.10** 1600	**6.89** 1550	1.05	13000	19000	**0.009** 0.019	—	**11.113** 0.4375	**11.100** 0.4370	**17.475** 0.6880	**17.450** 0.6870	Table B2-6	
1/2	**12.700** 0.5000	**17.463** 0.6875	**7.92** 0.312	**1.02** 0.040	J-85	MJ-851	**3.46** 780	**3.66** 820	0.630	16000	25000	**0.005** 0.010	**0.005** 0.012	**12.700** 0.5000	**12.687** 0.4995	**17.475** 0.6880	**17.450** 0.6870	Table B2-6	IRA-5
	12.700 0.5000	**17.463** 0.6875	**9.53** 0.375	**1.02** 0.040	J-86	MJ-861	**4.67** 1050	**5.39** 1210	0.830	16000	25000	**0.005** 0.011	**0.006** 0.013	**12.700** 0.5000	**12.687** 0.4995	**17.475** 0.6880	**17.450** 0.6870	Table B2-6	IRA-5
	12.700 0.5000	**17.463** 0.6875	**12.70** 0.500	**1.02** 0.040	J-88	MJ-881	**6.32** 1420	**7.92** 1780	1.20	16000	25000	**0.007** 0.015	**0.008** 0.018	**12.700** 0.5000	**12.687** 0.4995	**17.475** 0.6880	**17.450** 0.6870	Table B2-6	IRA-5
	12.700 0.5000	**17.463** 0.6875	**19.05** 0.750	—	J-812	—	**10.2** 2290	**14.7** 3300	2.25	16000	25000	**0.010** 0.023	—	**12.700** 0.5000	**12.687** 0.4995	**17.475** 0.6880	**17.450** 0.6870	Table B2-6	
	12.700 0.5000	**19.050** 0.7500	**11.13** 0.438	**1.02** 0.040	JH-87	MJH-871	**6.39** 1440	**6.20** 1390	0.950	12000	19000	**0.009** 0.019	**0.010** 0.023	**12.700** 0.5000	**12.687** 0.4995	**19.063** 0.7505	**19.037** 0.7495	Table B2-6	IRA-5
	12.700 0.5000	**19.050** 0.7500	**12.70** 0.500	**1.02** 0.040	JH-88	MJH-881	**7.56** 1700	**7.69** 1730	1.15	12000	19000	**0.010** 0.022	**0.012** 0.026	**12.700** 0.5000	**12.687** 0.4995	**19.063** 0.7505	**19.037** 0.7495	Table B2-6	IRA-5
	12.700 0.5000	**19.050** 0.7500	**19.05** 0.750	—	JH-812	—	**12.3** 2770	**14.4** 3240	2.25	12000	19000	**0.015** 0.032	—	**12.700** 0.5000	**12.687** 0.4995	**19.063** 0.7505	**19.037** 0.7495	Table B2-6	
9/16	**14.288** 0.5625	**19.050** 0.750	**11.13** 0.438	**1.02** 0.040	J-97	MJ-971	**5.47** 1230	**6.80** 1530	1.05	16000	25000	**0.007** 0.016	**0.009** 0.019	**14.288** 0.5625	**14.275** 0.5620	**19.063** 0.7505	**19.037** 0.7495	Table B2-6	IR-68
	14.288 0.5625	**19.050** 0.7500	**12.70** 0.500	**1.02** 0.040	J-98	MJ-981	**6.23** 1400	**8.03** 1810	1.20	16000	25000	**0.008** 0.017	**0.009** 0.020	**14.288** 0.5625	**14.275** 0.5620	**19.063** 0.7505	**19.037** 0.7495	Table B2-6	IR-68
	14.288 0.5625	**19.050** 0.7500	**15.88** 0.625	—	J-910	—	**8.27** 1860	**11.6** 2610	1.75	16000	25000	**0.010** 0.021	—	**14.288** 0.5625	**14.275** 0.5620	**19.063** 0.7505	**19.037** 0.7495	Table B2-6	IR-612[1]
	14.288 0.5625	**20.638** 0.8125	**12.70** 0.500	**1.02** 0.040	JH-98	MJH-981	**7.98** 1790	**8.49** 1910	1.30	12000	18000	**0.011** 0.025	**0.014** 0.030	**14.288** 0.5625	**14.275** 0.5620	**20.650** 0.8130	**20.625** 0.8120	Table B2-6	IR-68
5/8	**15.875** 0.6250	**20.638** 0.8125	**12.70** 0.500	**1.02** 0.040	J-108	MJ-1081	**6.71** 1510	**9.13** 2050	1.40	13000	21000	**0.009** 0.019	**0.010** 0.023	**15.875** 0.6250	**15.862** 0.6245	**20.650** 0.8130	**20.625** 0.8120	Table B2-6	IR-68-1
	15.875 0.6250	**20.638** 0.8125	**15.88** 0.625	**1.02** 0.040	J-1010	MJ-10101	**8.80** 1980	**12.9** 2900	1.95	13000	21000	**0.010** 0.023	**0.013** 0.028	**15.875** 0.6250	**15.862** 0.6245	**20.650** 0.8130	**20.625** 0.8120	Table B2-6	IR-612-1
	15.875 0.6250	**20.638** 0.8125	**19.05** 0.750	**1.02** 0.040	J-1012	MJ-10121	**11.8** 2650	**18.9** 4250	2.90	13000	21000	**0.013** 0.028	**0.015** 0.033	**15.875** 0.6250	**15.862** 0.6245	**20.650** 0.8130	**20.625** 0.8120	Table B2-6	IR-612-1
	15.875 0.6250	**22.212** 0.8745	**15.88** 0.625	**1.02** 0.040	JH-1010	MJH-10101	**11.6** 2610	**14.1** 3170	2.15	14000	21000	**0.015** 0.032	**0.017** 0.037	**15.875** 0.6250	**15.862** 0.6245	**22.238** 0.8755	**22.212** 0.8745	Table B2-6	IR-612-1
	15.875 0.6250	**22.212** 0.8745	**25.40** 1.000	**1.02** 0.040	JH-1016	MJH-10161	**19.8** 4450	**28.1** 6320	4.35	14000	21000	**0.024** 0.052	**0.028** 0.062	**15.875** 0.6250	**15.862** 0.6245	**22.238** 0.8755	**22.212** 0.8745	Table B2-6	
11/16	**17.463** 0.6875	**22.212** 0.8745	**19.05** 0.750	**1.02** 0.040	J-1112	MJ-11121	**12.5** 2800	**20.9** 4700	3.20	12000	19000	**0.014** 0.030	**0.016** 0.036	**17.463** 0.6875	**17.450** 0.6870	**22.238** 0.8755	**22.212** 0.8745	Table B2-6	
	17.463 0.6875	**23.813** 0.9375	**15.88** 0.625	**1.02** 0.040	JH-1110	MJH-11101	**12.1** 2710	**15.2** 3420	2.30	13000	19000	**0.016** 0.035	**0.019** 0.042	**17.463** 0.6875	**17.450** 0.6870	**23.825** 0.9380	**23.800** 0.9370	Table B2-6	
	17.463 0.6875	**23.813** 0.9375	**19.05** 0.750	—	JH-1112	—	**16.1** 3620	**22.2** 4990	3.10	13000	19000	**0.019** 0.042	—	**17.463** 0.6875	**17.450** 0.6870	**23.825** 0.9380	**23.800** 0.9370	Table B2-6	
3/4	**19.050** 0.7500	**25.400** 1.0000	**9.53** 0.375	—	J-126	—	**6.49** 1460	**7.05** 1580	1.10	11000	18000	**0.010** 0.022	—	**19.050** 0.7500	**19.037** 0.7495	**25.413** 1.0005	**25.387** 0.9995	Table B2-6	IR-88
	19.050 0.7500	**25.400** 1.0000	**12.70** 0.500	—	J-128	—	**9.94** 2230	**12.2** 2740	1.85	11000	18000	**0.014** 0.030	—	**19.050** 0.7500	**19.037** 0.7495	**25.413** 1.0005	**25.387** 0.9995	Table B2-6	IR-88
	19.050 0.7500	**25.400** 1.0000	**15.88** 0.625	**1.02** 0.040	J-1210	MJ-12101	**12.5** 2810	**16.3** 3670	2.50	11000	18000	**0.017** 0.038	**0.020** 0.045	**19.050** 0.7500	**19.037** 0.7495	**25.413** 1.0005	**25.387** 0.9995	Table B2-6	IR-812[1]
	19.050 0.7500	**25.400** 1.0000	**19.05** 0.750	**1.02** 0.040	J-1212	MJ-12121	**15.5** 3490	**21.6** 4860	3.35	11000	18000	**0.020** 0.045	**0.025** 0.054	**19.050** 0.7500	**19.037** 0.7495	**25.413** 1.0005	**25.387** 0.9995	Table B2-6	IR-812[1]
	19.050 0.7500	**26.988** 1.0625	**19.05** 0.750	**1.02** 0.040	JH-1212	MJH-12121	**19.1** 4290	**23.6** 5300	3.70	12000	18000	**0.026** 0.058	**0.031** 0.069	**19.050** 0.7500	**19.037** 0.7495	**27.000** 1.0630	**26.975** 1.0620	Table B2-6	IR-812[1]

(1) IRA inner ring provides additional length if required.

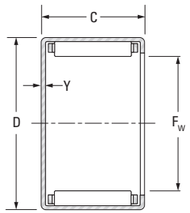
Continued on next page.

CAGED BEARINGS – OPEN ENDS, CLOSED ONE END

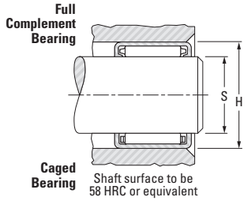
INCH SERIES
J, JH, MJ- 1, MJH- 1 SERIES



J, JH



MJ- 1, MJH- 1



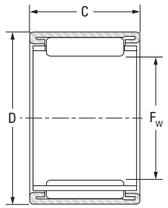
Shaft Dia.	F_w	D	C +0 +0.000 -0.3 -0.012	Y max.	Bearing Designation		Load Ratings Dynamic C	Load Ratings Static C_0	Fatigue Load Limit C_u	Speed Ratings Grease	Speed Ratings Oil	Approx. Wt. Open Ends	Approx. Wt. Closed One End	Mounting Dimensions Shaft Max.	Mounting Dimensions Shaft Min.	Mounting Dimensions Housing Max.	Mounting Dimensions Housing Min.	Inspection gage	Mounting inner ring (pages B-2-68 to B-2-70)
					Open Ends	Closed One End													
in	mm in	mm in	mm in	mm in			kN lbf		kN	min-1		kg lbs		mm in	mm in	mm in	mm in		
13/16	20.638 0.8125	26.988 1.0625	22.23 0.875	—	J-1314	—	19.3 4340	29.31 6590	4.55	10000	16000	0.025 0.056	—	20.638 0.8125	20.625 0.8120	27.000 1.0630	26.975 1.0620	Table B2-6	
	20.638 0.8125	28.575 1.1250	19.05 0.750	1.27 0.050	JH-1312	MJH-13121	18.8 4220	24.5 5510	3.85	11000	16000	0.028 0.062	0.034 0.074	20.638 0.8125	20.625 0.8120	28.588 1.1255	28.562 1.1245	Table B2-6	
7/8	22.225 0.8750	28.575 1.1250	9.53 0.375	—	J-146	—	7.20 1620	8.43 1900	1.30	9700	15000	0.012 0.026	—	22.225 0.8750	22.212 0.8745	28.588 1.1255	28.562 1.1245	Table B2-6	IR-1012(1)
	22.225 0.8750	28.575 1.1250	12.70 0.500	—	J-148	—	10.9 2460	14.5 3260	2.20	9700	15000	0.015 0.034	—	22.225 0.8750	22.212 0.8745	28.588 1.1255	28.562 1.1245	Table B2-6	IR-1012(1)
	22.225 0.8750	28.575 1.1250	19.05 0.750	1.02 0.040	J-1412	MJ-14121	17.9 4020	24.5 5510	4.20	9700	15000	0.024 0.052	0.028 0.062	22.225 0.8750	22.212 0.8745	28.588 1.1255	28.562 1.1245	Table B2-6	IR-1012(1)
	22.225 0.8750	28.575 1.1250	25.40 1.000	1.02 0.040	J-1416	MJ-14161	23.7 5320	39.0 8760	6.05	9700	15000	0.031 0.069	0.059 0.129	22.225 0.8750	22.212 0.8745	28.588 1.1255	28.562 1.1245	Table B2-6	IR-1016
	22.225 0.8750	30.163 1.1875	19.05 0.750	1.27 0.050	JH-1412	MJH-14121	18.3 4120	24.5 5510	3.75	9800	15000	0.030 0.066	0.036 0.079	22.225 0.8750	22.212 0.8745	30.175 1.1880	30.150 1.1870	Table B2-6	IR-1012(1)
	22.225 0.8750	30.163 1.1875	25.40 1.000	1.27 0.050	JH-1416	MJH-14161	25.4 5710	37.4 8400	5.80	9800	15000	0.040 0.089	0.048 0.106	22.225 0.8750	22.212 0.8745	30.175 1.1880	30.150 1.1870	Table B2-6	IR-1016
1	25.400 1.0000	31.750 1.2500	19.05 0.750	—	J-1612	—	18.1 4070	28.8 6480	4.45	8400	13000	0.026 0.058	—	25.400 1.0000	25.387 0.9995	31.763 1.2505	31.737 1.2495	Table B2-6	IR-1212
	25.400 1.0000	31.750 1.2500	25.40 1.000	1.02 0.040	J-1616	MJ-16161	25.0 5610	43.4 9760	6.75	8400	13000	0.035 0.077	0.042 0.092	25.400 1.0000	25.387 0.9995	31.763 1.2505	31.737 1.2495	Table B2-6	IR-1216(1)
	25.400 1.0000	33.338 1.3125	19.05 0.750	1.27 0.050	JH-1612	MJH-16121	20.7 4650	29.6 6650	4.60	8500	13000	0.034 0.074	0.040 0.088	25.400 1.0000	25.387 0.9995	33.350 1.3130	33.325 1.3120	Table B2-6	IR-1212
	25.400 1.0000	33.338 1.3125	25.40 1.000	1.27 0.050	JH-1616	MJH-16161	27.6 6200	42.9 9640	6.65	8500	13000	0.045 0.099	0.054 0.119	25.400 1.0000	25.387 0.9995	33.350 1.3130	33.325 1.3120	Table B2-6	IR-1216(1)
1 1/8	28.575 1.1250	34.925 1.3750	12.70 0.500	1.02 0.040	J-188	MJ-1881	11.7 2620	16.9 3800	2.55	7400	11000	0.020 0.043	0.023 0.050	28.575 1.1250	28.562 1.1245	34.938 1.3755	34.912 1.3745	Table B2-6	IR-1416(1)
	28.575 1.1250	34.925 1.3750	19.05 0.750	1.02 0.040	J-1812	MJ-18121	19.0 4280	31.8 7140	4.90	7400	11000	0.029 0.064	0.035 0.076	28.575 1.1250	28.562 1.1245	34.938 1.3755	34.912 1.3745	Table B2-6	IR-1416(1)
	28.575 1.1250	34.925 1.3750	25.40 1.000	1.02 0.040	J-1816	MJ-18161	26.2 5880	47.8 10750	7.40	7400	11000	0.039 0.086	0.047 0.103	28.575 1.1250	28.562 1.1245	34.938 1.3755	34.912 1.3745	Table B2-6	IR-1416(1)
	28.575 1.1250	38.100 1.5000	19.05 0.750	1.27 0.050	JH-1812	MJH-18121	23.3 5240	31.3 7040	4.75	7600	12000	0.046 0.101	0.055 0.121	28.575 1.1250	28.562 1.1245	38.113 1.5005	38.087 1.4995	Table B2-6	IR-1416(1)
	28.575 1.1250	38.100 1.5000	25.40 1.000	1.27 0.050	JH-1816	MJH-18161	33.1 7450	49.2 11060	7.70	7600	12000	0.061 0.135	0.074 0.162	28.575 1.1250	28.562 1.1245	38.113 1.5005	38.087 1.4995	Table B2-6	IR-1416(1)

Shaft Dia.	F_w	D	C +0 +0.000 -0.3 -0.012	Y max.	Bearing Designation		Load Ratings Dynamic C	Load Ratings Static C_0	Fatigue Load Limit C_u	Speed Ratings Grease	Speed Ratings Oil	Approx. Wt. Open Ends	Approx. Wt. Closed One End	Mounting Dimensions Shaft Max.	Mounting Dimensions Shaft Min.	Mounting Dimensions Housing Max.	Mounting Dimensions Housing Min.	Inspection gage	Mounting inner ring (pages B-2-68 to B-2-70)
					Open Ends	Closed One End													
in	mm in	mm in	mm in	mm in			kN lbf		kN	min-1		kg lbs		mm in	mm in	mm in	mm in		
1 1/8	28.575 1.1250	38.100 1.5000	28.58 1.125	1.27 0.050	JH-1818	MJH-18181	36.3 8160	55.3 12430	8.60	7600	12000	0.069 0.152	0.082 0.181	28.575 1.1250	28.562 1.1245	38.113 1.5005	38.087 1.4995	Table B2-6	
1 1/4	31.750 1.2500	38.100 1.5000	19.05 0.750	1.02 0.040	J-2012	MJ-20121	19.8 4460	34.7 7800	5.35	6600	10000	0.036 0.080	0.043 0.095	31.750 1.2500	31.737 1.2495	38.113 1.5005	38.087 1.4995	Table B2-6	IR-1612
	31.750 1.2500	38.100 1.5000	25.40 1.000	1.02 0.040	J-2016	MJ-20161	28.8 6480	56.3 12660	8.70	6600	10000	0.043 0.094	0.051 0.113	31.750 1.2500	31.737 1.2495	38.113 1.5005	38.087 1.4995	Table B2-6	IR-1616(1)
	31.750 1.2500	41.275 1.6250	19.05 0.750	—	JH-2012	—	24.1 5420	34.0 7640	5.80	6800	10000	0.050 0.111	—	31.750 1.2500	31.737 1.2495	41.288 1.6255	41.262 1.6245	Table B2-6	IR-1612
	31.750 1.2500	41.275 1.6250	25.40 1.000	—	JH-2016	—	34.0 7640	52.8 11870	8.20	6800	10000	0.067 0.148	—	31.750 1.2500	31.737 1.2495	41.288 1.6255	41.262 1.6245	Table B2-6	IR-1616(1)
	31.750 1.2500	41.275 1.6250	31.75 1.250	—	JH-2020	—	43.4 9750	72.3 16250	10.8	6800	10000	0.084 0.185	—	31.750 1.2500	31.737 1.2495	41.288 1.6255	41.262 1.6245	Table B2-6	
1 3/8	34.925 1.3750	41.275 1.6250	12.70 0.500	1.02 0.040	J-228	MJ-2281	14.0 3140	22.9 5150	3.50	6000	9200	0.024 0.052	0.028 0.062	34.925 1.3750	34.912 1.3745	41.288 1.6255	41.262 1.6245	Table B2-6	IR-1812
	34.925 1.3750	41.275 1.6250	19.05 0.750	—	J-2212	—	22.8 5130	43.0 9660	6.65	6000	9200	0.035 0.077	—	34.925 1.3750	34.912 1.3745	41.288 1.6255	41.262 1.6245	Table B2-6	IR-1812
	34.925 1.3750	44.450 1.7500	19.05 0.750	1.27 0.050	JH-2212	MJH-22121	26.2 5900	38.4 8640	5.90	6100	9400	0.055 0.121	0.065 0.144	34.925 1.3750	34.912 1.3745	44.463 1.7505	44.437 1.7495	Table B2-6	IR-1812
	34.925 1.3750	44.450 1.7500	25.40 1.000	1.27 0.050	JH-2216	MJH-22161	36.5 8210	58.8 13220	9.20	6100	9400	0.073 0.161	0.087 0.192	34.925 1.3750	34.912 1.3745	44.463 1.7505	44.437 1.7495	Table B2-6	IR-1816
1 1/2	38.100 1.5000	47.625 1.8750	19.05 0.750	1.27 0.050	J-2412	MJ-24121	29.9 6720	47.1 10590	7.40	5600	8600	0.059 0.131	0.094 0.208	38.100 1.5000	38.087 1.4995	47.638 1.8755	47.612 1.8745	Table B2-6	IR-1916
	38.100 1.5000	47.625 1.8750	25.40 1.000	1.27 0.050	J-2416	MJ-24161	39.3 8840	66.9 15040	10.4	5600	8600	0.079 0.174	0.094 0.208	38.100 1.5000	38.087 1.4995	47.638 1.8755	47.612 1.8745	Table B2-6	IR-1916
	38.100 1.5000	47.625 1.8750	31.75 1.250	—	J-2420	—	49.5 11130	90.0 20230	14.0	5600	8600	0.099 0.218	—	38.100 1.5000	38.087 1.4995	47.638 1.8755	47.612 1.8745	Table B2-6	IR-1920
1 5/8	41.275 1.6250	50.800 2.0000	15.88 0.625	—	J-2610	—	26.1 5870	41.0 9210	6.25	5100	7900	0.053 0.117	—	41.275 1.6250	41.262 1.6245	50.813 2.0005	50.787 1.9995	Table B2-6	IR-2020(1)
	41.275 1.6250	50.800 2.0000	25.40 1.000	1.27 0.050	J-2616	M-26161	39.3 8830	69.0 15500	10.8	5100	7900	0.085 0.187	0.101 0.223	41.275 1.6250	41.262 1.6245	50.813 2.0005	50.787 1.9995	Table B2-6	IR-2020(1)
1 3/4	44.450 1.7500	53.975 2.1250	19.05 0.750	1.27 0.050	J-2812	MJ-28121	29.6 6650	49.3 11080	7.45	4700	7300	0.068 0.150	0.081 0.179	44.450 1.7500	44.437 1.7495	53.988 2.1255	53.962 2.1245	Table B2-6	IR-2316
	44.450 1.7500	53.975 2.1250	25.40 1.000	1.27 0.050	J-2816	MJ-28161	40.1 9010	72.9 16390	11.4	4700	7300	0.091 0.200	0.108 0.239	44.450 1.7500	44.437 1.7495	53.988 2.1255	53.962 2.1245	Table B2-6	IR-2316
	44.450 1.7500	53.975 2.1250	38.10 1.500	1.27 0.050	J-2824	MJ-28241	59.8 13440	122 27400	18.9	4700	7300	0.136 0.300	0.162 0.358	44.450 1.7500	44.437 1.7495	53.988 2.1255	53.962 2.1245	Table B2-6	IR-2324
1 7/8	47.625 1.8750	57.150 2.2500	25.40 1.000	1.27 0.050	J-3016	MJ-30161	41.1 9240	76.0 17080	11.9	4400	6800	0.097 0.213	0.115 0.254	47.625 1.8750	47.612 1.8745	57.163 2.2505	57.137 2.2495	Table B2-6	
2	50.800 2.0000	60.325 2.3750	25.40 1.000	1.27 0.050	J-3216	MJ-32161	42.4 9530	81.2 18250	12.7	4100	6300	0.103 0.226	0.137 0.301	50.800 2.0000	50.785 1.9994	60.338 2.3755	60.312 2.3745	Table B2-6	
2 1/4	57.150 2.2500	66.675 2.6250	19.05 0.750	—	J-3612	—	35.4 7960	65.9 14810	10.0	3600	5600	0.086 0.189	—	57.150 2.2500	57.135 2.2494	66.688 2.6255	66.662 2.6245	Table B2-6	
	57.150 2.2500	66.675 2.6250	25.40 1.000	—	J-3616	—	46.1 10360	92.3 20750	14.4	3600	5600	0.114 0.252	—	57.150 2.2500	57.135 2.2494	66.688 2.6255	66.662 2.6245	Table B2-6	
2 3/4	69.850 2.7500	79.375 3.1250	19.05 0.750	—	J-4412	—	36.2 8140	72.9 16390	11.3	2900	4500	0.103 0.227	—	69.850 2.7500	69.835 2.7494	79.388 3.1255	79.362 3.1245	Table B2-6	IR-4016

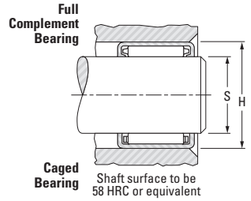
(1) IRA inner ring provides additional length if required.

CAGED BEARINGS – OPEN ENDS

INCH SERIES
BT SERIES



BT



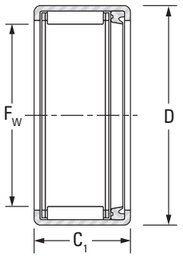
Shaft Dia.	F_w	D	C	Y max.	Bearing Designation	Load Ratings		Fatigue Load Limit C_u	Speed Ratings		Approx. Wt.	Mounting Dimensions				Inspection gage	Mounting inner ring (pages B-2-68 to B-2-70)
						Dynamic	Static					Shaft		Housing			
			+0 -0.3 +0.000 -0.012		Open Ends	C	C_0		Grease	Oil	Open Ends	Max.	Min.	Max.	Min.		
in	mm in	mm in	mm in	mm in		kN lbf		kN	min^{-1}		kg lbs	mm in	mm in	mm in	mm in		
$^{11}/_{16}$	**17.462** 0.6870	**22.225** 0.875	**19.05** 0.750	—	BT1112-1	**12.7** 2850	**21.2** 4770	3.30	12000	19000	**0.015** 0.033	**17.462** 0.6875	**17.451** 0.6870	**22.237** 0.8755	**22.216** 0.8746	Table B2-7	—
$^{7}/_{8}$	**22.225** 0.875	**28.575** 1.125	**9.525** 0.375	—	BT146P	**7.05** 1580	**8.55** 1920	1.35	9800	15000	**0.012** 0.027	**22.225** 0.8750	**22.212** 0.8745	**28.587** 1.1255	**28.566** 1.1246	Table B2-7	—
1	**25.400** 1.0000	**31.750** 1.250	**9.525** 0.375	—	BT166	**7.45** 1670	**9.50** 2140	1.50	8500	13000	**0.014** 0.031	**25.400** 1.0000	**25.387** 0.9995	**31.764** 1.2506	**31.739** 1.2496	Table B2-7	—
1 $^{1}/_{8}$	**28.575** 1.125	**34.925** 1.375	**12.70** 0.500	—	BT188	**13.1** 2940	**20.3** 4560	3.10	7200	11000	**0.021** 0.047	**28.575** 1.1250	**28.562** 1.1245	**34.939** 1.3756	**34.914** 1.3746	Table B2-7	—
1 $^{3}/_{16}$	**30.162** 1.187	**38.100** 1.500	**25.40** 1.000	—	BT1916M	**31.5** 7080	**51.9** 11670	8.15	7200	11000	**0.054** 0.119	**30.162** 1.1875	**30.146** 1.1869	**38.114** 1.5006	**38.089** 1.4996	Table B2-7	—
1 $^{1}/_{4}$	**31.750** 1.250	**38.100** 1.500	**19.05** 0.750	—	BT2012	**21.2** 4770	**38.7** 8700	6.00	6500	10000	**0.035** 0.077	**31.750** 1.2500	**31.734** 1.2494	**38.114** 1.5006	**38.089** 1.4996	Table B2-7	—
1 $^{5}/_{8}$	**41.275** 1.625	**50.800** 2.000	**22.225** 0.875	—	BT2614	**34.1** 7670	**56.9** 12790	9.00	5100	7900	**0.082** 0.180	**41.275** 1.6250	**41.259** 1.6244	**50.818** 2.0007	**50.788** 1.9995	Table B2-7	—
1 $^{7}/_{8}$	**47.625** 1.875	**57.150** 2.250	**15.875** 0.625	—	BT3010-1	**25.2** 5660	**40.1** 9010	6.20	4400	6800	**0.064** 0.140	**47.625** 1.8750	**47.609** 1.8744	**57.168** 2.2507	**57.138** 2.2495	Table B2-7	—

NOTES

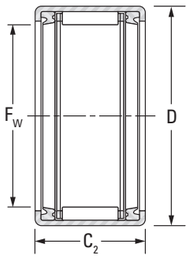
SEALED DRAWN CUP BEARINGS

INCH SERIES

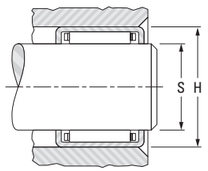
- Check for availability. Not all bearings are in production.
- Pre-packed with general purpose ball and roller bearing grease unless otherwise specified.
- Bearing operating temperature limited between -30° C and +110° C (-25° F and +225° F).
- Consult your representative for operating temperatures outside the above range or if seals have been exposed to unusual fluids.
- Speed rating based on shaft contact speed of 610 m/min. (2000 fpm).
- Reduce the listed speed rating by one-half for outer ring rotation.



JT – One Seal



JT – Two Seals



Shaft surface to be 58 HRC or equivalent

Drawn cup bearings of nominal inch dimensions, with one closed end, that are not tabulated, may be made available upon request.

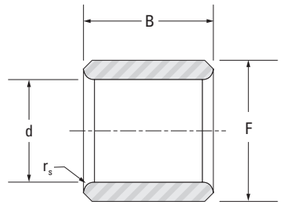
Mounting dimensions are based on the inner ring rotating and the outer ring being stationary, relative to the load. The housing should be of high strength material.

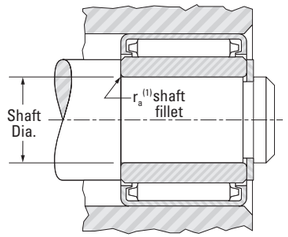
Shaft Dia.	F_w	D	Bearings With One Seal			Bearings With Two Seals		
			C_1 **+0** +0.000 **-0.3** -0.010	Bearing Designation	Approx. Wt.	C_2 **+0** +0.000 **-0.3** -0.010	Bearing Designation	Approx. Wt.
in	**mm** in	**mm** in	**mm** in		**kg** lbs			**kg** lbs
5/16	**7.938** 0.3125	**12.700** 0.5000	**9.53** 0.375	JT-56	**0.004** 0.008	**11.13** 0.438	JTT-57	**0.004** 0.009
	7.938 0.3125	**12.700** 0.5000	—	—	—	**14.27** 0.562	JTT-59	**0.005** 0.012
3/8	**9.525** 0.3750	**14.288** 0.5625	**9.53** 0.375	JT-66	**0.004** 0.009	**11.13** 0.438	JTT-67	**0.005** 0.011
	9.525 0.3750	**14.288** 0.5625	**14.27** 0.562	JT-69	**0.006** 0.014	—	—	—
1/2	**12.700** 0.5000	**17.463** 0.6875	**9.53** 0.375	JT-86	**0.005** 0.012	**11.13** 0.438	JTT-87	**0.006** 0.013
	12.700 0.5000	**17.463** 0.6875	**14.27** 0.562	JT-89	**0.008** 0.017	**15.88** 0.625	JTT-810	**0.009** 0.019
	12.700 0.5000	**17.463** 0.6875	—	—	—	**22.23** 0.875	JTT-814	**0.012** 0.027
9/16	**14.288** 0.5625	**19.050** 0.7500	**14.27** 0.562	JT-99	**0.009** 0.019	**15.88** 0.625	JTT-910	**0.010** 0.021
	14.288 0.5625	**19.050** 0.7500	—	—	—	**19.05** 0.750	JTT-912	**0.011** 0.025
5/8	**15.875** 0.6250	**20.638** 0.8125	**14.27** 0.562	JT-109	**0.010** 0.021	**15.88** 0.625	JTT-1010	**0.010** 0.023
	15.875 0.6250	**20.638** 0.8125	—	—	—	**19.05** 0.750	JTT-1012	**0.013** 0.028
	15.875 0.6250	**20.638** 0.8125	—	—	—	**22.23** 0.875	JTT-1014	**0.015** 0.032
11/16	**17.463** 0.6875	**22.225** 0.8750	—	—	—	**22.23** 0.875	JTT-1114	**0.016** 0.035
3/4	**19.050** 0.7500	**25.400** 1.0000	**14.27** 0.562	JT-129	**0.015** 0.034	**15.88** 0.625	JTT-1210	**0.017** 0.038
	19.050 0.7500	**25.400** 1.0000	**17.48** 0.688	JT-1211	**0.019** 0.041	—	—	—
	19.050 0.7500	**25.400** 1.0000	**20.62** 0.812	JT-1213	**0.022** 0.049	**22.23** 0.875	JTT-1214	**0.024** 0.053
7/8	**22.225** 0.8750	**28.575** 1.1250	**14.27** 0.562	JT-149	**0.018** 0.039	**15.88** 0.625	JTT-1410	**0.020** 0.043
	22.225 0.8750	**28.575** 1.1250	**26.97** 1.062	JT-1417	**0.033** 0.073	—	—	—
1	**25.400** 1.0000	**31.750** 1.2500	**20.62** 0.812	JT-1613	**0.029** 0.063	**22.23** 0.875	JTT-1614	**0.031** 0.068
1 1/8	**28.575** 1.1250	**34.925** 1.3750	**20.62** 0.812	JT-1813	**0.032** 0.070	**22.23** 0.875	JTT-1814	**0.034** 0.075
1 1/4	**31.750** 1.2500	**38.100** 1.5000	**20.62** 0.812	JT-2013	**0.035** 0.077	—	—	—
	31.750 1.2500	**38.100** 1.5000	—	—	—	**28.58** 1.125	JTT-2018	**0.048** 0.106
1 1/2	**38.100** 1.5000	**47.625** 1.8750	**33.32** 1.312	JT-2421	**0.104** 0.229	—	—	—

Load Ratings		Fatigue Load Limit C_u	Approx. Speed Rating (Grease)	Mounting Dimensions				Inspection			Shaft Dia.
Dynamic	Static			S		H		Ring Gage	Plug Gage		
C	C_0			Max.	Min.	Max.	Min.		go	no go	
kN lbf		kN	min^{-1}	**mm** in	**mm** in	**mm** in	**mm** in				in
2.40 540	**2.00** 450	0.340	18000	**7.938** 0.3125	**7.925** 0.3120	**12.713** 0.5005	**12.687** 0.4995	**12.713** 0.5005	**7.976** 0.3140	**8.001** 0.3150	5/16
4.05 910	**3.91** 880	0.590	18000	**7.938** 0.3125	**7.925** 0.3120	**12.713** 0.5005	**12.687** 0.4995	**12.713** 0.5005	**7.976** 0.3140	**8.001** 0.3150	
2.74 615	**2.49** 560	0.430	18000	**9.525** 0.3750	**9.512** 0.3745	**14.300** 0.5630	**14.275** 0.5620	**14.300** 0.5630	**9.563** 0.3765	**9.589** 0.3775	3/8
5.20 1 170	**5.74** 1 290	0.860	18000	**9.525** 0.3750	**9.512** 0.3745	**14.300** 0.5630	**14.275** 0.5620	**14.300** 0.5630	**9.563** 0.3765	**9.589** 0.3775	
3.47 780	**3.65** 820	0.630	15000	**12.700** 0.5000	**12.687** 0.4995	**17.475** 0.6880	**17.450** 0.6870	**17.475** 0.6880	**12.738** 0.5015	**12.764** 0.5025	1/2
6.32 1 420	**7.92** 1 780	1.20	15000	**12.700** 0.5000	**12.687** 0.4995	**17.475** 0.6880	**17.450** 0.6870	**17.475** 0.6880	**12.738** 0.5015	**12.764** 0.5025	
10.2 2 300	**14.7** 3 310	2.25	15000	**12.700** 0.5000	**12.687** 0.4995	**17.475** 0.6880	**17.450** 0.6870	**17.475** 0.6880	**12.738** 0.5015	**12.764** 0.5025	
6.23 1 400	**8.01** 1 800	1.20	14000	**14.288** 0.5625	**14.275** 0.5620	**19.063** 0.7505	**19.037** 0.7495	**19.063** 0.7505	**14.326** 0.5640	**14.351** 0.5650	9/16
8.18 1 840	**11.4** 2 560	1.70	14000	**14.288** 0.5625	**14.275** 0.5620	**19.063** 0.7505	**19.037** 0.7495	**19.063** 0.7505	**14.326** 0.5640	**14.351** 0.5650	
6.72 1 510	**9.12** 2 050	1.40	12000	**15.875** 0.6250	**15.862** 0.6245	**20.650** 0.8130	**20.625** 0.8120	**20.650** 0.8130	**15.913** 0.6265	**15.939** 0.6275	5/8
8.81 1 980	**12.9** 2 910	1.95	12000	**15.875** 0.6250	**15.862** 0.6245	**20.650** 0.8130	**20.625** 0.8120	**20.650** 0.8130	**15.913** 0.6265	**15.939** 0.6275	
11.7 2 640	**18.9** 4 240	2.90	12000	**15.875** 0.6250	**15.862** 0.6245	**20.650** 0.8130	**20.625** 0.8120	**20.650** 0.8130	**15.913** 0.6265	**15.939** 0.6275	
12.5 2 800	**20.9** 4 700	3.20	11000	**17.463** 0.6875	**17.450** 0.6870	**22.238** 0.8755	**22.212** 0.8745	**22.238** 0.8755	**17.501** 0.6890	**17.526** 0.6900	11/16
9.92 2 230	**12.2** 2 740	1.85	10000	**19.050** 0.7500	**19.037** 0.7495	**25.413** 1.0005	**25.387** 0.9995	**25.387** 0.9995	**19.063** 0.7505	**19.088** 0.7515	3/4
12.5 2 810	**16.3** 3 670	2.50	10000	**19.050** 0.7500	**19.037** 0.7495	**25.413** 1.0005	**25.387** 0.9995	**25.387** 0.9995	**19.063** 0.7505	**19.088** 0.7515	
15.5 3 490	**21.6** 4 860	3.35	10000	**19.050** 0.7500	**19.037** 0.7495	**25.413** 1.0005	**25.387** 0.9995	**25.387** 0.9995	**19.063** 0.7505	**19.088** 0.7515	
10.9 2 460	**14.5** 3 260	2.20	8700	**22.225** 0.8750	**22.212** 0.8745	**28.588** 1.1255	**28.562** 1.1245	**28.562** 1.1245	**22.238** 0.8755	**22.263** 0.8765	7/8
23.7 5 320	**39.0** 8 760	6.05	8700	**22.225** 0.8750	**22.212** 0.8745	**28.588** 1.1255	**28.562** 1.1245	**28.562** 1.1245	**22.238** 0.8755	**22.263** 0.8765	
18.1 4 080	**28.8** 6 480	4.45	7600	**25.400** 1.0000	**25.387** 0.9995	**31.763** 1.2505	**31.737** 1.2495	**31.737** 1.2495	**25.413** 1.0005	**25.438** 1.0015	1
19.0 4 280	**31.8** 7 140	4.90	6800	**28.575** 1.1250	**28.562** 1.1245	**34.938** 1.3755	**34.912** 1.3745	**34.912** 1.3745	**28.588** 1.1255	**28.613** 1.1265	1 1/8
19.8 4 460	**34.7** 7 800	5.35	6100	**31.750** 1.2500	**31.737** 1.2495	**38.113** 1.5005	**38.087** 1.4995	**38.087** 1.4995	**31.763** 1.2505	**31.788** 1.2515	1 1/4
28.8 6 480	**56.5** 12 700	8.70	6100	**31.750** 1.2500	**31.737** 1.2495	**38.113** 1.5005	**38.087** 1.4995	**38.087** 1.4995	**31.763** 1.2505	**31.788** 1.2515	
49.4 11 100	**89.9** 20 200	14.0	5100	**38.100** 1.5000	**38.087** 1.4995	**47.638** 1.8755	**47.612** 1.8745	**47.612** 1.8745	**38.113** 1.5005	**38.143** 1.5017	1 1/2

INNER RINGS FOR INCH SERIES DRAWN CUP BEARINGS

- Check for availability.
- Ideal choice when shaft is not practical to use as inner raceway.
- Provided in inch (IR, IRA) nominal dimensions for use with inch series drawn cup bearings.
- Designed to meet established inch tolerances.
- Designed to be wider than matching drawn cup bearing.
- Maximum shaft fillet radius ($r_{a\ max.}$) cannot exceed inner ring bore chamfer ($r_{s\ min.}$) as shown.
- Optional centralized lubrication groove (bore) and thru-hole available – specify when ordering.
- Designed to provide a loose transition fit on the shaft and should be axially clamped against a shoulder.
- If a tight transition fit must be used to keep the inner ring from rotating relative to the shaft, the inner ring O.D. must not exceed the raceway diameter for the matching drawn cup bearing after being mounted on the shaft.
- See tables for bearing raceway diameter dimensions.
- After mounting, if O.D. of inner ring exceeds required raceway diameter for matching bearing, ring should be ground to proper diameter while mounted on shaft.





Shaft Dia.	d		F		B		$r_{s\ min.}$	Inner Ring Designation	Mounting Dimensions Transition Fit				Approx. Wt.
									Loose		Tight		
	Max.	Min.	Max.	Min.	Max.	Min.	Min.		Max.	Min.	Max.	Min.	
in	mm in	mm in	mm in	mm in	mm in	mm in	mm in		mm in	mm in	mm in	mm in	kg lbs
3/16	4.826 0.1900	4.813 0.1895	9.525 0.3750	9.512 0.3745	13.61 0.536	13.36 0.526	0.64 0.025	IRA-3	4.818 0.1897	4.806 0.1892	4.829 0.1901	4.816 0.1896	0.005 0.012
1/4	6.350 0.2500	6.337 0.2495	11.113 0.4375	11.100 0.4370	13.61 0.536	13.36 0.526	0.64 0.025	IRA-4	6.342 0.2497	6.330 0.2492	6.353 0.2501	6.340 0.2496	0.006 0.014
5/16	7.938 0.3125	7.925 0.3120	12.700 0.5000	12.687 0.4995	13.61 0.536	13.36 0.526	0.64 0.025	IRA-5	7.930 0.3122	7.917 0.3117	7.940 0.3126	7.927 0.3121	0.008 0.017
3/8	9.525 0.3750	9.512 0.3745	14.288 0.5625	14.275 0.5620	13.08 0.515	12.83 0.505	0.64 0.025	IR-68	9.517 0.3747	9.505 0.3742	9.528 0.3751	9.515 0.3746	0.009 0.019
	9.525 0.3750	9.512 0.3745	14.288 0.5625	14.275 0.5620	19.43 0.765	19.18 0.755	0.64 0.025	IR-612	9.517 0.3747	9.505 0.3742	9.528 0.3751	9.515 0.3746	0.013 0.028
	9.525 0.3750	9.512 0.3745	14.288 0.5625	14.275 0.5620	19.96 0.786	19.71 0.776	0.64 0.025	IRA-6	9.517 0.3747	9.505 0.3742	9.528 0.3751	9.515 0.3746	0.013 0.029
	9.525 0.3750	9.512 0.3745	15.875 0.6250	15.862 0.6245	13.08 0.515	12.83 0.505	0.64 0.025	IR-68-1	9.517 0.3747	9.505 0.3742	9.528 0.3751	9.515 0.3746	0.012 0.027
	9.525 0.3750	9.512 0.3745	15.875 0.6250	15.862 0.6245	19.43 0.765	19.18 0.755	0.64 0.025	IR-612-1	9.517 0.3747	9.505 0.3742	9.528 0.3751	9.515 0.3746	0.018 0.040
7/16	11.113 0.4375	11.100 0.4370	15.875 0.6250	15.862 0.6245	19.96 0.786	19.71 0.776	0.64 0.025	IRA-7	11.105 0.4372	11.092 0.4367	11.115 0.4376	11.102 0.4371	0.015 0.033
1/2	12.700 0.5000	12.687 0.4995	19.050 0.7500	19.037 0.7495	13.08 0.515	12.83 0.505	1.02 0.040	IR-88	12.692 0.4997	12.680 0.4992	12.703 0.5001	12.690 0.4996	0.015 0.033
	12.700 0.5000	12.687 0.4995	19.050 0.7500	19.037 0.7495	19.43 0.765	19.18 0.755	1.02 0.040	IR-812	12.692 0.4997	12.680 0.4992	12.703 0.5001	12.690 0.4996	0.023 0.050
5/8	15.875 0.6250	15.862 0.6245	22.225 0.8750	22.212 0.8745	19.43 0.765	19.18 0.755	1.02 0.040	IR-1012	15.867 0.6247	15.855 0.6242	15.878 0.6251	15.865 0.6246	0.027 0.060
	15.875 0.6250	15.862 0.6245	22.225 0.8750	22.212 0.8745	19.96 0.786	19.71 0.776	1.02 0.040	IRA-10	15.867 0.6247	15.855 0.6242	15.878 0.6251	15.865 0.6246	0.028 0.062
	15.875 0.6250	15.862 0.6245	22.225 0.8750	22.212 0.8745	25.78 1.015	25.53 1.005	1.02 0.040	IR-1016	15.867 0.6247	15.855 0.6242	15.878 0.6251	15.865 0.6246	0.036 0.080
3/4	19.050 0.7500	19.037 0.7495	25.400 1.0000	25.387 0.9995	13.08 0.515	12.83 0.505	1.02 0.040	IR-128	19.042 0.7497	19.030 0.7492	19.053 0.7501	19.040 0.7496	0.021 0.047
	19.050 0.7500	19.037 0.7495	25.400 1.0000	25.387 0.9995	19.43 0.765	19.18 0.755	1.02 0.040	IR-1212	19.042 0.7497	19.030 0.7492	19.053 0.7501	19.040 0.7496	0.032 0.070
	19.050 0.7500	19.037 0.7495	25.400 1.0000	25.387 0.9995	25.78 1.015	25.53 1.005	1.02 0.040	IR-1216	19.042 0.7497	19.030 0.7492	19.053 0.7501	19.040 0.7496	0.042 0.093
	19.050 0.7500	19.037 0.7495	25.400 1.0000	25.387 0.9995	26.31 1.036	26.06 1.026	1.02 0.040	IRA-12	19.042 0.7497	19.030 0.7492	19.053 0.7501	19.040 0.7496	0.043 0.095
	19.050 0.7500	19.037 0.7495	25.400 1.0000	25.387 0.9995	32.13 1.265	31.88 1.255	1.02 0.040	IR-1220	19.042 0.7497	19.030 0.7492	19.053 0.7501	19.040 0.7496	0.053 0.116
	19.050 0.7500	19.037 0.7495	25.400 1.0000	25.387 0.9995	38.48 1.515	38.23 1.505	1.02 0.040	IR-1224	19.042 0.7497	19.030 0.7492	19.053 0.7501	19.040 0.7496	0.063 0.139
13/16	20.638 0.8125	20.625 0.8120	25.400 1.0000	25.387 0.9995	19.43 0.765	19.18 0.755	1.02 0.040	IR-1312	20.630 0.8122	20.617 0.8117	20.640 0.8126	20.627 0.8121	0.024 0.054
	20.638 0.8125	20.625 0.8120	25.400 1.0000	25.387 0.9995	25.78 1.015	25.53 1.005	1.02 0.040	IR-1316	20.630 0.8122	20.617 0.8117	20.640 0.8126	20.627 0.8121	0.033 0.072
7/8	22.225 0.8750	22.212 0.8745	28.575 1.1250	28.562 1.1245	25.78 1.015	25.53 1.005	1.02 0.040	IR-1416	22.217 0.8747	22.205 0.8742	22.228 0.8751	22.215 0.8746	0.050 0.111
	22.225 0.8750	22.212 0.8745	28.575 1.1250	28.562 1.1245	26.31 1.036	26.06 1.026	1.02 0.040	IRA-14	22.217 0.8747	22.205 0.8742	22.228 0.8751	22.215 0.8746	0.050 0.111
15/16	23.813 0.9375	23.800 0.9370	28.575 1.1250	28.562 1.1245	25.78 1.015	25.53 1.005	1.02 0.040	IR-1516	23.805 0.9372	23.792 0.9367	23.815 0.9376	23.802 0.9371	0.037 0.082
1	25.400 1.0000	25.387 0.9995	31.750 1.2500	31.737 1.2495	19.43 0.765	19.18 0.755	1.02 0.040	IR-1612	25.392 0.9997	25.380 0.9992	25.403 1.0001	25.390 0.9996	0.041 0.090
	25.400 1.0000	25.387 0.9995	31.750 1.2500	31.737 1.2495	25.78 1.015	25.53 1.005	1.02 0.040	IR-1616	25.392 0.9997	25.380 0.9992	25.403 1.0001	25.390 0.9996	0.057 0.125
	25.400 1.0000	25.387 0.9995	31.750 1.2500	31.737 1.2495	26.31 1.036	26.06 1.026	1.02 0.040	IRA-16	25.392 0.9997	25.380 0.9992	25.403 1.0001	25.390 0.9996	0.056 0.124
1 1/8	28.575 1.1250	28.562 1.1245	34.925 1.3750	34.912 1.3745	19.43 0.765	19.18 0.755	1.02 0.040	IR-1812	28.567 1.1247	28.555 1.1242	28.578 1.1251	28.565 1.1246	0.045 0.100
	28.575 1.1250	28.562 1.1245	34.925 1.3750	34.912 1.3745	25.78 1.015	25.53 1.005	1.02 0.040	IR-1816	28.567 1.1247	28.555 1.1242	28.578 1.1251	28.565 1.1246	0.060 0.133
	28.575 1.1250	28.562 1.1245	34.925 1.3750	34.912 1.3745	32.13 1.265	31.88 1.255	1.02 0.040	IR-1820	28.567 1.1247	28.555 1.1242	28.578 1.1251	28.565 1.1246	0.075 0.166
1 3/16	30.163 1.1875	30.150 1.1870	38.100 1.5000	38.087 1.4995	25.78 1.015	25.53 1.005	1.02 0.040	IR-1916	30.155 1.1872	30.142 1.1867	30.165 1.1876	30.152 1.1871	0.084 0.186
	30.163 1.1875	30.150 1.1870	38.100 1.5000	38.087 1.4995	32.13 1.265	31.88 1.255	1.02 0.040	IR-1920	30.155 1.1872	30.142 1.1867	30.165 1.1876	30.152 1.1871	0.101 0.223
1 1/4	31.750 1.2500	31.737 1.2495	38.100 1.5000	38.087 1.4995	25.78 1.015	25.53 1.005	1.52 0.060	IR-2016	31.742 1.2497	31.730 1.2492	31.753 1.2501	31.740 1.2496	0.069 0.152
	31.750 1.2500	31.737 1.2495	38.100 1.5000	38.087 1.4995	32.13 1.265	31.88 1.255	1.52 0.060	IR-2020	31.742 1.2497	31.730 1.2492	31.753 1.2501	31.740 1.2496	0.086 0.190

Bore and O.D. tolerance limits correspond to the single mean diameter (the arithmetical mean of the largest and smallest diameters in a single radial plane).

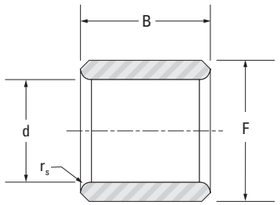
(1) $r_{a\ max.}$ is equal to minimum inner ring bore chamfer ($r_{s\ min.}$).

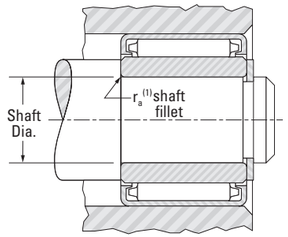
Continued on next page.

B

INNER RINGS FOR INCH SERIES DRAWN CUP BEARINGS

- Check for availability.
- Ideal choice when shaft is not practical to use as inner raceway.
- Provided in inch (IR, IRA) nominal dimensions for use with inch series drawn cup bearings.
- Designed to meet established inch tolerances.
- Designed to be wider than matching drawn cup bearing.
- Maximum shaft fillet radius ($r_{a\ max.}$) cannot exceed inner ring bore chamfer ($r_{s\ min.}$) as shown.
- Optional centralized lubrication groove (bore) and thru-hole available – specify when ordering.
- Designed to provide a loose transition fit on the shaft and should be axially clamped against a shoulder.
- If a tight transition fit must be used to keep the inner ring from rotating relative to the shaft, the innr ring O.D. must not exceed the raceway diameter for the matching drawn cup bearing after being mounted on the shaft.
- See tables for bearing raceway diameter dimensions.
- After mounting, if O.D. of inner ring exceeds required raceway diameter for matching bearing, ring should be ground to proper diameter while mounted on shaft.





Shaft Dia.	d		F		B		$r_{s\ min.}$	Inner Ring Designation	Mounting Dimensions Transition Fit				Approx. Wt.
									Loose		Tight		
	Max.	Min.	Max.	Min.	Max.	Min.	Min.		Max.	Min.	Max.	Min.	
in	mm in	mm in	mm in	mm in	mm in	mm in	mm in		mm in	mm in	mm in	mm in	kg lbs
1 1/4	**31.750** 1.2500	**31.737** 1.2495	**38.100** 1.5000	**38.087** 1.4995	**32.66** 1.286	**32.41** 1.276	**1.52** 0.060	IRA-20	**31.742** 1.2497	**31.730** 1.2492	**31.753** 1.2501	**31.740** 1.2496	**0.086** 0.190
1 3/8	**34.925** 1.3750	**34.912** 1.3745	**41.275** 1.6250	**41.262** 1.6245	**32.13** 1.265	**31.88** 1.255	**1.52** 0.060	IR-2220	**34.917** 1.3747	**34.905** 1.3742	**34.928** 1.3751	**34.915** 1.3746	**0.094** 0.208
1 7/16	**36.513** 1.4375	**36.500** 1.4370	**44.450** 1.7500	**44.437** 1.7495	**25.78** 1.015	**25.53** 1.005	**1.52** 0.060	IR-2316	**36.505** 1.4372	**36.492** 1.4367	**36.515** 1.4376	**36.502** 1.4371	**0.100** 0.220
	36.513 1.4375	**36.500** 1.4370	**44.450** 1.7500	**44.437** 1.7495	**38.48** 1.515	**38.23** 1.505	**1.52** 0.060	IR-2324	**36.505** 1.4372	**36.492** 1.4367	**36.515** 1.4376	**36.502** 1.4371	**0.150** 0.331
1 1/2	**38.100** 1.5000	**38.087** 1.4995	**44.450** 1.7500	**44.437** 1.7495	**25.78** 1.015	**25.53** 1.005	**1.52** 0.060	IR-2416	**38.092** 1.4997	**38.080** 1.4992	**38.103** 1.5001	**38.090** 1.4996	**0.078** 0.173
	38.100 1.5000	**38.087** 1.4995	**44.450** 1.7500	**44.437** 1.7495	**38.48** 1.515	**38.23** 1.505	**1.52** 0.060	IR-2424	**38.092** 1.4997	**38.080** 1.4992	**38.103** 1.5001	**38.090** 1.4996	**0.122** 0.270
1 11/16	**42.863** 1.6875	**42.850** 1.6870	**52.388** 2.0625	**52.375** 2.0620	**38.48** 1.515	**38.23** 1.505	**1.52** 0.060	IR-2724	**42.855** 1.6872	**42.842** 1.6867	**42.865** 1.6876	**42.852** 1.6871	**0.212** 0.468
1 3/4	**44.450** 1.7500	**44.437** 1.7495	**52.388** 2.0625	**52.375** 2.0620	**38.48** 1.515	**38.23** 1.505	**1.52** 0.060	IR-2824	**44.442** 1.7497	**44.430** 1.7492	**44.453** 1.7501	**44.440** 1.7496	**0.180** 0.396
1 13/16	**46.038** 1.8125	**46.025** 1.8120	**52.388** 2.0625	**52.375** 2.0620	**25.78** 1.015	**25.53** 1.005	**1.52** 0.060	IR-2916	**46.030** 1.8122	**46.017** 1.8117	**46.040** 1.8126	**46.027** 1.8121	**0.097** 0.214
	46.038 1.8125	**46.025** 1.8120	**52.388** 2.0625	**52.375** 2.0620	**38.48** 1.515	**38.23** 1.505	**1.52** 0.060	IR-2924	**46.030** 1.8122	**46.017** 1.8117	**46.040** 1.8126	**46.027** 1.8121	**0.146** 0.322
1 7/8	**47.625** 1.8750	**47.612** 1.8745	**53.975** 2.1250	**53.962** 2.1245	**38.48** 1.515	**38.23** 1.505	**1.52** 0.060	IR-3024	**47.617** 1.8747	**47.605** 1.8742	**47.628** 1.8751	**47.615** 1.8746	**0.145** 0.319
2 1/2	**63.500** 2.5000	**63.487** 2.4995	**69.850** 2.7500	**69.837** 2.7495	**25.78** 1.015	**25.53** 1.005	**1.52** 0.060	IR-4016	**63.495** 2.4998	**63.477** 2.4991	**63.505** 2.5002	**63.487** 2.4995	**0.132** 0.290

Bore and O.D. tolerance limits correspond to the single mean diameter (the arithmetical mean of the largest and smallest diameters in a single radial plane).

(1) $r_{a\ max.}$ is equal to minimum inner ring bore chamfer ($r_{s\ min.}$).

DRAWN CUP ROLLER CLUTCHES

Overview: Drawn cup needle roller clutches are similar to drawn cup needle roller bearings in design; however, they allow free rotation in only one direction while transmitting torque in the opposite direction. These designs use the same small radial section as drawn cup needle roller bearings and are offered as clutch-only units or as clutch and bearing assemblies.

- **Catalog range:** 3.175 mm – 35 mm (0.1250 in – 1.3780 in) bore.
- **Markets:** Office equipment, paper-towel dispensers, exercise equipment, appliances and two-speed gearboxes.
- **Features:** Compact, lightweight and operate directly on a hardened shaft.
- **Benefits:** Installation is easily accomplished with a simple press fit.

Drawn Cup Roller Clutches Metric Series

FCS, FC-K	regular clutch, single roller per stainless steel spring
FC	regular clutch, multi-roller per stainless steel spring
FCL-K	light series clutch, single roller per stainless steel spring
FCB	regular clutch and bearing assembly, multi-roller per stainless steel spring
FCBL-K, FCBN-K	light series clutch and bearing assembly, single roller per stainless steel spring

FCL - 10 - K

Bore, in millimeters

Inch Series

RC	regular clutch, single roller per integral spring
RC-FS	regular clutch, single roller per stainless steel spring
RCB	regular clutch and bearing assembly, single roller per integral spring
RCB-FS	regular clutch and bearing assembly, single roller per stainless steel spring

RC - 10 14 10 - FS

Bore
10 = $^{10}/_{16}$ = $^{5}/_{8}$ in

Outer Diameter
14 = $^{14}/_{16}$ = $^{7}/_{8}$ in

Width
10 = $^{10}/_{16}$ = $^{5}/_{8}$ in

Drawn Cup Roller Clutches

DRAWN CUP ROLLER CLUTCHES

METRIC AND INCH SERIES

Drawn cup roller clutch transmits torque between shaft and housing in one direction and allows free overrun in the opposite direction. When transmitting torque, either the shaft or the housing can be the input member. Applications are generally described as indexing, backstopping or overrunning.

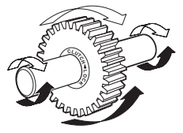


Fig. B3-1.
Lock function: shaft drives gear clockwise (white arrows) or gear can drive shaft counterclockwise (black arrows)

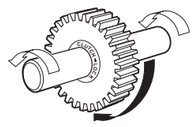


Fig. B3-2.
Overrun function: shaft overruns in gear counter-clockwise (white arrows) or gear overruns on shaft clockwise (black arrow)

IDENTIFICATION

The prefix letters in the designation of the drawn cup roller clutches and drawn cup roller clutch and bearing assemblies denote whether these are manufactured to metric or inch nominal dimensions. Designation codes for clutches and clutch and bearing assemblies with metric nominal dimensions begin with the letter "F." Designation codes for clutches and clutch and bearing assemblies with inch nominal dimensions begin with the letter "R."

The basic types of clutches and clutch and bearing assemblies are listed below:

METRIC SERIES TYPES

FCS, FC-K Regular clutch, single roller per stainless steel spring.

FC Regular clutch, multi-roller per stainless steel spring.

FCB Regular clutch and bearing assembly, multi-roller per stainless steel spring.

FCL-K Light series clutch, single roller per stainless steel spring.

FCBL-K, FCBN-K Light series clutch and bearing assembly. Single roller per stainless steel spring.

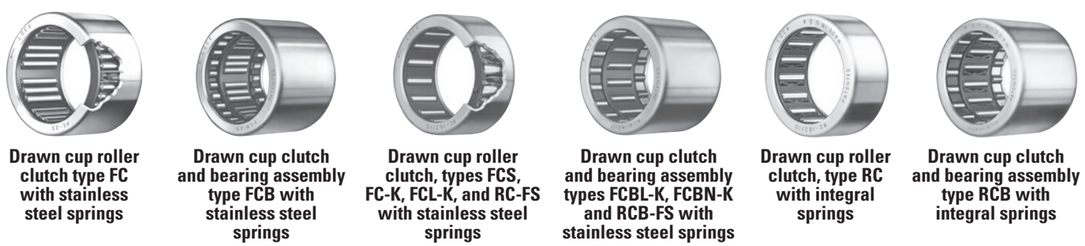
INCH SERIES TYPES

RC Regular clutch, single roller per integral spring.

RC-FS Regular clutch, single roller per stainless steel spring.

RCB Regular clutch and bearing assembly, single roller per integral spring.

RCB-FS Regular clutch and bearing assembly, single roller per stainless steel spring.



Drawn cup roller clutch type FC with stainless steel springs

Drawn cup clutch and bearing assembly type FCB with stainless steel springs

Drawn cup roller clutch, types FCS, FC-K, FCL-K, and RC-FS with stainless steel springs

Drawn cup clutch and bearing assembly types FCBL-K, FCBN-K and RCB-FS with stainless steel springs

Drawn cup roller clutch, type RC with integral springs

Drawn cup clutch and bearing assembly type RCB with integral springs

Fig. B3-3. Types of clutches and clutch and bearing assemblies

CONSTRUCTION

In many respects, construction is similar to that of drawn cup bearings. Design and manufacture of drawn cup clutches – just as with drawn cup bearings – was pioneered and developed by JTEKT. The well-established design utilizes the same low-profile radial section as drawn cup bearings. The precisely formed interior ramps provide surfaces against which the needle rollers wedge. These positively lock the clutch with the shaft when rotated in the proper direction. These ramps, formed during the operation of drawing the cup, are case hardened for wear resistance. The incorporation of ramp forming into the cup drawing operation is a manufacturing innovation that contributes to the low cost of the unit.

Two designs of precision molded clutch cages are employed. Clutch and clutch and bearing assembly types – FC, FC-K, FCS, FCL-K, RC-FS, FCB, FCBN-K, FCBL-K and RCB-FS – use a glass fiber, reinforced nylon cage, equipped with inserted stainless steel leaf springs. The stainless steel springs permit higher rates of clutch engagement and achieve greater spring life. The nylon cage permits operation at higher temperatures. Clutch types RC and RCB utilize a one-piece cage of acetyl resin polymer with integral leaf style springs. They are used for lower temperatures than permitted for the units with nylon cages.

Types FCB, FCBL-K, FCBN-K, RCB and RCB-FS clutch and bearing assemblies have cages, for retention and guidance of the needle rollers in the bearings, located on both sides of the clutch unit.

Fig. B3-4. Clutch and bearing assembly

Types FC, FC-K, FCS, FCL-K, RC and RC-FS are of clutch-only configurations for use with external radial support (usually two drawn cup needle roller bearings). Separate bearings position the shaft and housing concentrically and carry the radial load during overrun.

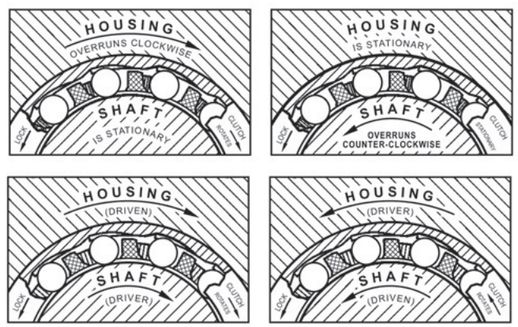
Fig. B3-5. Clutch only

OPERATION

Operation is in two modes: the overrun mode and the lock mode. Operational mode is controlled by the direction of the clutch or shaft rotation with respect to the locking ramps.

In the overrun mode, shown in the drawings below, the relative rotation between the housed clutch and the shaft causes the rollers to move away from their locking position against the locking ramps in the drawn cup. The housing and the clutch are then free to overrun in one direction, or the shaft is free to overrun in the other direction.

In the lock mode, shown in the drawings below, the relative rotation between the housed clutch and the shaft is opposite to that in the overrun mode. The rollers, assisted by the leaf-type springs, become wedged between the locking ramps and the shaft to transmit torque between the two members. Either the member housing the clutch drives the shaft in one direction, or the shaft can drive the clutch and its housing member in the other direction.



Clearance between the rollers and cup ramps is exaggerated in these drawings.

Fig. B3-6. Overrun mode and lock mode

APPLICATION

Clutches and clutch and bearing assemblies are successfully applied in a wide range of commercial products where indexing, backstopping and overrunning operations must be performed reliably. The sketches on these pages illustrate some of the many possible uses.

When applying the clutch-only unit, separate bearings on each side of the clutch are required to position the shaft concentrically with the housing, and to carry the radial loads during overrun. Drawn cup needle roller bearings, with the same radial section as the clutch, should be used in the through-bored housings for simplicity and economy. Two clutches can be used side by side for greater torque capacity.

Where the radial loads are light, the clutch and bearing assembly can be used without additional support bearings. This reduces the overall assembly width, the number of stocked and ordered parts and assembly costs, as well.

Fig. B3-7. Clutch and bearing arrangement for heavy loads

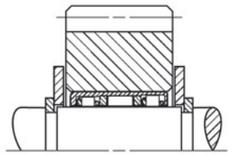


Fig. B3-8. Clutch and bearing assembly for light loads

Drawn cup roller clutches are manufactured to commercial hardware standards and are used extensively in appliances, business machines, industrial and recreation equipment and a wide range of other applications.

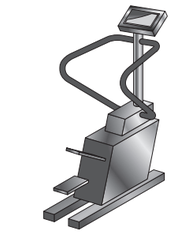
In any application where our clutch may be considered, it will be part of a system in which the operating conditions and the clutch mounting will affect its function. Before any clutch selection is made, it is important that the following catalog section be carefully studied to understand the effects of these factors. Consideration should be given to operating conditions such as:

- Magnitude of externally applied torque, as well as inertial torque.
- Magnitude of applied radial loads during overrunning.
- Potential for vibration or axial shaft movement within the clutch during engagement.
- Engagement rate, as it pertains to the selection of stainless steel or plastic leaf springs.
- Oil lubricant supply during high overrunning speeds.
- External and internal environmental temperatures that can affect clutch performance.
- Lubricant selection effect on clutch engagement.
- Indexing inaccuracies resulting from backlash (lost motion).

Consideration should be given to the shaft and housing design requirements such as:

- Shaft hardness and strength particularly when approaching torque rating limits.
- Shaft roundness, taper and surface finish necessary to ensure sufficient fatigue life and torque-carrying ability.
- Housing strength (hardness and cross section) to support the applied torque loads.
- Housing roundness, taper and surface finish necessary to ensure uniform torque and load distribution.

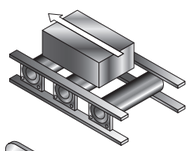
A test program under all expected operating conditions should be carried out before putting a new application into production. Customer engineers are constantly working with and testing new applications, and their experience can be of great help to the designer considering the use of a drawn cup roller clutch.



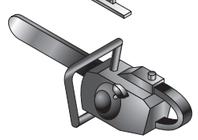
Stair steppers and other athletic equipment

Lawnmower differential

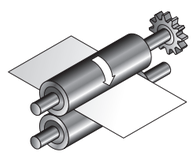
Towel dispensers and similar web roll feed mechanisms



Conveyor rollers

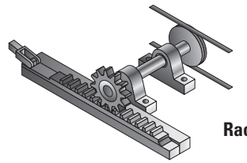


Chainsaw starters

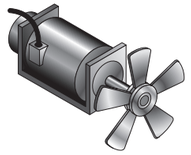


Paper feed rolls in business machines

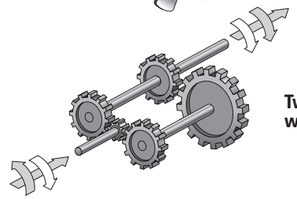
Fig. B3-9(1). Drawn cup clutches and clutch and bearing assembly applications



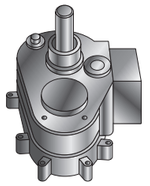
Rack indexing drive



Motor backstops



Two-speed gearbox with reversing input



Washing machine transmission

Fig. B3-9(2). Drawn cup clutches and clutch and bearing assembly applications

HOUSING DESIGN

Drawn cup clutches and clutch and bearing assemblies are mounted with a simple press fit in their housings. Through-bored and chamfered housings are preferred. A 30 degree angle is suggested and care should be taken to round the edge where the chamfer meets the housing bore. A sharp edge at this location can greatly increase installation forces. Provisions for axial location, such as shoulders or snap rings, are not required. The case hardened cups must be properly supported. Steel housings are preferred and must be used for applications involving high-torque loads to prevent radial expansion of the clutch cups. The suggested minimum housing outer diameters in the tables of dimensions are for steel.

The housing bore should be round within one-half of the diameter tolerance.

The taper within the length of the outer ring should not exceed 0.013 mm (0.0005 in).

The surface finish of the housing bore should not exceed 1.6 µm R_a (63 µin R_a).

The torque ratings, given in the clutch tables, are based on a steel housing of a large section. When other housing material must be used (such as aluminum, powdered metal and plastics), the torque rating of the clutch will be reduced. Such housings may be satisfactory for lightly torqued applications. But, your representative should be consulted for appropriate housing and shaft suggestions. Otherwise, an insufficient press fit and use of a lower strength housing material can result in more internal clearance and reduced performance of the clutch.

When using non-steel housings, thorough testing of the design is suggested.

Adhesive compounds can be used to prevent creeping rotation of the clutch in plastic housings with low friction properties. Adhesives will not provide proper support in oversized metal housings. When using adhesives, care must be taken to keep the adhesive out of the clutches and bearings.

SHAFT DESIGN

The clutch or clutch and bearing assembly operates directly on the shaft whose specifications of dimension, hardness and surface finish are well within standard manufacturing limits.

Either case-hardening or through-hardening grades of good bearing-quality steel are satisfactory for raceways. Steels modified for free machining, such as those high in sulfur content and particularly those containing lead, are seldom satisfactory for raceways.

For long fatigue life, the shaft raceway must have a hardness equivalent to 58 HRC minimum and must be ground to the suggested diameter shown in the tables of dimensions. It may be through-hardened, or it may be case hardened with an effective case depth of 0.40 mm (0.015 in). Effective case depth is defined as the distance from the surface inward to the equivalent of 50 HRC hardness level after grinding.

Taper within the length of the raceway should not exceed 0.008 mm (0.0003 in), or one-half the diameter tolerance – whichever is smaller. The radial deviation from true circular form of the raceway should not exceed 0.0025 mm (0.0001 in) for diameters up to and including 25 mm (1.0 in). For raceways greater than 25 mm (1.0 in), the allowable radial deviation should not exceed 0.0025 mm (0.0001 in) multiplied by a factor of the raceway diameter divided by 25 mm (1.0 in). Surface finish on the raceway should not exceed 0.4 µm (16 µin) R_a. Deviations will reduce the load capacity and fatigue life of the shaft.

INSTALLATION

Simplicity of installation promotes additional cost savings. The drawn cup roller clutch or the clutch and bearing assembly must be pressed into its housing. Procedures are virtually identical with those for installing drawn cup bearings, as detailed on pages B-2-11and B-2-46. The unit is pressed into the bore of a gear or pulley hub or housing of the proper size. No shoulders, splines, keys, screws or snap rings are required.

Installation procedures are summarized in the following sketches:

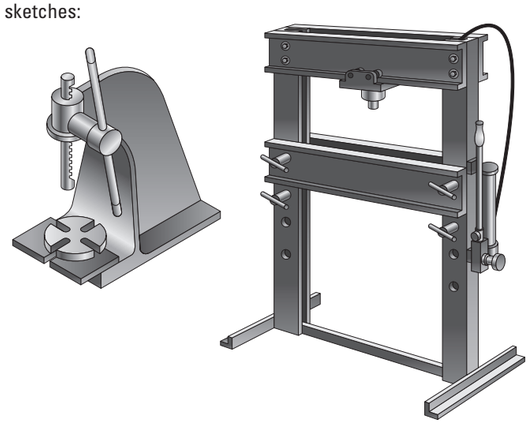


Fig. B3-10. Arbor press and hydraulic ram press

Use an arbor press or hydraulic ram press to exert steady pressure. Never use a hammer, or other tool requiring pounding to drive the clutch into its housing.

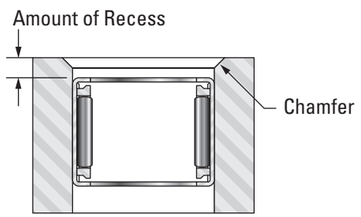


Fig. B3-11. Chamfered housing bore

Make sure that the housing bore is chamfered to permit easy introduction of the clutch and bearing or the clutch unit. Press unit slightly beyond the chamfer in the housing bore to assure full seating. Through-bored housings are always preferred. If the housing has a shoulder, never seat the clutch against the shoulder. For further details, see pages B-2-11 and B-2-46.

Fig. B3-12. Lock marking

IMPORTANT: The mounted clutch or clutch and bearing assembly engages when the housing is rotated relative to the shaft in the direction of the arrow and lock marking (◄– LOCK) stamped on the cup. Make sure that the unit is oriented properly before pressing it into its housing.

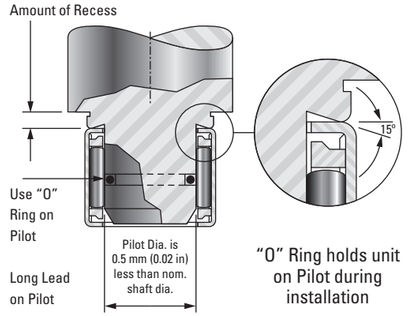


Fig. B3-13. Installation tool

Use an installation tool as shown in Fig. B3-13. If the clutch is straddled by needle roller bearings, press units into position – in proper sequence – and preferably leave a small clearance between units.

When assembling the shaft, it should be rotated in the overrun direction during insertion. The end of the shaft should have a large chamfer or rounding.

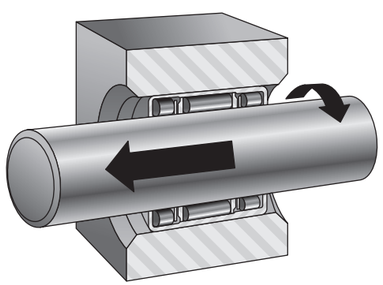


Fig. B3-14. Rotate shaft in the overrun direction during insertion

APPLIED LOADS

The clutch-only unit is designed to transmit purely torque loads. Applied torque should not exceed the catalog ratings, which are based on the compressive strength of well-aligned clutch components. Bearings on either side of the clutch are to assure concentricity between the shaft and the housing to support radial loads during clutch overrun. Integral clutch and bearing assemblies are available for this purpose, especially where the radial loads are light. The total maximum dynamic radial load that may be shared by the two needle roller and cage radial bearing assemblies should not be greater than Cr/3.

In determining the total torque load on a clutch, it is essential to consider the torque, due to inertial forces developed in the mechanism, in addition to the externally applied torque. The larger the clutch, and the greater the mass of the mechanism controlled by it, the more important this consideration becomes.

Clutch lockup depends on friction. For this reason, applications involving severe vibrations or axial motion of the shaft within the clutch are to be avoided. Applications where overhanging or overturning loads occur should incorporate bearings that will maintain alignment between the shaft and the clutch housing. Consult your representative for suggestions.

LUBRICATION

Oil is the preferred lubricant; it minimizes wear and heat generation. For those applications where oil is not practical, clutches are packed with a soft grease containing mineral oil. Thick grease will retard roller engagement and can cause individual rollers to slip, possibly overloading any engaged rollers.

TEMPERATURE

Temperature extremes can cause clutch malfunctions and failure. The molded plastic cage with integral springs holds its necessary resiliency and strength when the operating temperature within the clutch is kept below 90˚ C (200˚ F). The clutch with reinforced nylon cage and separate steel springs operates well at temperatures up to 120˚ C (250˚ F) continuously and to 150˚ C (300˚ F) intermittently. Excessive thickening of the lubricant at low temperatures may prevent some, or all, of the rollers from engaging. New applications should be tested under expected operating conditions to determine whether or not temperature problems exist.

BACKLASH

Backlash, or lost motion, prior to engagement is minimal. The variation in backlash from one cycle to another is extremely low. Grease lubrication, or improper fit (housing bore and shaft diameter), may increase backlash. Angular displacement between the shaft and housing increases as an applied torque load is increased.

RATE OF ENGAGEMENT

Clutch lockup depends upon static friction. Axial motion between shaft and clutch rollers prevents lockup.

Clutches with integral springs engage satisfactorily at cyclic rates up to 200 engagements per minute. Intermittent operation at higher rates has been successful. The steel spring type clutches have proven dependability at rates up to 6000 or 7000 engagements per minute. Even higher cyclic rates may be practical. Because grease may impair engagement at high cyclic rates, a light oil should be used.

OVERRUN LIMIT SPEED RATING

Exact limiting speed ratings are not easily predictable. The value for each clutch given in the bearing tables is not absolute but serves as a guide for the designer. Oil lubrication is absolutely necessary for high speed operations. Consult your representative when overrunning speeds are high.

INSPECTION

Although the outer cup of the clutch is accurately drawn from strip steel, it can go slightly out of round during heat treat. When the assembly is pressed into a ring gage, or properly prepared housing of correct size and wall thickness, it becomes round and properly sized. Direct measurement of the outer diameter of a drawn cup assembly is an incorrect procedure. The proper inspection procedure is as follows:

1. Press the assembly into a ring gage of the proper size, as given in the tables.
2. Gage the bore with the specified plug gages of the proper size, as given in the tables of dimensions.
   a. The locking plug is rotated to ensure lockup when the clutch is operated on a low-limit shaft and is mounted in a high-limit housing, strong enough to properly size the clutch.
   b. The overrun plug is rotated to ensure free overrunning when the clutch is operated on a high-limit shaft and is mounted in a low-limit housing.
   c. The "go" plug and "no go" plug ensure proper size of the bearings in the clutch and bearing assemblies.

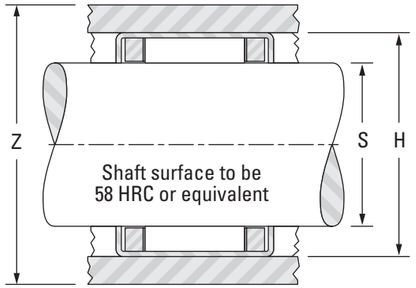
Gage sizes are listed in the tables of dimensions. Plug gage sizes reflect adjustment for the loose and tight conditions resulting from high or low housings or shafts.

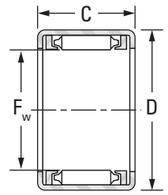
DRAWN CUP ROLLER CLUTCHES

METRIC SERIES

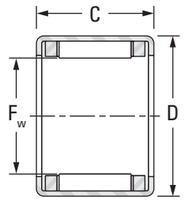
- For proper application, separate bearings are suggested (adjacent to clutch) to carry radial loads and assure concentricity between shaft and housing.
- The clutch engages when housing is rotated relative to the shaft in direction of arrow marking (← LOCK), as labeled on cup.
- Proper inspection requires use of ring gage and bore plug gage(s). See the inspection section on page B-3-9.
- Full details on installation are given on page B-3-8.
- Shaft raceway and housing bore diameters that are necessary for proper mounting and operation are listed on the opposite page.
- Types FC, FCS, FC-K and FCL-K clutches have stainless steel springs inserted in molded cage to position rollers for lockup.

The mounted clutch engages when the housing is rotated relative to the shaft in the direction of the arrow marking (← LOCK) stamped on the cup.





FC



FCS, FCL-K and FC-K

Shaft Diameter	F_w	D	C	Clutch Designation	Torque Rating	Minimum O.D. of Steel Housing for Rated Torque	Overrun Limiting Speed Rating for Rotating Shaft[1]	Suitable Drawn Cup Bearing[2]
			-0.30 mm -0.012 in			Z		
mm in	mm in	mm in	mm in		N-m lbf-in	mm in	min^{-1}	
4 0.1575	**4** 0.1575	**8** 0.3150	**6** 0.236	FC-4-K	**0.349** 3.09	**11** 0.433	26000	HK0408
6 0.2362	**6** 0.2362	**10** 0.3937	**12** 0.472	FCS-6	**2.15** 19.0	**14** 0.551	22000	HK0608
	6 0.2362	**10** 0.3937	**12** 0.472	FC-6	**2.63** 23.3	**14** 0.551	22000	HK0608
8 0.3150	**8** 0.3150	**12** 0.4724	**12** 0.472	FCL-8-K	**3.39** 30.0	**17** 0.669	21000	HK0808
	8 0.3150	**14** 0.5512	**12** 0.472	FC-8	**4.42** 39.1	**20** 0.787	21000	—
10 0.3937	**10** 0.3937	**14** 0.5512	**12** 0.472	FCL-10-K	**4.60** 40.7	**20** 0.787	19000	HK1010
	10 0.3937	**16** 0.6299	**12** 0.472	FC-10	**5.82** 51.5	**25** 0.984	19000	—
12 0.4724	**12** 0.4724	**18** 0.7087	**16** 0.630	FC-12	**14.0** 124	**27** 1.063	19000	HK1212
16 0.6299	**16** 0.6299	**22** 0.8661	**16** 0.630	FC-16	**21.7** 192	**31** 1.22	14000	HK1612
20 0.7874	**20** 0.7874	**26** 1.0236	**16** 0.630	FC-20	**32.6** 289	**38** 1.496	11000	HK2012
25 0.9843	**25** 0.9843	**32** 1.2598	**20** 0.787	FC-25	**71.0** 628	**46** 1.811	8700	HK2512
30 1.1811	**30** 1.1811	**37** 1.4567	**20** 0.787	FC-30	**99.1** 877	**51** 2.008	7300	HK3012
35 1.3780	**35** 1.3780	**42** 1.6535	**20** 0.787	FCS-35	**107.0** 947	**56** 2.205	6100	HK3512

Gaging			Mounting				Approx. Wt.
			Shaft Raceway Diameter		Housing Bore		
			S		H		
Ring Gage	Clutch Locking Plug	Clutch Overrun Plug	Max.	Min.	Max.	Min.	
mm in	mm in	mm in	mm in	mm in	mm in	mm in	kg lbs
7.984 0.3143	**3.980** 0.1567	**4.004** 0.1576	**4.000** 0.1575	**3.995** 0.1573	**7.993** 0.3147	**7.984** 0.3143	**0.001** 0.002
9.984 0.3931	**5.980** 0.2354	**6.004** 0.2364	**6.000** 0.2362	**5.995** 0.2360	**9.993** 0.3934	**9.984** 0.3931	**0.003** 0.007
9.984 0.3931	**5.980** 0.2354	**6.004** 0.2364	**6.000** 0.2362	**5.995** 0.2360	**9.993** 0.3934	**9.984** 0.3931	**0.004** 0.009
11.980 0.4717	**7.976** 0.3140	**8.005** 0.3152	**8.000** 0.3150	**7.994** 0.3147	**11.991** 0.4721	**11.980** 0.4717	**0.003** 0.007
13.980 0.5504	**7.976** 0.3140	**8.005** 0.3152	**8.000** 0.3150	**7.994** 0.3147	**13.991** 0.5508	**13.980** 0.5504	**0.007** 0.015
13.980 0.5504	**9.976** 0.3928	**10.005** 0.3939	**10.000** 0.3937	**9.994** 0.3935	**13.991** 0.5508	**13.980** 0.5504	**0.004** 0.009
15.980 0.6291	**9.976** 0.3928	**10.005** 0.3939	**10.000** 0.3937	**9.994** 0.3935	**15.991** 0.6296	**15.980** 0.6291	**0.009** 0.020
17.980 0.7079	**11.974** 0.4714	**12.006** 0.4727	**12.000** 0.4724	**11.992** 0.4721	**17.991** 0.7083	**17.980** 0.7079	**0.012** 0.026
21.976 0.8652	**15.972** 0.6288	**16.006** 0.6302	**16.000** 0.6299	**15.992** 0.6296	**21.989** 0.8657	**21.976** 0.8652	**0.018** 0.040
25.976 1.0227	**19.970** 0.7862	**20.007** 0.7877	**20.000** 0.7874	**19.991** 0.7870	**25.989** 1.0232	**25.976** 1.0227	**0.021** 0.046
31.972 1.2587	**24.967** 0.9830	**25.007** 0.9845	**25.000** 0.9843	**24.991** 0.9839	**31.988** 1.2594	**31.972** 1.2587	**0.034** 0.075
36.972 1.4556	**29.967** 1.1798	**30.007** 1.1814	**30.000** 1.1811	**29.991** 1.1807	**36.988** 1.4562	**36.972** 1.4556	**0.042** 0.093
41.972 1.6524	**34.964** 1.3765	**35.009** 1.3783	**35.000** 1.3780	**34.989** 1.3775	**41.988** 1.6531	**41.972** 1.6524	**0.048** 0.106

[1] Indicates the number of relative rotations allowed when the shaft idles.
[2] See pages B-2-14 to B-2-25 for suitable bearing types and sizes.

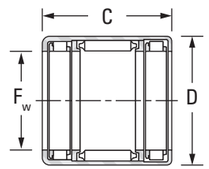
DRAWN CUP ROLLER CLUTCHES AND BEARING ASSEMBLIES

METRIC SERIES

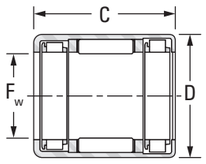
- The clutch and bearing assembly engages when the housing is rotated relative to shaft in direction of arrow marking (← LOCK), as labeled on cup.
- Shaft raceway and housing bore diameters that are necessary for proper mounting and operation are listed on the opposite page.
- Proper inspection requires use of ring gage and bore plug gage(s). See the inspection section on page B-3-9.
- Full details on installation are given on page B-3-8.
- Types FCB, FCBL-K and FCBN-K clutch and bearing assemblies have stainless steel springs inserted in molded cage to position rollers for lockup.

The mounted clutch and bearing assembly engages when the housing is rotated relative to the shaft in the direction of the arrow marking (← LOCK) stamped on the cup.

Clutch and bearing assemblies



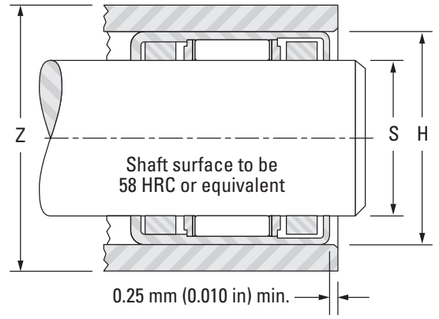
FCB



FCBL-K and FCBN-K

Shaft Diameter	F_w	D	C	Clutch and Bearing Assembly Designation	Torque Rating	Minimum O.D. of Steel Housing for Rated Torque	Load Ratings[1]		Fatigue Load Limit C_u
							Dynamic	Static	
			-0.30 mm -0.012 in			Z	C	C_0	
mm in	**mm** in	**mm** in	**mm** in		**N-m** lbf-in		**kN** lbf	**kN** lbf	kN
4 0.1575	**4** 0.1575	**10** 0.3937	**9** 0.354	FCBN-4-K	**0.19** 1.68	**16** 0.630	**1.86** 418	**0.99** 223	0.160
6 0.2362	**6** 0.2362	**12** 0.4724	**10** 0.394	FCBN-6-K	**0.56** 4.96	**18** 0.709	**2.48** 558	**1.48** 333	0.240
8 0.3150	**8** 0.3150	**12** 0.4724	**22** 0.866	FCBL-8-K	**3.39** 30.0	**17** 0.669	**3.62** 814	**3.28** 737	0.520
	8 0.3150	**14** 0.5512	**20** 0.787	FCB-8	**4.42** 39.1	**20** 0.787	**4.22** 949	**3.04** 683	0.500
10 0.3937	**10** 0.3937	**16** 0.6299	**20** 0.787	FCB-10	**5.82** 51.5	**25** 0.984	**4.84** 1090	**3.80** 854	0.630
12 0.4724	**12** 0.4724	**18** 0.7087	**26** 1.024	FCB-12	**14.0** 124	**27** 1.063	**6.30** 1420	**5.84** 1310	0.970
16 0.6299	**16** 0.6299	**22** 0.8661	**26** 1.024	FCB-16	**21.7** 192	**31** 1.220	**6.64** 1490	**7.12** 1600	1.20
20 0.7874	**20** 0.7874	**26** 1.0236	**26** 1.024	FCB-20	**32.6** 289	**38** 1.496	**8.16** 1830	**9.46** 2130	1.55
25 0.9843	**25** 0.9843	**32** 1.2598	**30** 1.181	FCB-25	**71.0** 628	**46** 1.811	**11.3** 2540	**13.1** 2940	2.20
30 1.1811	**30** 1.1811	**37** 1.4567	**30** 1.181	FCB-30	**99.1** 877	**51** 2.008	**11.5** 2590	**14.9** 3350	2.50

[1] Load ratings are based on a minimum raceway hardness of 58 HRC or equivalent.
[2] Indicates the number of relative rotations allowed when the shaft idles.



Overrun Limiting Speed Rating for Rotating Shaft[2]	Gaging				Mounting				Approx. Wt.
	Ring Gage	Clutch Locking Plug	Clutch Overrun and Bearing Go Plug	Bearing No Go Plug	S		H		
					Max.	Min.	Max.	Min.	
min^{-1}	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**kg** lbs
26000	**9.984** 0.3931	**3.980** 0.1567	**4.004** 0.1576	**4.030** 0.1587	**4.000** 0.1575	**3.995** 0.1573	**9.993** 0.3934	**9.984** 0.3931	**0.003** 0.007
22000	**11.980** 0.4717	**5.980** 0.2354	**6.004** 0.2364	**6.030** 0.2374	**6.000** 0.2362	**5.995** 0.2360	**11.991** 0.4721	**11.980** 0.4717	**0.004** 0.009
21000	**11.980** 0.4717	**7.976** 0.3140	**8.005** 0.3152	**8.033** 0.3163	**8.000** 0.3150	**7.994** 0.3147	**11.991** 0.4721	**11.980** 0.4717	**0.005** 0.011
21000	**13.980** 0.5504	**7.976** 0.3140	**8.005** 0.3152	**8.033** 0.3163	**8.000** 0.3150	**7.994** 0.3147	**13.991** 0.5508	**13.980** 0.5504	**0.011** 0.024
19000	**15.980** 0.6291	**9.976** 0.3928	**10.005** 0.3939	**10.033** 0.3950	**10.000** 0.3937	**9.994** 0.3935	**15.991** 0.6296	**15.980** 0.6291	**0.013** 0.029
19000	**17.980** 0.7079	**11.974** 0.4714	**12.006** 0.4727	**12.036** 0.4739	**12.000** 0.4724	**11.992** 0.4721	**17.991** 0.7083	**17.980** 0.7079	**0.018** 0.040
14000	**21.976** 0.8652	**15.972** 0.6288	**16.006** 0.6302	**16.036** 0.6313	**16.000** 0.6299	**15.992** 0.6296	**21.989** 0.8657	**21.976** 0.8652	**0.024** 0.053
11000	**25.976** 1.0227	**19.970** 0.7862	**20.007** 0.7877	**20.043** 0.7891	**20.000** 0.7874	**19.991** 0.7870	**25.989** 1.0232	**25.976** 1.0227	**0.028** 0.062
8700	**31.972** 1.2587	**24.967** 0.9830	**25.007** 0.9845	**25.043** 0.9859	**25.000** 0.9843	**24.991** 0.9839	**31.988** 1.2594	**31.972** 1.2587	**0.048** 0.106
7300	**36.972** 1.4556	**29.967** 1.1798	**30.007** 1.1814	**30.043** 1.1828	**30.000** 1.1811	**29.991** 1.1807	**36.988** 1.4562	**36.972** 1.4556	**0.054** 0.119

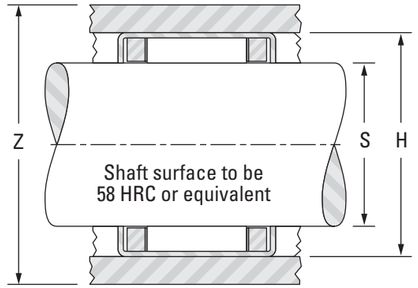
DRAWN CUP ROLLER CLUTCHES

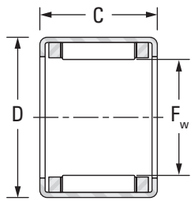
INCH SERIES

- For proper application, separate bearings are suggested (adjacent to clutch) to carry radial loads and assure concentricity between shaft and housing.
- The clutch engages when housing is rotated relative to the shaft in direction of arrow marking (← LOCK), as labeled on cup.
- Proper inspection requires use of ring gage and bore plug gage(s). See the inspection section on page B-3-9.
- Full details on installation are given on page B-3-8.
- Shaft raceway and housing bore diameters that are necessary for proper mounting and operation are listed on the opposite page.
- Type RC clutches have springs integrally molded with the cage to position the rollers for lockup.

  Type RC-FS clutches have stainless steel springs inserted into the molded cage to position the rollers for lockup.

The mounted clutch engages when the housing is rotated relative to the shaft in the direction of the arrow marking (← LOCK) stamped on the cup.





RC and RC-FS

Shaft Diameter	F_w	D	C	Clutch Designations		Torque Rating	Minimum O.D. of Steel Housing for Rated Torque	Overrun Limiting Speed Rating for Rotating Shaft[1]
			-0.25 mm -0.010 in	With Stainless Steel Springs	With Integral Springs		Z	
mm in	mm in	mm in	mm in			N-m lbs-in		min^{-1}
3.175 0.1250	**3.18** 0.125	**7.14** 0.281	**6.35** 0.250	—	RC-02	**0.323** 2.86	**11.2** 0.44	34000
6.350 0.2500	**6.35** 0.250	**11.13** 0.438	**12.70** 0.500	RC-040708-FS[2]	RC-040708	**1.94** 17.2	**15.7** 0.62	20000
9.525 0.3750	**9.53** 0.375	**15.88** 0.625	**12.70** 0.500	RC-061008-FS[2]	RC-061008	**5.45** 48.2	**22.4** 0.88	18000
12.700 0.5000	**12.70** 0.500	**19.05** 0.750	**12.70** 0.500	RC-081208-FS[2]	RC-081208	**8.85** 78.3	**27.9** 1.10	17000
15.875 0.6250	**15.88** 0.625	**22.23** 0.875	**15.88** 0.625	RC-101410-FS[2]	RC-101410	**16.8** 149	**30.5** 1.20	14000
19.050 0.7500	**19.05** 0.750	**25.40** 1.000	**15.88** 0.625	RC-121610-FS[2]	RC-121610	**23.3** 206	**35.6** 1.40	12000
25.400 1.0000	**25.40** 1.000	**33.35** 1.313	**15.88** 0.625	RC-162110-FS[2]	RC-162110	**49.6** 439	**48.3** 1.90	8700

Suitable Drawn Cup Bearing[3]	Gaging			Mounting				Approx. Wt.
				Shaft Raceway Diameter		Housing Bore		
	Ring Gage	Clutch Locking Plug	Clutch Overrun Plug	S		H		
				Max.	Min.	Max.	Min.	
	mm in	mm in	mm in	mm in	mm in	mm in	mm in	kg lbs
—	**7.155** 0.2817	**3.160** 0.1244	**3.195** 0.1258	**3.175** 0.1250	**3.167** 0.1247	**7.155** 0.2817	**7.142** 0.2812	**0.001** 0.002
J-45	**11.125** 0.4380	**6.337** 0.2495	**6.383** 0.2513	**6.350** 0.2500	**6.337** 0.2495	**11.125** 0.4380	**11.100** 0.4370	**0.004** 0.008
JH-68	**15.888** 0.6255	**9.512** 0.3745	**9.558** 0.3763	**9.525** 0.3750	**9.512** 0.3745	**15.888** 0.6255	**15.862** 0.6245	**0.008** 0.017
JH-87	**19.063** 0.7505	**12.687** 0.4995	**12.733** 0.5013	**12.700** 0.5000	**12.687** 0.4995	**19.063** 0.7505	**19.037** 0.7495	**0.009** 0.020
JH-1010	**22.238** 0.8755	**15.862** 0.6245	**15.908** 0.6263	**15.875** 0.6250	**15.862** 0.6245	**22.238** 0.8755	**22.212** 0.8745	**0.014** 0.030
J-126	**25.387** 0.9995	**19.012** 0.7485	**19.058** 0.7503	**19.050** 0.7500	**19.037** 0.7495	**25.413** 1.0005	**25.387** 0.9995	**0.015** 0.034
JH-1612	**33.325** 1.3120	**25.362** 0.9985	**25.408** 1.0003	**25.400** 1.0000	**25.387** 0.9995	**33.350** 1.3130	**33.325** 1.3120	**0.026** 0.058

(1) Indicates the number of relative rotations allowed when the shaft idles.
(2) Suffix "-FS" is not always stamped on the clutch cup. Type RC-FS with stainless steel springs are always readily identified by RED clutch cage.
(3) See pages B-2-60 to B-2-63 for other suitable bearing types and sizes.

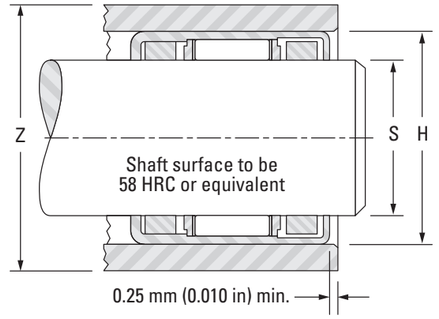
DRAWN CUP ROLLER CLUTCH AND BEARING ASSEMBLIES

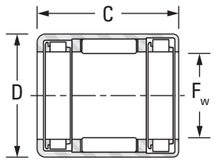
INCH SERIES

- Clutch and bearing assembly engages when the housing is rotated relative to shaft in direction of arrow marking (← LOCK), as labeled on cup.
- Shaft raceway and housing bore diameters that are necessary for proper mounting and operation are listed on the opposite page.
- Proper inspection requires use of ring gage and bore plug gage(s). See the inspection section on page B-3-9.
- Full details on installation are given on page B-3-8.
- Type RCB clutch and bearing assemblies have springs integrally molded with the cage to position the rollers for lockup.

  Type RCB-FS clutch and bearing assemblies have stainless steel springs inserted into the molded cage to position the rollers for lockup.

The mounted clutch and bearing assembly engages when the housing is rotated relative to the shaft in the direction of the arrow marking (← LOCK) stamped on the cup.





RCB and RCB-FS

Shaft Diameter	F_w	D	C	Clutch and Bearing Designations		Torque Rating	Minimum O.D. of Steel Housing for Rated Torque	Load Ratings[2]		Fatigue Load Limit C_u
			-0.25 mm -0.010 in	With Stainless Steel Springs	With Integral Springs		Z	Dynamic C	Static C_0	
mm in	mm in	mm in	mm in			N-m lbf-in		kN lbf	kN lbf	kN
9.525 0.3750	**9.53** 0.375	**15.88** 0.625	**22.23** 0.875	RCB-061014-FS[1]	RCB-061014	**5.45** 48.2	**22.4** 0.88	**6.01** 1350	**4.89** 1100	0.800
12.700 0.5000	**12.70** 0.500	**19.05** 0.750	**22.23** 0.875	RCB-081214-FS[1]	RCB-081214	**8.85** 78.3	**27.9** 1.1	**7.12** 1600	**6.49** 1460	1.05
15.875 0.6250	**15.88** 0.625	**22.23** 0.875	**25.40** 1.000	RCB-101416-FS[1]	RCB-101416	**16.8** 149	**30.5** 1.2	**8.05** 1810	**8.14** 1830	1.35
19.050 0.7500	**19.05** 0.750	**25.40** 1.000	**25.40** 1.000	RCB-121616-FS[1]	RCB-121616	**23.3** 206	**35.6** 1.4	**8.90** 2000	**9.79** 2200	1.60
25.400 1.0000	**25.40** 1.000	**33.35** 1.313	**27.00** 1.063	RCB-162117-FS[1]	RCB-162117	**49.6** 439	**48.3** 1.9	**15.4** 3460	**17.6** 3960	2.85

[1] Suffix "-FS" is not always stamped on the clutch cup. Type RC-FS with stainless steel springs are always readily identified by RED clutch cage.
[2] Load ratings are based on a minimum raceway hardness of 58 HRC or equivalent.
[3] Indicates the number of relative rotations allowed when the shaft idles.

Overrun Limiting Speed Rating for Rotating Shaft[3]	Gaging				Mounting				Approx. Wt.
	Ring Gage	Clutch Locking Plug	Clutch Overrun and Bearing Go Plug	Bearing No Go Plug	Shaft Raceway Diameter S		Housing Bore H		
					Max.	Min.	Max.	Min.	
min^{-1}	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	kg lbs
18000	**15.888** 0.6255	**9.512** 0.3745	**9.553** 0.3761	**9.589** 0.3775	**9.525** 0.3750	**9.512** 0.3745	**15.888** 0.6255	**15.862** 0.6245	**0.014** 0.030
17000	**19.063** 0.7505	**12.687** 0.4995	**12.728** 0.5011	**12.764** 0.5025	**12.700** 0.5000	**12.687** 0.4995	**19.063** 0.7505	**19.037** 0.7495	**0.016** 0.036
14000	**22.238** 0.8755	**15.862** 0.6245	**15.903** 0.6261	**15.939** 0.6275	**15.875** 0.6250	**15.862** 0.6245	**22.238** 0.8755	**22.212** 0.8745	**0.023** 0.050
12000	**25.387** 0.9995	**19.012** 0.7485	**19.053** 0.7501	**19.088** 0.7515	**19.050** 0.7500	**19.037** 0.7495	**25.413** 1.0005	**25.387** 0.9995	**0.026** 0.057
8700	**33.325** 1.3120	**25.362** 0.9985	**25.403** 1.0001	**25.438** 1.0015	**25.400** 1.0000	**25.387** 0.9995	**33.350** 1.3130	**33.325** 1.3120	**0.045** 0.100

INTRODUCTION

OTHER AVAILABLE CLUTCHES

In addition to the metric and inch sizes of drawn cup clutches and clutch and bearing assemblies already discussed, JTEKT offers other types of drawn cup clutches to address special customer needs:

CHARACTERISTICS

- Locking protrusions are provided around the drawn cup, so that creeping can be prevented without having to hold the surface dimensional accuracy precisely.
- Pre-lubricated with optimum grease, so that no lubrication is necessary under normal operating conditions.
- Unit products with a synthetic resin housing are also available.
  They are compatible with components of various types, such as gears, timing pulleys, cams and rubber rollers. Consult with JTEKT for further information.

Fig. B3-15. 1WC series

Fig. B3-16. EWC series

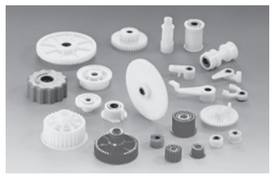


Fig. B3-17. Various housings and unit products

STRUCTURE AND PRINCIPLES

WHEN THE CLUTCH SYSTEM WORKS

When the shaft rotates clockwise as in cross section A-A', rollers are locked while engaged with the drawn cup cam surfaces by the effect of springs (wedging of the shaft by the cam surfaces). The drawn cup is driven as a consequence.

CLUTCH IDLE RUNNING

When the shaft rotates counter-clockwise as in cross section A-A', rollers move away from the drawn cup cam surfaces and rotate freely.

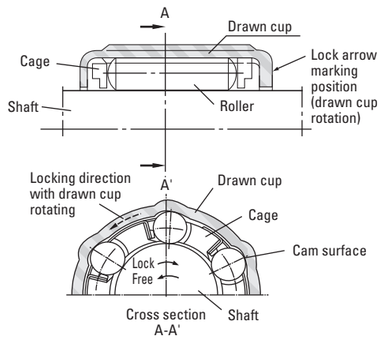


Fig. B3-18.

Table B3-1. Miniature one-way clutch types and characteristics

	1WC series (with metal springs)	EWC series (with synthetic resin springs)	
	Heavy load type	Heavy load type	Light load type
	1WC...	EWC...C	EWC...A
Torque capacity	Heavy load	Heavy load	Light load
Operating temperature range	– 10 to + 90°C	– 10 to + 70°C	
Locking life	Locking system can function more than one million. (Note : this estimation is valid as long as torque magnitude does not exceed the torque capacity shown in the specification table.)		
Insert molding	Possible	Impossible	
Delivery of clutch only	Possible		
Unit delivery	Possible		

Table B3-2. Shaft tolerance

	Heavy load type (1WC... , EWC...C)	Light load type (EWC...A)
Shaft tolerance class	h 8	
Surface hardness	50 HRC or harder	30 HRC or harder
Roughness (Ra)	0.3 a or less	0.8 a or less
Roundness and cylindricity	0.005 mm or less	

[Remarks] In some operating conditions, shafts need not be as accurate as shown here. For example :

1. When clutch engaging accuracy is considered unimportant, or when a radial load or moment is not generated, the shaft diameter tolerance can be :
   - **shaft diameter 6 mm or less, and EWC0809 (C, A)** ····· 0 to – 0.040 mm
   - **shaft diameter 8 mm or more** ····· h 10
2. When the loaded torque is smaller than the torque capacity, shaft surface hardness can be determined as follows :
   - The diagram on the right shows approximate shaft surface hardness relative to torque ratio A.

$$\text{Torque ratio (A)} = \frac{\text{Loaded torque}}{\text{Heavy load type torque capacity}}$$

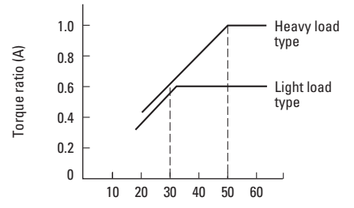
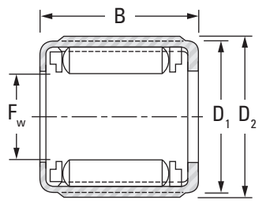
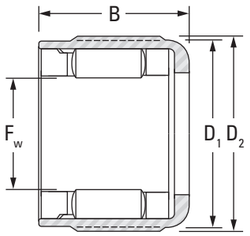


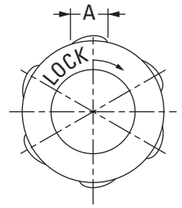
Fig. B3-19.

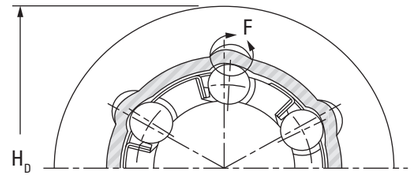


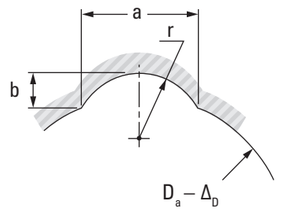
1WC Series



EWC Series







Details of Section F

Shaft Diameter	F_w	D_1	D_2	B	A	Torque Capacity	Designations		No. of (1) Outer Ring Protrusion
							1WC Series (With Metal Springs)	EWC Series (With Resin Springs)	
mm in	mm in	mm in	mm in	mm in	mm in	N-m			
4	4	8	8.4	6	2.6	0.08	—	EWC0406A	4
	4	8	8.4	6	2.6	0.15	—	EWC0406C	4
6	6	10	10.4	8	2.8	0.25	—	EWC0608A	6
	6	10	10.4	8	2.8	0.44	—	EWC0608C	6
	6	10	10.4	8	2.8	0.44	1WC0608	—	6
	6	10	10.4	12	2.8	0.88	1WC0612	—	6
8	8	12	12.4	9	2.6	0.49	—	EWC0809A	6
	8	12	12.4	9	2.6	0.88	—	EWC0809C	6
	8	14.2	15	12	3.6	1.18	—	EWC0812A	6
	8	14.2	15	12	3.6	1.96	—	EWC0812C	6
	8	14.2	15	12	3.6	1.96	1WC0812	—	6
	8	14.2	15	14.5	3.6	2.65	1WC0815	—	6
10	10	16	17	10	5	1.18	—	EWC1010A	6
	10	16	17	10	5	1.96	—	EWC1010C	6
	10	16	17	12	5	1.37	—	EWC1012A	6
	10	16	17	12	5	2.35	—	EWC1012C	6
	10	16	17	12	5	2.35	1WC1012	—	6
12	12	18	19	16	5.1	6.28	1WC1216	—	8

Recommended Housing Dimensions						Approx. Wt.	
H_D	a	b	r	D_a	Δ_D(2)	1WC	EWC
mm in	mm in	mm in	mm in	mm in	mm in	g	
12	2.65	0.50	2	8	0.06	—	1.0
12	2.65	0.50	2	8	0.06	—	1.0
14	2.8	0.57	2	10	0.08	—	1.7
14	2.8	0.57	2	10	0.08	—	1.7
14	2.8	0.57	2	10	0.08	2.0	—
14	2.8	0.57	2	10	0.08	3.0	—
16	2.6	0.48	2	12	0.10	—	2.4
16	2.6	0.48	2	12	0.10	—	2.4
18.5	3.6	0.87	2.3	14.2	0.11	—	5.8
18.5	3.6	0.87	2.3	14.2	0.11	—	5.8
18.5	3.6	0.87	2.3	14.2	0.11	7.0	—
18.5	3.6	0.87	2.3	14.2	0.11	8.0	—
21	5.0	1.20	3.2	16	0.13	—	6.0
21	5.0	1.20	3.2	16	0.13	—	6.0
21	5.0	1.20	3.2	16	0.13	—	6.8
21	5.0	1.20	3.2	16	0.13	—	6.8
21	5.0	1.20	3.2	16	0.13	8.0	—
23	5.1	1.20	3.3	18	0.14	12	—

(1) Provided at equal intervals.
(2) Recommended interference when polyacetal resin housing is used.

NOTES

HEAVY-DUTY NEEDLE ROLLER BEARINGS

Overview: Heavy-duty needle roller bearings consist of a machined and ground channel-shaped outer ring with a complement of needle rollers, and a cage. The high-strength cage retains and guides the rollers. An optional lubrication groove and hole in the outer ring facilitates re-lubrication. These bearings can be used with or without a machined and ground inner ring, depending on the suitability of the shaft as a raceway surface.

- **Catalog range:** 5 mm – 175 mm (0.1969 in – 6.8898 in) bore.
- **Markets:** Gear pumps, sheaves, automotive transmissions and two-cycle engines.
- **Features:** Thick outer ring provides maximum load capacity and shock resistance with a relatively small radial cross section.
- **Benefits:** Optimum speed and lubrication-retention capability.

Needle Roller Bearings with Inner Rings – Metric Nominal Dimensions

Series
48 = dimension series 48
49 = dimension series 49
69 = dimension series 69

Inner Ring Bore Diameter
(for NA49, NA69: < 17 mm bore)
00 = 10 mm **02** = 15 mm
01 = 12 mm **03** = 17 mm

(for NA48, NA49, NA69: ≥ 20 mm bore)
bore code x 5 = bore diameter

NA **49** **04** **.2RS**

NA **69** / **22**

Suffix
RS lip contact seal on one side
.2RS lip contact seal on both sides
TN molded cage of reinforced polymer
A modified internal design

Prefix
NA needle roller bearing with inner ring, lube hole in outer ring
NKJ needle roller bearing with inner ring
NKJS needle roller bearing with inner ring, lube hole in outer ring
NAO needle roller bearing with inner ring, without flanges

NKJ **7** / **16** **TN**

Inner Ring Bore Diameter
(for NA49, NA69, NKJ, NKJS, NAO)
7 = 7 mm
22 = 22 mm
30 = 3 mm

Bearing Width
(for NKJ, NAO)
16 = 16 mm
17 = 17 mm

NAO **30** x **45** x **17**

Outer Ring Diameter
45 = 45 mm

Prefix
NQI with inner ring

Width
16 = 16 mm

NQI **15** / **16**

Inner ring bore diameter
15 = 15 mm

Needle Roller Bearings without Inner Rings – Metric Nominal Dimensions

Series
48 = dimension series 48
49 = dimension series 49
69 = dimension series 69

Needle Roller Complement Bore Code
See tables for dimensions

RNA **49** **04** **.2RS**

Suffix
RS lip contact seal on one side
.2RS lip contact seal on both sides
TN molded cage of reinforced polymer
A modified internal design

Prefix
RNA needle roller bearing without inner ring, lube hole in outer ring
NK needle roller bearing without inner ring
NKS needle roller bearing without inner ring, lube hole in outer ring
RNAO needle roller bearing without inner ring, without flanges

RNA **69** / **22**

NK **10** / **16** **TN**

Needle Roller Complement Bore Diameter
(NK, NKS, RNAO):
10 = 10 mm
35 = 35 mm
(for RNA49, RNA69):
22 = 28 mm
28 = 32 mm
32 = 40 mm

Outer Ring Width
(for NK, RNAO)
16 = 16 mm
17 = 17 mm

RNAO **35** x **45** x **17**

Outer Ring Diameter
45 = 45 mm

Prefix
NQ without inner ring

Width
10 = 10 mm

15 **NQ** **24** **10** **D**

Needle roller complement bore diameter
15 = 15 mm

Outer diameter
24 = 24 mm

Suffix
D Case hardened steel used for outer rings
N With snap ring groove (outer ring)

Inner Rings for Needle Roller Bearings – Metric Nominal Dimensions

Prefix
JR inner ring for use with metric needle roller bearing
JRZ inner ring for use with metric needle roller bearing, without mounting chamfers

Bore Diameter
25 = 25 mm

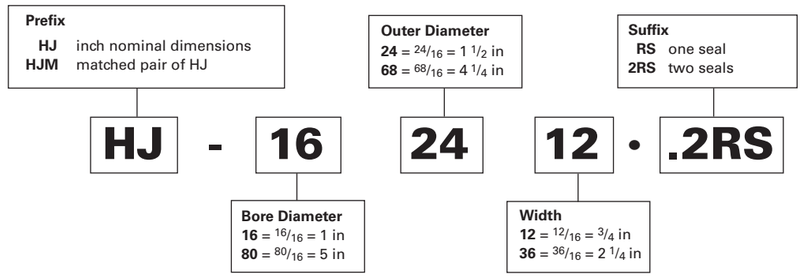
Width
18 = 18 mm

JRZ **25** x **30** x **18** **JS1**

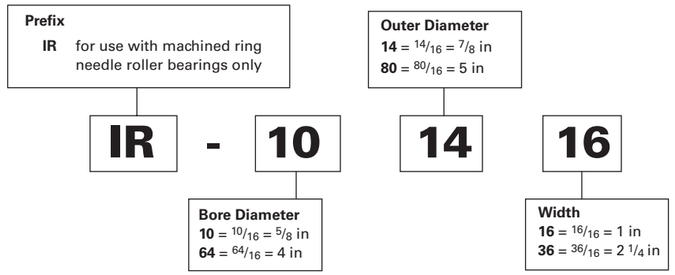
Outer Diameter
30 = 30 mm

Suffix
JS1 lubrication hole

Needle Roller Bearings – Inch Nominal Dimensions



Inner Rings (six-digit number) – Inch Nominal Dimensions



B

Heavy-Duty Needle Roller Bearings

NEEDLE ROLLER BEARINGS

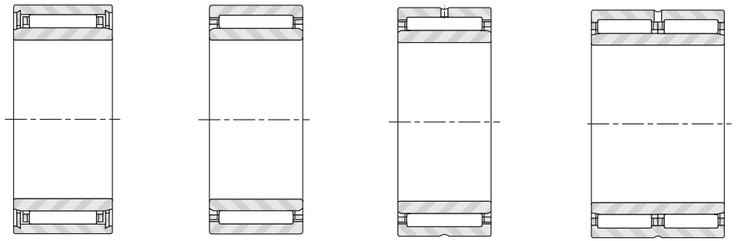
METRIC SERIES

When applications involve very heavy dynamic, static or even shock load conditions, the needle roller bearing may be found to give best results.

REFERENCE STANDARDS ARE:

- **ISO 1206** – needle roller bearings – light and medium series – dimensions and tolerances.
- **DIN 617** – rolling bearings – needle roller bearings with cage – dimension Series 48 and 49.
- **JIS B 1536** – rolling bearings – needle roller bearings – boundary dimensions and precision.

TYPES OF METRIC SERIES NEEDLE ROLLER BEARINGS



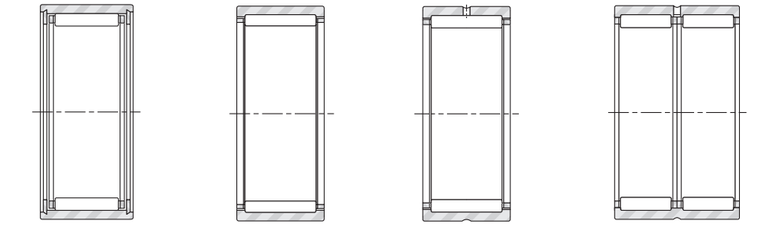
NKJ
(d ≤ 7 mm [0.2756 in])

NQI

NKJ, NKJS
(d ≥ 9 mm [0.3543 in])
NA48, NA49
NA69 (d ≤ 30 mm [1.1811 in])

NA69
(d ≥ 32 mm [1.2598 in])

Fig. B4-1. Needle roller bearings with inner rings



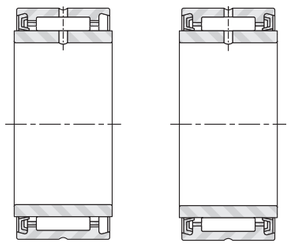
NK
(F_w ≤ 10 mm [0.03937 in])

NQ

NK (F_w ≥ 12 mm [0.4724 in])
NKS, RNA48, RNA49
RNA69 (F_w ≤ 35 mm [1.3780 in])

RNA69
(F_w ≥ 40 mm [1.5748 in])

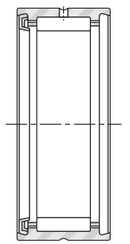
Fig. B4-2. Needle roller bearings without inner rings



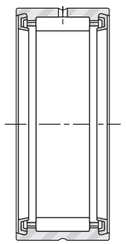
NA49RS

NA49.2RS

Fig. B4-3. Sealed needle roller bearings with inner rings

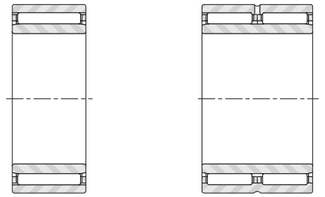


RNA49RS



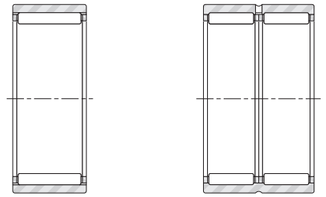
RNA49.2RS

Fig. B4-4. Sealed needle roller bearings without inner rings



NAO **NAO**

Fig. B4-5. Needle roller bearings without flanges, with inner rings



RNAO **RNAO**

Fig. B4-6. Needle roller bearings without flanges, without inner rings

CONSTRUCTION

The basic constructions of metric series needle roller bearings are:

- With integral end flanges on the one-piece, channel-shaped outer rings ($F_w \geq$ 12.000 mm[0.4724 in]).
- With inserted-end washers to provide axial retention of the needle roller and cage assemblies ($F_w \leq$ 10.000 mm 0.3937 in).
- Without flanges where separate end washers or housing shoulders are required to provide axial retention of the needle roller and cage assemblies.
- Full, outer ring piloted complement of needle rollers (with or without inner ring).

METRIC SERIES NEEDLE ROLLER BEARINGS WITH INNER RINGS

This applies to the NKJ, NA, and NAO series.

When it is impractical to finish the shaft to meet the desired raceway design requirements, an inner ring may be used. Standard needle roller bearings are available with inner rings (such as the NA Series) to form complete bearings. Bearings furnished with inner rings meet the quality requirements in accordance with ISO standards.

- For inner- and outer-ring tolerances, the metric series bearings follow the normal tolerance class in ISO Standard 1206 covering radial bearings. Bearings to more precise tolerance classes, P6 and P5, may be obtained upon request.
- The metric series bearings may be obtained with radial internal clearance in accordance with ISO Standard 5753, also specified for cylindrical roller bearings. Mostly, they follow the normal (C0) radial clearance group, although bearings to clearance groups C2, C3 and C4 may be made available on request.
- Inner ring and outer ring chamfer dimensions meet the requirements of ISO Standard 582.

METRIC SERIES NEEDLE ROLLER BEARINGS WITHOUT INNER RINGS

Whenever the shaft can be used as the inner raceway, needle roller bearings without inner rings provide advantages of economy and close control of radial internal clearance in operation. Tolerance class F6 is the normal specification for the metric series needle roller complement bore diameter of an unmounted bearing, as shown in Table B4-1 on page B-4-7. In the case of needle roller bearings of series RNAO, without flanges and without inner rings, the outer rings and needle roller and cage assemblies are not interchangeable.

Table B4-1. Metric series caged needle roller complement bore diameter for bearings without inner rings

F_w		ΔF_w min.	
>	≤	Max.	Min.
mm in	mm in	mm in	mm in
3.000 0.1181	**6.000** 0.2362	**+0.018** +0.0007	**+0.010** +0.0004
6.000 0.2362	**10.000** 0.3937	**+0.022** +0.0009	**+0.013** +0.0005
10.000 0.3937	**18.000** 0.7087	**+0.027** +0.0011	**+0.016** +0.0006
18.000 0.7087	**30.000** 1.1811	**+0.033** +0.0013	**+0.020** +0.0008
30.000 1.1811	**50.000** 1.9685	**+0.041** +0.0016	**+0.025** +0.0010
50.000 1.9685	**80.000** 3.1496	**+0.049** +0.0019	**+0.030** +0.0012
80.000 3.1496	**120.000** 4.7244	**+0.058** +0.0023	**+0.036** +0.0014
120.000 4.7244	**180.000** 7.0866	**+0.068** +0.0027	**+0.043** +0.0017
180.000 7.0866	**250.000** 9.8425	**+0.079** +0.0031	**+0.050** +0.0020
250.000 9.8425	**315.000** 12.4016	**+0.088** +0.0035	**+0.056** +0.0022
315.000 12.4016	**400.000** 15.7480	**+0.098** +0.0039	**+0.062** +0.0024

METRIC SERIES NEEDLE ROLLER BEARINGS WITH INTEGRAL FLANGES

The needle roller bearing has a one-piece, channel-shaped outer ring of bearing-quality steel heat treated to yield maximum load rating. The integral end flanges provide axial location for the needle rollers. The bores of the end flanges serve as piloting surfaces for the cage.

A steel cage provides inward retention for the needle rollers, and the design assures roller stability and minimizes friction between the cage and the needle rollers. The cage has maximum strength consistent with the inherent high-load ratings of needle roller bearings.

Needle roller bearings of series NKJ, NQI, NKJS, NA48 and NA49 contain one needle roller and cage assembly. Bearings of series NA69, with bearing bores of 32.000 mm (1.2598 in) and above, have two needle roller and cage assemblies.

The outer ring has a lubricating groove and a lubricating hole for more convenient lubrication of the bearing. However, the smaller bearings of series **NKJ** and **NK** (Fw < 12 mm [0.4724 in]) do not have a lubricating groove or a lubricating hole.

METRIC SERIES NEEDLE ROLLER BEARINGS WITH INSERTED END WASHERS

Some metric series needle roller bearings have inserted end washers to provide axial retention of the needle roller and cage assembly. The radial needle roller and cage assemblies, consistent with other designs, provide inward and outward retention for the needle rollers.

METRIC SERIES NEEDLE ROLLER BEARINGS WITHOUT FLANGES

The radial needle roller and cage assembly, used in the metric series needle roller bearings without flanges, is slightly narrower than the inner and outer rings to ensure unobstructed operation. Separate end washers are required to provide axial retention of the radial needle roller and cage assembly. Wide needle roller bearings, using two needle roller and cage assemblies, have a lubricating groove and one lubricating hole in the outer ring to facilitate re-lubrication of the bearing. Narrow needle roller bearings do not have a lubricating groove or a lubricating hole in the outer ring.

SEALED METRIC SERIES NEEDLE ROLLER BEARINGS OF DIMENSION SERIES 49

Needle roller bearings of Series 49 are available with one or two integral lip-contact seals, as listed on page B-4-30. One seal is designated by suffix letters RS. Two seals are designated by .2RS. When combining sealed metric series needle roller bearings with inner rings, it is suggested to use inner rings, shown on pages B-2-28 and B-8-22, with designation JRZ because they are wider than the outer rings to ensure positive seal contact.

Sealed bearings are normally packed with a high quality lithium soap-based grease suitable up to 120° C (248° F) for short periods of operation.

The speed rating specified for sealed bearings listed in the bearing tables is based on operating conditions determined by testing. Optimum performance may be expected providing the bearing is properly installed with appropriate internal clearances and subjected to a load of low magnitude. Care should be taken that overheating will not occur, thus preventing breakdown of the grease and eventual bearing failure.

BEARING MOUNTING

MOUNTING DIMENSIONS

It is suggested that needle roller bearings are mounted in their housings with a clearance fit, if the load is stationary relative to the housing, or with a tight transition fit, if the load rotates relative to the housing. Table B4-2 lists the suggested tolerances for the housing bore and the shaft raceway for metric series bearings without inner rings. Table B4-3 lists the suggested shaft tolerances for the above two mounting conditions when the metric series bearings are used with inner rings. The suggested housing bore tolerances for metric series bearings with inner rings is the same as the housing bore tolerance listed in Table B4-2 for metric series bearings without inner rings. Other quality requirements for shafts and housings are given in the engineering section.

Other mounting dimensions may be required for special operating conditions such as:

1. Extremely heavy radial loads.
2. Shock loads.
3. Temperature gradient across bearing.
4. Housing material with heat expansion coefficient different than that of the bearing.
5. Oscillating motion applications.

Table B4-2. Mounting tolerances for metric series bearings without inner ring

Rotation conditions	Nominal housing bore diameter D	ISO tolerance zone for housing		Nominal shaft diameter F shaft	ISO tolerance zone for shaft	
	mm	caged	full	mm	caged	full
Load stationary relative to housing	all diameters	H7 (J7)	J6	all diameters	**h6 (h5)**	**h5**
General work with larger clearance		K7	—		**g6**	—
Load rotates relative to housing		N7	M6		**f6**	**g5**

Care should be taken that the selected bearing internal clearance is appropriate for the operating conditions.

Table B4-3. Shaft tolerances for metric series bearings with inner rings (use housing tolerance shown in Table B4-2)

Rotation conditions	Nominal shaft diameter, d		ISO tolerance zone for shaft	
	mm in	**mm** in	caged	full
Load rotates relative to housing	all diameters		g6	h5 (h6)
Load stationary relative to housing	>	≤		
		40.000 1.5748	k6	k5
	40.000 1.5748	**100.000** 3.9370	m6	m5
	100.000 3.9370	**140.000** 5.5118	m6	m5
	140.000 5.5118		n6	n6

Care should be taken that the selected bearing internal clearance is appropriate for the operating conditions.

Regardless of the fit of the bearing outer ring in the housing, the outer ring should be axially located by housing shoulders or other positive means. The bearing rings should closely fit against the shaft and housing shoulders and must not contact the fillet radius. The maximum shaft or housing fillet $r_{a\ max}$ should be no greater than the minimum bearing chamfer $r_{s\ min}$, as shown in Table B4-4 on page B-4-10.

In order to permit mounting and dismounting of the shaft, the maximum diameter D_1 in Table B4-5 on page B-4-10 must not be exceeded. F_w is shown in the bearing tables.

Needle roller bearings without flanges of series RNAO and NAO must have the radial needle roller and cage assembly properly end-guided by shoulders, as shown in Table B4-6(1) on page B-4-11 and Table B4-6(2) on page B-4-12, or other suitable means, such as spring steel washers (SNSH) shown on page B-8-30. These end-guiding surfaces should be hardened and precision turned, or ground to minimize wear, and should properly fit against the outer rings and the inner rings to provide the desired end clearance for the needle roller and cage assembly.

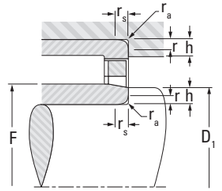


Fig. B4-7. Fillet

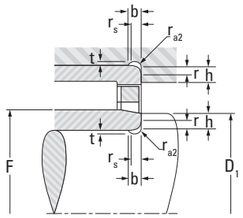


Fig. B4-8. Undercut

Table B4-4. Fillets, undercuts, and shoulder heights for metric series bearings

r_s(1)	r_a	t	r_{a2}	b	h
Min.	Max.		Min.		Min.
mm in	mm in	mm in	mm in	mm in	mm in
0.15 0.0059	**0.15** 0.0059				**0.6** 0.0236
0.3 0.0118	**0.3** 0.0118				**1** 0.0394
0.6 0.0236	**0.6** 0.0236				**2** 0.0787
1 0.0394	**1** 0.0394	**0.2** 0.0079	**1.3** 0.0512	**2** 0.0787	**2.5** 0.0984
1.1 0.0433	**1** 0.0394	**0.3** 0.0118	**2** 0.0787	**3** 0.1181	**3.25** 0.1280
1.5 0.0591	**1.5** 0.0591	**0.4** 0.0158	**2** 0.0787	**3.2** 0.1260	**4** 0.1575
2 0.0787	**2** 0.0787	**0.5** 0.0197	**2.5** 0.0984	**4** 0.1575	**5** 0.1969
2.1 0.0827	**2.1** 0.0827	**0.5** 0.0197	**3** 0.1181	**4.7** 0.1850	**5.5** 0.2165
3 0.1181	**2.5** 0.0984	**0.5** 0.0197	**3.5** 0.1378	**5.3** 0.2087	**6** 0.2362

(1) r_s : Bearing component corner rounding.

Table B4-5. Shoulder diameter $D_{1\ max.}$ for metric series bearings

		mm in	mm in	mm in	mm in	mm in
Needle roller complement bore diameter F_w	>		**20.000** 0.7874	**55.000** 2.1653	**100.000** 3.9370	**250.000** 9.8425
	≤	**20.000** 0.7874	**55.000** 2.1653	**100.000** 3.9370	**250.000** 9.8425	
Diameter	D_{1max}	F_w -0.3	F_w -0.5	F_w -0.7	F_w -1.0	F_w -1.5

LOAD RATING FACTORS

DYNAMIC LOADS

Needle roller bearings can accommodate only radial loads.

$$P = F_r \quad (kN)$$

P = The maximum dynamic radial load that may be applied to a needle roller bearing based on the dynamic load rating, C_r, given in the bearing tables. This load should be ≤ $C_r/3$.

STATIC LOADS

Needle roller bearings can accommodate only radial loads.

$$P_0 = F_r \quad (kN)$$

MOUNTING IN SETS

Radial needle roller and cage assemblies that are mounted side by side must have needle rollers of the same group limits to ensure uniform load distribution.

RNAO Series

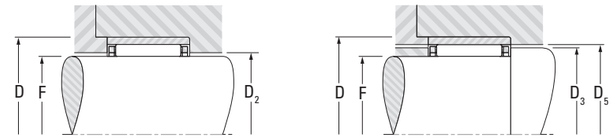


Fig. B4-9. Guidance in the housing (left) and on the shaft (right)

Table B4-6(1). Mounting dimensions for metric series needle roller bearings without flanges

Dimensions	Bearing series RNAO		
	D_3	D_2	D_5
FxD	Max.	Min.	Min.
mm in	mm in	mm in	mm in
10x17 0.3937x0.6693	**12.7** 0.5000	**10.3** 0.4055	**13.3** 0.5236
12x19 0.4724x0.7480	**14.7** 0.5787	**12.3** 0.4843	**15.3** 0.6024
14x22 0.5512x0.8661	**17.6** 0.6929	**14.4** 0.5669	**18.3** 0.7205
15x23 0.5906x0.9055	**18.6** 0.7323	**15.4** 0.6063	**19.3** 0.7598
16x24 0.6299x0.9499	**19.6** 0.7717	**16.4** 0.6457	**20.3** 0.7992
17x25 0.6693x0.9843	**20.6** 0.8110	**17.4** 0.6850	**21.3** 0.8386
18x26 0.7087x1.0236	**21.6** 0.8504	**18.4** 0.7244	**22.3** 0.8780
18x30 0.7087x1.1811	**23.6** 0.9291	**18.6** 0.7323	**24.5** 0.9646
20x28 0.7874x1.1024	**23.6** 0.9291	**20.4** 0.8032	**24.3** 0.9567
20x32 0.7874x1.2598	**25.6** 1.0079	**20.6** 0.8110	**26.5** 1.0433
22x30 0.8661x1.1811	**25.6** 1.0079	**22.4** 0.8819	**26.3** 0.9291
22x35 0.8661x1.3780	**28.4** 1.1181	**22.8** 0.8976	**29.5** 1.1614
25x35 0.9843x1.3780	**29.4** 1.1575	**25.6** 1.0079	**30.5** 1.2008
25x37 0.9843x1.4567	**31.4** 1.2362	**25.8** 1.0158	**32.5** 1.2795
28x40 1.1024x1.5748	**34.4** 1.3543	**28.8** 1.1339	**35.5** 1.3976
30x40 1.1811x1.5748	**34.4** 1.3543	**30.6** 1.2047	**35.5** 1.3976
30x42 1.1811x1.6535	**36.4** 1.4331	**30.8** 1.2126	**37.5** 1.4764
35x45 1.3780x1.7717	**39.4** 1.5512	**35.6** 1.4016	**40.5** 1.5945

Dimensions	Bearing series RNAO		
	D_3	D_2	D_5
FxD	Max.	Min.	Min.
mm in	mm in	mm in	mm in
35x47 1.3780x1.8504	**41.4** 1.6299	**35.8** 1.4096	**42.5** 1.6732
40x50 1.5748x1.9685	**44.4** 1.7480	**40.6** 1.5984	**45.5** 1.7913
40x55 1.5748x2.1654	**47.2** 1.8582	**41** 1.6142	**48.5** 1.9095
45x55 1.7717x2.1654	**49.4** 1.9449	**45.6** 1.7953	**50.5** 1.9882
45x62 1.7717x2.4409	**52.2** 2.0551	**46** 1.8110	**53.5** 2.1063
50x62 1.9685x2.4409	**54.4** 2.1417	**50.6** 1.9921	**55.8** 2.1969
50x65 1.9685x2.5591	**57.2** 2.2520	**51** 2.0079	**58.8** 2.3032
55x68 2.1654x2.6772	**59.4** 2.3386	**55.6** 2.1890	**60.8** 2.3937
55x72 2.1654x2.8347	**62.2** 2.4488	**56** 2.2047	**63.8** 2.5118
60x78 2.3622x3.0709	**67.2** 2.6457	**61** 2.4016	**68.8** 2.7087
65x85 2.5591x3.3465	**72.2** 2.8425	**66** 2.5984	**73.8** 2.9055
70x90 2.7559x3.5433	**77.2** 3.0394	**71** 2.7953	**78.8** 3.1024
75x95 2.9528x3.7402	**82.2** 3.2362	**76** 2.9921	**84** 3.3071
80x100 3.1496x3.9370	**87.2** 3.4331	**81** 3.1890	**89** 3.5039
85x105 3.3465x4.1339	**92.2** 3.6299	**86** 3.3858	**94** 3.7008
90x110 3.5433x4.3307	**97.2** 3.8268	**91** 3.5827	**99** 3.8976
95x115 3.7402x4.5276	**102.2** 4.0236	**96** 3.7795	**104** 4.0945
100x120 3.9370x4.7244	**107.2** 4.2205	**101** 3.9764	**109** 4.2913

B

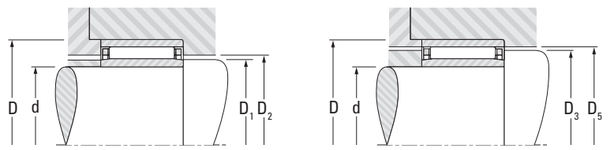


Fig. B4-10. Guidance in the housing (left) and on the shaft (right)

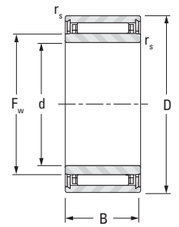
Table B4-6(2). Mounting dimensions for metric series needle roller bearings without flanges

Dimensions	Bearing series NAO			
	D_1	D_2	D_3	D_5
dxD	Max.	Min.	Max.	Min.
mm in	mm in	mm in	mm in	mm in
6x17 0.2362x'0.6693	**9.7** 0.3819	**10.3** 0.4055	**12.7** 0.5000	**13.3** 0.5236
8x19 0.3150x'0.7480	**11.7** 0.4606	**12.3** 0.4843	**14.7** 0.5787	**15.3** 0.6024
10x22 0.3937x'0.8661	**13.7** 0.5394	**14.4** 0.5669	**17.6** 0.6929	**18.3** 0.7205
10x26 0.3937x1.0236	**13.7** 0.5394	**14.6** 0.5748	**19.6** 0.7717	**20.3** 0.7992
12x24 0.4724x'0.9449	**15.7** 0.6181	**16.4** 0.6457	**19.6** 0.7717	**20.3** 0.7992
12x28 0.4724x1.1024	**15.7** 0.6181	**16.6** 0.6535	**21.6** 0.8504	**22.3** 0.878
15x28 0.5906x1.1024	**19.5** 0.7677	**20.4** 0.8032	**23.6** 0.9291	**24.3** 0.9567
15x32 0.5906x1.2598	**19.5** 0.7677	**20.6** 0.811	**25.6** 1.0079	**26.5** 1.0433
17x30 0.6693x1.1811	**21.5** 0.8465	**22.4** 0.8819	**25.6** 1.0079	**26.3** 1.0354
17x35 0.6693x1.3780	**21.5** 0.8465	**22.8** 0.8976	**28.4** 1.1181	**29.5** 1.1614
20x35 0.7874x1.3780	**24.5** 0.9646	**25.6** 1.0079	**29.4** 1.1575	**30.5** 1.2008
20x37 0.7874x1.4567	**24.5** 0.9646	**25.8** 1.0158	**31.4** 1.2362	**32.5** 1.2795
25x40 0.9843x1.5748	**29.5** 1.1614	**30.6** 1.2047	**34.4** 1.3543	**35.5** 1.3976
25x42 0.9843x1.6535	**29.5** 1.1614	**30.8** 1.2126	**36.4** 1.4331	**37.5** 1.4764
30x45 1.1811x1.7717	**34.5** 1.3583	**35.6** 1.4016	**39.4** 1.5512	**40.5** 1.5945
30x47 1.1811x1.8504	**34.5** 1.3583	**35.8** 1.4095	**41.4** 1.6299	**42.5** 1.6732

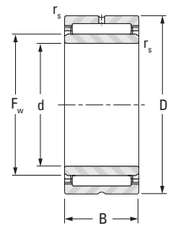
Dimensions	Bearing series NAO			
	D_1	D_2	D_3	D_5
dxD	Max.	Min.	Max.	Min.
mm in	mm in	mm in	mm in	mm in
35x50 1.3780x1.9685	**39.5** 1.5551	**40.6** 1.5984	**44.4** 1.748	**45.5** 1.7913
35x55 1.3780x2.1654	**39.5** 1.5551	**41** 1.6142	**47.2** 1.8583	**48.5** 1.9095
40x55 1.5748x2.1654	**44.5** 1.7520	**45.6** 1.7952	**49.4** 1.9449	**50.5** 1.9882
40x62 1.5748x2.4409	**44.5** 1.7520	**46** 1.8110	**52.2** 2.0551	**53.5** 2.1063
45x62 1.7717x2.4409	**49.5** 1.9488	**50.6** 1.9921	**54.4** 2.1417	**55.8** 2.1969
45x72 1.7717x2.8347	**54.5** 2.1457	**56** 2.2047	**62.2** 2.4488	**63.8** 2.5118
50x68 1.9685x2.6772	**54.5** 2.1457	**55.6** 2.1890	**59.4** 2.3386	**60.8** 2.3937
50x78 1.9685x3.0709	**59.3** 2.3347	**61** 2.4016	**67.2** 2.6457	**68.8** 2.7087
55x85 2.1654x3.3465	**64.3** 2.5315	**66** 2.5984	**72.2** 2.8425	**73.8** 2.9055
60x90 2.3622x3.5433	**69.3** 2.7284	**71** 2.7953	**77.2** 3.0394	**78.8** 3.1024
65x95 2.5591x3.7402	**74.3** 2.9252	**76** 2.9921	**82.2** 3.2362	**84** 3.3071
70x100 2.7559x3.9370	**79.3** 3.1221	**81** 3.1890	**87.2** 3.4331	**89** 3.5039
75x105 2.9528x4.1339	**84.3** 3.3189	**86** 3.3858	**92.2** 3.6299	**94** 3.7008
80x110 3.1496x4.3307	**89.3** 3.5158	**91** 3.5827	**97.2** 3.8268	**99** 3.8976
85x115 3.3465x4.5276	**94.3** 3.7126	**96** 3.7795	**102.2** 4.0236	**104** 4.0945
90x120 3.5433x4.7244	**99.3** 3.9095	**101** 3.9764	**107.2** 4.2205	**109** 4.2913

NEEDLE ROLLER BEARINGS WITH INNER RINGS

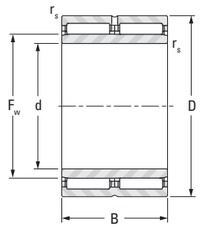
METRIC SERIES
NKJ, NKJS, NA48
NA49, NA69 SERIES



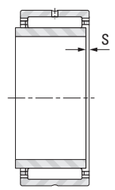
NKJ (d ≤ 7)



NKJ (d ≥ 9), NKJS, NA48, NA49, NA69 (d ≤ 30)



NA69 (d ≥ 32)



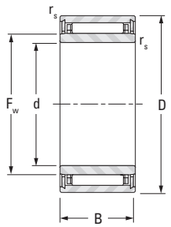
Shaft Dia.	d	D	B	F_w	$r_{s\ min.}$	s(1)	Bearing Designation	Load Ratings		Fatigue Load Limit C_u	Speed Ratings		Approx. Wt.
								Dynamic	Static				
								C	C_0		Grease	Oil	
mm in	mm in	mm in	mm in	mm in	mm in	mm in		kN lbf		kN	min^{-1}		kg lbs
5 0.1969	**5** 0.1969	**15** 0.5906	**12** 0.472	**8** 0.315	**0.3** 0.012	**1.5** 0.059	NKJ5/12	**4.57** 1030	**4.89** 1100	0.740	26000	41000	**0.014** 0.031
	5 0.1969	**15** 0.5906	**16** 0.63	**8** 0.315	**0.3** 0.012	**1.5** 0.059	NKJ5/16	**5.22** 1170	**5.78** 1300	0.880	26000	41000	**0.017** 0.037
6 0.2362	**6** 0.2362	**16** 0.6299	**12** 0.472	**9** 0.3543	**0.3** 0.012	**1.5** 0.059	NKJ6/12	**4.27** 960	**4.6** 1030	0.700	26000	40000	**0.015** 0.033
	6 0.2362	**16** 0.6299	**16** 0.63	**9** 0.3543	**0.3** 0.012	**1.5** 0.059	NKJ6/16	**5.57** 1250	**6.47** 1450	0.980	26000	40000	**0.019** 0.042
7 0.2756	**7** 0.2756	**17** 0.6693	**12** 0.472	**10** 0.3937	**0.3** 0.012	**1.5** 0.059	NKJ7/12	**5.4** 1210	**6.43** 1450	0.980	25000	39000	**0.017** 0.037
	7 0.2756	**17** 0.6693	**16** 0.63	**10** 0.3937	**0.3** 0.012	**1.5** 0.059	NKJ7/16TN	**5.3** 1190	**6.27** 1410	0.940	25000	39000	**0.021** 0.046
9 0.3543	**9** 0.3543	**19** 0.748	**12** 0.472	**12** 0.4724	**0.3** 0.012	**1.5** 0.059	NKJ9/12A	**6.86** 1540	**7.6** 1710	1.15	19000	30000	**0.018** 0.04
	9 0.3543	**19** 0.748	**16** 0.63	**12** 0.4724	**0.3** 0.012	**1.5** 0.059	NKJ9/16	**6.78** 1520	**9.03** 2030	1.40	19000	30000	**0.024** 0.053
10 0.3937	**10** 0.3937	**22** 0.8661	**13** 0.512	**14** 0.5512	**0.3** 0.012	**1** 0.039	NA4900	**9.39** 2110	**10.3** 2320	1.55	16000	24000	**0.025** 0.055
	10 0.3937	**22** 0.8661	**16** 0.63	**14** 0.5512	**0.3** 0.012	**1.5** 0.059	NKJ10/16A	**12.4** 2790	**14.8** 3330	2.10	16000	24000	**0.032** 0.071
	10 0.3937	**22** 0.8661	**20** 0.787	**14** 0.5512	**0.3** 0.012	**1.5** 0.059	NKJ10/20A	**14.7** 3300	**18.4** 4140	2.75	16000	24000	**0.04** 0.088
12 0.4724	**12** 0.4724	**24** 0.9449	**13** 0.512	**16** 0.6299	**0.3** 0.012	**1** 0.039	NA4901	**10.5** 2360	**12.3** 2770	1.90	18000	28000	**0.028** 0.062
	12 0.4724	**24** 0.9449	**16** 0.63	**16** 0.6299	**0.3** 0.012	**1.5** 0.059	NKJ12/16A	**13** 2920	**16.2** 3640	2.50	18000	28000	**0.036** 0.079
	12 0.4724	**24** 0.9449	**20** 0.787	**16** 0.6299	**0.3** 0.012	**1.5** 0.059	NKJ12/20A	**15.4** 3460	**20.2** 4540	3.20	18000	28000	**0.046** 0.101
	12 0.4724	**24** 0.9449	**22** 0.866	**16** 0.6299	**0.3** 0.012	**1** 0.039	NA6901A	**16.1** 3620	**21.3** 4790	3.55	18000	28000	**0.051** 0.11
15 0.5906	**15** 0.5906	**27** 1.063	**16** 0.63	**19** 0.748	**0.3** 0.012	**1.5** 0.059	NKJ15/16A	**14.1** 3170	**19** 4270	2.90	15000	24000	**0.042** 0.093
	15 0.5906	**27** 1.063	**20** 0.787	**19** 0.748	**0.3** 0.012	**1.5** 0.059	NKJ15/20A	**16.8** 3780	**23.6** 5310	3.75	15000	24000	**0.054** 0.119
	15 0.5906	**28** 1.1024	**13** 0.512	**20** 0.7874	**0.3** 0.012	**1** 0.039	NA4902	**11.8** 2650	**15.3** 3440	2.35	14000	22000	**0.037** 0.082
	15 0.5906	**28** 1.1024	**23** 0.906	**20** 0.7874	**0.3** 0.012	**1.5** 0.059	NA6902A	**18.4** 4140	**26.9** 6050	4.20	14000	22000	**0.067** 0.148
17 0.6693	**17** 0.6693	**29** 1.1417	**16** 0.63	**21** 0.8268	**0.3** 0.012	**2** 0.079	NKJ17/16A	**15.3** 3440	**21.6** 4860	3.30	14000	21000	**0.047** 0.104

(1) Max. axial displacement

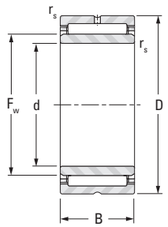
Continued on next page.

NEEDLE ROLLER BEARINGS WITH INNER RINGS

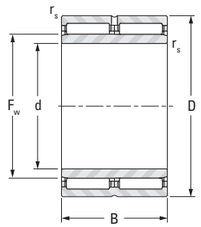
METRIC SERIES
NKJ, NKJS, NA48
NA49, NA69 SERIES



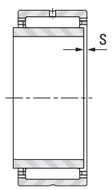
NKJ (d ≤ 7)



NKJ (d ≥ 9), NKJS, NA48, NA49, NA69 (d ≤ 30)



NA69 (d ≥ 32)



Shaft Dia.	d	D	B	F_w	$r_{s\ min.}$	$s^{(1)}$	Bearing Designation	Load Ratings		Fatigue Load Limit C_u	Speed Ratings		Approx. Wt.
								Dynamic	Static				
								C	C_0		Grease	Oil	
mm in	mm in	mm in	mm in	mm in	mm in	mm in		kN lbf		kN	min^{-1}		kg lbs
17 0.6693	**17** 0.6693	**29** 1.1417	**20** 0.787	**21** 0.8268	**0.3** 0.012	**1.5** 0.059	NKJ17/20A	**18.1** 4070	**26.9** 6050	4.80	14000	21000	**0.059** 0.13
	17 0.6693	**30** 1.1811	**13** 0.512	**22** 0.8661	**0.3** 0.012	**1** 0.039	NA4903	**12.2** 2740	**16.4** 3690	2.50	13000	20000	**0.04** 0.088
	17 0.6693	**30** 1.1811	**23** 0.906	**22** 0.8661	**0.3** 0.012	**1** 0.039	NA6903A	**19.8** 4450	**30.6** 6880	4.75	13000	20000	**0.084** 0.185
	17 0.6693	**37** 1.4567	**20** 0.787	**24** 0.9449	**0.6** 0.024	**1** 0.039	NKJS17A	**29.1** 6540	**32.8** 7370	5.30	13000	20000	**0.108** 0.238
20 0.7874	**20** 0.7874	**32** 1.2598	**16** 0.63	**24** 0.9449	**0.3** 0.012	**1.5** 0.059	NKJ20/16A	**16.2** 3640	**24.3** 5460	3.70	12000	18000	**0.053** 0.117
	20 0.7874	**32** 1.2598	**20** 0.787	**24** 0.9449	**0.3** 0.012	**1.5** 0.059	NKJ20/20A	**19.3** 4340	**30.3** 6810	4.80	12000	18000	**0.067** 0.148
	20 0.7874	**37** 1.4567	**17** 0.669	**25** 0.9843	**0.3** 0.012	**1.5** 0.059	NA4904	**21.3** 4790	**25.5** 5730	6.75	12000	18000	**0.084** 0.185
	20 0.7874	**37** 1.4567	**30** 1.181	**25** 0.9843	**0.3** 0.012	**1.5** 0.059	NA6904A	**36.6** 8230	**51** 11500	7.95	12000	18000	**0.133** 0.293
	20 0.7874	**42** 1.6535	**20** 0.787	**28** 1.1024	**0.6** 0.024	**1** 0.039	NKJS20A	**30.3** 6810	**38.4** 8630	6.15	11000	16000	**0.13** 0.287
22 0.8661	**22** 0.8661	**34** 1.3386	**16** 0.63	**26** 1.0236	**0.3** 0.012	**1.5** 0.059	NKJ22/16A	**16.6** 3730	**25.7** 5780	3.95	11000	17000	**0.058** 0.128
	22 0.8661	**34** 1.3386	**20** 0.787	**26** 1.0236	**0.3** 0.012	**2** 0.079	NKJ22/20A	**19.7** 4430	**32** 7190	5.05	11000	17000	**0.071** 0.157
	22 0.8661	**39** 1.5354	**17** 0.669	**28** 1.1024	**0.3** 0.012	**1.5** 0.059	NA49/22	**23.3** 5240	**29.6** 6650	4.55	10000	16000	**0.089** 0.196
	22 0.8661	**39** 1.5354	**30** 1.181	**28** 1.1024	**0.3** 0.012	**1** 0.039	NA69/22A	**30.6** 6880	**50.7** 11400	7.85	10000	16000	**0.163** 0.359
25 0.9843	**25** 0.9843	**38** 1.4961	**20** 0.787	**29** 1.1417	**0.3** 0.012	**2** 0.079	NKJ25/20A	**23.4** 5260	**36.4** 8180	5.80	9800	15000	**0.086** 0.19
	25 0.9843	**38** 1.4961	**30** 1.181	**29** 1.1417	**0.3** 0.012	**2** 0.079	NKJ25/30A	**29.8** 6700	**56.4** 12700	8.70	9800	15000	**0.13** 0.287
	25 0.9843	**42** 1.6535	**17** 0.669	**30** 1.1811	**0.3** 0.012	**1.5** 0.059	NA4905	**24.3** 5460	**31.7** 7130	4.90	9700	15000	**0.099** 0.218
	25 0.9843	**42** 1.6535	**30** 1.181	**30** 1.1811	**0.3** 0.012	**1.5** 0.059	NA6905A	**39.7** 8920	**59.6** 13400	9.30	9700	15000	**0.178** 0.392
	25 0.9843	**47** 1.8504	**22** 0.866	**32** 1.2598	**0.6** 0.024	**1.5** 0.059	NKJS25A	**36** 8090	**36.2** 8140	7.40	9200	14000	**0.174** 0.384
28 1.1024	**28** 1.1024	**42** 1.6535	**20** 0.787	**32** 1.2598	**0.3** 0.012	**2** 0.079	NKJ28/20A	**24.8** 5580	**40.4** 9080	6.45	8800	14000	**0.104** 0.229
	28 1.1024	**42** 1.6535	**30** 1.181	**32** 1.2598	**0.3** 0.012	**2** 0.079	NKJ28/30A	**38.9** 8750	**72.2** 16200	11.2	8800	14000	**0.156** 0.344

(1) Max. axial displacement

Shaft Dia.	d	D	B	F_w	$r_{s\ min.}$	$s^{(1)}$	Bearing Designation	Load Ratings		Fatigue Load Limit C_u	Speed Ratings		Approx. Wt.
								Dynamic	Static				
								C	C_0		Grease	Oil	
mm in	mm in	mm in	mm in	mm in	mm in	mm in		kN lbf		kN	min^{-1}		kg lbs
28 1.1024	**28** 1.1024	**45** 1.7717	**17** 0.669	**32** 1.2598	**0.3** 0.012	**1.5** 0.059	NA49/28	**25.1** 5640	**33.8** 7600	5.20	9000	14000	**0.108** 0.238
	28 1.1024	**45** 1.7717	**30** 1.181	**32** 1.2598	**0.3** 0.012	**1.5** 0.059	NA69/28A	**43.2** 9700	**62.5** 14100	11.0	9000	14000	**0.19** 0.419
30 1.1811	**30** 1.1811	**45** 1.7717	**20** 0.787	**35** 1.378	**0.3** 0.012	**1.5** 0.059	NKJ30/20A	**26.1** 5870	**44.4** 9980	7.05	8000	12000	**0.12** 0.265
	30 1.1811	**45** 1.7717	**30** 1.181	**35** 1.378	**0.3** 0.012	**1.5** 0.059	NKJ30/30A	**37.4** 8410	**70.6** 15900	11.0	8000	12000	**0.179** 0.395
	30 1.1811	**47** 1.8504	**17** 0.669	**35** 1.378	**0.3** 0.012	**1.5** 0.059	NA4906	**25.9** 5820	**36** 8090	5.55	8200	13000	**0.114** 0.251
	30 1.1811	**47** 1.8504	**30** 1.181	**35** 1.378	**0.3** 0.012	**1** 0.039	NA6906A	**42.6** 9580	**68.2** 15300	10.6	8200	13000	**0.205** 0.452
	30 1.1811	**52** 2.0472	**22** 0.866	**37** 1.4567	**0.6** 0.024	**1.5** 0.059	NKJS30A	**39** 8770	**53.4** 12000	8.55	7900	12000	**0.198** 0.437
32 1.2598	**32** 1.2598	**47** 1.8504	**20** 0.787	**37** 1.4567	**0.3** 0.012	**2** 0.079	NKJ32/20A	**26.6** 6000	**46.4** 10400	7.20	7600	12000	**0.127** 0.28
	32 1.2598	**47** 1.8504	**30** 1.181	**37** 1.4567	**0.3** 0.012	**1.5** 0.059	NKJ32/30A	**38.2** 8590	**73.9** 16600	11.5	7600	12000	**0.192** 0.423
	32 1.2598	**52** 2.0472	**20** 0.787	**40** 1.5748	**0.6** 0.024	**1.5** 0.059	NA49/32	**32** 7190	**49.3** 11100	7.85	7100	11000	**0.169** 0.373
	32 1.2598	**52** 2.0472	**36** 1.417	**40** 1.5748	**0.6** 0.024	**1** 0.039	NA69/32A	**48.6** 10900	**84.5** 19000	13.1	7100	11000	**0.313** 0.69
35 1.378	**35** 1.378	**50** 1.9685	**20** 0.787	**40** 1.5748	**0.3** 0.012	**2** 0.079	NKJ35/20A	**27.8** 6250	**50.4** 11300	8.05	7000	11000	**0.135** 0.298
	35 1.378	**50** 1.9685	**30** 1.181	**40** 1.5748	**0.3** 0.012	**1.5** 0.059	NKJ35/30A	**40** 8990	**80.2** 18000	12.4	7000	11000	**0.208** 0.459
	35 1.378	**55** 2.1654	**20** 0.787	**42** 1.6535	**0.6** 0.024	**1.5** 0.059	NA4907	**32.8** 7370	**51.7** 11600	8.25	6700	10000	**0.179** 0.395
	35 1.378	**55** 2.1654	**36** 1.417	**42** 1.6535	**0.6** 0.024	**1** 0.039	NA6907A	**49.9** 11200	**88.7** 19900	13.7	6700	10000	**0.34** 0.75
	35 1.378	**58** 2.2835	**22** 0.866	**43** 1.6929	**0.6** 0.024	**1** 0.039	NKJS35A	**41.6** 9350	**60.7** 13600	9.75	6700	10000	**0.235** 0.518
38 1.4961	**38** 1.4961	**53** 2.0866	**20** 0.787	**43** 1.6929	**0.3** 0.012	**2** 0.079	NKJ38/20A	**29** 6520	**54.4** 12200	8.65	6400	9900	**0.146** 0.322
	38 1.4961	**53** 2.0866	**30** 1.181	**43** 1.6929	**0.3** 0.012	**1.5** 0.059	NKJ38/30A	**41.6** 9350	**86.6** 19500	13.4	6400	9900	**0.196** 0.432
40 1.5748	**40** 1.5748	**55** 2.1654	**20** 0.787	**45** 1.7717	**0.3** 0.012	**2** 0.079	NKJ40/20A	**29.5** 6630	**56.4** 12700	9.00	6100	9400	**0.152** 0.335
	40 1.5748	**55** 2.1654	**30** 1.181	**45** 1.7717	**0.3** 0.012	**1.5** 0.059	NKJ40/30A	**42.3** 9510	**89.8** 20200	13.9	6100	9400	**0.229** 0.505
	40 1.5748	**62** 2.4409	**22** 0.866	**48** 1.8898	**0.6** 0.024	**1.5** 0.059	NA4908	**44.2** 9940	**67.8** 15200	10.9	5900	9100	**0.248** 0.547
	40 1.5748	**62** 2.4409	**40** 1.575	**48** 1.8898	**0.6** 0.024	**1.5** 0.059	NA6908A	**70.8** 15900	**124** 27900	19.8	5900	9100	**0.473** 1.043
	40 1.5748	**65** 2.5591	**22** 0.866	**50** 1.9685	**1** 0.039	**1** 0.039	NKJS40A	**45.5** 10200	**71.3** 16000	11.4	5700	8700	**0.292** 0.644
42 1.6535	**42** 1.6535	**57** 2.2441	**20** 0.787	**47** 1.8504	**0.3** 0.012	**2** 0.079	NKJ42/20A	**30** 6740	**58.5** 13200	9.30	5900	9000	**0.159** 0.351
	42 1.6535	**57** 2.2441	**30** 1.181	**47** 1.8504	**0.3** 0.012	**1.5** 0.059	NKJ42/30A	**43** 9670	**93.1** 20900	14.4	5900	9000	**0.241** 0.531
45 1.7717	**45** 1.7717	**62** 2.4409	**25** 0.984	**50** 1.9685	**0.6** 0.024	**3** 0.118	NKJ45/25A	**40.7** 9150	**79.3** 17800	12.5	5500	8500	**0.223** 0.492

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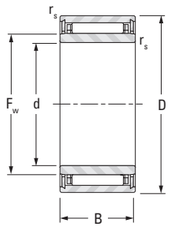
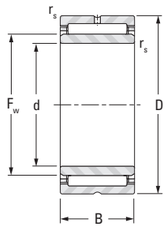
NEEDLE ROLLER BEARINGS WITH INNER RINGS

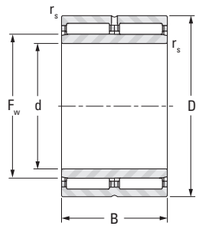
METRIC SERIES
NKJ, NKJS, NA48
NA49, NA69 SERIES



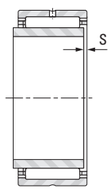
NKJ (d ≤ 7)



NKJ (d ≥ 9), NKJS, NA48, NA49, NA69 (d ≤ 30)



NA69 (d ≥ 32)



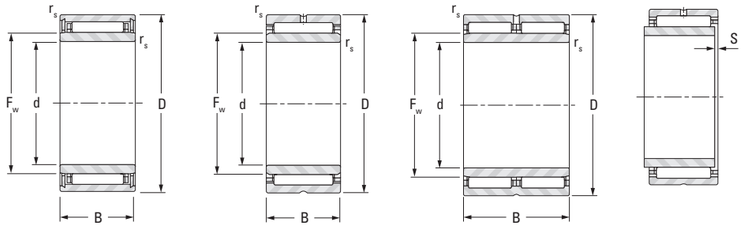
Shaft Dia.	d	D	B	F_w	$r_{s\ min.}$	$s^{(1)}$	Bearing Designation	Load Ratings		Fatigue Load Limit C_u	Speed Ratings		Approx. Wt.
								Dynamic	Static				
								C	C_0		Grease	Oil	
mm in	mm in	mm in	mm in	mm in	mm in	mm in		kN lbf		kN	min^{-1}		kg lbs
45 1.7717	**45** 1.7717	**62** 2.4409	**35** 1.378	**50** 1.9685	**0.6** 0.024	**3** 0.118	NKJ45/35A	**55** 12400	**117** 26300	18.2	5500	8500	**0.345** 0.761
	45 1.7717	**68** 2.6772	**22** 0.866	**52** 2.0472	**0.6** 0.024	**2** 0.079	NA4909	**46.8** 10500	**74.8** 16800	12.0	5400	8400	**0.291** 0.642
	45 1.7717	**68** 2.6772	**40** 1.575	**52** 2.0472	**0.6** 0.024	**1.5** 0.059	NA6909A	**74.7** 16800	**137** 30800	21.7	5400	8400	**0.55** 1.232
	45 1.7717	**72** 2.8346	**22** 0.866	**55** 2.1654	**1** 0.039	**1** 0.039	NKJS45A	**47.9** 10800	**78.4** 17600	12.6	5100	7900	**0.36** 0.794
50 1.9685	**50** 1.9685	**68** 2.6772	**25** 0.984	**55** 2.1654	**0.6** 0.024	**3** 0.118	NKJ50/25A	**46.1** 10400	**87.3** 19600	13.9	5000	7800	**0.288** 0.635
	50 1.9685	**68** 2.6772	**35** 1.378	**55** 2.1654	**0.6** 0.024	**3** 0.118	NKJ50/35A	**62.3** 14000	**129** 29000	20.0	5000	7800	**0.406** 0.895
	50 1.9685	**72** 2.8346	**22** 0.866	**58** 2.2835	**0.6** 0.024	**2** 0.079	NA4910	**49** 11000	**82** 18400	13.2	4800	7400	**0.296** 0.653
	50 1.9685	**72** 2.8346	**40** 1.575	**58** 2.2835	**0.6** 0.024	**1.5** 0.059	NA6910A	**75.7** 17000	**144** 32400	22.8	4800	7400	**0.577** 1.272
	50 1.9685	**80** 3.1496	**28** 1.102	**60** 2.3622	**1.1** 0.043	**1.5** 0.059	NKJS50A	**66.9** 15000	**103** 23200	16.5	4800	7300	**0.523** 1.153
55 2.1654	**55** 2.1654	**72** 2.8346	**25** 0.984	**60** 2.3622	**0.6** 0.024	**3** 0.118	NKJ55/25A	**44.3** 9960	**94** 21100	14.9	4600	7000	**0.29** 0.639
	55 2.1654	**72** 2.8346	**35** 1.378	**60** 2.3622	**0.6** 0.024	**3** 0.118	NKJ55/35A	**59.9** 13500	**139** 31200	21.5	4600	7000	**0.41** 0.904
	55 2.1654	**80** 3.1496	**25** 0.984	**63** 2.4803	**1** 0.039	**2.5** 0.098	NA4911	**62** 13900	**107** 24100	17.1	4500	6900	**0.426** 0.939
	55 2.1654	**80** 3.1496	**45** 1.772	**63** 2.4803	**1** 0.039	**2.5** 0.098	NA6911A	**94.2** 21200	**172** 38700	27.8	4500	6900	**0.8** 1.764
	55 2.1654	**85** 3.3465	**28** 1.102	**65** 2.5591	**1.1** 0.043	**1.5** 0.059	NKJS55A	**71** 16000	**114** 25600	18.3	4400	6700	**0.569** 1.254
60 2.3622	**60** 2.3622	**82** 3.2283	**25** 0.984	**68** 2.6772	**0.6** 0.024	**2** 0.079	NKJ60/25A	**49** 11000	**101** 22700	16.1	4000	6200	**0.44** 0.97
	60 2.3622	**82** 3.2283	**35** 1.378	**68** 2.6772	**0.6** 0.024	**2.5** 0.098	NKJ60/35A	**66.2** 14900	**149** 33500	23.2	4000	6200	**0.52** 1.146
	60 2.3622	**85** 3.3465	**25** 0.984	**68** 2.6772	**1** 0.039	**1.5** 0.059	NA4912	**64.8** 14600	**116** 26100	18.6	4100	6300	**0.457** 1.008
	60 2.3622	**85** 3.3465	**45** 1.772	**68** 2.6772	**1** 0.039	**2** 0.079	NA6912A	**99.3** 22300	**189** 42500	30.5	4100	6400	**0.829** 1.828
	60 2.3622	**90** 3.5433	**28** 1.102	**70** 2.7559	**1.1** 0.043	**1.5** 0.059	NKJS60A	**72.6** 16300	**120** 27000	19.3	4000	6200	**0.607** 1.338
65 2.5591	**65** 2.5591	**90** 3.5433	**25** 0.984	**72** 2.8346	**1** 0.039	**1.5** 0.059	NA4913	**66** 14800	**121** 27200	19.4	3900	5900	**0.489** 1.078
65 2.5591	**65** 2.5591	**90** 3.5433	**35** 1.378	**73** 2.874	**0.6** 0.024	**2** 0.079	NKJ65/25A	**61.5** 13800	**119** 26800	19.0	3800	5800	**0.5** 1.102
	65 2.5591	**90** 3.5433	**35** 1.378	**73** 2.874	**0.6** 0.024	**2** 0.079	NKJ65/35A	**82.5** 18500	**173** 38900	27.1	3800	5800	**0.69** 1.521
	65 2.5591	**90** 3.5433	**45** 1.772	**72** 2.8346	**1** 0.039	**2** 0.079	NA6913A	**107** 24100	**213** 47900	34.5	3900	6000	**0.945** 2.083
	65 2.5591	**95** 3.7402	**28** 1.102	**75** 2.9528	**1.1** 0.043	**1.5** 0.059	NKJS65A	**76.5** 17200	**132** 29700	21.1	3700	5800	**0.655** 1.444
70 2.7559	**70** 2.7559	**95** 3.7402	**25** 0.984	**80** 3.1496	**1** 0.039	**2** 0.079	NKJ70/25A	**66.4** 14900	**130** 29200	20.8	3400	5300	**0.561** 1.237
	70 2.7559	**95** 3.7402	**35** 1.378	**80** 3.1496	**1** 0.039	**3.5** 0.138	NKJ70/35A	**79.7** 17900	**184** 41400	28.7	3400	5300	**0.779** 1.717
	70 2.7559	**100** 3.937	**28** 1.102	**80** 3.1496	**1.1** 0.043	**1.5** 0.059	NKJS70A	**80.1** 18000	**143** 32100	22.9	3500	5400	**0.772** 1.702
	70 2.7559	**100** 3.937	**30** 1.181	**80** 3.1496	**1** 0.039	**2.5** 0.098	NA4914	**86.3** 19400	**157** 35300	25.1	3500	5400	**0.772** 1.702
	70 2.7559	**100** 3.937	**54** 2.126	**80** 3.1496	**1** 0.039	**2** 0.079	NA6914A	**137** 30800	**286** 64300	45.7	3500	5400	**1.45** 3.197
75 2.9528	**75** 2.9528	**105** 4.1339	**25** 0.984	**85** 3.3465	**1** 0.039	**2** 0.079	NKJ75/25A	**76.4** 17200	**137** 30800	22.2	3300	5000	**0.64** 1.411
	75 2.9528	**105** 4.1339	**30** 1.181	**85** 3.3465	**1** 0.039	**2.5** 0.098	NA4915	**92.4** 20800	**175** 39300	28.0	3300	5000	**0.817** 1.801
	75 2.9528	**105** 4.1339	**35** 1.378	**85** 3.3465	**1** 0.039	**2** 0.079	NKJ75/35A	**108** 24300	**214** 48100	33.6	3300	5000	**1.05** 2.315
	75 2.9528	**105** 4.1339	**54** 2.126	**85** 3.3465	**1** 0.039	**2** 0.079	NA6915A	**143** 32100	**308** 69200	49.3	3300	5000	**1.554** 3.426
	75 2.9528	**110** 4.3307	**32** 1.26	**90** 3.5433	**1.1** 0.043	**1.5** 0.059	NKJS75A	**91.5** 20600	**176** 39600	28.1	3100	4700	**1.06** 2.337
80 3.1496	**80** 3.1496	**110** 4.3307	**25** 0.984	**90** 3.5433	**1** 0.039	**2** 0.079	NKJ80/25A	**79.5** 17900	**147** 33000	23.8	3100	4700	**0.79** 1.742
	80 3.1496	**110** 4.3307	**30** 1.181	**90** 3.5433	**1** 0.039	**2.5** 0.098	NA4916	**91.5** 20600	**176** 39600	28.1	3100	4700	**0.862** 1.9
	80 3.1496	**110** 4.3307	**35** 1.378	**90** 3.5433	**1** 0.039	**2** 0.079	NKJ80/35A	**113** 25400	**230** 51700	36.1	3100	4700	**0.98** 2.161
	80 3.1496	**110** 4.3307	**54** 2.126	**90** 3.5433	**1** 0.039	**2** 0.079	NA6916	**126** 28300	**320** 71900	50.8	3000	4700	**1.615** 3.56
	80 3.1496	**115** 4.5276	**32** 1.26	**95** 3.7402	**1.1** 0.043	**2** 0.079	NKJS80A	**95.1** 21400	**188** 42300	30.0	2900	4500	**1.14** 2.513
85 3.3465	**85** 3.3465	**115** 4.5276	**26** 1.024	**95** 3.7402	**1** 0.039	**3** 0.118	NKJ85/26A	**80.7** 18100	**152** 34200	32.8	2800	4400	**0.862** 1.9
	85 3.3465	**115** 4.5276	**36** 1.417	**95** 3.7402	**1** 0.039	**2** 0.079	NKJ85/36A	**114** 25600	**238** 53500	37.3	2800	4400	**1.04** 2.293
	85 3.3465	**120** 4.7244	**35** 1.378	**100** 3.937	**1.1** 0.043	**2.5** 0.098	NA4917	**110** 24700	**230** 51700	36.0	2800	4200	**1.31** 2.888
	85 3.3465	**120** 4.7244	**63** 2.48	**100** 3.937	**1.1** 0.043	**2** 0.079	NA6917A	**150** 33700	**416** 93500	64.2	2700	4200	**2.427** 5.351
90 3.5433	**90** 3.5433	**120** 4.7244	**26** 1.024	**100** 3.937	**1** 0.039	**3** 0.118	NKJ90/26A	**83.6** 18800	**163** 36600	25.8	2800	4200	**0.78** 1.72
	90 3.5433	**120** 4.7244	**36** 1.417	**100** 3.937	**1** 0.039	**2.5** 0.098	NKJ90/36A	**118** 26500	**254** 57100	39.1	2800	4200	**1.08** 2.381
	90 3.5433	**125** 4.9213	**35** 1.378	**105** 4.1339	**1.1** 0.043	**2.5** 0.098	NA4918	**114** 25600	**245** 55100	37.8	2600	4000	**1.37** 3.02

(1) Max. axial displacement

Continued on next page.

NEEDLE ROLLER BEARINGS WITH INNER RINGS

METRIC SERIES
NKJ, NKJS, NA48
NA49, NA69 SERIES



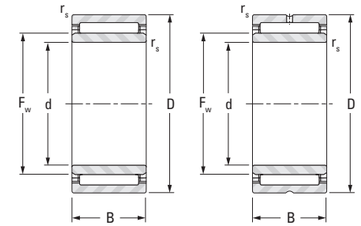
NKJ (d ≤ 7) | **NKJ (d ≥ 9), NKJS, NA48, NA49, NA69 (d ≤ 30)** | **NA69 (d ≥ 32)**

Shaft Dia.	d	D	B	F_w	$r_{s\ min.}$	$s^{(1)}$	Bearing Designation	Load Ratings		Fatigue Load Limit C_u	Speed Ratings		Approx. Wt.
								Dynamic	Static				
								C	C_0		Grease	Oil	
mm in	mm in	mm in	mm in	mm in	mm in	mm in		kN lbf		kN	min^{-1}		kg lbs
90 3.5433	**90** 3.5433	**125** 4.9213	**63** 2.48	**105** 4.1339	**1.1** 0.043	**2** 0.079	NA6918A	**175** 39300	**427** 96000	66.0	2600	4000	**2.64** 5.82
95 3.7402	**95** 3.7402	**125** 4.9213	**26** 1.024	**105** 4.1339	**1** 0.039	**2.5** 0.098	NKJ95/26A	**84.7** 19000	**168** 37800	26.3	2600	3900	**0.935** 2.061
	95 3.7402	**130** 5.1181	**35** 1.378	**110** 4.3307	**1.1** 0.043	**2.5** 0.098	NA4919	**115** 25900	**253** 56900	38.4	2500	3800	**1.43** 3.153
	95 3.7402	**130** 5.1181	**63** 2.48	**110** 4.3307	**1.1** 0.043	**2** 0.079	NA6919A	**180** 40500	**452** 102000	68.6	2500	3800	**2.67** 5.88
100 3.937	**100** 3.937	**130** 5.1181	**30** 1.181	**110** 4.3307	**1.1** 0.043	**2** 0.079	NKJ100/30A	**103** 23200	**220** 49500	33.6	2500	3800	**0.984** 2.169
	100 3.937	**130** 5.1181	**40** 1.575	**110** 4.3307	**1.1** 0.043	**2** 0.079	NKJ100/40A	**130** 29200	**296** 66500	44.8	2500	3800	**1.41** 3.109
	100 3.937	**135** 5.315	**32** 1.26	**115** 4.5276	**1.1** 0.043	**2** 0.079	NKJS100A	**104** 23400	**226** 50800	34.1	2400	3700	**2.01** 4.431
	100 3.937	**140** 5.5118	**40** 1.575	**115** 4.5276	**1.1** 0.043	**3.5** 0.138	NA4920	**152** 34200	**332** 74600	49.2	2400	3700	**2.01** 4.431
110 4.3307	**110** 4.3307	**140** 5.5118	**30** 1.181	**120** 4.7244	**1** 0.039	**0.5** 0.02	NA4822	**90.3** 20300	**230** 51700	33.7	2300	3500	**1.21** 2.668
	110 4.3307	**150** 5.9055	**40** 1.575	**125** 4.9213	**1.1** 0.043	**3.5** 0.138	NA4922	**147** 33000	**325** 73100	47.0	2200	3400	**2.19** 4.828
120 4.7244	**120** 4.7244	**150** 5.9055	**30** 1.181	**130** 5.1181	**1** 0.039	**0.5** 0.02	NA4824	**94.2** 21200	**249** 56000	35.7	2100	3200	**1.31** 2.888
	120 4.7244	**165** 6.4961	**45** 1.772	**135** 5.315	**1.1** 0.043	**3.5** 0.138	NA4924	**177** 39800	**407** 91500	58.5	2000	3100	**3.04** 6.702
130 5.1181	**130** 5.1181	**165** 6.4961	**35** 1.378	**145** 5.7087	**1.1** 0.043	**1** 0.039	NA4826	**112** 25200	**323** 72600	44.8	1900	2900	**1.99** 4.387
	130 5.1181	**180** 7.0866	**50** 1.969	**150** 5.9055	**1.5** 0.059	**3** 0.118	NA4926	**201** 45200	**495** 111000	68.7	1800	2800	**4.14** 9.127
140 5.5118	**140** 5.5118	**175** 6.8898	**35** 1.378	**155** 6.1024	**1.1** 0.043	**1** 0.039	NA4828	**116** 26100	**346** 77800	47.1	1700	2700	**2.12** 4.674
	140 5.5118	**190** 7.4803	**50** 1.969	**160** 6.2992	**1.5** 0.059	**3** 0.118	NA4928	**214** 48100	**549** 123000	74.8	1700	2600	**4.41** 9.72
150 5.9055	**150** 5.9055	**190** 7.4803	**40** 1.575	**165** 6.4961	**1.1** 0.043	**2** 0.079	NA4830A	**142** 31900	**402** 90400	53.5	1600	2500	**2.7** 5.952
160 6.2992	**160** 6.2992	**200** 7.874	**40** 1.575	**175** 6.8898	**1.1** 0.043	**2** 0.079	NA4832A	**146** 32800	**425** 95500	46.6	1500	2400	**3.15** 6.944

(1) Max. axial displacement

NEEDLE ROLLER BEARINGS WITH INNER RINGS

METRIC SERIES
NQI, NA49 SERIES



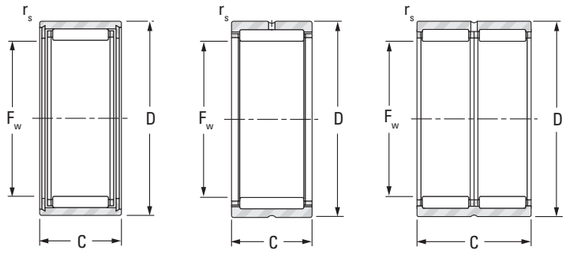
NQI | **NA49**

Shaft Dia.	d	D	B	F_w	$r_{s\ min.}$	$s^{(1)}$	Bearing Designation	Load Ratings		Fatigue Load Limit C_u	Speed Ratings		Approx. Wt.
								Dynamic	Static				
								C	C_0		Grease	Oil	
mm in	mm in	mm in	mm in	mm in	mm in	mm in		kN lbf		kN	min^{-1}		kg lbs
12 0.4724	**12**	**24**	**13**	**16**	**0.3**	—	NA4901C3	**8.65**	**11.1**	1.70	—	28000	**0.027**
20 0.7874	**20**	**32**	**20**	**24**	**0.3**	—	NQI203220AD	**17.4**	**26.5**	4.15	—	18000	**0.062**
	20	**37**	**17**	**25**	**0.3**	—	NA4904NA	**16.2**	**21.5**	3.25	—	18000	**0.083**
25 0.9843	**25**	**44**	**25**	**30**	**0.3**	—	25NQI4425A[2]	**36.6**	**49.6**	7.90	—	15000	**0.161**
30 1.1811	**30**	**47**	**17**	**35**	**0.3**	—	NA4906D	**20.2**	**31.9**	4.85	—	12000	**0.114**
38 1.4961	**38**	**53**	**30**	**43**	**0.6**	—	NQI38/30	**41.3**	**85.9**	13.4	—	9900	**0.205**

(1) Max. axial displacement
(2) Inner ring width 25.5mm

NEEDLE ROLLER BEARINGS WITHOUT INNER RINGS

METRIC SERIES
NK, NKS, RNA48, RNA49
RNA69 SERIES



NK (Fw ≤ 10) | **NK (Fw ≥ 12), NKS, RNA48, RNA49, RNA69 (Fw ≤ 35)** | **RNA69 (Fw ≥ 40)**

Shaft Dia.	F_w	D	C	$r_{s\ min.}$	Bearing Designation	Load Ratings		Fatigue Load Limit C_u	Speed Ratings		Approx. Wt.
						Dynamic	Static				
						C	C_0				
mm in	mm in	mm in	mm in	mm in		kN lbf		kN	min^{-1}		kg lbs
5 0.1969	**5** 0.1969	**10** 0.3937	**10** 0.394	**0.2** 0.006	NK5/10TN	**2.18** 490	**1.71** 384	0.260	31000	47000	**0.004** 0.009
	5 0.1969	**10** 0.3937	**12** 0.472	**0.2** 0.006	NK5/12TN	**3.04** 683	**2.63** 591	0.400	31000	47000	**0.004** 0.009
6 0.2362	**6** 0.2362	**12** 0.4724	**10** 0.394	**0.2** 0.006	NK6/10	**3.19** 717	**2.9** 652	0.420	29000	44000	**0.005** 0.011
	6 0.2362	**12** 0.4724	**12** 0.472	**0.2** 0.006	NK6/12TN	**3.07** 690	**2.74** 616	0.420	29000	44000	**0.006** 0.013
7 0.2756	**7** 0.2756	**14** 0.5512	**10** 0.394	**0.3** 0.012	NK7/10TN	**2.74** 616	**2.44** 549	0.370	28000	42000	**0.007** 0.015
	7 0.2756	**14** 0.5512	**12** 0.472	**0.3** 0.012	NK7/12TN	**3.4** 764	**3.22** 724	0.490	28000	42000	**0.009** 0.020
8 0.315	**8** 0.315	**15** 0.5906	**12** 0.472	**0.3** 0.012	NK8/12	**4.57** 1030	**4.89** 1 100	0.740	26000	41000	**0.011** 0.024
	8 0.315	**15** 0.5906	**12** 0.472	**0.3** 0.012	NK8/12ASR1	**4.57** 1030	**4.89** 1100	0.740	26000	41000	**0.011** 0.024
	8 0.315	**15** 0.5906	**16** 0.63	**0.3** 0.012	NK8/16	**5.22** 1170	**5.78** 1300	0.880	26000	41000	**0.013** 0.029
9 0.3543	**9** 0.3543	**16** 0.6299	**12** 0.472	**0.3** 0.012	NK9/12	**4.27** 960	**4.6** 1030	0.700	26000	40000	**0.012** 0.026
	9 0.3543	**16** 0.6299	**16** 0.63	**0.3** 0.012	NK9/16	**5.57** 1250	**6.47** 1450	0.980	26000	40000	**0.015** 0.033
10 0.3937	**10** 0.3937	**17** 0.6693	**12** 0.472	**0.3** 0.012	NK10/12	**5.4** 1210	**6.43** 1450	0.980	25000	39000	**0.013** 0.029
	10 0.3937	**17** 0.6693	**16** 0.63	**0.3** 0.012	NK10/16TN	**5.3** 1190	**6.27** 1410	0.940	25000	39000	**0.015** 0.033
12 0.4724	**12** 0.4724	**19** 0.748	**12** 0.472	**0.3** 0.012	NK12/12A	**6.86** 1540	**7.6** 1710	1.15	19000	30000	**0.013** 0.029
	12 0.4724	**19** 0.748	**16** 0.63	**0.3** 0.012	NK12/16	**6.78** 1520	**9.03** 2030	1.40	24000	37000	**0.018** 0.040
14 0.5512	**14** 0.5512	**22** 0.8661	**13** 0.512	**0.3** 0.012	RNA4900	**9.39** 2110	**10.3** 2320	1.55	16000	24000	**0.018** 0.040
	14 0.5512	**22** 0.8661	**16** 0.63	**0.3** 0.012	NK14/16A	**12.4** 2790	**14.8** 3330	2.25	16000	24000	**0.023** 0.051
	14 0.5512	**22** 0.8661	**20** 0.787	**0.3** 0.012	NK14/20A	**14.7** 3300	**18.4** 4140	2.90	16000	24000	**0.028** 0.060
15 0.5906	**15** 0.5906	**23** 0.9055	**16** 0.63	**0.3** 0.012	NK15/16A	**12.4** 2790	**15** 3370	2.30	15000	24000	**0.024** 0.053
	15 0.5906	**23** 0.9055	**20** 0.787	**0.3** 0.012	NK15/20A	**14.7** 3300	**18.6** 4180	2.95	15000	24000	**0.031** 0.068
16 0.6299	**16** 0.6299	**24** 0.9449	**13** 0.512	**0.3** 0.012	RNA4901	**10.5** 2360	**12.3** 2770	1.85	18000	28000	**0.020** 0.044
	16 0.6299	**24** 0.9449	**16** 0.63	**0.3** 0.012	NK16/16A	**13** 2920	**16.2** 3640	2.50	18000	28000	**0.025** 0.055
16 0.6299	**16** 0.6299	**24** 0.9449	**20** 0.787	**0.3** 0.012	NK16/20A	**15.4** 3460	**20.2** 4540	3.20	18000	28000	**0.036** 0.079
	16 0.6299	**24** 0.9449	**22** 0.866	**0.3** 0.012	RNA6901	**16.1** 3620	**21.3** 4790	3.30	18000	28000	**0.036** 0.079
17 0.6693	**17** 0.6693	**25** 0.9843	**16** 0.63	**0.3** 0.012	NK17/16A	**13.6** 3060	**17.5** 3930	2.70	17000	27000	**0.027** 0.060
	17 0.6693	**25** 0.9843	**20** 0.787	**0.3** 0.012	NK17/20A	**15.4** 3460	**20.4** 4590	3.25	17000	27000	**0.034** 0.075
18 0.7087	**18** 0.7087	**26** 1.0236	**16** 0.63	**0.3** 0.012	NK18/16A	**13.6** 3060	**17.7** 3980	2.70	16000	25000	**0.028** 0.062
	18 0.7087	**26** 1.0236	**20** 0.787	**0.3** 0.012	NK18/20A	**16.1** 3620	**22.0** 4950	3.50	16000	25000	**0.035** 0.077
	18 0.7087	**30** 1.1811	**16** 0.63	**0.3** 0.012	NKS18A	**15.9** 3570	**16.2** 3640	2.45	17000	26000	**0.045** 0.099
19 0.748	**19** 0.748	**27** 1.063	**16** 0.63	**0.3** 0.012	NK19/16A	**14.1** 3170	**19.0** 4270	2.90	15000	24000	**0.029** 0.064
	19 0.748	**27** 1.063	**20** 0.787	**0.3** 0.012	NK19/20A	**18.8** 4230	**23.6** 5310	3.75	15000	24000	**0.037** 0.082
20 0.7874	**20** 0.7874	**28** 1.1024	**13** 0.512	**0.3** 0.012	RNA4902	**11.8** 2650	**15.3** 3440	2.35	14000	22000	**0.023** 0.051
	20 0.7874	**28** 1.1024	**16** 0.63	**0.3** 0.012	NK20/16A	**14.1** 3170	**19.1** 4290	2.90	14000	22000	**0.030** 0.066
	20 0.7874	**28** 1.1024	**20** 0.787	**0.3** 0.012	NK20/20A	**17.5** 3930	**25.3** 5690	4.00	14000	22000	**0.038** 0.084
	20 0.7874	**28** 1.1024	**23** 0.906	**0.3** 0.012	RNA6902A	**18.4** 4140	**26.9** 6050	4.20	14000	22000	**0.042** 0.093
	20 0.7874	**32** 1.2598	**20** 0.787	**0.6** 0.024	NKS20A	**24.4** 5490	**26.7** 6000	4.30	15000	24000	**0.058** 0.128
21 0.8268	**21** 0.8268	**29** 1.1417	**16** 0.63	**0.3** 0.012	NK21/16A	**15.3** 3440	**21.6** 4860	3.30	14000	21000	**0.032** 0.071
	21 0.8268	**29** 1.1417	**20** 0.787	**0.3** 0.012	NK21/20A	**18.1** 4070	**26.9** 6050	4.25	14000	21000	**0.040** 0.088
22 0.8661	**22** 0.8661	**30** 1.1811	**13** 0.512	**0.3** 0.012	RNA4903	**12.2** 2740	**16.4** 3690	2.50	13000	20000	**0.025** 0.055
	22 0.8661	**30** 1.1811	**16** 0.63	**0.3** 0.012	NK22/16A	**15.2** 3420	**21.7** 4880	3.30	13000	20000	**0.033** 0.073
	22 0.8661	**30** 1.1811	**20** 0.787	**0.3** 0.012	NK22/20A	**18** 4050	**27** 6070	4.30	13000	20000	**0.041** 0.090
	22 0.8661	**30** 1.1811	**23** 0.906	**0.3** 0.012	RNA6903A	**19.8** 4450	**30.6** 6880	4.75	13000	20000	**0.056** 0.123
	22 0.8661	**35** 1.378	**20** 0.787	**0.6** 0.024	NKS22A	**22.9** 5150	**27.1** 6090	4.30	14000	21000	**0.069** 0.152
24 0.9449	**24** 0.9449	**32** 1.2598	**16** 0.63	**0.3** 0.012	NK24/16A	**16.2** 3640	**24.3** 5460	3.70	12000	18000	**0.035** 0.077
	24 0.9449	**32** 1.2598	**20** 0.787	**0.3** 0.012	NK24/20A	**19.3** 4340	**30.3** 6810	4.80	12000	18000	**0.045** 0.099
	24 0.9449	**37** 1.4567	**20** 0.787	**0.6** 0.024	NKS24A	**29.1** 6540	**32.8** 7370	5.30	13000	20000	**0.073** 0.161
25 0.9843	**25** 0.9843	**33** 1.2992	**16** 0.63	**0.3** 0.012	NK25/16A	**16.1** 3620	**24.4** 5490	3.75	11000	17000	**0.037** 0.082
	25 0.9843	**33** 1.2992	**20** 0.787	**0.3** 0.012	NK25/20A	**19.1** 4290	**30.4** 6830	4.80	11000	17000	**0.047** 0.104
	25 0.9843	**37** 1.4567	**17** 0.669	**0.3** 0.012	RNA4904	**21.3** 4790	**25.5** 5730	3.95	12000	18000	**0.061** 0.134
	25 0.9843	**37** 1.4567	**30** 1.181	**0.3** 0.012	RNA6904A	**36.6** 8230	**51.0** 11500	7.95	12000	18000	**0.091** 0.201

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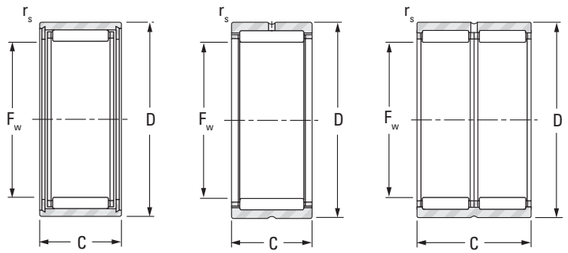
NEEDLE ROLLER BEARINGS WITHOUT INNER RINGS

METRIC SERIES
NK, NKS, RNA48, RNA49
RNA69 SERIES



NK (Fw ≤ 10) | **NK (Fw ≥ 12), NKS, RNA48, RNA49, RNA69 (Fw ≤ 35)** | **RNA69 (Fw ≥ 40)**

Shaft Dia.	F_w	D	C	$r_{s\ min.}$	Bearing Designation	Load Ratings		Fatigue Load Limit C_u	Speed Ratings		Approx. Wt.
						Dynamic	Static				
						C	C_0				
mm in	mm in	mm in	mm in	mm in		kN lbf		kN	min^{-1}		kg lbs
25 0.9843	**25** 0.9843	**38** 1.4961	**20** 0.787	**0.6** 0.024	NKS25A	**29.1** 6540	**33** 7420	5.30	12000	19000	**0.076** 0.168
26 1.0236	**26** 1.0236	**34** 1.3386	**16** 0.63	**0.3** 0.012	NK26/16A	**16.6** 3730	**25.7** 5780	3.95	11000	17000	**0.039** 0.086
	26 1.0236	**34** 1.3386	**20** 0.787	**0.3** 0.012	NK26/20A	**19.7** 4430	**32** 7190	5.05	11000	17000	**0.048** 0.106
28 1.1024	**28** 1.1024	**37** 1.4567	**20** 0.787	**0.3** 0.012	NK28/20A	**22.6** 5080	**34.4** 7730	5.50	10000	16000	**0.057** 0.126
	28 1.1024	**37** 1.4567	**30** 1.181	**0.3** 0.012	NK28/30A	**29** 6520	**53.8** 12100	8.30	10000	16000	**0.088** 0.194
	28 1.1024	**39** 1.5354	**17** 0.669	**0.3** 0.012	RNA49/22	**23.3** 5240	**29.6** 6650	4.55	10000	16000	**0.059** 0.130
	28 1.1024	**39** 1.5354	**30** 1.181	**0.3** 0.012	RNA69/22A	**30.6** 6880	**50.7** 11400	3.95	10000	16000	**0.107** 0.236
	28 1.1024	**42** 1.6535	**20** 0.787	**0.6** 0.024	NKS28A	**30.3** 6810	**38.4** 8630	6.15	11000	16000	**0.094** 0.207
29 1.1417	**29** 1.1417	**38** 1.4961	**20** 0.787	**0.3** 0.012	NK29/20A	**23.4** 5260	**36.4** 8180	5.80	9800	15000	**0.059** 0.130
	29 1.1417	**38** 1.4961	**30** 1.181	**0.3** 0.012	NK29/30A	**29.8** 6700	**56.4** 12700	8.70	9700	15000	**0.090** 0.198
30 1.1811	**30** 1.1811	**40** 1.5748	**20** 0.787	**0.3** 0.012	NK30/20A	**24.2** 5440	**38.3** 8610	6.10	9500	15000	**0.071** 0.157
	30 1.1811	**40** 1.5748	**30** 1.181	**0.3** 0.012	NK30/30A	**34.7** 7800	**61** 13700	9.45	9500	15000	**0.107** 0.236
	30 1.1811	**42** 1.6535	**17** 0.669	**0.3** 0.012	RNA4905	**24.3** 5460	**31.7** 7130	4.90	9700	15000	**0.071** 0.157
	30 1.1811	**42** 1.6535	**30** 1.181	**0.3** 0.012	RNA6905A	**39.7** 8920	**59.6** 13400	9.30	9700	15000	**0.127** 0.280
	30 1.1811	**45** 1.7717	**22** 0.866	**0.6** 0.024	NKS30A	**34.3** 7710	**42.8** 9620	6.85	9900	15000	**0.114** 0.251
32 1.2598	**32** 1.2598	**42** 1.6535	**20** 0.787	**0.3** 0.012	NK32/20A	**24.8** 5580	**40.4** 9080	6.45	8800	14000	**0.074** 0.163
	32 1.2598	**42** 1.6535	**30** 1.181	**0.3** 0.012	NK32/30A	**35.6** 8000	**64.3** 14500	9.95	8800	14000	**0.112** 0.247
	32 1.2598	**45** 1.7717	**17** 0.669	**0.3** 0.012	RNA49/28	**25.1** 5640	**33.8** 7600	5.20	9000	14000	**0.080** 0.176
	32 1.2598	**45** 1.7717	**30** 1.181	**0.3** 0.012	RNA69/28A	**43.2** 9710	**62.5** 14100	9.75	9100	14000	**0.140** 0.309
	32 1.2598	**47** 1.8504	**22** 0.866	**0.6** 0.024	NKS32A	**36** 8090	**46.2** 10400	7.40	9200	14000	**0.120** 0.265
35 1.378	**35** 1.378	**45** 1.7717	**20** 0.787	**0.3** 0.012	NK35/20A	**26.1** 5870	**44.4** 9980	7.05	8000	12000	**0.081** 0.179
	35 1.378	**45** 1.7717	**30** 1.181	**0.3** 0.012	NK35/30A	**37.4** 8410	**70.6** 15900	11.0	8000	12000	**0.122** 0.269

Shaft Dia.	F_w	D	C	$r_{s\ min.}$	Bearing Designation	Load Ratings		Fatigue Load Limit C_u	Speed Ratings		Approx. Wt.
						Dynamic	Static				
						C	C_0				
mm in	mm in	mm in	mm in	mm in		kN lbf		kN	min^{-1}		kg lbs
35 1.378	**35** 1.378	**47** 1.8504	**18** 0.709	**0.3** 0.012	RNA4906	**25.9** 5820	**36** 8090	5.55	8200	13000	**0.081** 0.179
	35 1.378	**47** 1.8504	**30** 1.181	**0.3** 0.012	RNA6906A	**42.6** 9580	**68.2** 15300	10.6	8200	13000	**0.148** 0.326
	35 1.378	**50** 1.9685	**22** 0.866	**0.6** 0.024	NKS35A	**37.5** 8430	**49.9** 11200	8.00	8400	13000	**0.130** 0.287
37 1.4567	**37** 1.4567	**47** 1.8504	**20** 0.787	**0.3** 0.012	NK37/20A	**26.6** 5980	**46.4** 10400	7.40	7600	12000	**0.084** 0.185
	37 1.4567	**47** 1.8504	**30** 1.181	**0.3** 0.012	NK37/30A	**38.2** 8590	**73.9** 16600	11.5	7600	12000	**0.128** 0.282
	37 1.4567	**52** 2.0472	**22** 0.866	**0.6** 0.024	NKS37A	**39** 8770	**53.4** 12000	8.55	7900	12000	**0.134** 0.295
38 1.4961	**38** 1.4961	**48** 1.8898	**20** 0.787	**0.3** 0.012	NK38/20A	**21.7** 4880	**40.9** 9190	6.40	7300	11000	**0.087** 0.192
	38 1.4961	**48** 1.8898	**30** 1.181	**0.3** 0.012	NK38/30A	**31.9** 7170	**67** 15100	10.4	7300	11000	**0.131** 0.289
40 1.5748	**40** 1.5748	**50** 1.9685	**20** 0.787	**0.3** 0.012	NK40/20A	**27.8** 6250	**50.4** 11300	8.05	7000	11000	**0.089** 0.196
	40 1.5748	**50** 1.9685	**30** 1.181	**0.3** 0.012	NK40/30A	**40** 8990	**80.2** 18000	12.4	7000	11000	**0.137** 0.302
	40 1.5748	**52** 2.0472	**20** 0.787	**0.6** 0.024	RNA49/32	**32** 7190	**49.3** 11100	7.85	7100	11000	**0.100** 0.220
	40 1.5748	**52** 2.0472	**36** 1.417	**0.6** 0.024	RNA69/32A	**48.6** 10900	**84.5** 19000	26.1	7100	11000	**0.185** 0.408
	40 1.5748	**55** 2.1654	**22** 0.866	**0.6** 0.024	NKS40A	**40.3** 9060	**57** 12800	9.15	7200	11000	**0.140** 0.309
42 1.6535	**42** 1.6535	**52** 2.0472	**20** 0.787	**0.3** 0.012	NK42/20A	**28.3** 6360	**52.4** 11800	8.35	6600	10000	**0.085** 0.187
	42 1.6535	**52** 2.0472	**30** 1.181	**0.3** 0.012	NK42/30A	**40.7** 9150	**83.5** 18800	13.0	6600	10000	**0.141** 0.311
	42 1.6535	**55** 2.1654	**20** 0.787	**0.6** 0.024	RNA4907	**32.8** 7370	**51.7** 11600	8.25	6700	10000	**0.114** 0.251
	42 1.6535	**55** 2.1654	**36** 1.417	**0.6** 0.024	RNA6907A	**49.9** 11200	**88.7** 19900	13.7	6700	10000	**0.218** 0.481
43 1.6929	**43** 1.6929	**53** 2.0866	**20** 0.787	**0.3** 0.012	NK43/20A	**29** 6520	**54.4** 12200	8.65	6400	9900	**0.096** 0.212
	43 1.6929	**53** 2.0866	**30** 1.181	**0.3** 0.012	NK43/30A	**41.6** 9350	**86.6** 19500	13.4	6400	9900	**0.134** 0.295
	43 1.6929	**58** 2.2835	**22** 0.866	**0.6** 0.024	NKS43A	**41.6** 9350	**60.7** 13600	9.75	6700	10000	**0.150** 0.331
45 1.7717	**45** 1.7717	**55** 2.1654	**20** 0.787	**0.3** 0.012	NK45/20A	**29.5** 6630	**56.4** 12700	9.00	6100	9400	**0.100** 0.220
	45 1.7717	**55** 2.1654	**30** 1.181	**0.3** 0.012	NK45/30A	**42.3** 9510	**89.8** 20200	13.9	6100	9400	**0.151** 0.333
	45 1.7717	**60** 2.3622	**22** 0.866	**0.6** 0.024	NKS45A	**43** 9670	**64.2** 14400	10.3	6400	9800	**0.156** 0.344
47 1.8504	**47** 1.8504	**57** 2.2441	**20** 0.787	**0.3** 0.012	NK47/20A	**30** 6740	**58.5** 13200	9.30	5900	9000	**0.104** 0.229
	47 1.8504	**57** 2.2441	**30** 1.181	**0.3** 0.012	NK47/30A	**43** 9670	**93.1** 20900	14.4	5900	9000	**0.158** 0.348
48 1.8898	**48** 1.8898	**62** 2.4409	**22** 0.866	**0.6** 0.024	RNA4908	**44.2** 9940	**67.8** 15200	10.9	5900	9100	**0.154** 0.340
	48 1.8898	**62** 2.4409	**40** 1.575	**0.6** 0.024	RNA6908A	**70.8** 15900	**124** 27900	19.8	5900	9100	**0.300** 0.661
50 1.9685	**50** 1.9685	**62** 2.4409	**25** 0.984	**0.3** 0.012	NK50/25A	**40.7** 9150	**79.3** 17800	12.5	5500	8500	**0.171** 0.377

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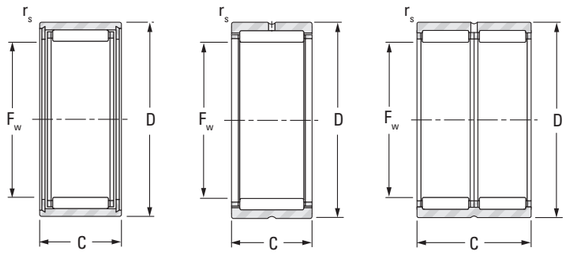
NEEDLE ROLLER BEARINGS WITHOUT INNER RINGS

METRIC SERIES
NK, NKS, RNA48, RNA49
RNA69 SERIES



NK (Fw ≤ 10) | **NK (Fw ≥ 12), NKS, RNA48, RNA49, RNA69 (Fw ≤ 35)** | **RNA69 (Fw ≥ 40)**

Shaft Dia.	F_w	D	C	$r_{s\ min.}$	Bearing Designation	Load Ratings		Fatigue Load Limit C_u	Speed Ratings		Approx. Wt.
						Dynamic	Static				
						C	C_0		Grease	Oil	
mm in	mm in	mm in	mm in	mm in		kN lbf		kN	min^{-1}		kg lbs
50 1.9685	**50** 1.9685	**62** 2.4409	**35** 1.378	**0.6** 0.024	NK50/35A	**55** 12400	**117** 26300	18.2	5500	8500	**0.242** 0.534
	50 1.9685	**65** 2.5591	**22** 0.866	**1** 0.039	NKS50A	**45.5** 10200	**71.3** 16000	11.4	5700	8700	**0.170** 0.375
52 2.0472	**52** 2.0472	**68** 2.6772	**22** 0.866	**0.6** 0.024	RNA4909	**46.8** 10500	**74.8** 16800	12.0	5400	8400	**0.201** 0.443
	52 2.0472	**68** 2.6772	**40** 1.575	**0.6** 0.024	RNA6909A	**74.7** 16800	**137** 30800	21.7	5400	8400	**0.392** 0.864
55 2.1654	**55** 2.1654	**68** 2.6772	**25** 0.984	**0.6** 0.024	NK55/25A	**46.1** 10400	**87.3** 19600	13.9	5000	7800	**0.207** 0.456
	55 2.1654	**68** 2.6772	**35** 1.378	**0.6** 0.024	NK55/35A	**62.3** 14000	**129** 29000	20.0	5000	7800	**0.293** 0.646
	55 2.1654	**72** 2.8346	**22** 0.866	**1** 0.039	NKS55A	**47.9** 10800	**78.4** 17600	12.6	5100	7900	**0.225** 0.496
58 2.2835	**58** 2.2835	**72** 2.8346	**22** 0.866	**0.6** 0.024	RNA4910	**48.9** 11000	**82** 18400	13.2	4800	7400	**0.179** 0.395
	58 2.2835	**72** 2.8346	**40** 1.575	**0.6** 0.024	RNA6910A	**75.7** 17000	**144** 32400	22.8	4800	7400	**0.364** 0.802
60 2.3622	**60** 2.3622	**72** 2.8346	**25** 0.984	**0.6** 0.024	NK60/25A	**44.3** 9960	**94** 21100	14.9	4400	7000	**0.202** 0.445
	60 2.3622	**72** 2.8346	**35** 1.378	**0.6** 0.024	NK60/35A	**59.9** 13500	**139** 31200	21.5	4400	7000	**0.286** 0.631
	60 2.3622	**80** 3.1496	**28** 1.102	**1.1** 0.043	NKS60A	**66.9** 15000	**103** 23200	16.5	4800	7300	**0.337** 0.743
63 2.4803	**63** 2.4803	**80** 3.1496	**25** 0.984	**1** 0.039	RNA4911	**62** 13900	**107** 24100	17.1	4500	6900	**0.285** 0.628
	63 2.4803	**80** 3.1496	**45** 1.772	**1** 0.039	RNA6911A	**94.2** 21200	**172** 38700	27.8	4500	6900	**0.540** 1.190
65 2.5591	**65** 2.5591	**78** 3.0709	**25** 0.984	**0.6** 0.024	NK65/25A	**48.2** 10800	**97.7** 22000	15.5	4200	6500	**0.257** 0.567
	65 2.5591	**78** 3.0709	**35** 1.378	**0.6** 0.024	NK65/35A	**65.2** 14700	**144** 32400	22.4	4200	6500	**0.298** 0.657
	65 2.5591	**85** 3.3465	**28** 1.102	**1.1** 0.043	NKS65A	**71** 16000	**114** 25600	18.3	4200	6700	**0.362** 0.798
68 2.6772	**68** 2.6772	**82** 3.2283	**25** 0.984	**0.6** 0.024	NK68/25A	**49** 11000	**101** 22700	16.1	4000	6200	**0.287** 0.633
	68 2.6772	**82** 3.2283	**35** 1.378	**0.6** 0.024	NK68/35A	**66.2** 14900	**149** 33500	23.2	4000	6200	**0.350** 0.772
	68 2.6772	**85** 3.3465	**25** 0.984	**1** 0.039	RNA4912	**64.8** 14600	**116** 26100	18.6	4100	6300	**0.304** 0.670
	68 2.6772	**85** 3.3465	**45** 1.772	**1** 0.039	RNA6912A	**99.3** 22300	**189** 42500	30.5	4100	6300	**0.546** 1.204
70 2.7559	**70** 2.7559	**85** 3.3465	**25** 0.984	**0.6** 0.024	NK70/25A	**43.6** 9800	**87.9** 19800	16.6	3900	6000	**0.298** 0.657
70 2.7559	**70** 2.7559	**85** 3.3465	**35** 1.378	**0.6** 0.024	NK70/35A	**62.2** 14000	**139** 31200	24.0	3900	6000	**0.411** 0.906
	70 2.7559	**90** 3.5433	**28** 1.102	**1.1** 0.043	NKS70A	**72.6** 16300	**120** 27000	19.3	4000	6200	**0.383** 0.844
72 2.8346	**72** 2.8346	**90** 3.5433	**25** 0.984	**1** 0.039	RNA4913	**66** 14800	**121** 27200	19.4	3900	5900	**0.346** 0.763
	72 2.8346	**90** 3.5433	**45** 1.772	**1** 0.039	RNA6913A	**107** 24100	**213** 47900	34.5	3900	5900	**0.679** 1.497
73 2.874	**73** 2.874	**90** 3.5433	**25** 0.984	**0.6** 0.024	NK73/25A	**61.5** 13800	**119** 26800	19.0	3800	5800	**0.320** 0.705
	73 2.874	**90** 3.5433	**35** 1.378	**0.6** 0.024	NK73/35A	**82.5** 18500	**173** 38900	27.1	3800	5800	**0.450** 0.992
75 2.9528	**75** 2.9528	**92** 3.622	**25** 0.984	**0.6** 0.024	NK75/25A	**43.7** 9820	**90.2** 20300	19.0	3600	5600	**0.364** 0.802
	75 2.9528	**92** 3.622	**35** 1.378	**0.6** 0.024	NK75/35A	**60.9** 13700	**138** 31000	27.1	3600	5600	**0.518** 1.142
	75 2.9528	**95** 3.7402	**28** 1.102	**1.1** 0.043	NKS75A	**76.5** 17200	**132** 29700	21.1	3700	5800	**0.413** 0.911
80 3.1496	**80** 3.1496	**95** 3.7402	**25** 0.984	**1** 0.039	NK80/25A	**65** 14600	**131** 29400	21.0	3400	5300	**0.331** 0.730
	80 3.1496	**95** 3.7402	**35** 1.378	**1** 0.039	NK80/35A	**79.7** 17900	**184** 41400	28.7	3400	5300	**0.380** 0.838
	80 3.1496	**100** 3.937	**30** 1.181	**1** 0.039	RNA4914	**86.3** 19400	**157** 35300	25.1	3500	5400	**0.502** 1.107
	80 3.1496	**100** 3.937	**54** 2.126	**1** 0.039	RNA6914A	**137** 30800	**286** 64300	45.7	3500	5400	**0.946** 2.086
85 3.3465	**85** 3.3465	**105** 4.1339	**25** 0.984	**1** 0.039	NK85/25A	**76.4** 17200	**137** 30800	22.2	3300	5000	**0.506** 1.116
	85 3.3465	**105** 4.1339	**30** 1.181	**1** 0.039	RNA4915	**92.4** 20800	**175** 39300	28.0	3300	5000	**0.528** 1.164
	85 3.3465	**105** 4.1339	**35** 1.378	**1** 0.039	NK85/35A	**108** 24300	**214** 48100	34.7	3300	5000	**0.610** 1.345
	85 3.3465	**105** 4.1339	**54** 2.126	**1** 0.039	RNA6915A	**143** 32100	**308** 69200	49.3	3300	5000	**1.020** 2.249
90 3.5433	**90** 3.5433	**110** 4.3307	**25** 0.984	**1** 0.039	NK90/25A	**79.5** 17900	**147** 33000	23.8	3100	4700	**0.450** 0.992
	90 3.5433	**110** 4.3307	**30** 1.181	**1** 0.039	RNA4916	**91.5** 20600	**176** 39600	28.1	3100	4700	**0.556** 1.226
	90 3.5433	**110** 4.3307	**35** 1.378	**1** 0.039	NK90/35A	**113** 25400	**230** 51700	36.1	3100	4700	**0.745** 1.642
	90 3.5433	**110** 4.3307	**54** 2.126	**1** 0.039	RNA6916A	**126** 28300	**320** 71900	50.8	3100	4700	**1.050** 2.315
95 3.7402	**95** 3.7402	**115** 4.5276	**26** 1.024	**1** 0.039	NK95/26A	**49.3** 11100	**114** 25600	24.6	2800	4400	**0.572** 1.261
	95 3.7402	**115** 4.5276	**36** 1.417	**1** 0.039	NK95/36A	**114** 25600	**238** 53500	37.3	2900	4500	**0.803** 1.770
100 3.937	**100** 3.937	**120** 4.7244	**26** 1.024	**1** 0.039	NK100/26A	**83.6** 18800	**163** 36600	25.8	2800	4200	**0.530** 1.168
	100 3.937	**120** 4.7244	**35** 1.378	**1.1** 0.043	RNA4917	**110** 24700	**230** 51700	36.0	2800	4200	**0.715** 1.576
	100 3.937	**120** 4.7244	**36** 1.417	**1** 0.039	NK100/36A	**118** 26500	**254** 57100	39.1	2800	4200	**0.658** 1.451
	100 3.937	**120** 4.7244	**63** 2.48	**1.1** 0.043	RNA6917A	**150** 33700	**416** 93500	63.0	2800	4200	**1.350** 2.976
105 4.1339	**105** 4.1339	**125** 4.9213	**26** 1.024	**1** 0.039	NK105/26A	**52.2** 11700	**127** 28600	19.9	2600	3900	**0.595** 1.312

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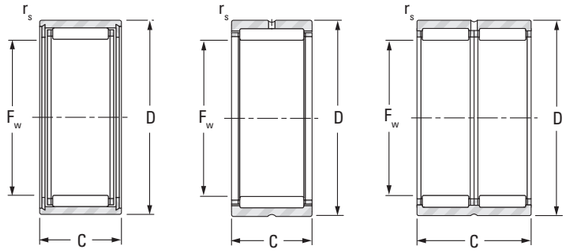
NEEDLE ROLLER BEARINGS WITHOUT INNER RINGS

METRIC SERIES
NK, NKS, RNA48, RNA49
RNA69 SERIES

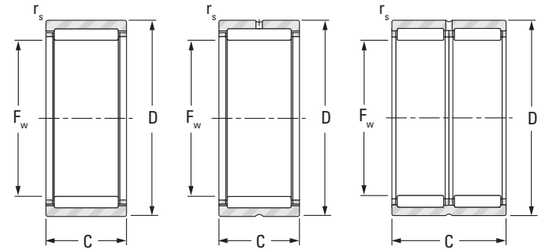


NK (Fw ≤ 10) | **NK (Fw ≥ 12), NKS, RNA48, RNA49, RNA69 (Fw ≤ 35)** | **RNA69 (Fw ≥ 40)**

Shaft Dia.	F_w	D	C	$r_{s\ min.}$	Bearing Designation	Load Ratings		Fatigue Load Limit C_u	Speed Ratings		Approx. Wt.
						Dynamic	Static				
						C	C_0		Grease	Oil	
mm in	mm in	mm in	mm in	mm in		kN lbf		kN	min^{-1}		kg lbs
105 4.1339	**105** 4.1339	**125** 4.9213	**35** 1.378	**1.1** 0.043	RNA4918	**114** 25600	**245** 55100	37.8	2600	4000	**0.746** 1.645
	105 4.1339	**125** 4.9213	**63** 2.48	**1.1** 0.043	RNA6918A	**154** 34600	**437** 98200	66.0	2600	4000	**1.500** 3.300
110 4.3307	**110** 4.3307	**130** 5.1181	**30** 1.181	**1.1** 0.043	NK110/30A	**103** 23200	**220** 49500	33.6	2500	3800	**0.660** 1.455
	110 4.3307	**130** 5.1181	**35** 1.378	**1.1** 0.043	RNA4919	**115** 25900	**253** 56900	38.4	2500	3800	**0.777** 1.713
	110 4.3307	**130** 5.1181	**40** 1.575	**1.1** 0.043	NK110/40A	**132** 29700	**301** 67700	45.7	2500	3800	**0.900** 1.984
	110 4.3307	**130** 5.1181	**63** 2.48	**1.1** 0.043	RNA6919A	**158** 35500	**458** 103000	68.8	2500	3800	**1.470** 3.241
115 4.5276	**115** 4.5276	**140** 5.5118	**40** 1.575	**1.1** 0.043	RNA4920	**139** 31200	**296** 66500	43.9	2400	3700	**1.220** 2.690
120 4.7244	**120** 4.7244	**140** 5.5118	**30** 1.181	**1** 0.039	RNA4822	**90.3** 20300	**230** 51700	33.7	2300	3500	**0.785** 1.731
125 4.9213	**125** 4.9213	**150** 5.9055	**40** 1.575	**1.1** 0.043	RNA4922	**147** 33000	**325** 73100	47.0	2200	3400	**1.320** 2.910
130 5.1181	**130** 5.1181	**150** 5.9055	**30** 1.181	**1** 0.039	RNA4824	**94.1** 21200	**249** 56000	35.7	2100	3200	**0.850** 1.874
135 5.315	**135** 5.315	**165** 6.4961	**45** 1.772	**1.1** 0.043	RNA4924	**177** 39800	**407** 91500	58.5	2000	3100	**1.980** 4.365
145 5.7087	**145** 5.7087	**165** 6.4961	**35** 1.378	**1** 0.039	RNA4826	**112** 25200	**323** 72600	44.8	1900	2900	**1.100** 2.425
150 5.9055	**150** 5.9055	**180** 7.0866	**50** 1.969	**1.5** 0.059	RNA4926	**201** 45200	**495** 111000	68.7	1800	2800	**2.420** 5.335
155 6.1024	**155** 6.1024	**175** 6.8898	**35** 1.378	**1.1** 0.043	RNA4828	**116** 26100	**346** 77800	47.1	1700	2700	**1.170** 2.579
160 6.2992	**160** 6.2992	**190** 7.4803	**50** 1.969	**1.5** 0.059	RNA4928	**214** 48100	**549** 123000	74.8	1700	2600	**2.560** 5.644
165 6.4961	**165** 6.4961	**190** 7.4803	**40** 1.575	**1.1** 0.043	RNA4830A	**142** 31900	**402** 90400	53.5	1600	2500	**1.540** 3.395
175 6.8898	**175** 6.8898	**200** 7.874	**40** 1.575	**1.1** 0.043	RNA4832A	**146** 32800	**425** 95500	55.6	1500	2400	**1.910** 4.211

NEEDLE ROLLER BEARINGS WITHOUT INNER RINGS

METRIC SERIES
NQ, RNA49, RNA69 SERIES



NQ | **RNA49** | **RNA69**

Shaft Dia.	F_w	D	C	$r_{s\ min.}$	Bearing Designation	Load Ratings		Fatigue Load Limit C_u	Speed Ratings		Approx. Wt.
						Dynamic	Static				
						C	C_0		Grease	Oil	
mm in	mm in	mm in	mm in	mm in		kN lbf		kN	min^{-1}		kg lbs
12 0.4724	**12**	**19**	**12**	**0.3**	NQ12/12AD	**5.3**	**5.45**	0.820	—	30000	**0.012**
	12	**24**	**9.8**	**0.3**	12NQ2410A	**5.9**	**6.3**	0.960	—	30000	**0.023**
13 0.5118	**13**	**21**	**12**	**0.3**	NQ132112	**8.25**	**8.4**	1.30	—	24000	**0.015**
14 0.5512	**14**	**22**	**16**	**0.5**	NQ14/16D	**11.8**	**13.8**	2.10	—	24000	**0.021**
15 0.5906	**15**	**23**	**16**	**0.5**	NQ15/16B	**15.2**	**17.4**	2.65	—	21000	**0.021**
	15	**24**	**10**	**0.3**	15NQ2410D	**8.65**	**8.45**	1.30	—	21000	**0.016**
	15	**24**	**12**	**0.3**	15NQ2412A	**9.7**	**9.75**	1.50	—	21000	**0.019**
	15	**25**	**12**	**0.6**	NQ152512	**10.7**	**11.1**	1.70	—	21000	**0.022**
	15	**25**	**16**	**0.5**	NQ152516[1]	**11.8**	**14**	2.10	—	24000	**0.032**
	15	**28**	**12**	**0.6**	15NQ2812	**10.7**	**11.1**	1.70	—	21000	**0.034**
	15	**28**	**12**	**0.6**	NQ152812-1	**10.7**	**11.1**	1.70	—	21000	**0.034**
	15	**28**	**15**	**1.0**	15NQ2815	**12.7**	**13.7**	2.10	—	21000	**0.042**
16 0.6299	**16**	**23**	**16**	**0.5**	16NQ2316	**13**	**16.2**	2.50	—	23000	**0.019**
	16	**23**	**22**	**0.5**	16NQ2322A	**17**	**22.9**	3.55	—	23000	**0.026**
17 0.6693	**17**	**25**	**16**	**0.5**	NQ17/16D	**11.4**	**16.2**	2.45	—	26000	**0.026**
	17	**30**	**13**	**0.3**	17NQ3013D	**10.2**	**10.8**	1.65	—	27000	**0.041**
	17	**32**	**16**	**0.6**	17NQ3216D	**18.5**	**17.1**	2.65	—	29000	**0.053**
18 0.7087	**18**	**29**	**25**	**0.3**	NQ182925-1	**24.2**	**27.5**	4.30	—	26000	**0.056**
	18	**34**	**20**	**0.3**	18NQ3420AD	**17.1**	**21.2**	3.35	—	25000	**0.090**
20 0.7874	**20**	**28**	**16**	**0.3**	NQ20/16D	**12.1**	**18.2**	2.75	—	22000	**0.030**
	20	**28**	**23**	**0.3**	NQ202823	**18.5**	**27.1**	4.25	—	22000	**0.040**
	20	**30**	**15**	**0.6**	20NQ3015ED	**11.4**	**15.4**	2.35	—	22000	**0.037**

[1] With outer ring groove

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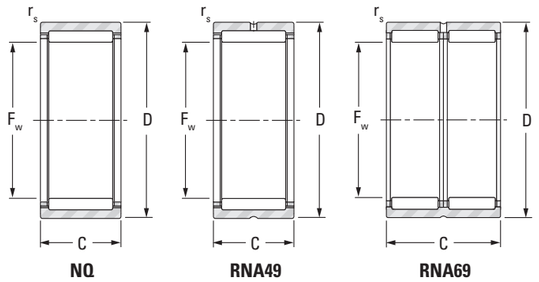
B

NEEDLE ROLLER BEARINGS WITHOUT INNER RINGS

METRIC SERIES
NQ, RNA49, RNA69 SERIES



Shaft Dia.	F_w	D	C	$r_{s\ min.}$	Bearing Designation	Load Ratings		Fatigue Load Limit C_u	Speed Ratings		Approx. Wt.
						Dynamic	Static				
						C	C_0		Grease	Oil	
mm in	mm in	mm in	mm in	mm in		kN lbf		kN	min^{-1}		kg lbs
20 0.7874	**20**	**30**	**20**	**0.3**	20NQ3020	**19.9**	**26.4**	4.10	—	23000	**0.048**
	20	**32**	**12**	**0.3**	20NQ3212	**11.9**	**11.3**	1.70	—	23000	**0.033**
	20	**32**	**18**	**0.3**	NQ203218	**21.2**	**26.1**	4.05	—	23000	**0.053**
	20	**32**	**20**	**0.3**	NQ203220	**23**	**26.6**	4.20	—	23000	**0.057**
	20	**33**	**15**	**0.3**	20NQ3315NE[1]	**13.8**	**16.5**	2.50	—	23000	**0.053**
	20	**34**	**18**	**0.6**	20NQ3418D	**21.6**	**21.5**	3.35	—	24000	**0.060**
22 0.8661	**22**	**30**	**20**	**0.3**	NQ22/20	**15.3**	**25.6**	3.95	—	20000	**0.041**
	22	**35**	**20**	**0.3**	NQS22/20D	**21.8**	**25.4**	4.05	—	21000	**0.071**
24 0.9449	**24**	**32**	**20**	**0.3**	NQ24/20AD	**17.4**	**26.5**	4.15	—	18000	**0.041**
25 0.9843	**25**	**37**	**17**	**1.0**	25NQ3717AD-1	**19.4**	**22.5**	3.45	—	18000	**0.056**
	25	**37**	**17**	**0.9**	RNA4904ARD	**21.5**	**25.7**	3.95	—	18000	**0.057**
28 1.1024	**28**	**37**	**20**	**0.3**	NQ283720D	**20.7**	**34.9**	5.40	—	15000	**0.056**
	28	**39**	**17**	**0.3**	RNA49/22R	**22.2**	**30.3**	4.80	—	16000	**0.055**
30 1.1811	**30**	**42**	**30**	**0.6**	NQ304230	**40.6**	**61.2**	9.60	—	15000	**0.118**
35 1.378	**35**	**45**	**14**	**0.6**	NQ354514	**16.9**	**29**	4.40	—	12000	**0.055**
	35	**47**	**17**	**0.3**	RNA4906D	**20.2**	**31.9**	4.85	—	12000	**0.081**
	35	**47**	**30**	**0.3**	RNA6906	**43.1**	**69.3**	10.8	—	13000	**0.131**
37 1.4567	**37**	**47**	**20**	**0.3**	NQ37/20D	**26.3**	**45.7**	7.10	—	12000	**0.079**
40 1.5748	**40**	**48**	**20**	**0.3**	NQ404820	**21.2**	**40.4**	6.20	—	11000	**0.064**
	40	**50**	**15**	**0.3**	NQ40/15AD	**21.3**	**35.8**	5.45	—	11000	**0.063**
	40	**52**	**20**	**0.6**	RNA49/32R-1[2]	**32.4**	**50**	7.85	—	11000	**0.100**
	40	**60**	**25**	**1.0**	NQ406025	**54.2**	**66.8**	10.7	—	11000	**0.213**

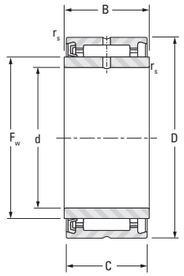
Shaft Dia.	F_w	D	C	$r_{s\ min.}$	Bearing Designation	Load Ratings		Fatigue Load Limit C_u	Speed Ratings		Approx. Wt.
						Dynamic	Static				
						C	C_0		Grease	Oil	
mm in	mm in	mm in	mm in	mm in		kN lbf		kN	min^{-1}		kg lbs
45 1.7717	**45**	**58**	**20**	**0.6**	RNA49/38R-1[2]	**36.7**	**56.2**	8.90	—	9700	**0.116**
48 1.8898	**48**	**62**	**22**	**0.6**	RNA4908R-2[2]	**44.3**	**67.8**	10.9	—	9100	**0.142**

[1] With outer ring groove
[2] Without outer ring lubrication holes

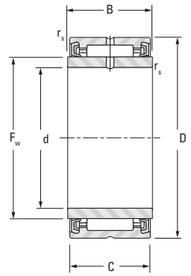
B

SEALED NEEDLE ROLLER BEARINGS WITH INNER RINGS

METRIC SERIES



NA49RS

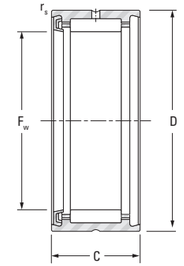


NA49.2RS

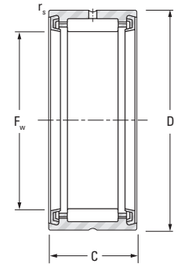
Shaft Dia.	d	D	B	C	F_w	$r_{s\ min.}$	Bearing Designation	Load Ratings		Fatigue Load Limit C_u	Speed Rating Grease	Approx. Wt.
								Dynamic	Static			
								C	C_0			
mm in	mm in	mm in	mm in	mm in	mm in	mm in		kN lbf		kN	min^{-1}	kg lbs
10 0.3937	**10** 0.3937	**22** 0.8661	**14** 0.551	**13** 0.512	**14** 0.5512	**0.3** 0.012	NA4900ARS	**7.76** 1740	**8.06** 1810	1.20	14000	**0.027** 0.060
	10 0.3937	**22** 0.8661	**14** 0.551	**13** 0.512	**14** 0.5512	**0.3** 0.012	NA4900A.2RS	**7.76** 1740	**8.06** 1810	1.20	14000	**0.027** 0.060
12 0.4724	**12** 0.4724	**24** 0.9449	**14** 0.551	**13** 0.512	**16** 0.6299	**0.3** 0.012	NA4901ARS	**8.64** 1940	**9.59** 2160	1.45	12000	**0.031** 0.068
	12 0.4724	**24** 0.9449	**14** 0.551	**13** 0.512	**16** 0.6299	**0.3** 0.012	NA4901A.2RS	**8.64** 1940	**9.59** 2160	1.45	12000	**0.031** 0.068
15 0.5906	**15** 0.5906	**28** 1.1024	**14** 0.551	**13** 0.512	**20** 0.7874	**0.3** 0.012	NA4902ARS	**9.77** 2200	**12.0** 2700	1.80	9700	**0.041** 0.090
	15 0.5906	**28** 1.1024	**14** 0.551	**13** 0.512	**20** 0.7874	**0.3** 0.012	NA4902A.2RS	**9.77** 2200	**12.0** 2700	1.80	9700	**0.041** 0.090
17 0.6693	**17** 0.6693	**30** 1.1811	**14** 0.551	**13** 0.512	**22** 0.8661	**0.3** 0.012	NA4903ARS	**10.1** 2270	**12.8** 2880	1.95	8800	**0.044** 0.097
	17 0.6693	**30** 1.1811	**14** 0.551	**13** 0.512	**22** 0.8661	**0.3** 0.012	NA4903A.2RS	**10.1** 2270	**12.8** 2880	1.95	8800	**0.044** 0.097
20 0.7874	**20** 0.7874	**37** 1.4567	**18** 0.709	**17** 0.669	**25** 0.9843	**0.3** 0.012	NA4904ARS	**18.5** 4160	**21.2** 4770	3.30	7800	**0.087** 0.192
	20 0.7874	**37** 1.4567	**18** 0.709	**17** 0.669	**25** 0.9843	**0.3** 0.012	NA4904A.2RS	**18.5** 4160	**21.2** 4770	3.30	7800	**0.087** 0.192
25 0.9843	**25** 0.9843	**42** 1.6535	**18** 0.709	**17** 0.669	**30** 1.1811	**0.3** 0.012	NA4905ARS	**21.0** 4720	**26.4** 5930	4.10	6500	**0.106** 0.234
	25 0.9843	**42** 1.6535	**18** 0.709	**17** 0.669	**30** 1.1811	**0.3** 0.012	NA4905A.2RS	**21.0** 4720	**26.4** 5930	4.10	6500	**0.106** 0.234
30 1.1811	**30** 1.1811	**47** 1.8504	**18** 0.709	**17** 0.669	**35** 1.3780	**0.3** 0.012	NA4906ARS	**22.5** 5060	**30.0** 6740	4.65	5500	**0.119** 0.262
	30 1.1811	**47** 1.8504	**18** 0.709	**17** 0.669	**35** 1.3780	**0.3** 0.012	NA4906A.2RS	**22.5** 5060	**30.0** 6740	4.65	5500	**0.119** 0.262
35 1.3780	**35** 1.3780	**55** 2.1654	**21** 0.827	**20** 0.787	**42** 1.6535	**0.6** 0.024	NA4907ARS	**29.1** 6540	**44.4** 9980	6.85	4600	**0.198** 0.437
	35 1.3780	**55** 2.1654	**21** 0.827	**20** 0.787	**42** 1.6535	**0.6** 0.024	NA4907A.2RS	**29.1** 6540	**44.4** 9980	6.85	4600	**0.198** 0.437
40 1.5748	**40** 1.5748	**62** 2.4409	**23** 0.906	**22** 0.866	**48** 1.8898	**0.6** 0.024	NA4908ARS	**38.6** 8680	**57.0** 12800	9.10	4000	**0.263** 0.580
	40 1.5748	**62** 2.4409	**23** 0.906	**22** 0.866	**48** 1.8898	**0.6** 0.024	NA4908A.2RS	**38.6** 8680	**57.0** 12800	9.10	4000	**0.263** 0.580
45 1.7717	**45** 1.7717	**68** 2.6772	**23** 0.906	**22** 0.866	**52** 2.0472	**0.6** 0.024	NA4909ARS	**39.4** 8860	**60.0** 13500	9.60	3700	**0.303** 0.668
	45 1.7717	**68** 2.6772	**23** 0.906	**22** 0.866	**52** 2.0472	**0.6** 0.024	NA4909A.2RS	**39.4** 8860	**60.0** 13500	9.60	3700	**0.303** 0.668
50 1.9685	**50** 1.9685	**72** 2.8346	**23** 0.906	**22** 0.866	**58** 2.2835	**0.6** 0.024	NA4910ARS	**41.2** 9260	**65.8** 14800	10.5	3300	**0.309** 0.681
	50 1.9685	**72** 2.8346	**23** 0.906	**22** 0.866	**58** 2.2835	**0.6** 0.024	NA4910A.2RS	**41.2** 9260	**65.8** 14800	10.5	3300	**0.309** 0.681

SEALED NEEDLE ROLLER BEARINGS WITHOUT INNER RINGS

METRIC SERIES



RNA49RS

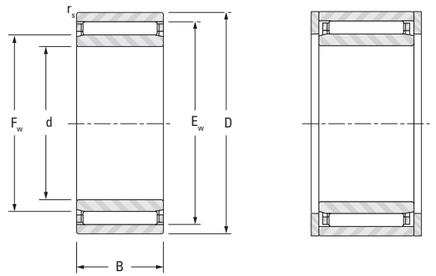


RNA49.2RS

Shaft Dia.	F_w	D	C	$r_{s\ min.}$	Bearing Designation	Load Ratings		Fatigue Load Limit C_u	Speed Rating Grease	Approx. Wt.
						Dynamic	Static			
						C	C_0			
mm in	mm in	mm in	mm in	mm in		kN lbf		kN	min^{-1}	kg lbs
14 0.5512	**14** 0.5512	**22** 0.8661	**13** 0.512	**0.3** 0.012	RNA4900ARS	**7.76** 1740	**8.06** 1810	1.20	14000	**0.019** 0.042
	14 0.5512	**22** 0.8661	**13** 0.512	**0.3** 0.012	RNA4900A.2RS	**7.76** 1740	**8.06** 1810	1.20	14000	**0.019** 0.042
16 0.6299	**16** 0.6299	**24** 0.9449	**13** 0.512	**0.3** 0.012	RNA4901ARS	**8.64** 1940	**9.59** 2160	1.45	12000	**0.021** 0.046
	16 0.6299	**24** 0.0449	**13** 0.512	**0.3** 0.012	RNA4901A.2RS	**8.64** 1940	**9.59** 2160	1.45	12000	**0.021** 0.046
20 0.7874	**20** 0.7874	**28** 1.1024	**13** 0.512	**0.3** 0.012	RNA4902ARS	**9.70** 2180	**12.0** 2700	1.80	9700	**0.026** 0.057
	20 0.7874	**28** 1.1024	**13** 0.512	**0.3** 0.012	RNA4902A.2RS	**9.70** 2180	**12.0** 2700	1.80	9700	**0.026** 0.057
22 0.8661	**22** 0.8661	**30** 1.1811	**13** 0.512	**0.3** 0.012	RNA4903ARS	**10.1** 2270	**12.8** 2880	1.95	8800	**0.027** 0.060
	22 0.8661	**30** 1.1811	**13** 0.512	**0.3** 0.012	RNA4903A.2RS	**10.1** 2270	**12.8** 2880	1.95	8800	**0.027** 0.060
25 0.9843	**25** 0.9843	**37** 1.4567	**17** 0.669	**0.3** 0.012	RNA4904ARS	**18.5** 4160	**21.2** 4770	3.30	7800	**0.062** 0.137
	25 0.9843	**37** 1.4567	**17** 0.669	**0.3** 0.012	RNA4904A.2RS	**18.5** 4160	**21.2** 4770	3.30	7800	**0.062** 0.137
30 1.1811	**30** 1.1811	**42** 1.6535	**17** 0.669	**0.3** 0.012	RNA4905ARS	**21.0** 4720	**26.4** 5930	4.10	6500	**0.075** 0.165
	30 1.1811	**42** 1.6535	**17** 0.669	**0.3** 0.012	RNA4905A.2RS	**21.0** 4720	**26.4** 5930	4.10	6500	**0.075** 0.165
35 1.3780	**35** 1.3780	**47** 1.864	**17** 0.669	**0.3** 0.012	RNA4906ARS	**22.5** 5060	**30.0** 6740	4.65	5500	**0.083** 0.183
	35 1.3780	**47** 1.8504	**17** 0.669	**0.3** 0.012	RNA4906A.2RS	**22.5** 5060	**30.0** 6740	4.65	5500	**0.083** 0.183
42 1.6535	**42** 1.6535	**55** 2.1654	**20** 0.787	**0.6** 0.024	RNA4907ARS	**29.1** 6540	**44.4** 9980	6.85	4600	**0.130** 0.287
	42 1.6535	**55** 2.1654	**20** 0.787	**0.6** 0.024	RNA4907A.2RS	**29.1** 6540	**44.4** 9980	6.85	4600	**0.130** 0.287
48 1.8898	**48** 1.8898	**62** 2.4409	**22** 0.866	**0.6** 0.024	RNA4908ARS	**38.6** 8680	**57.0** 12800	9.10	4000	**0.163** 0.359
	48 1.8898	**62** 2.4409	**22** 0.866	**0.6** 0.024	RNA4908A.2RS	**38.6** 8680	**57.0** 12800	9.10	4000	**0.163** 0.359
52 2.0472	**52** 2.0472	**68** 2.6772	**22** 0.866	**0.6** 0.024	RNA4909ARS	**39.4** 8860	**60.0** 13500	9.60	3700	**0.207** 0.456
	52 2.0472	**68** 2.6772	**22** 0.866	**0.6** 0.024	RNA4909A.2RS	**39.4** 8860	**60.0** 13500	9.60	3700	**0.207** 0.456
58 2.2835	**58** 2.2835	**72** 2.8346	**22** 0.866	**0.6** 0.024	RNA4910ARS	**41.2** 9260	**65.8** 14800	10.5	3300	**0.187** 0.412
	58 2.2835	**72** 2.8346	**22** 0.866	**0.6** 0.024	RNA4910A.2RS	**41.2** 9260	**65.8** 14800	10.5	3300	**0.187** 0.412

NEEDLE ROLLER BEARINGS WITHOUT FLANGES WITH INNER RINGS

METRIC SERIES



NAO **SNSH**

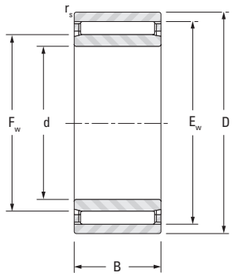
Shaft Dia.	d	D	B	F_w	E_w	$r_{s\ min.}$	$s^{(1)}$	Bearing Designation	End Washer Designation	Load Ratings		Fatigue Load Limit C_u	Speed Ratings		Approx. Wt.
										Dynamic	Static				
										C	C_0		Grease	Oil	
mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in			kN lbf		kN	min^{-1}		kg lbs
6 0.2362	**6** 0.2362	**17** 0.6693	**10** 0.394	**10** 0.3937	**13** 0.5118	**0.3** 0.012	**0.5** 0.020	NAO6X17X10	SNSH10,5X17X0,5	**5.40** 1210	**6.43** 1450	0.980	25000	39000	**0.014** 0.031
	8 0.3150	**19** 0.7480	**10** 0.394	**12** 0.4724	**15** 0.5906	**0.3** 0.012	**0.5** 0.020	NAO8X19X10	SNSH12,5X19X0,5	**5.85** 1320	**7.51** 1690	1.15	24000	37000	**0.017** 0.037
10 0.3937	**10** 0.3937	**22** 0.8661	**13** 0.512	**14** 0.5512	**18** 0.7087	**0.3** 0.012	**1.0** 0.039	NAO10X22X13	SNSH14,5X22X0,5	**9.73** 2190	**12.5** 2810	1.90	19000	29000	**0.026** 0.057
	10 0.3937	**22** 0.8661	**20** 0.787	**14** 0.5512	**18** 0.7087	**0.3** 0.012	**0.5** 0.020	NAO10X22X20	SNSH14,5X22X0,5	**12.3** 2770	**16.8** 3780	1.30	19000	29000	**0.041** 0.090
	10 0.3937	**26** 1.0236	**12** 0.472	**14** 0.5512	**20** 0.7874	**0.3** 0.012	**0.7** 0.028	NAO10X26X12	SNSH14,5X26X0,5	**10.5** 2360	**10.6** 2380	1.60	14000	21000	**0.036** 0.079
12 0.4724	**12** 0.4724	**24** 0.9449	**13** 0.512	**16** 0.6299	**20** 0.7874	**0.3** 0.012	**1.0** 0.039	NAO12X24X13	SNSH16,5X24X0,5	**1 0.1** 2270	**13.5** 3030	2.05	18000	28000	**0.030** 0.066
	12 0.4724	**24** 0.9449	**20** 0.787	**16** 0.6299	**20** 0.7874	**0.3** 0.012	**0.5** 0.020	NAO12X24X20	SNSH16,5X24X0,5	**13.4** 3010	**19.5** 4380	2.95	18000	28000	**0.046** 0.101
	12 0.4724	**28** 1.1024	**12** 0.472	**16** 0.6299	**22** 0.8661	**0.3** 0.012	**0.7** 0.028	NAO12X28X12	SNSH16,5X28X0,5	**11.2** 2520	**11.9** 2680	1.80	19000	29000	**0.041** 0.090
15 0.5906	**15** 0.5906	**28** 1.1024	**13** 0.512	**20** 0.7874	**24** 0.9449	**0.3** 0.012	**1.0** 0.039	NAO15X28X13	SNSH20,5X28X0,5	**11.5** 2590	**17.3** 3890	2.65	14000	22000	**0.039** 0.086
	15 0.5906	**28** 1.1024	**26** 1.024	**20** 0.7874	**24** 0.9449	**0.3** 0.012	**1.0** 0.039	NAO15X28X26	SNSH20,5X28X0,5	**19.8** 4450	**34.6** 7780	5.25	14000	22000	**0.078** 0.172
	15 0.5906	**32** 1.2598	**12** 0.472	**20** 0.7874	**26** 1.0236	**0.3** 0.012	**0.7** 0.028	NAO15X32X12	SNSH20,5X32X0,5	**13.0** 2920	**15.0** 3370	2.30	15000	23000	**0.050** 0.110
17 0.6693	**17** 0.6693	**30** 1.1811	**13** 0.512	**22** 0.8661	**26** 1.0236	**0.3** 0.012	**1.0** 0.039	NAO17X30X13	SNSH22,5X30X0,5	**11.8** 2650	**18.3** 4110	2.80	13000	20000	**0.043** 0.095
	17 0.6693	**30** 1.1811	**26** 1.024	**22** 0.8661	**26** 1.0236	**0.3** 0.012	**1.0** 0.039	NAO17X30X26	SNSH22,5X30X0,5	**20.2** 4540	**36.6** 8230	5.55	13000	20000	**0.084** 0.185
	17 0.6693	**35** 1.3780	**16** 0.630	**22** 0.8661	**29** 1.1417	**0.3** 0.012	**1.5** 0.059	NAO17X35X16	SNSH22,5X35X0,5	**19.0** 4270	**23.3** 5240	3.70	13000	20000	**0.078** 0.172
	17 0.6693	**35** 1.3780	**32** 1.260	**22** 0.8661	**29** 1.1417	**0.3** 0.012	**1.5** 0.059	NAO17X35X32	SNSH22,5X35X0,5	**32.7** 7350	**46.5** 10500	7.35	13000	20000	**0.154** 0.340
20 0.7874	**20** 0.7874	**35** 1.3780	**17** 0.669	**25** 0.9843	**30** 1.1811	**0.3** 0.012	**1.2** 0.047	NAO20X35X17	SNSH25,5X35X0,5	**18.8** 4230	**29.8** 6700	4.60	11000	17000	**0.073** 0.161
	20 0.7874	**35** 1.3780	**26** 1.024	**25** 0.9843	**30** 1.1811	**0.3** 0.012	**1.2** 0.047	NAO20X35X26	SNSH25,5X35X0,5	**25.0** 5620	**42.8** 9620	6.50	11000	17000	**0.112** 0.247
	20 0.7874	**37** 1.4567	**16** 0.630	**25** 0.9843	**32** 1.2598	**0.3** 0.012	**1.5** 0.059	NAO20X37X16	SNSH25,5X37X0,5	**19.8** 4450	**25.3** 5690	4.10	11000	17000	**0.080** 0.176
	20 0.7874	**37** 1.4567	**32** 1.260	**25** 0.9843	**25** 0.9843	**0.3** 0.012	**1.5** 0.059	NAO20X37X32	SNSH25,5X37X0,5	**34.0** 7640	**50.7** 11400	8.00	11000	17000	**0.162** 0.357
25 0.9843	**25** 0.9843	**40** 1.5748	**17** 0.669	**30** 1.1811	**35** 1.3780	**0.3** 0.012	**1.2** 0.047	NAO25X40X17	SNSH30,5X40X0,5	**20.2** 4540	**34.9** 7850	5.35	9300	14000	**0.088** 0.194
	25 0.9843	**40** 1.5748	**26** 1.024	**30** 1.1811	**35** 1.3780	**0.3** 0.012	**1.2** 0.047	NAO25X40X26	SNSH30,5X40X0,5	**26.8** 6020	**49.7** 11200	7.55	9300	14000	**0.132** 0.291
	25 0.9843	**42** 1.6535	**16** 0.630	**30** 1.1811	**37** 1.4567	**0.3** 0.012	**1.5** 0.059	NAO25X42X16		**22.4** 5040	**31.0** 6970	4.90	9600	15000	**0.096** 0.212
	25 0.9843	**42** 1.6535	**32** 1.260	**30** 1.1811	**37** 1.4567	**0.3** 0.012	**1.5** 0.059	NAO25X42X32		**38.2** 8590	**62.1** 14000	9.85	9600	15000	**0.185** 0.408
30 1.1811	**30** 1.1811	**45** 1.7717	**17** 0.669	**35** 1.3780	**40** 1.5748	**0.3** 0.012	**1.2** 0.047	NAO30X45X17		**22.1** 4970	**40.8** 9170	6.35	7900	12000	**0.102** 0.225
	30 1.1811	**45** 1.7717	**26** 1.024	**35** 1.3780	**40** 1.5748	**0.3** 0.012	**1.2** 0.047	NAO30X45X26		**27.7** 6230	**54.5** 12300	8.95	7900	12000	**0.155** 0.342
	30 1.1811	**47** 1.8504	**16** 0.630	**35** 1.3780	**42** 1.6535	**0.3** 0.012	**1.5** 0.059	NAO30X47X16	SNSH35,5X47X0,5	**24.5** 5510	**36.8** 8270	5.80	8100	12000	**0.106** 0.234
	30 1.1811	**47** 1.8504	**32** 1.260	**35** 1.3780	**42** 1.6535	**0.3** 0.012	**1.5** 0.059	NAO30X47X32	SNSH35,5X47X0,5	**42.0** 9440	**73.5** 16500	11.6	8100	12000	**0.218** 0.481
35 1.3780	**35** 1.3780	**50** 1.9685	**17** 0.669	**40** 1.5748	**45** 1.7717	**0.3** 0.012	**1.2** 0.047	NAO35X50X17		**23.8** 5350	**47.0** 10600	7.30	6900	11000	**0.126** 0.278
	35 1.3780	**50** 1.9685	**34** 1.339	**40** 1.5748	**45** 1.7717	**0.3** 0.012	**0.7** 0.028	NAO35X50X34	SNSH40,5X50X0,5	**40.9** 9190	**94.1** 21200	14.6	6900	11000	**0.232** 0.511
	35 1.3780	**55** 2.1654	**20** 0.787	**40** 1.5748	**48** 1.8898	**0.3** 0.012	**1.5** 0.059	NAO35X55X20	SNSH41X55X1	**35.5** 7980	**56.3** 12700	8.95	7100	11000	**0.185** 0.408
	35 1.3780	**55** 2.1654	**40** 1.575	**40** 1.5748	**48** 1.8898	**0.3** 0.012	**1.7** 0.067	NAO35X55X40		**60.8** 13700	**113** 25400	17.9	7100	11000	**0.370** 0.816
40 1.5748	**40** 1.5748	**55** 2.1654	**17** 0.669	**45** 1.7717	**50** 1.9685	**0.3** 0.012	**0.7** 0.028	NAO40X55X17	SNSH45,5X55X0,5	**24.9** 5600	**51.8** 11600	8.05	6100	9400	**0.133** 0.293
	40 1.5748	**55** 2.1654	**34** 1.339	**45** 1.7717	**50** 1.9685	**0.3** 0.012	**0.7** 0.028	NAO40X55X34	SNSH45,5X55X0,5	**42.7** 9600	**104** 23400	16.1	6100	9400	**0.257** 0.567
	40 1.5748	**62** 2.4409	**20** 0.787	**45** 1.7717	**53** 2.0866	**0.3** 0.012	**1.5** 0.059	NAO40X62X20	SNSH46X62X1	**36.0** 8090	**59.5** 13400	9.05	6200	9600	**0.215** 0.474
	40 1.5748	**62** 2.4409	**40** 1.575	**45** 1.7717	**53** 2.0866	**0.3** 0.012	**1.7** 0.067	NAO40X62X40	SNSH46X62X1	**61.7** 13900	**119** 26800	18.1	6200	9600	**0.440** 0.970
45 1.7717	**45** 1.7717	**62** 2.4409	**20** 0.787	**50** 1.9685	**55** 2.1654	**0.3** 0.012	**0.7** 0.028	NAO45X62X20		**30.2** 6790	**68.5** 15400	10.7	5400	8400	**0.200** 0.441
	45 1.7717	**62** 2.4409	**40** 1.575	**50** 1.9685	**55** 2.1654	**0.3** 0.012	**0.5** 0.020	NAO45X62X40		**50.7** 11400	**137** 30800	21.4	5400	8400	**0.386** 0.851
	45 1.7717	**72** 2.8346	**20** 0.787	**55** 2.1654	**63** 2.4803	**1.0** 0.039	**1.5** 0.059	NAO45X72X20	SNSH56X72X1	**40.3** 9060	**73.5** 16500	11.7	5000	7800	**0.345** 0.761
	45 1.7717	**72** 2.8346	**40** 1.575	**55** 2.1654	**63** 2.4803	**1.0** 0.039	**1.7** 0.067	NAO45X72X40	SNSH56X72X1	**69.1** 15500	**147** 33000	23.4	5000	7800	**0.680** 1.499
50 1.9685	**50** 1.9685	**68** 2.6772	**20** 0.787	**55** 2.1654	**60** 2.3622	**0.3** 0.012	**0.7** 0.028	NAO50X68X20		**30.7** 6900	**72.4** 16300	11.3	4900	7600	**0.230** 0.507
	50 1.9685	**68** 2.6772	**40** 1.575	**55** 2.1654	**60** 2.3622	**0.3** 0.012	**0.5** 0.020	NAO50X68X40		**52.7** 11800	**145** 32600	22.6	4900	7600	**0.450** 0.992
	50 1.9685	**78** 3.0709	**20** 0.787	**60** 2.3622	**68** 2.6772	**1.0** 0.039	**1.5** 0.059	NAO50X78X20	SNSH61X78X1	**41.8** 9400	**79.2** 17800	12.6	4600	7100	**0.385** 0.849

(1) Max. axial displacement.

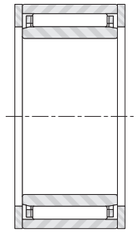
Continued on next page.

NEEDLE ROLLER BEARINGS WITHOUT FLANGES WITH INNER RINGS

METRIC SERIES



NAO



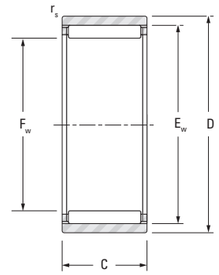
SNSH

Shaft Dia.	d	D	B	F_w	E_w	$r_{s\ min.}$	$s^{(1)}$	Bearing Designation	End Washer Designation	Load Ratings		Fatigue Load Limit C_u	Speed Ratings		Approx. Wt.
										Dynamic	Static				
										C	C_0		Grease	Oil	
mm in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in			**kN** lbf		kN	min^{-1}		**kg** lbs
50 1.9685	**50** 1.9685	**78** 3.0709	**40** 1.575	**60** 2.3622	**68** 2.6772	**1.0** 0.039	**1.7** 0.067	NAO50X78X40	SNSH61X78X1	**71.7** 16100	**158** 35500	25.2	4600	7100	**0.746** 1.645
55 2.1654	**55** 2.1654	**85** 3.3465	**30** 1.181	**65** 2.5591	**73** 2.8740	**1.0** 0.039	**2.0** 0.079	NAO55X85X30	SNSH66X85X1	**60.1** 13500	**129** 29000	20.3	4200	6500	**0.690** 1.521
	55 2.1654	**85** 3.3465	**60** 2.362	**65** 2.5591	**73** 2.8740	**1.0** 0.039	**1.5** 0.059	NAO55X85X60	SNSH66X85X1	**103** 23200	**259** 58200	40.7	4200	6500	**1.320** 2.910
60 2.3622	**60** 2.3622	**90** 3.5433	**30** 1.181	**70** 2.7559	**78** 3.0709	**1.0** 0.039	**2.0** 0.079	NAO60X90X30		**62.2** 14000	**139** 31200	21.8	3900	6000	**0.745** 1.642
	60 2.3622	**90** 3.5433	**60** 2.362	**70** 2.7559	**78** 3.0709	**1.0** 0.039	**1.7** 0.067	NAO60X90X60		**107** 24100	**277** 62300	43.6	3900	6000	**1.405** 3.097
65 2.5591	**65** 2.5591	**95** 3.7402	**30** 1.181	**75** 2.9528	**83** 3.2677	**1.0** 0.039	**2.0** 0.079	NAO65X95X30		**60.9** 13700	**138** 31000	21.7	3600	5600	**0.770** 1.698
	65 2.5591	**95** 3.7402	**60** 2.362	**75** 2.9528	**83** 3.2677	**1.0** 0.039	**1.7** 0.067	NAO65X95X60		**116** 26100	**277** 62300	43.3	3600	5600	**1.500** 3.307
70 2.7559	**70** 2.7559	**100** 3.9370	**30** 1.181	**80** 3.1496	**88** 3.4646	**1.0** 0.039	**2.0** 0.079	NAO70X100X30		**67.5** 15200	**161** 36200	25.4	3400	5200	**0.850** 1.874
	70 2.7559	**100** 3.9370	**60** 2.362	**80** 3.1496	**88** 3.4646	**1.0** 0.039	**1.7** 0.067	NAO70X100X60		**116** 26100	**322** 72400	50.7	3400	5200	**1.600** 3.527
80 3.1496	**80** 3.1496	**110** 4.3307	**30** 1.181	**90** 3.5433	**98** 3.8583	**1.0** 0.039	**2.0** 0.079	NAO80X110X30		**63.6** 14300	**155** 34800	24.3	3000	4600	**0.920** 2.028
85 3.3465	**85** 3.3465	**115** 4.5276	**30** 1.181	**95** 3.7402	**103** 4.0551	**1.0** 0.039	**2.0** 0.079	NAO85X115X30		**71.0** 16000	**183** 41100	28.6	2800	4400	**0.985** 2.172
90 3.5433	**90** 3.5433	**120** 4.7244	**30** 1.181	**100** 3.9370	**108** 4.2520	**1.0** 0.039	**2.0** 0.079	NAO90X120X30		**72.4** 16300	**191** 42900	29.5	2700	4200	**1.010** 2.22

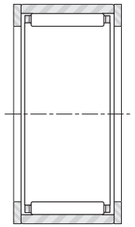
(1) Max. axial displacement.

NEEDLE ROLLER BEARINGS WITHOUT FLANGES WITHOUT INNER RINGS

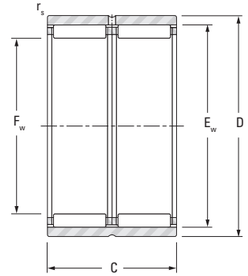
METRIC SERIES



RNAO



SNSH



RNAO

Shaft Dia.	F_w	D	C	E_w	$r_{s\ min.}$	Bearing Designation	End Washer Designation	Load Ratings		Fatigue Load Limit C_u	Speed Ratings		Approx. Wt.
								Dynamic	Static				
								C	C_0		Grease	Oil	
mm in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in			**kN** lbf		kN	min^{-1}		**kg** lbs
6 0.2362	**6** 0.2362	**13** 0.5118	**8** 0.315	**9** 0.3543	**0.3** 0.012	RNAO6X13X8TN		**2.47** 560	**2.07** 470	0.310	29000	44000	**0.005** 0.011
7 0.2756	**7** 0.2756	**14** 0.5512	**8** 0.315	**10** 0.3937	**0.3** 0.012	RNAO7X14X8TN		**2.74** 620	**2.44** 550	0.370	28000	42000	**0.007** 0.015
8 0.3150	**8** 0.3150	**15** 0.5906	**10** 0.394	**11** 0.4331	**0.3** 0.012	RNAO8X15X10	SNSH8,5X15X0,5	**4.57** 1030	**4.89** 1100	0.740	26000	41000	**0.008** 0.018
9 0.3543	**9** 0.3543	**16** 0.6299	**10** 0.394	**12** 0.4724	**0.3** 0.012	RNAO9X16X10		**4.27** 960	**4.60** 1030	0.700	26000	40000	**0.009** 0.020
10 0.3937	**10** 0.3937	**17** 0.6693	**10** 0.394	**13** 0.5118	**0.3** 0.012	RNAO10X17X10	SNSH10,5X17X0,5	**5.40** 1210	**6.43** 1450	0.980	25000	39000	**0.010** 0.022
	10 0.3937	**17** 0.6693	**20** 0.787	**13** 0.5118	**0.3** 0.012	RNAO10X17X20	SNSH10,5X17X0,5	**9.25** 2080	**12.9** 2900	0.980	25000	39000	**0.019** 0.042
12 0.4724	**12** 0.4724	**19** 0.7480	**10** 0.394	**15** 0.5906	**0.3** 0.012	RNAO12X19X10	SNSH12,5X19X0,5	**5.85** 1320	**7.51** 1690	1.15	24000	37000	**0.012** 0.026
14 0.5512	**14** 0.5512	**22** 0.8661	**13** 0.512	**18** 0.7087	**0.3** 0.012	RNAO14X22X13	SNSH14,5X22X0,5	**9.73** 2190	**12.5** 2810	1.90	19000	29000	**0.018** 0.040
	14 0.5512	**22** 0.8661	**20** 0.787	**18** 0.7087	**0.3** 0.012	RNAO14X22X20	SNSH14,5X22X0,5	**12.3** 2770	**16.8** 3780	1.30	19000	29000	**0.029** 0.064
	14 0.5512	**26** 1.0236	**12** 0.472	**20** 0.7874	**0.3** 0.012	RNAO14X26X12	SNSH14,5X26X0,5	**10.5** 2360	**10.6** 2380	1.60	14000	21000	**0.029** 0.064
15 0.5906	**15** 0.5906	**23** 0.9055	**13** 0.512	**19** 0.7480	**0.3** 0.012	RNAO15X23X13	SNSH15,5X23X0,5	**9.66** 2170	**12.6** 2830	1.90	18000	28000	**0.019** 0.042
	15 0.5906	**23** 0.9055	**20** 0.787	**19** 0.7480	**0.3** 0.012	RNAO15X23X20	SNSH15,5X23X0,5	**13.5** 3030	**19.4** 4360	1.45	18000	28000	**0.029** 0.064
16 0.6299	**16** 0.6299	**24** 0.9449	**13** 0.512	**20** 0.7874	**0.3** 0.012	RNAO16X24X13	SNSH16,5X24X0,5	**10.1** 2270	**13.5** 3030	2.10	18000	28000	**0.022** 0.049
	16 0.6299	**24** 0.9449	**20** 0.787	**20** 0.7874	**0.3** 0.012	RNAO16X24X20	SNSH16,5X24X0,5	**13.4** 3010	**19.5** 4380	2.95	18000	28000	**0.032** 0.071
	16 0.6299	**28** 1.1024	**12** 0.472	**22** 0.8661	**0.3** 0.012	RNAO16X28X12	SNSH16,5X28X0,5	**11.2** 2520	**11.9** 2680	1.80	19000	29000	**0.033** 0.073
17 0.6693	**17** 0.6693	**25** 0.9843	**13** 0.512	**21** 0.8268	**0.3** 0.012	RNAO17X25X13	SNSH17,5X25X0,5	**10.5** 2360	**14.5** 3260	2.20	17000	26000	**0.022** 0.049
	17 0.6693	**25** 0.9843	**20** 0.787	**21** 0.8268	**0.3** 0.012	RNAO17X25X20	SNSH17,5X25X0,5	**14.7** 3300	**22.5** 5060	3.20	17000	26000	**0.032** 0.071
18 0.7087	**18** 0.7087	**26** 1.0236	**13** 0.512	**22** 0.8661	**0.3** 0.012	RNAO18X26X13	SNSH18,5X26X0,5	**10.8** 2430	**15.4** 3460	2.35	16000	24000	**0.024** 0.053
	18 0.7087	**26** 1.0236	**13** 0.512	**22** 0.8661	**0.3** 0.012	RNAO18X26X13ASR1	SNSH18,5X26X0,5	**10.8** 2430	**15.4** 3460	2.35	16000	24000	**0.024** 0.053
	18 0.7087	**26** 1.0236	**20** 0.787	**22** 0.8661	**0.3** 0.012	RNAO18X26X20	SNSH18,5X26X0,5	**14.4** 3240	**22.2** 4990	3.40	16000	24000	**0.034** 0.075
	18 0.7087	**30** 1.1811	**24** 0.945	**24** 0.9449	**0.3** 0.012	RNAO18X30X24		**20.2** 4540	**26.2** 5890	3.95	17000	25000	**0.070** 0.154
20 0.7874	**20** 0.7874	**28** 1.1024	**13** 0.512	**24** 0.9449	**0.3** 0.012	RNAO20X28X13	SNSH20,5X28X0,5	**11.5** 2590	**17.3** 3890	1.45	14000	22000	**0.025** 0.055

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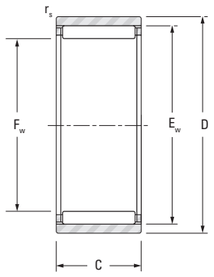
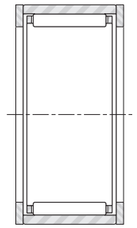
NEEDLE ROLLER BEARINGS
WITHOUT FLANGES
WITHOUT INNER RINGS

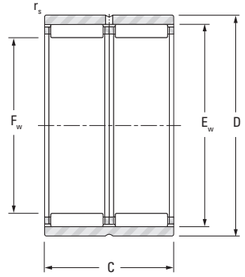
METRIC SERIES



RNAO



SNSH



RNAO

Shaft Dia.	F_w	D	C	E_w	$r_{s\ min.}$	Bearing Designation	End Washer Designation	Load Ratings		Fatigue Load Limit C_u	Speed Ratings		Approx. Wt.
								Dynamic	Static				
								C	C_0		Grease	Oil	
mm in	mm in	mm in	mm in	mm in	mm in			kN lbf		kN	min^{-1}		kg lbs
20 0.7874	**20** 0.7874	**28** 1.1024	**26** 1.024	**24** 0.9449	**0.3** 0.012	RNAO20X28X26	SNSH20,5X28X0,5	**19.8** 4450	**34.6** 7780	2.90	14000	22000	**0.050** 0.110
	20 0.7874	**32** 1.2598	**12** 0.472	**26** 1.0236	**0.3** 0.012	RNAO20X32X12	SNSH20,5X32X0,5	**13.0** 2920	**15.3** 3440	2.30	15000	23000	**0.038** 0.084
	20 0.7874	**32** 1.2598	**24** 0.945	**26** 1.0236	**0.3** 0.012	RNAO20X32X24	SNSH20,5X32X0,5	**22.3** 5010	**30.6** 6880	4.60	15000	23000	**0.080** 0.176
22 0.8661	**22** 0.8661	**30** 1.1811	**13** 0.512	**26** 1.0236	**0.3** 0.012	RNAO22X30X13	SNSH22,5X30X0,5	**11.8** 2650	**18.3** 4110	2.80	13000	20000	**0.028** 0.062
	22 0.8661	**30** 1.1811	**26** 1.024	**26** 1.0236	**0.3** 0.012	RNAO22X30X26	SNSH22,5X30X0,5	**20.2** 4540	**36.6** 8230	5.55	13000	20000	**0.053** 0.117
	22 0.8661	**35** 1.3780	**16** 0.630	**29** 1.1417	**0.3** 0.012	RNAO22X35X16	SNSH22,5X35X0,5	**19.1** 4290	**23.3** 5240	3.70	13000	21000	**0.059** 0.130
	22 0.8661	**35** 1.3780	**32** 1.260	**29** 1.1417	**0.3** 0.012	RNAO22X35X32	SNSH22,5X35X0,5	**32.7** 7350	**46.5** 10500	7.35	13000	21000	**0.116** 0.256
25 0.9843	**25** 0.9843	**35** 1.3780	**17** 0.669	**30** 1.1811	**0.3** 0.012	RNAO25X35X17	SNSH25,5X35X0,5	**18.8** 4230	**29.8** 6700	4.60	11000	17000	**0.050** 0.110
	25 0.9843	**35** 1.3780	**26** 1.024	**30** 1.1811	**0.3** 0.012	RNAO25X35X26	SNSH25,5X35X0,5	**25.0** 5620	**42.8** 9620	6.50	11000	17000	**0.076** 0.168
	25 0.9843	**37** 1.4567	**16** 0.630	**32** 1.2598	**0.3** 0.012	RNAO25X37X16	SNSH25,5X37X0,5	**19.8** 4450	**25.3** 5690	4.00	12000	18000	**0.058** 0.128
	25 0.9843	**37** 1.4567	**32** 1.260	**32** 1.2598	**0.3** 0.012	RNAO25X37X32	SNSH25,5X37X0,5	**19.2** 4320	**23.6** 5310	8.00	12000	18000	**0.118** 0.260
28 1.1024	**28** 1.1024	**40** 1.5748	**16** 0.630	**35** 1.3780	**0.3** 0.012	RNAO28X40X16	SNSH28,5X40X0,5	**20.9** 4700	**27.9** 6270	4.30	10000	16000	**0.063** 0.139
	28 1.1024	**40** 1.5748	**32** 1.260	**35** 1.3780	**0.3** 0.012	RNAO28X40X32	SNSH28,5X40X0,5	**35.8** 8050	**55.9** 12600	8.60	10000	16000	**0.128** 0.282
30 1.1811	**30** 1.1811	**40** 1.5748	**17** 0.669	**35** 1.3780	**0.3** 0.012	RNAO30X40X17	SNSH30,5X40X0,5	**20.2** 4540	**34.6** 7780	5.35	9300	14000	**0.060** 0.132
	30 1.1811	**40** 1.5748	**26** 1.024	**35** 1.3780	**0.3** 0.012	RNAO30X40X26	SNSH30,5X40X0,5	**26.8** 6020	**49.7** 11200	7.55	9300	14000	**0.088** 0.194
	30 1.1811	**42** 1.6535	**16** 0.630	**37** 1.4567	**0.3** 0.012	RNAO30X42X16		**22.3** 5010	**31.0** 6970	4.90	9600	15000	**0.069** 0.152
	30 1.1811	**42** 1.6535	**32** 1.260	**37** 1.4567	**0.3** 0.012	RNAO30X42X32		**38.2** 8590	**62.1** 14000	9.85	9600	15000	**0.131** 0.289
35 1.3780	**35** 1.3780	**45** 1.7717	**17** 0.669	**40** 1.5748	**0.3** 0.012	RNAO35X45X17		**22.1** 4970	**40.8** 9170	6.35	7900	12000	**0.069** 0.152
	35 1.3780	**45** 1.7717	**26** 1.024	**40** 1.5748	**0.3** 0.012	RNAO35X45X26		**27.7** 6230	**54.5** 12300	8.30	7900	12000	**0.091** 0.201
	35 1.3780	**47** 1.8504	**16** 0.630	**41** 1.6142	**0.3** 0.012	RNAO35X47X16	SNSH35,5X47X0,5	**24.5** 5510	**36.8** 8270	5.80	8100	12000	**0.075** 0.165
	35 1.3780	**47** 1.8504	**32** 1.260	**42** 1.6535	**0.3** 0.012	RNAO35X47X32	SNSH35,5X47X0,5	**42.0** 9440	**73.5** 16500	11.6	8100	12000	**0.156** 0.344
40 1.5748	**40** 1.5748	**50** 1.9685	**17** 0.669	**45** 1.7717	**0.3** 0.012	RNAO40X50X17	SNSH40,5X50X0,5	**23.8** 5350	**47.0** 10600	7.30	6900	11000	**0.086** 0.190

Shaft Dia.	F_w	D	C	E_w	$r_{s\ min.}$	Bearing Designation	End Washer Designation	Load Ratings		Fatigue Load Limit C_u	Speed Ratings		Approx. Wt.
								Dynamic	Static				
								C	C_0		Grease	Oil	
mm in	mm in	mm in	mm in	mm in	mm in			kN lbf		kN	min^{-1}		kg lbs
40 1.5748	**40** 1.5748	**50** 1.9685	**34** 1.339	**45** 1.7717	**0.3** 0.012	RNAO40X50X34	SNSH40,5X50X0,5	**40.9** 9190	**94.1** 21200	14.6	6900	11000	**0.152** 0.335
	40 1.5748	**55** 2.1654	**20** 0.787	**48** 1.8898	**0.3** 0.012	RNAO40X55X20	SNSH41X55X1	**35.5** 7980	**56.3** 12700	8.95	7100	11000	**0.139** 0.306
	40 1.5748	**55** 2.1654	**40** 1.575	**48** 1.8898	**0.3** 0.012	RNAO40X55X40	SNSH41X55X1	**60.8** 13700	**113** 25400	17.9	7100	11000	**0.276** 0.608
45 1.7717	**45** 1.7717	**55** 2.1654	**17** 0.669	**50** 1.9685	**0.3** 0.012	RNAO45X55X17	SNSH45,5X55X0,5	**24.9** 5600	**51.8** 11600	8.05	6100	9400	**0.089** 0.196
	45 1.7717	**55** 2.1654	**34** 1.339	**50** 1.9685	**0.3** 0.012	RNAO45X55X34	SNSH45,5X55X0,5	**42.7** 9600	**104** 23400	16.1	6100	9400	**0.168** 0.370
	45 1.7717	**62** 2.4409	**20** 0.787	**53** 2.0866	**0.3** 0.012	RNAO45X62X20	SNSH46X62X1	**30.8** 6920	**68.1** 15300	9.05	6100	9400	**0.163** 0.359
	45 1.7717	**62** 2.4409	**40** 1.575	**53** 2.0866	**0.3** 0.012	RNAO45X62X40	SNSH46X62X1	**61.7** 13900	**119** 26800	18.1	6200	9600	**0.325** 0.717
50 1.9685	**50** 1.9685	**62** 2.4409	**20** 0.787	**55** 2.1654	**0.3** 0.012	RNAO50X62X20		**30.2** 6790	**68.5** 15400	10.7	5400	8400	**0.142** 0.313
	50 1.9685	**62** 2.4409	**40** 1.575	**55** 2.1654	**0.3** 0.012	RNAO50X62X40		**51.7** 11600	**137** 30800	21.4	5400	8400	**0.269** 0.593
	50 1.9685	**65** 2.5591	**20** 0.787	**58** 2.2835	**0.3** 0.012	RNAO50X65X20	SNSH51X65X1	**38.8** 8720	**67.8** 15200	10.8	5600	8600	**0.167** 0.368
	50 1.9685	**65** 2.5591	**40** 1.575	**58** 2.2835	**0.3** 0.012	RNAO50X65X40		**66.5** 14900	**136** 30600	21.6	5600	8600	**0.342** 0.754
55 2.1654	**55** 2.1654	**68** 2.6772	**20** 0.787	**60** 2.3622	**0.3** 0.012	RNAO55X68X20		**30.7** 6900	**72.4** 16300	11.3	4900	7600	**0.165** 0.364
	55 2.1654	**68** 2.6772	**40** 1.575	**60** 2.3622	**0.3** 0.012	RNAO55X68X40		**52.7** 11800	**145** 32600	22.6	4900	7600	**0.320** 0.705
	55 2.1654	**72** 2.8346	**20** 0.787	**63** 2.4803	**1.0** 0.039	RNAO55X72X20	SNSH56X72X1	**40.3** 9060	**73.5** 16500	11.7	5000	7800	**0.212** 0.467
	55 2.1654	**72** 2.8346	**40** 1.575	**63** 2.4803	**1.0** 0.039	RNAO55X72X40	SNSH56X72X1	**69.1** 15500	**127** 28600	23.4	5000	7800	**0.433** 0.955
60 2.3622	**60** 2.3622	**78** 3.0709	**20** 0.787	**68** 2.6772	**1.0** 0.039	RNAO60X78X20	SNSH61X78X1	**41.8** 9400	**79.2** 17800	12.6	4600	7100	**0.230** 0.507
	60 2.3622	**78** 3.0709	**40** 1.575	**68** 2.6772	**1.0** 0.039	RNAO60X78X40	SNSH61X78X1	**71.7** 16100	**158** 35500	25.2	4600	7100	**0.436** 0.961
65 2.5591	**65** 2.5591	**85** 3.3465	**30** 1.181	**73** 2.8740	**1.0** 0.039	RNAO65X85X30	SNSH66X85X1	**60.1** 13500	**129** 29000	20.3	4200	6500	**0.468** 1.032
	65 2.5591	**85** 3.3465	**60** 2.362	**73** 2.8740	**1.0** 0.039	RNAO65X85X60	SNSH66X85X1	**103** 23200	**259** 58200	40.7	4200	6500	**0.876** 1.931
70 2.7559	**70** 2.7559	**90** 3.5433	**30** 1.181	**78** 3.0709	**1.0** 0.039	RNAO70X90X30		**62.2** 14000	**139** 31200	21.8	3900	6000	**0.505** 1.113
	70 2.7559	**90** 3.5433	**60** 2.362	**78** 3.0709	**1.0** 0.039	RNAO70X90X60		**107** 24100	**277** 62300	43.6	3900	6000	**0.925** 2.039
75 2.9528	**75** 2.9528	**95** 3.7402	**30** 1.181	**83** 3.2677	**1.0** 0.039	RNAO75X95X30		**60.9** 13700	**138** 31000	21.7	3600	5600	**0.510** 1.124
	75 2.9528	**95** 3.7402	**60** 2.362	**83** 3.2677	**1.0** 0.039	RNAO75X95X60		**104** 23400	**277** 62300	43.3	3600	5600	**0.980** 2.161
80 3.1496	**80** 3.1496	**100** 3.9370	**30** 1.181	**88** 3.4646	**1.0** 0.039	RNAO80X100X30		**67.5** 15200	**161** 36200	25.4	3400	5200	**0.580** 1.279
	80 3.1496	**100** 3.9370	**60** 2.362	**88** 3.4646	**1.0** 0.039	RNAO80X100X60		**116** 26100	**322** 72400	50.7	3400	5200	**1.044** 2.30
85 3.3465	**85** 3.3465	**105** 4.1339	**30** 1.181	**93** 3.6614	**1.0** 0.039	RNAO85X105X30		**69.4** 15600	**170** 38200	26.8	3000	4600	**0.586** 1.292
100 3.9370	**100** 3.9370	**120** 4.7244	**30** 1.181	**108** 4.2520	**1.0** 0.039	RNAO100X120X30		**72.4** 16300	**191** 42900	29.5	2700	4200	**0.660** 1.455

NEEDLE ROLLER BEARINGS

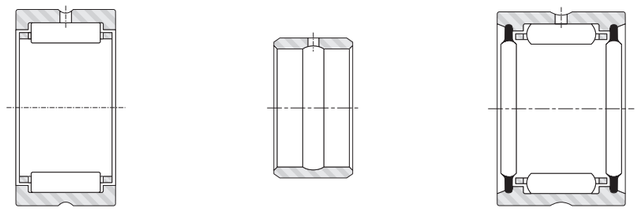
INCH SERIES

When there is a requirement for a rolling bearing to support very high dynamic, static or even shock loads with a restricted mounting space – the needle roller bearing may give best results.

REFERENCE STANDARDS ARE:

- **ANSI/ABMA Standard 18.2** – needle roller bearings – radial, inch design.
- **ASTM Standard F 2246** – standard specification for bearing, roller, needle: thick outer ring with rollers and cage.
- **Military Standard MS 51961** – bearing, roller, needle: thick outer ring with rollers and cage.
- **ASTM Standard F2431** – standard specification for ring, bearing, inner: needle roller bearing with thick outer ring.

IDENTIFICATION



HJ IR HJ – .2RS

Fig. B4-11. Construction of inch series heavy-duty needle roller bearings

The prefix letters HJ in the needle roller bearing designation denote that the bearing is manufactured to inch nominal dimensions.

Bearings are available with one or two lip-contact seals, as listed on pages B-4-46 and B-4-47. One seal is designated by suffix letters RS. Two seals are designated by .2RS.

Inner rings can be used with HJ Series needle roller bearings for applications where it is impractical to use the shaft as the inner raceway. These inch series inner rings are identified by the prefix letters IR.

Because the entire identification code may not appear on the bearing itself, the manufacturer's parts list or another reliable source should always be consulted when ordering bearings for service or field replacement to make certain that the correct bearing with the correct lubricant is used.

CONSTRUCTION

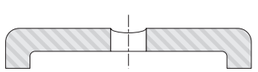


Fig. B4-12. One-piece, channel-shaped outer ring

Fig. B4-13. Steel cage

The HJ Series needle roller bearing has a one-piece channel-shaped outer ring of bearing-quality steel heat treated to provide maximum load rating. The integral end flanges provide axial location for the needle rollers. The bores of the end flanges serve as piloting surfaces for the cage, locating it to prevent removal of the lubricant film on the raceway.

These bearings have a steel cage, which provides inward retention for the needle rollers. The design assures roller stability and minimizes friction between the cage and the needle rollers. The cage has a maximum strength consistent with the inherent high load ratings of needle roller bearings.

The needle rollers are made from high-carbon chrome steel, through-hardened, ground and lapped to close tolerance with controlled contour for optimum load distribution.

SEALS

Shaft contact seals, which fit into the same housing bore as the heavy-duty needle roller bearings, may be obtained from recognized seal manufacturers. Bearings can also be made available with one or two integral seals. For information and listing of sealed bearings, see pages B-4-46 and B-4-47.

LUBRICATION

The outer rings of the HJ bearings are supplied with a lubrication groove on the O.D. and a lubrication hole in this groove to facilitate re-lubrication through the outer ring. The IR inner rings have lubrication grooves in the bore and a re-lubrication hole to facilitate re-lubrication through the inner ring.

HJ Series bearings (with or without seals) are typically shipped protected with a corrosion-preventive compound that is not a lubricant. When specified by the customer, HJ Series bearings may be ordered prelubricated with suitable greases and oils.

MOUNTING DIMENSIONS

HJ needle roller bearings are normally mounted in their housings with a clearance fit if the load is stationary relative to the housing, and with a tight transition fit if the load rotates relative to the housing. Because the tight transition fit of the bearing in its housing may result in a reduction of the needle roller complement bore diameter, the shaft raceway diameter should be reduced to a like amount.

The mounting dimensions in the bearing tables (pages B-4-42 to B-4-47) list the suggested ISO H7 tolerances for the housing bore and the suggested ISO h6 tolerances for the shaft raceway when the outer ring is to be mounted with a clearance fit. The tables also list the suggested ISO N7 tolerances for the housing bore and the suggested ISO f6 tolerances for the shaft raceway when the outer ring is to be mounted with a tight transition fit.

Other mounting dimensions may be required for special conditions such as:

1. Extremely heavy radial loads.
2. Shock loads.
3. Load rotating relative to both inner and outer rings.
4. Temperature gradient across bearing.
5. Housing with heat expansion coefficient differing from that of the bearing.

If these conditions are expected, please consult your representative.

DIMENSIONAL ACCURACY, BEARINGS

HJ SERIES

Tolerances for the HJ bearings are given in Tables B4-7 and B4-8. Pages B-4-42 to B-4-47 list the nominal outer diameter, width and needle roller complement bore diameter for the HJ bearings.

Table B4-7. Outer diameter and width tolerances, HJ bearings

D				Deviaiton from nominal							
Nominal outer diameter				of single mean outer diameter, D_{mp}[1]				of width, C			
>	≤	>	≤	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
mm	mm	in	in	mm	mm	in	in	mm	mm	in	in
19.050	**50.800**	0.7500	2.0000	**+0**	**-0.013**	+0	-0.0005	**+0**	**-0.013**	+0	-0.005
50.800	**82.550**	2.0000	3.2500	**+0**	**-0.015**	+0	-0.0006	**+0**	**-0.013**	+0	-0.005
82.550	**120.650**	3.2500	4.7500	**+0**	**-0.020**	+0	-0.0008	**+0**	**-0.013**	+0	-0.005

[1] "Single mean diameter" is defined as the mean diameter in a single radial plane.

Table B4-8. Roller complement bore tolerance, HJ bearings

F_w				Deviaiton from nominal of the smallest single diameter of the roller complement bore, F_m[1]			
Nominal roller complement bore diameter							
>	≤	>	≤	Max.	Min.	Max.	Min.
mm	mm	in	in	mm	mm	in	in
12.700	**15.875**	0.5000	0.6250	**+0.043**	**+0.020**	+0.0017	+0.0008
15.875	**28.575**	0.6250	1.1250	**+0.046**	**+0.023**	+0.0018	+0.0009
28.575	**41.275**	1.1250	1.6250	**+0.048**	**+0.025**	+0.0019	+0.0010
41.275	**47.625**	1.6250	1.8750	**+0.050**	**+0.025**	+0.0020	+0.0010
47.625	**69.850**	1.8750	2.7500	**+0.053**	**+0.028**	+0.0021	+0.0011
69.850	**76.200**	2.7500	3.0000	**+0.058**	**+0.028**	+0.0023	+0.0011
76.200	**101.600**	3.0000	4.0000	**+0.060**	**+0.030**	+0.0024	+0.0012

[1] "The smallest single diameter of the roller complement bore" is defined as the diameter of the cylinder which, when used as a bearing inner ring, results in zero radial internal clearance in the bearing on at least one diameter.

DIMENSIONAL ACCURACY, INNER RINGS

IR SERIES

Tolerances for the IR inner rings are given in Tables B4-9 and B4-10. Pages B-4-48 to B-4-51 list the nominal outer diameter, width and bore diameter for the IR series inner rings.

Table B4-9. Bore and width tolerances, IR inner rings

d				Deviaiton from nominal							
Nominal bore diameter				of single mean bore diameter, d_{mp}[1]				of width, B			
>	≤	>	≤	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
mm	mm	in	in	mm	mm	in	in	mm	mm	in	in
7.938	19.050	0.3125	0.7500	+0	-0.010	+0	-0.0004	+0.25	+0.12	+0.010	+0.005
19.050	50.800	0.7500	2.0000	+0	-0.013	+0	-0.0005	+0.25	+0.12	+0.010	+0.005
50.800	82.550	2.0000	3.2500	+0	-0.015	+0	-0.0006	+0.25	+0.12	+0.010	+0.005

[1] "Single mean diameter" is defined as the mean diameter in a single radial plane.

Table B4-10. Outer diameter tolerance, IR inner rings

F				Deviaiton from nominal of single mean outer diameter, F_{mp}[1]			
Nominal outer diameter							
>	≤	>	≤	Max.	Min.	Max.	Min.
mm	mm	in	in	mm	mm	in	in
12.700	15.875	0.5000	0.6250	-0.013	-0.023	-0.0005	-0.0009
15.875	25.400	0.6250	1.0000	-0.018	-0.031	-0.0007	-0.0012
25.400	28.575	1.0000	1.1250	-0.023	-0.036	-0.0009	-0.0014
28.575	34.925	1.1250	1.3750	-0.023	-0.036	-0.0009	-0.0015
34.925	47.625	1.3750	1.8750	-0.025	-0.038	-0.0010	-0.0016
47.625	76.200	1.8750	3.0000	-0.028	-0.040	-0.0011	-0.0018
76.200	95.250	3.0000	3.7500	-0.033	-0.046	-0.0013	-0.0022

[1] "Single mean diameter" is defined as the mean diameter in a single radial plane.

LOAD RATING FACTORS

DYNAMIC LOADS

Needle roller bearings can accommodate only radial loads.

$$P = F_r$$

P = The maximum dynamic radial load that may be applied to a needle roller bearing based on the dynamic load rating, C_r, given in the bearing tables. This load should be $\leq C_r/3$.

STATIC LOADS

Needle roller bearings can accommodate only radial loads.

$$P_0 = F_r$$

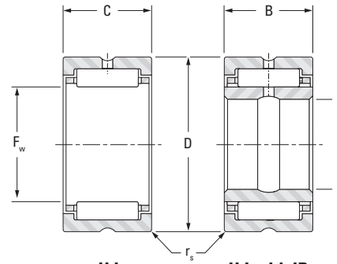
SPECIAL BEARINGS

For needle roller bearings with special dimensions or special features, such as split outer ring, consult your representative.

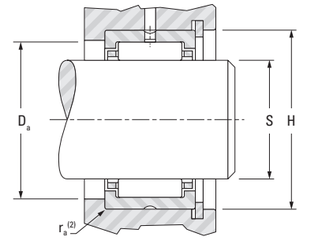
HJ TYPE

INCH SERIES

- Check for availability.
- Nominal bearing diameters and widths shown.
- Tolerance tables found on page B-4-39.
- Clearance fit suggested for outer ring when housing is stationary relative to load.
- Tight transition fit suggested if housing rotates relative to load.
- Consult your representative for oscillating applications (e.g., low radial clearance concerns).
- Unmarked end of outer ring should be assembled against housing shoulder to clear maximum allowed housing fillet.
- Meets Military Standard MS 51961 and ASTM F2246.



HJ HJ with IR



Shaft surface to be 58 HRC or equivalent

Shaft Dia.	F_w	D	C (B)	$r_{s\ min.}$	Bearing Designation	Used With Inner Ring Designation(1)	Load Ratings		Fatigue Load Limit C_u	Speed Ratings	
							Dynamic	Static		Grease	Oil
							C	C_0			
in	mm in	mm in	mm in	mm in			kN lbf		kN	min^{-1}	
5/8	**15.875** 0.6250	**28.575** 1.1250	**19.050** 0.750	**0.64** 0.025	HJ-101812	IR-061012	**19.3** 4350	**20.7** 4650	3.25	20000	30000
3/4	**19.050** 0.7500	**31.750** 1.2500	**19.050** 0.750	**1.02** 0.04	HJ-122012	IR-081212	**20.7** 4650	**23.3** 5240	3.65	16000	25000
	19.050 0.7500	**31.750** 1.2500	**25.400** 1.000	**1.02** 0.04	HJ-122016	IR-081216	**27.8** 6250	**33.8** 7600	5.30	16000	25000
7/8	**22.225** 0.8750	**34.925** 1.3750	**19.050** 0.750	**1.02** 0.04	HJ-142212	IR-101412	**23.1** 5180	**27.9** 6270	4.35	13000	21000
	22.225 0.8750	**34.925** 1.3750	**25.400** 1.000	**1.02** 0.04	HJ-142216	IR-101416	**31.0** 6970	**40.5** 9100	6.35	13000	21000
1	**25.400** 1.0000	**38.100** 1.5000	**19.050** 0.750	**1.02** 0.04	HJ-162412	IR-121612	**25.2** 5680	**32.5** 7300	5.10	12000	18000
	25.400 1.0000	**38.100** 1.5000	**25.400** 1.000	**1.02** 0.04	HJ-162416	IR-121616 IR-131616	**34.0** 7640	**47.2** 10600	7.40	12000	18000
1 1/8	**28.575** 1.1250	**41.275** 1.6250	**25.400** 1.000	**1.02** 0.04	HJ-182616	IR-141816 IR-151816	**36.3** 8170	**53.8** 12100	8.45	10000	16000
	28.575 1.1250	**41.275** 1.6250	**31.750** 1.250	**1.02** 0.04	HJ-182620	IR-141820 IR-151820	**44.9** 10100	**70.3** 15800	10.9	10000	16000
1 1/4	**31.750** 1.2500	**44.450** 1.7500	**25.400** 1.000	**1.02** 0.04	HJ-202816	IR-162016	**37.4** 8410	**57.4** 12900	9.00	9100	14000
	31.750 1.2500	**44.450** 1.7500	**31.750** 1.250	**1.02** 0.04	HJ-202820	IR-162020	**46.3** 10400	**75.2** 16900	11.7	9100	14000
1 3/8	**34.925** 1.3750	**47.625** 1.8750	**25.400** 1.000	**1.02** 0.04	HJ-223016	IR-182216	**39.8** 8950	**64.1** 14400	10.1	8200	13000
	34.925 1.3750	**47.625** 1.8750	**31.750** 1.250	**1.02** 0.04	HJ-223020	IR-182220	**49.4** 11100	**84.1** 18900	13.0	8200	13000
1 1/2	**38.100** 1.5000	**52.388** 2.0625	**25.400** 1.000	**1.52** 0.06	HJ-243316	IR-202416	**47.6** 10700	**72.5** 16300	11.4	7600	12000
	38.100 1.5000	**52.388** 2.0625	**31.750** 1.250	**1.52** 0.06	HJ-243320	IR-192420 IR-202420	**58.7** 13200	**95.2** 21400	14.9	7600	12000
1 5/8	**41.275** 1.6250	**55.563** 2.1875	**25.400** 1.000	**1.52** 0.06	HJ-263516	IR-212616	**48.5** 10900	**76.5** 17200	12.1	7000	11000
	41.275 1.6250	**55.563** 2.1875	**31.750** 1.250	**1.52** 0.06	HJ-263520	IR-212620 IR-222620	**60.1** 13500	**100.5** 22600	15.7	7000	11000
1 3/4	**44.450** 1.7500	**58.738** 2.3125	**25.400** 1.000	**1.52** 0.06	HJ-283716	IR-232816 IR-242816	**49.8** 11200	**81.0** 18200	12.8	6400	9900

Approx. Wt.	Mounting Dimensions Clearance Fit				Bearing Designation	Mounting Dimensions Tight Transition Fit				Shoulder Dia.	Shaft Dia.
	S (ISO h6)		H (ISO H7)			S (ISO f6)		H (ISO N7)		D_a	
	Max.	Min.	Max.	Min.		Max.	Min.	Max.	Min.	±0.38 ±0.015	
kg lbs	mm in	mm in	mm in	mm in		mm in	mm in	mm in	mm in	mm in	in
0.050 0.11	**15.875** 0.6250	**15.865** 0.6246	**28.595** 1.1258	**28.575** 1.1250	HJ-101812	**15.860** 0.6244	**15.850** 0.6240	**28.567** 1.1247	**28.547** 1.1239	**23.83** 0.938	5/8
0.059 0.13	**19.050** 0.7500	**19.037** 0.7495	**31.775** 1.2510	**31.750** 1.2500	HJ-122012	**19.030** 0.7492	**19.017** 0.7487	**31.742** 1.2497	**31.717** 1.2487	**26.97** 1.062	3/4
0.077 0.17	**19.050** 0.7500	**19.037** 0.7495	**31.775** 1.2510	**31.750** 1.2500	HJ-122016	**19.030** 0.7492	**19.017** 0.7487	**31.742** 1.2497	**31.717** 1.2487	**26.97** 1.062	
0.064 0.14	**22.225** 0.8750	**22.212** 0.8745	**34.950** 1.3760	**34.925** 1.3750	HJ-142212	**22.205** 0.8742	**22.192** 0.8737	**34.917** 1.3747	**34.892** 1.3737	**30.18** 1.188	7/8
0.086 0.19	**22.225** 0.8750	**22.212** 0.8745	**34.950** 1.3760	**34.925** 1.3750	HJ-142216	**22.205** 0.8742	**22.192** 0.8737	**34.917** 1.3747	**34.892** 1.3737	**30.18** 1.188	
0.073 0.16	**25.400** 1.0000	**25.387** 0.9995	**38.125** 1.5010	**38.100** 1.5000	HJ-162412	**25.380** 0.9992	**25.367** 0.9987	**38.092** 1.4997	**38.067** 1.4987	**33.32** 1.312	1
0.095 0.21	**25.400** 1.0000	**25.387** 0.9995	**38.125** 1.5010	**38.100** 1.5000	HJ-162416	**25.380** 0.9992	**25.367** 0.9987	**38.092** 1.4997	**38.067** 1.4987	**33.32** 1.312	
0.104 0.23	**28.575** 1.1250	**28.562** 1.1245	**41.300** 1.6260	**41.275** 1.6250	HJ-182616	**28.555** 1.1242	**28.542** 1.1237	**41.267** 1.6247	**41.242** 1.6237	**36.53** 1.438	1 1/8
0.132 0.29	**28.575** 1.1250	**28.562** 1.1245	**41.300** 1.6260	**41.275** 1.6250	HJ-182620	**28.555** 1.1242	**28.542** 1.1237	**41.267** 1.6247	**41.242** 1.6237	**36.53** 1.438	
0.113 0.25	**31.750** 1.2500	**31.735** 1.2494	**44.475** 1.7510	**44.450** 1.7500	HJ-202816	**31.725** 1.2490	**31.709** 1.2484	**44.442** 1.7497	**44.417** 1.7487	**39.67** 1.562	1 1/4
0.145 0.32	**31.750** 1.2500	**31.735** 1.2494	**44.475** 1.7510	**44.450** 1.7500	HJ-202820	**31.725** 1.2490	**31.709** 1.2484	**44.442** 1.7497	**44.417** 1.7487	**39.67** 1.562	
0.127 0.28	**34.925** 1.3750	**34.910** 1.3744	**47.650** 1.8760	**47.625** 1.8750	HJ-223016	**34.900** 1.374	**34.884** 1.3734	**47.617** 1.8747	**47.592** 1.8737	**42.88** 1.688	1 3/8
0.159 0.35	**34.925** 1.3750	**34.910** 1.3744	**47.650** 1.8760	**47.625** 1.8750	HJ-223020	**34.900** 1.3740	**34.884** 1.3734	**47.617** 1.8747	**47.592** 1.8737	**42.88** 1.688	
0.154 0.34	**38.100** 1.5000	**38.085** 1.4994	**52.418** 2.0637	**52.388** 2.0625	HJ-243316	**38.075** 1.4990	**38.059** 1.4984	**52.380** 2.0622	**52.349** 2.0610	**47.63** 1.875	1 1/2
0.195 0.43	**38.100** 1.5000	**38.085** 1.4994	**52.418** 2.0637	**52.388** 2.0625	HJ-243320	**38.075** 1.4990	**38.059** 1.4984	**52.380** 2.0622	**52.349** 2.0610	**47.63** 1.875	
0.163 0.36	**41.275** 1.6250	**41.260** 1.6244	**55.593** 2.1887	**55.563** 2.1875	HJ-263516	**41.250** 1.6240	**41.234** 1.6234	**55.555** 2.1872	**55.524** 2.1860	**50.80** 2.000	1 5/8
0.209 0.46	**41.275** 1.6250	**41.260** 1.6244	**55.593** 2.1887	**55.563** 2.1875	HJ-263520	**41.250** 1.6240	**41.234** 1.6234	**55.555** 2.1872	**55.524** 2.1860	**50.80** 2.000	
0.177 0.39	**44.450** 1.7500	**44.435** 1.7494	**58.768** 2.3137	**58.738** 2.3125	HJ-283716	**44.425** 1.7490	**44.409** 1.7484	**58.730** 2.3122	**58.699** 2.3110	**53.98** 2.125	1 3/4

(1) See pages B-4-48 to B-4-51 for inch series inner rings. Order inner rings separately.
(2) $r_{a\ max.}$ is equal to the minimum bearing chamfer ($r_{s\ min.}$) at unmarked end.

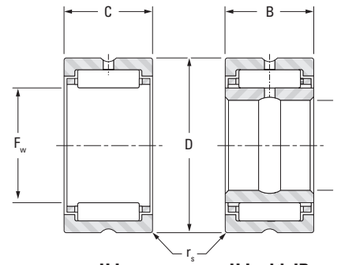
Continued on next page.

B

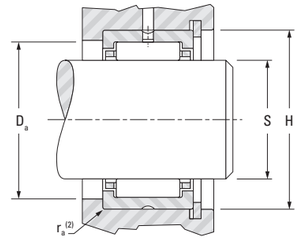
HJ TYPE

INCH SERIES

- Check for availability.
- Nominal bearing diameters and widths shown.
- Tolerance tables found on page B-4-39.
- Clearance fit suggested for outer ring when housing is stationary relative to load.
- Tight transition fit suggested if housing rotates relative to load.
- Consult your representative for oscillating applications (e.g., low radial clearance concerns).
- Unmarked end of outer ring should be assembled against housing shoulder to clear maximum allowed housing fillet ($r_{a\ max.}$[2]).
- Meets Military Standard MS 51961 and ASTM F2246.



HJ **HJ with IR**



Shaft surface to be 58 HRC or equivalent

Shaft Dia.	F_w	D	C (B)	$r_{s\ min.}$	Bearing Designation	Used With Inner Ring Designation[1]	Load Ratings		Fatigue Load Limit C_u	Speed Ratings	
							Dynamic	Static		Grease	Oil
							C	C_0			
in	**mm** in	**mm** in	**mm** in	**mm** in			**kN** lbf		kN	min^{-1}	
1 3/4	**44.450** 1.7500	**58.738** 2.3125	**31.750** 1.250	**1.52** 0.06	HJ-283720	IR-222820 IR-232820 IR-242820	**61.8** 13900	**106** 23900	16.6	6400	9900
1 7/8	**47.625** 1.8750	**61.913** 2.4375	**31.750** 1.250	**1.52** 0.06	HJ-303920	IR-253020	**65.4** 14700	**117** 26300	18.1	6000	9200
2	**50.800** 2.0000	**65.088** 2.5625	**25.400** 1.000	**1.52** 0.06	HJ-324116	IR-273216	**53.8** 12100	**93.0** 20900	14.7	5600	8600
	50.800 2.0000	**65.088** 2.5625	**31.750** 1.250	**1.52** 0.06	HJ-324120	IR-243220 IR-253220 IR-263220 IR-273220	**66.7** 15000	**122** 27500	19.1	5600	8600
2 1/4	**57.150** 2.2500	**76.200** 3.0000	**38.100** 1.500	**1.52** 0.06	HJ-364824	IR-283624	**89.9** 20200	**164** 36900	25.7	5000	7600
	57.150 2.2500	**76.200** 3.0000	**44.450** 1.750	**1.52** 0.06	HJ-364828	IR-283628	**104** 23400	**198** 44500	30.8	5000	7600
2 1/2	**63.500** 2.5000	**82.550** 3.2500	**38.100** 1.500	**2.03** 0.08	HJ-405224	IR-314024 IR-324024	**97.0** 21800	**187** 42100	29.4	4400	6800
	63.500 2.5000	**82.550** 3.2500	**44.450** 1.750	**2.03** 0.08	HJ-405228	IR-314028 IR-324028	**112** 25200	**226** 50800	35.2	4400	6800
2 3/4	**69.850** 2.7500	**88.900** 3.5000	**25.400** 1.000	**2.03** 0.08	HJ-445616	—	**67.2** 15100	**120** 27000	19.1	4000	6200
	69.850 2.7500	**88.900** 3.5000	**38.100** 1.500	**2.03** 0.08	HJ-445624	IR-364424	**101** 22700	**203** 45700	31.9	4000	6200
	69.850 2.7500	**88.900** 3.5000	**44.450** 1.750	**2.03** 0.08	HJ-445628	IR-354428 IR-364428	**117** 26300	**245** 55100	38.2	4000	6200
3	**76.200** 3.0000	**95.250** 3.7500	**38.100** 1.500	**2.03** 0.08	HJ-486024	IR-404824	**107** 24100	**226** 50900	35.5	3700	5600
	76.200 3.0000	**95.250** 3.7500	**44.450** 1.750	**2.03** 0.08	HJ-486028	IR-384828 IR-404828	**124** 27900	**273** 61400	42.5	3700	5600
3 1/4	**82.550** 3.2500	**107.950** 4.2500	**44.450** 1.750	**2.03** 0.08	HJ-526828	IR-445228	**163** 36600	**307** 69000	48.3	3400	5300
	82.550 3.2500	**107.950** 4.2500	**50.800** 2.000	**2.03** 0.08	HJ-526832	IR-445232	**184** 41300	**360** 80900	56.2	3400	5300
3 1/2	**88.900** 3.5000	**114.300** 4.5000	**50.800** 2.000	**2.03** 0.08	HJ-567232	IR-475632 IR-485632	**188** 42200	**377** 84700	58.9	3200	4900

Approx. Wt.	Mounting Dimensions Clearance Fit				Bearing Designation	Mounting Dimensions Tight Transition Fit				Shoulder Dia.	Shaft Dia.
	S (ISO h6)		H (ISO H7)			S (ISO f6)		H (ISO N7)		D_a	
	Max.	Min.	Max.	Min.		Max.	Min.	Max.	Min.	**±0.38** ±0.015	
kg lbs	**mm** in	**mm** in	**mm** in	**mm** in		**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	in
0.222 0.49	**44.450** 1.7500	**44.435** 1.7494	**58.768** 2.3137	**58.738** 2.3125	HJ-283720	**44.425** 1.7490	**44.409** 1.7484	**58.730** 2.3122	**58.699** 2.3110	**53.98** 2.125	
0.236 0.52	**47.625** 1.8750	**47.610** 1.8744	**61.943** 2.4387	**61.913** 2.4375	HJ-303920	**47.600** 1.8740	**47.584** 1.8734	**61.905** 2.4372	**61.874** 2.4360	**57.15** 2.250	1 7/8
0.200 0.44	**50.800** 2.0000	**50.782** 1.9993	**65.118** 2.5637	**65.088** 2.5625	HJ-324116	**50.770** 1.9988	**50.752** 1.9981	**65.080** 2.5622	**65.049** 2.5610	**60.33** 2.375	
0.249 0.55	**50.800** 2.0000	**50.782** 1.9993	**65.118** 2.5637	**65.088** 2.5625	HJ-324120	**50.770** 1.9988	**50.752** 1.9981	**65.080** 2.5622	**65.049** 2.5610	**60.33** 2.375	2
0.458 1.01	**57.150** 2.2500	**57.132** 2.2493	**76.230** 3.0012	**76.200** 3.0000	HJ-364824	**57.120** 2.2488	**57.102** 2.2481	**76.192** 2.9997	**76.162** 2.9985	**68.28** 2.688	2 1/4
0.531 1.17	**57.150** 2.2500	**57.132** 2.2493	**76.230** 3.0012	**76.200** 3.0000	HJ-364828	**57.120** 2.2488	**57.102** 2.2481	**76.192** 2.9997	**76.162** 2.9985	**68.28** 2.688	
0.499 1.10	**63.500** 2.5000	**63.482** 2.4993	**82.586** 3.2514	**82.550** 3.2500	HJ-405224	**63.470** 2.4988	**63.452** 2.4981	**82.537** 3.2495	**82.502** 3.2481	**74.63** 2.938	2 1/2
0.499 1.29	**63.500** 2.5000	**63.482** 2.4993	**82.586** 3.2514	**82.550** 3.2500	HJ-405228	**63.470** 2.4988	**63.452** 2.4981	**82.537** 3.2495	**82.502** 3.2481	**74.63** 2.938	
0.363 0.80	**69.850** 2.7500	**69.832** 2.7493	**88.936** 3.5014	**88.900** 3.5000	HJ-445616	**69.820** 2.7488	**69.802** 2.7481	**88.887** 3.4995	**88.852** 3.4981	**80.98** 3.188	
0.544 1.20	**69.850** 2.7500	**69.832** 2.7493	**88.936** 3.5014	**88.900** 3.5000	HJ-445624	**69.820** 2.7488	**69.802** 2.7481	**88.887** 3.4995	**88.852** 3.4981	**80.98** 3.188	2 3/4
0.635 1.40	**69.850** 2.7500	**69.832** 2.7493	**88.936** 3.5014	**88.900** 3.5000	HJ-445628	**69.820** 2.7488	**69.802** 2.7481	**88.887** 3.4995	**88.852** 3.4981	**80.98** 3.188	
0.585 1.29	**76.200** 3.0000	**76.182** 2.9993	**95.286** 3.7514	**95.250** 3.7500	HJ-486024	**76.170** 2.9988	**76.152** 2.9981	**95.237** 3.7495	**95.202** 3.7481	**87.33** 3.438	3
0.685 1.51	**76.200** 3.0000	**76.182** 2.9993	**95.286** 3.7514	**95.250** 3.7500	HJ-486028	**76.170** 2.9988	**76.152** 2.9981	**95.237** 3.7495	**95.202** 3.7481	**87.33** 3.438	
1.016 2.24	**82.550** 3.2500	**82.527** 3.2491	**107.986** 4.2514	**107.950** 4.2500	HJ-526828	**82.514** 3.2486	**82.492** 3.2477	**107.937** 4.2495	**107.902** 4.2481	**98.43** 3.875	3 1/4
1.161 2.56	**82.550** 3.2500	**82.527** 3.2491	**107.986** 4.2514	**107.950** 4.2500	HJ-526832	**82.514** 3.2486	**82.492** 3.2477	**107.937** 4.2495	**107.902** 4.2481	**98.43** 3.875	
1.238 2.73	**88.900** 3.5000	**88.877** 3.4991	**114.336** 4.5014	**114.300** 4.5000	HJ-567232	**88.864** 3.4986	**88.842** 3.4977	**114.287** 4.4995	**114.252** 4.4981	**104.78** 4.125	3 1/2

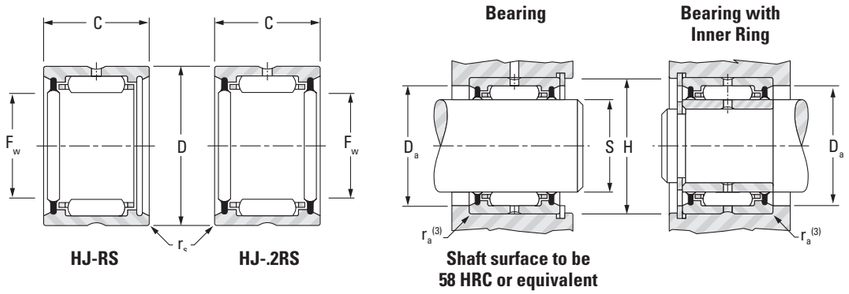
[1] See pages B-4-48 to B-4-51 for inch series inner rings. Order inner rings separately.
[2] $r_{a\ max.}$ is equal to the minimum bearing chamfer ($r_{s\ min.}$) at unmarked end.

B

SEALED HEAVY-DUTY NEEDLE ROLLER BEARINGS

INCH SERIES

- Bearing diameters and widths listed are nominal.
- For inspection purposes, see tolerance tables on page B-4-39.
- Available with one or two lip-contact seals designed to retain lubricant and exclude foreign material.
- Single seals are normally installed in the stamped end of bearing.
- Seals limit the bearing operating temperature between -30° C and +110° C (-25° F and +225° F).
- For operating temperature outside of the above range or if seals are exposed to unusual fluids, please consult your representative.



Shaft Dia.	F_w	D	C (B)	$r_{s\ min.}$	Bearing Designation		Used With Inner Ring(1)	Load Ratings		Fatigue Load Limit C_u	Speed Rating(2)
					One Seal	Two Seals		Dynamic	Static		
								C	C_0		
in	mm in	mm in	mm in	mm in				kN lbf		kN	min^{-1}
5/8	**15.875** 0.6250	**28.575** 1.1250	**25.40** 1.000	**0.64** 0.03	HJ-101816RS	HJ-101816.2RS	—	**19.3** 4350	**20.7** 4650	3.25	12000
3/4	**19.050** 0.7500	**31.750** 1.2500	**25.40** 1.000	**1.02** 0.04	HJ-122016RS	HJ-122016.2RS	IR-081216	**20.7** 4650	**23.3** 5240	3.65	10000
7/8	**22.225** 0.8750	**34.925** 1.3750	**25.40** 1.000	**1.02** 0.04	HJ-142216RS	HJ-142216.2RS	IR-101416	**23.0** 5180	**27.9** 6270	4.35	8700
1	**25.400** 1.0000	**38.100** 1.5000	**25.40** 1.000	**1.02** 0.04	HJ-162416RS	HJ-162416.2RS	IR-121616 IR-131616	**25.3** 5680	**32.5** 7300	5.10	7600
1 1/8	**28.575** 1.1250	**41.275** 1.6250	**31.75** 1.250	**1.02** 0.04	HJ-182620RS	HJ-182620.2RS	IR-141820	**36.3** 8170	**53.8** 12100	8.45	6800
1 1/4	**31.750** 1.2500	**44.450** 1.7500	**31.75** 1.250	**1.02** 0.04	HJ-202820RS	HJ-202820.2RS	IR-162020	**37.4** 8410	**57.4** 12900	9.00	6100
1 3/8	**34.925** 1.3750	**47.625** 1.8750	**31.75** 1.250	**1.02** 0.04	HJ-223020RS	HJ-223020.2RS	IR-182220	**39.8** 8950	**64.1** 14400	10.1	5600
1 1/2	**38.100** 1.5000	**52.388** 2.0625	**31.75** 1.250	**1.52** 0.06	HJ-243320RS	HJ-243320.2RS	IR-192420	**47.6** 10700	**72.5** 16300	11.4	5100
1 5/8	**41.275** 1.6250	**55.563** 2.1875	**31.75** 1.250	**1.52** 0.06	HJ-263520RS	HJ-263520.2RS	IR-212620	**48.5** 10900	**76.5** 17200	12.1	2400
1 3/4	**44.450** 1.7500	**58.738** 2.3125	**31.75** 1.250	**1.52** 0.06	HJ-283720RS	HJ-283720.2RS	IR-222820 IR-232820 IR-242820	**49.8** 11200	**81.0** 18200	12.8	4400
2	**50.800** 2.0000	**65.088** 2.5625	**31.75** 1.250	**1.52** 0.06	HJ-324120RS	HJ-324120.2RS	IR-243220 IR-253220 IR-263220 IR-273220	**53.8** 12100	**93.0** 20900	14.7	3800
2 1/4	**57.150** 2.2500	**76.200** 3.0000	**44.45** 1.750	**1.52** 0.06	HJ-364828RS	HJ-364828.2RS	IR-283628	**89.9** 20200	**164.1** 36900	25.7	1700
2 1/2	**63.500** 2.5000	**82.550** 3.2500	**44.45** 1.750	**2.03** 0.08	HJ-405228RS	HJ-405228.2RS	IR-314028 IR-324028	**97.0** 21800	**187.3** 42100	29.4	3100
2 3/4	**69.850** 2.7500	**88.900** 3.5000	**44.45** 1.750	**2.03** 0.08	HJ-445628RS	HJ-445628.2RS	IR-354428 IR-364428	**101.0** 22700	**203.3** 45700	31.9	1400
3	**76.200** 3.0000	**95.250** 3.7500	**44.45** 1.750	**2.03** 0.08	HJ-486028RS	HJ-486028.2RS	IR-384828 IR-404828	**107.2** 24100	**226.4** 50900	35.5	2500

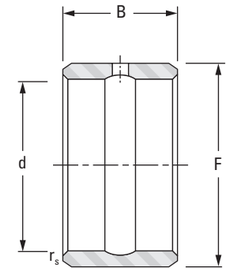
Approx. Wt.	Mounting Dimensions Clearance Fit				Bearing Designation	Mounting Dimensions Tight Transition Fit				Shoulder Dia.	Shaft Dia.
	S (ISO h6)		H (ISO H7)			S (ISO f6)		H (ISO N7)		D_a	
	Max.	Min.	Max.	Min.		Max.	Min.	Max.	Min.	±0.38 ±0.015	
kg lbs	mm in	mm in	mm in	mm in		mm in	mm in	mm in	mm in	mm in	in
0.07 0.15	**15.875** 0.6250	**15.865** 0.6246	**28.595** 1.1258	**28.575** 1.1250	HJ-101816-	**15.860** 0.6244	**15.850** 0.6240	**28.567** 1.1247	**28.547** 1.1239	**23.83** 0.938	5/8
0.08 0.17	**19.050** 0.7500	**19.037** 0.7495	**31.775** 1.2510	**31.750** 1.2500	HJ-122016-	**19.030** 0.7492	**19.017** 0.7487	**31.742** 1.2497	**31.717** 1.2487	**26.97** 1.062	3/4
0.09 0.19	**22.225** 0.8750	**22.212** 0.8745	**34.950** 1.3760	**34.925** 1.3750	HJ-142216-	**22.205** 0.8742	**22.192** 0.8737	**34.917** 1.3747	**34.892** 1.3737	**30.18** 1.188	7/8
0.10 0.21	**25.400** 1.0000	**25.387** 0.9995	**38.125** 1.5010	**38.100** 1.5000	HJ-162416-	**25.380** 0.9992	**25.367** 0.9987	**38.092** 1.4997	**38.067** 1.4987	**33.32** 1.312	1
0.13 0.29	**28.575** 1.1250	**28.562** 1.1245	**41.300** 1.6260	**41.275** 1.6250	HJ-182620-	**28.555** 1.1242	**28.542** 1.1237	**41.267** 1.6247	**41.242** 1.6237	**36.53** 1.438	1 1/8
0.15 0.32	**31.750** 1.2500	**31.735** 1.2494	**44.475** 1.7510	**44.450** 1.7500	HJ-202820-	**31.725** 1.2490	**31.709** 1.2484	**44.442** 1.7497	**44.417** 1.7487	**39.67** 1.562	1 1/4
0.16 0.35	**34.925** 1.3750	**34.910** 1.3744	**47.650** 1.8760	**47.625** 1.8750	HJ-223020-	**34.900** 1.3740	**34.884** 1.3734	**47.617** 1.8747	**47.592** 1.8737	**42.88** 1.688	1 3/8
0.20 0.43	**38.100** 1.5000	**38.085** 1.4994	**52.418** 2.0637	**52.388** 2.0625	HJ-243320-	**38.075** 1.4990	**38.059** 1.4984	**52.380** 2.0622	**52.349** 2.0610	**47.63** 1.875	1 1/2
0.21 0.46	**41.275** 1.6250	**41.260** 1.6244	**55.593** 2.1887	**55.563** 2.1875	HJ-263520-	**41.250** 1.6240	**41.234** 1.6234	**55.555** 2.1872	**55.524** 2.1860	**50.80** 2.000	1 5/8
0.22 0.49	**44.450** 1.7500	**44.435** 1.7494	**58.768** 2.3137	**58.738** 2.3125	HJ-283720-	**44.425** 1.7490	**44.409** 1.7484	**58.730** 2.3122	**58.699** 2.3110	**53.98** 2.125	1 3/4
0.25 0.55	**50.800** 2.0000	**50.782** 1.9993	**65.118** 2.5637	**65.088** 2.5625	HJ-324120-	**50.770** 1.9988	**50.752** 1.9981	**65.080** 2.5622	**65.049** 2.5610	**60.33** 2.375	2
0.53 1.17	**57.150** 2.2500	**57.132** 2.2493	**76.230** 3.0012	**76.200** 3.0000	HJ-364828-	**57.120** 2.2488	**57.102** 2.2481	**76.192** 2.9997	**76.162** 2.9985	**68.28** 2.688	2 1/4
0.59 1.29	**63.500** 2.5000	**63.482** 2.4993	**82.586** 3.2514	**82.550** 3.2500	HJ-405228-	**63.470** 2.4988	**63.452** 2.4981	**82.537** 3.2495	**82.502** 3.2481	**74.63** 2.938	2 1/2
0.64 1.40	**69.850** 2.7500	**69.832** 2.7493	**88.936** 3.5014	**88.900** 3.5000	HJ-445628-	**69.820** 2.7488	**69.802** 2.7481	**88.887** 3.4995	**88.852** 3.4981	**80.98** 3.188	2 3/4
0.68 1.51	**76.200** 3.0000	**76.182** 2.9993	**95.286** 3.7514	**95.250** 3.7500	HJ-486028-	**76.170** 2.9988	**76.152** 2.9981	**95.237** 3.7495	**95.202** 3.7481	**87.33** 3.438	3

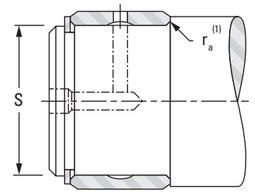
(1) See pages B-4-48 to B-4-51 for inch series inner rings. Order inner rings separately.
(2) Based on standard seal shaft contact speed of 5 m/sec., 1000 ft./min.
(3) $r_{a\ max.}$ is equal to the minimum bearing chamfer ($r_{s\ min.}$) at unmarked end.

INNER RINGS

INCH SERIES

- Check for availability.
- Ideal choice when shaft is not practical to use as inner raceway.
- Provided in inch nominal dimensions for use with inch series heavy-duty needle roller bearings.
- Designed to meet established inch tolerances.
- Selected size should be wider than matching needle roller bearing.
- Maximum shaft fillet radius ($r_{a\ max.}$) cannot exceed inner ring bore chamfer ($r_{s\ min.}$) as shown.
- Optional centralized lubrication groove (bore) or through-hole available. Specify when ordering.
- Designed to be axially clamped against shoulder for loose transition fit on shaft.
- After mounting, for tight transition fit (keeping inner ring from rotating relative to shaft), inner ring O.D. must not exceed raceway diameter on matching bearing. (See mounting dimensions in the bearing table for the required raceway diameter.)
- After mounting, if O.D. of inner ring exceeds the required raceway diameter for matching bearing, ring should be ground to proper diameter while mounted on shaft.
- Meets ASTMF-2431.





Shaft Dia.	d	F	B	$r_{s\ min.}$	Bearing Designation	Approx. Wt.	Loose Transition Fit S		Interference Fit S		Used With Bearing Designation
							Max.	Min.	Max.	Min.	
in	mm in	mm in	mm in	mm in		kg lbs	mm in	mm in	mm in	mm in	
3/8	**9.525** 0.3750	**15.875** 0.6250	**19.05** 0.750	**0.64** 0.025	IR-061012	**0.018** 0.040	**9.520** 0.3748	**9.510** 0.3744	**9.538** 0.3755	**9.530** 0.3752	HJ-101812
1/2	**12.700** 0.5000	**19.050** 0.7500	**19.05** 0.750	**1.02** 0.04	IR-081212	**0.023** 0.050	**12.692** 0.4997	**12.682** 0.4993	**12.715** 0.5006	**12.708** 0.5003	HJ-122012
	12.700 0.5000	**19.050** 0.7500	**25.40** 1.000	**1.02** 0.04	IR-081216	**0.032** 0.070	**12.692** 0.4997	**12.682** 0.4993	**12.715** 0.5006	**12.708** 0.5003	HJ-122016
5/8	**15.875** 0.6250	**22.225** 0.8750	**19.05** 0.750	**1.02** 0.04	IR-101412	**0.027** 0.060	**15.867** 0.6247	**15.857** 0.6243	**15.890** 0.6256	**15.883** 0.6253	HJ-142212
	15.875 0.6250	**22.225** 0.8750	**25.40** 1.000	**1.02** 0.04	IR-101416	**0.036** 0.080	**15.867** 0.6247	**15.857** 0.6243	**15.890** 0.6256	**15.883** 0.6253	HJ-142216
11/16	**17.463** 0.6875	**22.225** 0.8750	**19.05** 0.750	**1.02** 0.04	IR-111412	**0.023** 0.050	**17.455** 0.6872	**17.445** 0.6868	**17.478** 0.6881	**17.470** 0.6878	HJ-142212
3/4	**19.050** 0.7500	**25.400** 1.0000	**19.05** 0.750	**1.02** 0.04	IR-121612	**0.032** 0.070	**19.042** 0.7497	**19.030** 0.7492	**19.068** 0.7507	**19.058** 0.7503	HJ-162412
	19.050 0.7500	**25.400** 1.0000	**25.40** 1.000	**1.02** 0.04	IR-121616	**0.041** 0.090	**19.042** 0.7497	**19.030** 0.7492	**19.068** 0.7507	**19.058** 0.7503	HJ-162416
13/16	**20.638** 0.8125	**25.400** 1.0000	**25.40** 1.000	**1.02** 0.04	IR-131616	**0.032** 0.070	**20.630** 0.8122	**20.617** 0.8117	**20.655** 0.8132	**20.645** 0.8128	HJ-162416
7/8	**22.225** 0.8750	**28.575** 1.1250	**25.40** 1.000	**1.02** 0.04	IR-141816	**0.050** 0.110	**22.217** 0.8747	**22.205** 0.8742	**22.243** 0.8757	**22.233** 0.8753	HJ-182616
	22.225 0.8750	**28.575** 1.1250	**31.75** 1.250	**1.02** 0.04	IR-141820	**0.059** 0.130	**22.217** 0.8747	**22.205** 0.8742	**22.243** 0.8757	**22.233** 0.8753	HJ-182620
15/16	**23.813** 0.9375	**28.575** 1.1250	**25.40** 1.000	**1.02** 0.04	IR-151816	**0.036** 0.080	**23.805** 0.9372	**23.792** 0.9367	**23.830** 0.9382	**23.820** 0.9378	HJ-182616
	23.813 0.9375	**28.575** 1.1250	**31.75** 1.250	**1.02** 0.04	IR-151820	**0.045** 0.100	**23.805** 0.9372	**23.792** 0.9367	**23.830** 0.9382	**23.820** 0.9378	HJ-182620
1	**25.400** 1.0000	**31.750** 1.2500	**25.40** 1.000	**1.02** 0.04	IR-162016	**0.054** 0.120	**25.392** 0.9997	**25.380** 0.9992	**25.418** 1.0007	**25.408** 1.0003	HJ-202816
	25.400 1.0000	**31.750** 1.2500	**31.75** 1.250	**1.02** 0.04	IR-162020	**0.068** 0.150	**25.392** 0.9997	**25.380** 0.9992	**25.418** 1.0007	**25.408** 1.0003	HJ-202820
1 1/8	**28.575** 1.1250	**34.925** 1.3750	**25.40** 1.000	**1.02** 0.04	IR-182216	**0.059** 0.130	**28.567** 1.1247	**28.555** 1.1242	**28.593** 1.1257	**28.583** 1.1253	HJ-223016
	28.575 1.1250	**34.925** 1.3750	**31.75** 1.250	**1.02** 0.04	IR-182220	**0.077** 0.170	**28.567** 1.1247	**28.555** 1.1242	**28.593** 1.1257	**28.583** 1.1253	HJ-223020
1 3/16	**30.163** 1.1875	**38.100** 1.5000	**31.75** 1.250	**1.52** 0.06	IR-192420	**0.100** 0.220	**30.155** 1.1872	**30.142** 1.1867	**30.180** 1.1882	**30.170** 1.1878	HJ-243320
1 1/4	**31.750** 1.2500	**38.100** 1.5000	**25.40** 1.000	**1.52** 0.06	IR-202416	**0.068** 0.150	**31.740** 1.2496	**31.725** 1.2490	**31.770** 1.2508	**31.760** 1.2504	HJ-243316
1 1/4	**31.750** 1.2500	**38.100** 1.5000	**31.75** 1.250	**1.52** 0.06	IR-202420	**0.082** 0.180	**31.740** 1.2496	**31.725** 1.2490	**31.770** 1.2508	**31.760** 1.2504	HJ-243320
1 5/16	**33.338** 1.3125	**41.275** 1.6250	**25.40** 1.000	**1.52** 0.06	IR-212616	**0.086** 0.190	**33.327** 1.3121	**33.312** 1.3115	**33.358** 1.3133	**33.348** 1.3129	HJ-263516
	33.338 1.3125	**41.275** 1.6250	**31.75** 1.250	**1.52** 0.06	IR-212620	**0.109** 0.240	**33.327** 1.3121	**33.312** 1.3115	**33.358** 1.3133	**33.348** 1.3129	HJ-263520
1 3/8	**34.925** 1.3750	**41.275** 1.6250	**31.75** 1.250	**1.52** 0.06	IR-222620	**0.091** 0.200	**34.915** 1.3746	**34.900** 1.3740	**34.945** 1.3758	**34.935** 1.3754	HJ-263520
	34.925 1.3750	**44.450** 1.7500	**31.75** 1.250	**1.52** 0.06	IR-222820	**0.141** 0.310	**34.915** 1.3746	**34.900** 1.3740	**34.945** 1.3758	**34.935** 1.3754	HJ-283720
1 7/16	**36.513** 1.4375	**44.450** 1.7500	**25.40** 1.000	**1.52** 0.06	IR-232816	**0.095** 0.210	**36.502** 1.4371	**36.487** 1.4365	**36.533** 1.4383	**36.523** 1.4379	HJ-283716
	36.513 1.4375	**44.450** 1.7500	**31.75** 1.250	**1.52** 0.06	IR-232820	**0.118** 0.260	**36.502** 1.4371	**36.487** 1.4365	**36.533** 1.4383	**36.523** 1.4379	HJ-283720
1 1/2	**38.100** 1.5000	**44.450** 1.7500	**25.40** 1.000	**1.52** 0.06	IR-242816	**0.077** 0.170	**38.090** 1.4996	**38.075** 1.4990	**38.120** 1.5008	**38.110** 1.5004	HJ-283716
	38.100 1.5000	**44.450** 1.7500	**31.75** 1.250	**1.52** 0.06	IR-242820	**0.095** 0.210	**38.090** 1.4996	**38.075** 1.4990	**38.120** 1.5008	**38.110** 1.5004	HJ-283720
	38.100 1.5000	**50.800** 2.0000	**31.75** 1.250	**1.52** 0.06	IR-243220	**0.209** 0.460	**38.090** 1.4996	**38.075** 1.4990	**38.120** 1.5008	**38.110** 1.5004	HJ-324120
1 9/16	**39.688** 1.5625	**47.625** 1.8750	**31.75** 1.250	**1.52** 0.06	IR-253020	**0.127** 0.280	**39.677** 1.5621	**39.662** 1.5615	**39.708** 1.5633	**39.698** 1.5629	HJ-303920
	39.688 1.5625	**50.800** 2.0000	**31.75** 1.250	**1.52** 0.06	IR-253220	**0.186** 0.410	**39.677** 1.5621	**39.662** 1.5615	**39.708** 1.5633	**39.698** 1.5629	HJ-324120
1 5/8	**41.275** 1.6250	**50.800** 2.0000	**31.75** 1.250	**1.52** 0.06	IR-263220	**0.163** 0.360	**41.265** 1.6246	**41.250** 1.6240	**41.295** 1.6258	**41.285** 1.6254	HJ-324120
1 11/16	**42.863** 1.6875	**50.800** 2.0000	**25.40** 1.000	**1.52** 0.06	IR-273216	**0.109** 0.240	**42.852** 1.6871	**42.837** 1.6865	**42.883** 1.6883	**42.873** 1.6879	HJ-324116
	42.863 1.6875	**50.800** 2.0000	**31.75** 1.250	**1.52** 0.06	IR-273220	**0.136** 0.300	**42.852** 1.6871	**42.837** 1.6865	**42.883** 1.6883	**42.873** 1.6879	HJ-324120
1 3/4	**44.450** 1.7500	**57.150** 2.2500	**38.10** 1.500	**1.52** 0.06	IR-283624	**0.286** 0.630	**44.440** 1.7496	**44.425** 1.7490	**44.470** 1.7508	**44.460** 1.7504	HJ-364824
	44.450 1.7500	**57.150** 2.2500	**44.45** 1.750	**1.52** 0.06	IR-283628	**0.336** 0.740	**44.440** 1.7496	**44.425** 1.7490	**44.470** 1.7508	**44.460** 1.7504	HJ-364828
1 15/16	**49.213** 1.9375	**63.500** 2.5000	**38.10** 1.500	**2.03** 0.08	IR-314024	**0.358** 0.790	**49.202** 1.9371	**49.187** 1.9365	**49.233** 1.9383	**49.223** 1.9379	HJ-405224
	49.213 1.9375	**63.500** 2.5000	**44.45** 1.750	**2.03** 0.08	IR-314028	**0.417** 0.920	**49.202** 1.9371	**49.187** 1.9365	**49.233** 1.9383	**49.223** 1.9379	HJ-405228

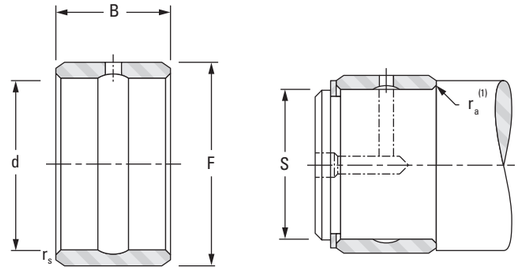
(1) $r_{a\ max.}$ is equal to the minimum bearing chamfer ($r_{s\ min.}$).

Continued on next page.

INNER RINGS

INCH SERIES

- Check for availability.
- Ideal choice when shaft is not practical to use as inner raceway.
- Provided in inch nominal dimensions for use with inch series heavy-duty needle roller bearings.
- Designed to meet established inch tolerances.
- Selected size should be wider than matching needle roller bearing.
- Maximum shaft fillet radius ($r_{a\ max.}$) cannot exceed inner ring bore chamfer ($r_{s\ min.}$) as shown.
- Optional centralized lubrication groove (bore) or through-hole available. Specify when ordering.
- Designed to be axially clamped against shoulder for loose transition fit on shaft.
- After mounting, for tight transition fit (keeping inner ring from rotating relative to shaft), inner ring O.D. must not exceed raceway diameter on matching bearing. (See mounting dimensions in the bearing table for the required raceway diameter).
- After mounting, if O.D. of inner ring exceeds the required raceway diameter for matching bearing, ring should be ground to proper diameter while mounted on shaft.
- Meets ASTMF-2431.



Shaft Dia.	d	F	B	$r_{s\ min.}$	Bearing Designation	Approx. Wt.	Loose Transition Fit S		Interference Fit S		Used With Bearing Designation
							Max.	Min.	Max.	Min.	
in	**mm** in	**mm** in	**mm** in	**mm** in		**kg** lbs	**mm** in	**mm** in	**mm** in	**mm** in	
2	**50.800** 2.0000	**63.500** 2.5000	**38.10** 1.500	**2.03** 0.08	IR-324024	**0.322** 0.710	**50.790** 1.9996	**50.772** 1.9989	**50.823** 2.0009	**50.810** 2.0004	HJ-405224
	50.800 2.0000	**63.500** 2.5000	**44.45** 1.750	**2.03** 0.08	IR-324028	**0.376** 0.830	**50.790** 1.9996	**50.772** 1.9989	**50.823** 2.0009	**50.810** 2.0004	HJ-405228
2 3/16	**55.563** 2.1875	**69.850** 2.7500	**44.45** 1.750	**2.03** 0.08	IR-354428	**0.467** 1.030	**55.552** 2.1871	**55.535** 2.1864	**55.585** 2.1884	**55.573** 2.1879	HJ-445628
2 1/4	**57.150** 2.2500	**69.850** 2.7500	**38.10** 1.500	**2.03** 0.08	IR-364424	**0.358** 0.790	**57.140** 2.2496	**57.122** 2.2489	**57.173** 2.2509	**57.160** 2.2504	HJ-445624
	57.150 2.2500	**69.850** 2.7500	**44.45** 1.750	**2.03** 0.08	IR-364428	**0.417** 0.920	**57.140** 2.2496	**57.122** 2.2489	**57.173** 2.2509	**57.160** 2.2504	HJ-445628
2 3/8	**60.325** 2.3750	**76.200** 3.0000	**44.45** 1.750	**2.03** 0.08	IR-384828	**0.562** 1.240	**60.315** 2.3746	**60.297** 2.3739	**60.348** 2.3759	**60.335** 2.3754	HJ-486028
2 1/2	**63.500** 2.5000	**76.200** 3.0000	**38.10** 1.500	**2.03** 0.08	IR-404824	**0.395** 0.870	**63.490** 2.4996	**63.472** 2.4989	**63.523** 2.5009	**63.510** 2.5004	HJ-486024
	63.500 2.5000	**76.200** 3.0000	**44.45** 1.750	**2.03** 0.08	IR-404828	**0.463** 1.020	**63.490** 2.4996	**63.472** 2.4989	**63.523** 2.5009	**63.510** 2.5004	HJ-486028
2 3/4	**69.850** 2.7500	**82.550** 3.2500	**44.45** 1.750	**2.03** 0.08	IR-445228	**0.503** 1.110	**69.840** 2.7496	**69.822** 2.7489	**69.873** 2.7509	**69.860** 2.7504	HJ-526828
	69.850 2.7500	**82.550** 3.2500	**50.80** 2.000	**2.03** 0.08	IR-445232	**0.576** 1.270	**69.840** 2.7496	**69.822** 2.7489	**69.873** 2.7509	**69.860** 2.7504	HJ-526832
2 15/16	**74.613** 2.9375	**88.900** 3.5000	**50.80** 2.000	**2.03** 0.08	IR-475632	**0.694** 1.530	**74.602** 2.9371	**74.585** 2.9364	**74.635** 2.9384	**74.623** 2.9379	HJ-567232
3	**76.200** 3.0000	**88.900** 3.5000	**50.80** 2.000	**2.03** 0.08	IR-485632	**0.621** 1.370	**76.190** 2.9996	**76.172** 2.9989	**76.223** 3.0009	**76.210** 3.0004	HJ-567232

(1) $r_{a\ max.}$ is equal to the minimum bearing chamfer ($r_{s\ min.}$).

NOTES

TRACK ROLLERS

Overview: Track rollers (also known as cam followers) are characterized by their thick-walled outer rings that run directly on a track. The thick outer rings permit high load-carrying capability while minimizing both distortion and bending stresses. Sealed designs with internal thrust washers help extend service life under conditions of infrequent lubrication.

- **Catalog range:** Stud-Type: 12.7 mm – 152.4 mm (0.5 in – 6 in) O.D.
  Yoke-Type: 16 mm – 152.4 mm (0.6299 in – 6 in) O.D.
- **Markets:** Ram support rollers, material handling and indexing equipment.
- **Features:** Available in two basic designs: with an inner ring for straddle mounting in a yoke or with an integral stud for cantilever mounting.
- **Benefits:** High load-carrying capability with minimized distortion and bending stresses. Extended service life under conditions of infrequent re-lubrication.

Caged Yoke-Type Track Rollers – Metric Nominal Dimensions

Bore diameter from 10 mm to 17 mm (for NA22)
00 = 10 mm
01 = 12 mm
02 = 15 mm
03 = 17 mm

Bore diameter > 17 mm (for NA22)
05 = 25 mm

NA22 **05** **2RS**

Prefix
NA22 track roller, yoke-type, profiled outer diameter, with inner ring, sealed
RNA22 track roller, yoke-type, profiled outer diameter, without inner ring, sealed
RSTO track roller, yoke-type, profiled outer diameter, without inner ring, without washers
STO track roller, yoke-type, profiled outer diameter, with inner ring, without washers
NATR track roller, yoke-type, profiled outer diameter, with inner ring, with washers

Suffix
TN molded cage of reinforced, engineered polymer
DZ cylindrical outer diameter
ZZ two washers for track rollers used for axial location
.2RS lip contact seal on each side of the bearing
ZZ.DZ two washers for track rollers used for axial location; cylindrical outer diameter
DZ.TN cylindrical outer diameter; molded cage of reinforced, engineered polymer
.2RS.DZ lip contact seal on each side of bearing; cylindrical outer diameter

STO **25** **DZ**

Bore diameter for STO, NATR
25 = 25 mm
45 = 45 mm

Caged Stud-Type Track Rollers – Metric Nominal Dimensions

Prefix Modification
E eccentric stud

Suffix
SK hexagonal wrench socket in stud head
.2RS lip contact seal on each side of the bearing

KR **E** **22** **.2RS**

Prefix
KR track roller, stud-type with cage, profiled outer diameter

Outer Diameter
22 = 22 mm

Full Complement Track Rollers – Inch Nominal Dimensions

Prefix
CR stud-type
YCR yoke-type

Outer Diameter
8 = 8⁄16 = 1⁄2 in
16 = 16⁄16 = 1 in
32 = 32⁄16 = 2 in
36 = 36⁄16 = 2 1⁄4 in

CR **S** **B** **E** - **16**

Design Modifications
S seals with internal thrust washers
B hex wrench socket (CR Type only)
C crowned O.D.
E eccentric stud (CR Type only)
H heavy stud (CR Type only)

Full Complement Yoke-Type Track Rollers – Metric Nominal Dimensions

Prefix
NUTR track roller, yoke-type, crowned outer diameter with inner ring and washers (two paths of cylindrical rollers)

NUTR **45** **100** **.DZ**

Bore Diameter
6 = 6 mm
45 = 45 mm

Outer Diameter
19 = 19 mm
100 = 100 mm

Suffix
.DZ cylindrical outer diameter (NUTR styles only)

Full Complement Stud-Type Track Rollers – Metric Nominal Dimensions

Prefix
NUKR track roller, stud-type, crowned outer diameter (two paths of cylindrical rollers)
KRV track roller, stud-type, crowned outer diameter with full complement of needle rollers

Outer Diameter
16 = 16 mm
19 = 19 mm
62 = 62 mm

KRV **16**

NUKR **E** **62** **.2SK**

Prefix Modification
E eccentric stud (NUKR style only)

Suffix
.2SK hexagonal socket in stud head (NUKR styles only)

Track Rollers

STUD-TYPE AND YOKE-TYPE TRACK ROLLERS

METRIC SERIES

JTEKT track rollers listed in this catalog have been designed with outer rings of a large radial cross section to withstand heavy rolling and shock loads on track-type or cam-controlled equipment. The outer diameters of the outer rings are either crowned or cylindrical. Crowned track rollers are designed to alleviate uneven bearing loading resulting from deflection, bending or misalignment in mounting.

Stud-type track rollers are available in various open designs, as well as with lip contact seals or metal shields.

Yoke-type track rollers are designed for straddle mounting. The various metric series designs are grouped and organized on page B-5-7 and page B-5-8.

REFERENCE STANDARDS ARE:

- **ISO 7063** – needle roller bearings – track rollers – boundary dimensions.
- **ISO 492** – Rolling bearing – Radial bearing – Geometrical product specifications (GPS) and tolerance values.
- **DIN 620** – tolerances of ball and roller bearings.
- **ISO 281** – rolling bearings – dynamic load ratings and rating life.

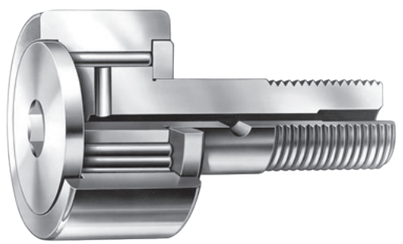


Fig. B5-1. Stud-type track rollers

Fig. B5-2. Yoke-type track rollers

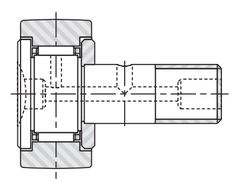
Suffixes – Stud-Type, Metric Series

.2RS	two seals
SK	hexagonal socket in flange end
2SK	hexagonal socket in both flange and stud ends

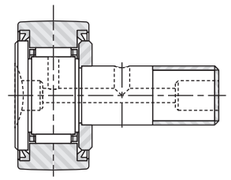
Suffixes – Yoke-Type, Metric Series

DZ.TN	cylindrical outer diameter • molded cage of reinforced engineered polymer
TN	molded cage of reinforced engineered polymer
DZ	cylindrical outer diameter
ZZ	two end washers for the outer ring
ZZ.DZ	two end washers for the outer ring • cylindrical outer diameter
.2RS	two seals
.2RS.DZ	two seals • cylindrical outer diameter

STUD-TYPE METRIC SERIES TRACK ROLLER TYPES

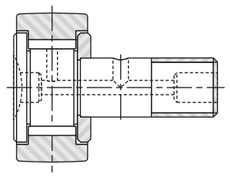


KR.2SK
KR.SK (D≤19 mm(0.7480 in))



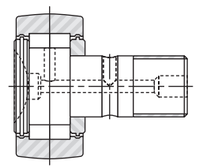
KR.2RS.2SK
KR.2RS.SK (D≤19 mm(0.7480 in))

Fig. B5-3. Stud-type track rollers, caged needle rollers



KRV.2SK
KRV.SK (D≤19 mm(0.7480 in))

Fig. B5-4. Stud-type track rollers, full complement needle rollers



NUKR.2SK

Fig. B5-5. Stud-type track rollers, full complement cylindrical rollers

TYPES OF METRIC SERIES YOKE-TYPE TRACK ROLLERS

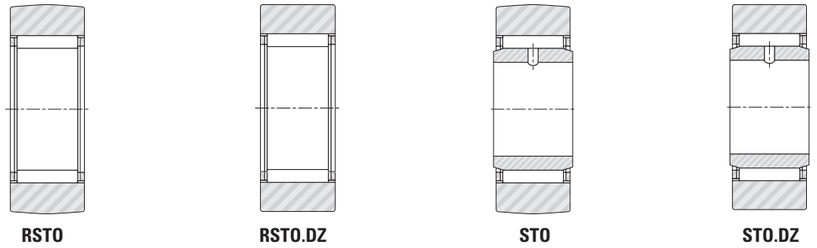


Fig. B5-6. Yoke-type track rollers without end washers

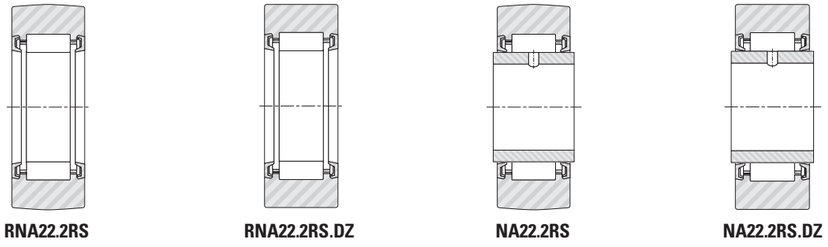


Fig. B5-7. Sealed yoke-type track rollers without end washers

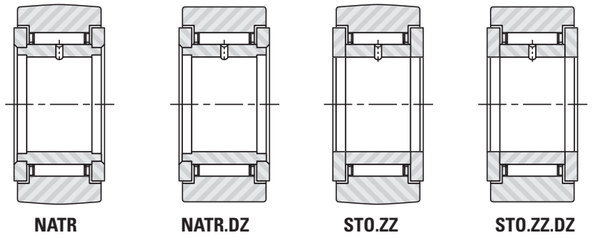


Fig. B5-8. Yoke-type track rollers with end washers

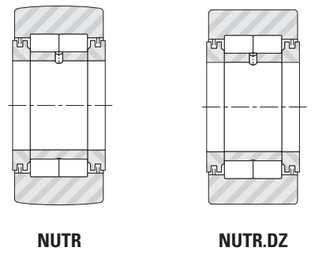


Fig. B5-9. Yoke-type track rollers with end washers, full complement of cylindrical rollers

CONSTRUCTION

STUD-TYPE TRACK ROLLERS

The metric series stud-type track roller is a non-separable unit – consisting of a large radial cross section outer ring, radial needle roller and cage assembly, or a full complement of needle or cylindrical rollers, a stud and a retaining washer securely fastened to the stud.

The seals on the sealed stud-type track rollers are located in the counterbores of the outer ring and seal against the stud flange and the retaining washer, providing good retention of lubricant and exclusion of foreign material. The seals are thermally stable in a temperature range between -30° C and 110° C (-25° F and 225° F).

A screwdriver slot (standard) or a hexagonal wrench socket (customer requested) in the head of the stud facilitates mounting. Metric series hexagonal socket sizes are listed in Table B5-1.

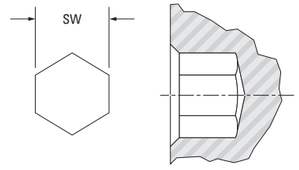


Fig. B5-10. Hexagonal socket – metric series.

Table B5-1. Hexagonal socket wrench sizes

Stud-type track roller O.D.		
>	≤	SW
mm in	mm in	mm in
- -	**16.000** 0.6299	**3.000** 0.1181
16.000 0.6299	**19.000** 0.7480	**4.000** 0.1575
19.000 0.7480	**26.000** 1.0236	**5.000** 0.1969
26.000 1.0236	**32.000** 1.2598	**6.000** 0.2362
32.000 1.2598	**40.000** 1.5748	**8.000** 0.3150
40.000 1.5748	**52.000** 2.0472	**10.000** 0.3937
52.000 2.0472	- -	**14.000** 0.5511

ECCENTRIC STUDS FOR STUD-TYPE TRACK ROLLERS

To provide radial adjustment of the outer ring toward the track or cam surface at the time of installation, some metric series stud-type track rollers are available with eccentric studs – specified by adding the letter "E" to the designation letters: KRE and NUKRE. Appropriate dimensions of the eccentric stud bushing are listed in Table B5-2 on page B-5-9.

Since a track roller with an eccentric stud is usually adjusted upon installation by turning the stud in the mounting hole, a close clearance fit between the outer diameter of the bushing and the mounting hole is necessary. For turning the stud, a hexagonal wrench is generally more convenient than a screwdriver. Thus, the option of a hexagonal wrench socket in the head of the stud should be exercised.

Some applications may require more secure positioning than provided by the tightened stud nut. If so, it is recommended that the mounting hole and the eccentric bushing be drilled at the time of installation to accept a locating dowel pin.

Fig. B5-11. Eccentric bushing dimensions – metric series

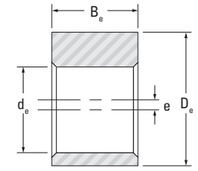


Table B5-2. Eccentric bushing dimensions – metric series

Stud-type track roller O.D.		d_e	D_e	B_e	e
>	≤	Eccentric bushing dimensions			
mm in	mm in	mm in	mm in	mm in	mm in
19.000 07480	**19.000** 0.7480	**8.000** 0.3150	**11.000** 0.4331	**9.000** 0.3543	**0.500** 0.0197
22.000 0.8661	**26.000** 1.10236	**10.000** 0.3937	**13.000** 0.5118	**10.000** 0.3937	**0.500** 0.0197
30.000 1.1811	**32.000** 1.2598	**12.000** 0.4724	**15.000** 0.5905	**11.000** 0.4331	**0.500** 0.0197
35.000 1.3779	**35.000** 1.3779	**16.000** 0.6299	**20.000** 0.7874	**14.000** 0.5512	**1.000** 0.0394
40.000 1.5748	**40.000** 1.5748	**18.000** 0.7087	**22.000** 0.8661	**16.000** 0.6299	**1.000** 0.0394
47.000 1.8504	**52.000** 2.0472	**20.000** 0.7874	**24.000** 0.9449	**18.000** 0.7087	**1.000** 0.0394
62.000 2.4409	**72.000** 2.8346	**24.000** 0.9449	**28.000** 1.1024	**22.000** 0.8661	**1.000** 0.0394
80.000 3.1496	**90.000** 3.5433	**30.000** 1.1811	**35.000** 1.3779	**29.000** 1.1417	**1.500** 0.0591

B

METRIC SERIES YOKE-TYPE TRACK ROLLERS WITHOUT END WASHERS

These yoke-type track rollers are available with a profiled or a cylindrical outer diameter of the outer ring, and with or without a separable inner ring. Since they are supplied without end washers, their outer rings must be guided by the adjacent end locating surfaces. Tolerance class F6 is the normal specification for the bore of the metric series radial needle roller and cage assemblies used with these yoke-type track rollers.

YOKE-TYPE TRACK ROLLERS – SERIES RSTO AND STO

Series STO have a separable inner ring and when the inner ring is removed they become series RSTO. They run directly on a hardened and ground inner raceway. Quality requirements for inner raceways are given in the engineering section of this catalog.

SEALED YOKE-TYPE TRACK ROLLERS WITHOUT END WASHERS – SERIES RNA 22.2RS AND NA22.2RS

These yoke-type track rollers have the same bore diameter and outer diameter as most of the other metric series yoke-type track rollers listed in this catalog. The thick section outer ring is made of one-piece channel-shaped bearing-quality steel – heat-treated to yield maximum load-carrying capability. The integral end flanges provide axial guidance for the large diameter needle rollers, and a cage supplies their inward retention. These track rollers have two integral lip contact seals designated by .2RS. The seals are thermally stable in a temperature range between -30° C and 110° C (-25° F and 225° F). Care should be exercised when mounting track rollers without inner rings onto inner raceways, to avoid damage to the seals.

METRIC SERIES YOKE-TYPE TRACK ROLLERS WITH END WASHERS

These yoke-type track rollers are available with a crowned or a cylindrical outer diameter to the outer ring. Metric series yoke-type track rollers with end washers – depending on the internal construction – may be end guided, either through the end washers or between the end faces of the rollers and the inside faces of the outer ring flanges.

YOKE-TYPE TRACK ROLLERS – SERIES NATR AND STO.ZZ

The series NATR yoke-type track rollers are of non-separable design, consisting of a crowned or a cylindrical outer ring, caged needle rollers, an inner ring and two retaining end washers securely fastened to the inner ring. The series STO.ZZ yoke-type track rollers are of separable design with two loose end washers. These end washers, placed in the counter bores of the outer ring, form very effective labyrinth-type shields, providing good retention of lubricant and exclusion of foreign material. A lubrication hole in the inner ring enables re-lubrication when a cross-drilled bolt or shaft – which can be serviced from the end – is used.

YOKE-TYPE TRACK ROLLERS – SERIES NUTR

The series NUTR yoke-type track rollers are of non-separable design consisting of a crowned or cylindrical outer ring, two rows of full complements of cylindrical rollers, an inner ring, two retaining end washers and two shields. The outer ring is located axially through the cylindrical rollers.

A lubricating hole in the inner ring enables re-lubrication when a cross-drilled bolt or shaft, which can be serviced from the end, is used.

The smallest track roller of this series has an outer diameter of 35.000 mm (1.3780 in). NUTR yoke-type track rollers are well-suited to carry high loads and designs with a thicker outer ring and particularly suitable for high shock loads. Designs with thicker outer rings have a larger outer diameter which can be identified by the bearing designation (e.g., NUTR 1542).

B

DIMENSIONAL ACCURACY

The tolerances of the basic metric series caged roller and NUKR stud-type and yoke-type track rollers, whose outer rings have a cylindrical outer diameter, correspond to tolerances specified in ISO 492 Radial bearings tolerances. The outer ring tolerances given in Table B5-3 apply to the outer rings used in the caged roller and NUKR stud-type and caged roller and NUTR yoke-type, metric series, track rollers. Metric series track rollers with a crowned outer diameter are the exception – their outer diameter tolerance is 0-0.05 for all caged roller sizes and NUTR, NUKR types. The remaining types have h9 tolerance on profiled outer diameters and h7 for straight diameters. Stud diameter and stud length tolerances are given in Table B5-4. The inner ring tolerances, given in Table B5-5 on page B-5-12, apply to inner rings used in metric series caged roller, NUKR Series yoke-type track rollers.

MOUNTING

STUD-TYPE TRACK ROLLERS

When the stud shank of a metric series stud-type track roller is mounted in a hole of tolerance H7, the installation force should be applied only to the center portion of the flanged end of the stud – preferably with an arbor press. The surface of the hole in the machine element which supports the stud must not deform under the expected load. And the support should be sufficiently rigid to resist bending loads. Deformation and bending will cause uneven loading of the outer ring.

Table B5-4. Tolerances for stud diameter and stud length – metric series

d_1		Δd_{1S}		B_2	ΔB_2	
Stud diameters				Stud lengths		
>	≤	Max.	Min.		Max.	Min.
mm		µm		mm		
3	6	0	-12	all lengths	0	-1
6	10	0	-15			
10	18	0	-18			
18	30	0	-21			
30	50	0	-25			
50	80	0	-30			
80	100	0	-35			

Table B5-3. Outer ring – metric series (caged roller and NUKR, NUTR types)

Nominal outside dia. D		Single plane mean outside diameter deviation ΔDmp				Deviation of a single outer ring width ΔCs		Radial runout of assembled bearing outer ring Kea
		Cylindrical		Crowned				
>	≤	Max.	Min.	Max.	Min.	Max.	Min.	Max.
mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in
10.000 0.3937	**18.000** 0.7087	**0.000** 0.0000	**-0.008** -0.0003	**0.000** 0.0000	**-0.050** -0.0020	**0.000** 0.0000	**-0.120** -0.0047	**0.015** 0.0006
18.000 0.7087	**30.000** 1.1811	**0.000** 0.0000	**-0.009** -0.00035	**0.000** 0.0000	**-0.050** -0.0020	**0.000** 0.0000	**-0.120** -0.0047	**0.015** 0.0006
30.000 1.1811	**50.000** 1.9685	**0.000** 0.0000	**-0.011** -0.0004	**0.000** 0.0000	**-0.050** -0.0020	**0.000** 0.0000	**-0.120** -0.0047	**0.020** 0.0008
50.000 1.9685	**80.000** 3.1496	**0.000** 0.0000	**-0.013** -0.0005	**0.000** 0.0000	**-0.050** -0.0020	**0.000** 0.0000	**-0.120** -0.0047	**0.025** 0.0010
80.000 3.1496	**120.000** 4.7244	**0.000** 0.0000	**-0.015** -0.0006	**0.000** 0.0000	**-0.050** -0.0020	**0.000** 0.0000	**-0.120** -0.0047	**0.035** 0.0014
120.000 4.7244	**150.000** 5.9055	**0.000** 0.0000	**-0.018** -0.0007	**0.000** 0.0000	**-0.050** -0.0020	**0.000** 0.0000	**-0.120** -0.0047	**0.040** 0.0016
150.000 5.9055	**180.000** 7.0866	**0.000** 0.0000	**-0.025** -0.0010	**0.000** 0.0000	**-0.050** -0.0020	**0.000** 0.0000	**-0.150** -0.0059	**0.045** 0.0018
180.000 7.0866	**240.000** 9.4488	**0.000** 0.0000	**-0.030** -0.0012	**0.000** 0.0000	**-0.050** -0.0020	**0.000** 0.0000	**-0.200** -0.0079	**0.050** 0.0020

Table B5-5. Inner ring – metric series (caged roller types)

Nominal bore diameter d		Single plane mean bore diameter deviation Δdmp		Single inner ring width ΔBs	
>	≤	Max.	Min.	Max.	Min.
mm in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in
2.500 0.0984	**18.000** 0.7087	**0.000** 0.0000	**-0.008** -0.0003	**0.000** 0.0000	**-0.180** -0.0071
18.000 0.7087	**30.000** 1.1811	**0.000** 0.0000	**0.010** -0.0004	**0.000** 0.0000	**-0.210** -0.0083
30.000 1.1811	**50.000** 1.9685	**0.000** 0.0000	**-0.012** -0.0005	**0.000** 0.0000	**-0.250** -0.0098
50.000 1.9685	**80.000** 3.1496	**0.000** 0.0000	**-0.015** '-0.0006	**0.000** 0.0000	**-0.300** -0.0118
80.000 3.1496	**120.000** 4.7244	**0.000** 0.0000	**-0.020** -0.0008	**0.000** 0.0000	**-0.350** -0.0138

In mounting the stud-type track roller, the retaining washer must be firmly backed up by a flat shoulder which is square with the stud center line. The shoulder diameter must be no smaller than the minimum clamping diameter, d_a listed in the bearing tables.

The maximum inherent strength of the stud is obtained when the track roller is supported, as close as possible, to the retaining washer – which minimizes the bending moment. For this reason the edge of the housing – which supports the stud shank – should be kept as sharp as practical but free from burrs.

The clamping nut should not be tightened with a torque value higher than the maximum listed. A screwdriver slot, or hexagonal wrench socket in the flanged end of the stud, is provided for a tool to prevent the stud from turning when the nut is being tightened. Since the bottom of the screwdriver slot is not flat, it is helpful to put a radius on the tip of the screwdriver being used to hold the stud more securely. Hexagonal nuts are supplied with all metric series stud-type track rollers.

YOKE-TYPE TRACK ROLLERS

The machine element with the holes in which the mounting bolt or shaft is supported must be sufficiently rigid to resist local crushing under the applied load and to resist bending which can cause uneven loading of the needle rollers.

When applied loads are high, the h6 or j6 tolerance should be used in conjunction with a high strength shaft or bolt for mounting metric series yoke-type track rollers. When loads are moderate, a g6 tolerance may be used with a high strength shaft or bolt. For light loads, the loose transition fit with the f6 tolerance may be used with an unhardened shaft or bolt.

The yoke-type track rollers with inner rings – including those with end washers as well as inner rings – should be clamped endwise between parallel faces, perpendicular to the axis to prevent the retaining washers from coming off under load. The dimensions of machine parts, adjoining the metric series yoke-type track rollers, should be based on the minimum clamping diameter d_a to ensure that the washers are adequately supported. If the track roller cannot be end clamped, a close axial fit in the yoke is required. Care should be taken to assure that the lubricating hole is located in the unloaded zone of the raceway.

The metric series yoke-type track rollers without inner rings require a hardened and ground shaft, or bolt with a k5 tolerance. Inner raceway quality requirements are given in the engineering section.

LOAD RATINGS

DYNAMIC LOADING AS A TRACK ROLLER

When the outer ring of a stud-type or yoke-type track roller runs on a track, the contact – under a radial load – causes elastic (oval) deformation of the outer ring. As a result, a smaller zone of the raceway is loaded and the load is distributed on fewer needle rollers. This, in turn, affects the dynamic and static load ratings of the track rollers. Also, this deformation generates bending stress in the outer ring which must not exceed the maximum permitted for the material of the outer ring. The maximum permissible dynamic ($F_{r\ perm}$) radial load condition is determined by this requirement.

The rating life of stud-type or yoke-type track rollers should be calculated using the dynamic load ratings, C_w, shown in the following tables. The tables also show the maximum permissible radial load, $F_{r\ perm}$, that can be dynamically applied on stud-type or yoke-type track rollers. However, to calculate the L_{10} life of a track roller, the applied radial load must not be greater than $C_w/2$ based on ideal operating conditions of alignment, lubrication, temperature, speed and accelerations.

Example:

Given: A track roller application for a linear slide in which each roller supports a 4.45 kN (1000 lbf.) load and travels at 609.600 mm (24.0000 in) per second.

Select a track roller and calculate the L_{10} life in hours assuming continuous operation at the given speed. Assume conditions of alignment, lubrication and temperature are ideal.

Solution: Calculate the minimum C_w required.

The applied radial load must not be greater than $C_w/2$ based on ideal operating conditions.

Therefore, Fr < C_w/2 or C_w > 8.9 kN (2000 lbf.)

For a KRV30, C_w = 9.85 kN (2210 lbf.)

To calculate the speed in min^{-1}, V = Pi · D · n

Where:

V = linear velocity
Pi = 3.14
D = outside diameter of the track roller assembly

Therefore, 609.600 mm (24.000 in)/sec. = 3.14 · 30.000 mm · n

Making appropriate substitutions and solving for n yields a value of approximately 388 min^{-1}.

The standard catalog life equation of a roller bearing is:

$L_{10} = (C/P)10/3 \cdot (16667/n)$

Where:

L_{10} = calculated fatigue life in hours
C = the dynamic radial load ratings based on 1000000 revolutions
P = the dynamic equivalent radial load
n = speed in min^{-1}

Substituting C_w for C and solving:

$L_{10} = (9.85/4.45)\ 10/3 \cdot (16667/388) = 604$ hours

STATIC RATING AS A TRACK ROLLER

In addition to the basic static load rating, C_0, the tables also list the maximum permissible static radial load, $F_{0r\ perm}$, that may be applied to a stud-type or yoke-type metric series track roller. The values of $F_{0r\ perm}$ result in a calculated minimum static factor f_s of 0.7 for the worst condition of internal load distribution in metric series track roller operation. The $F_{0r\ perm}$ values must not be exceeded. Exceeding $F_{0r\ perm}$ may cause permanent damage to the track roller. A damaged track roller could cause the equipment in which the track roller is installed to malfunction. The static factor f_s can be calculated using the following formula:

$$f_s \geq 0.7 \left(\frac{F_{0r\ perm}}{P_{0r}} \right)$$

Where:

$F_{0r\ perm}$ = Maximum permissible static radial load
P_{0r} = Equivalent static load (F_{0r} for yoke-type track rollers)
F_{0r} = Static radial load
f_s = Static factor whose values should not be smaller than those suggested in Table B5-6.

Table B5-6. Suggested values for static factors f_s for metric series track rollers

Requirements for yoke – type track rollers and stud – type track rollers	Suggested f_s values	
	Max.	Min.
High shock-type loads Quiet running	2.5	1.5
Normal loading Normal quietness of running	1.5	1
Minor impact loads and rotary motion particularly quiet running not required	1	0.7

LUBRICATION OF STUD-TYPE TRACK ROLLERS

JTEKT metric series stud-type track rollers are supplied with a lithium soap-based, general-purpose grease. When the caged KR Series track rollers are operated at low speeds, with light loads and in clean environments, there is often no need to re-lubricate the track roller. In other applications, periodic re-lubrication may be necessary to obtain optimum performance. The full complement series of track rollers have less internal volume available for grease storage. Therefore, they may require more frequent lubrication than caged-type track rollers. Stud-type track rollers – with a screwdriver slot in the flanged end of the stud – have provisions for re-lubrication through the flanged end of the stud. Metric series stud-type track rollers, with hexagonal sockets, can not be re-lubricated from the flanged end of the stud. Both types of metric series stud-type track rollers – with outer diameters larger than 22.000 mm (0.8661 in) – allow for re-lubrication through the threaded end of the stud. In addition, caged roller and NUKR Series stud-type track rollers – with 30.000 mm (1.8110 in) and larger outer diameters – allow for re-lubrication through a cross-drilled hole in the stud shank. The ends of the axial holes are counterbored to accept press-fit grease fittings of series VENN. The grease fittings are supplied with metric series stud-type track rollers. Hole diameters (d_4) for these grease fittings are listed in the tables of dimensions on pages later in this chapter as it applies.

One or more plugs are supplied with every metric series stud-type track roller, to close off unused holes. At the flanged end, the plug must not be pushed in too deeply, as it may cover the cross-drilled lubricating hole. The plug should be pressed in using an installation tool whose dimensions are given in Table B5-8. If the cross-drilled hole in the stud shank is not used, it will be covered when the track roller is properly installed.

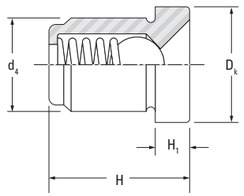


Fig. B5-12. Metric series grease fittings

Table B5-7. Metric series grease fittings, series VENN

Designation	d_4	D_k	H	H_1	Approx. wt.
	mm in	**mm** in	**mm** in	**mm** in	**g** lbs
VENN 4	**4.000** 0.1575	**6.000** 0.2362	**6.000** 0.2362	**1.500** 0.0591	**0.4** 0.0009
VENN 6	**6.000** 0.2362	**8.000** 0.3147	**7.000** 0.2756	**2.000** 0.0787	**1.6** 0.0035
VENN 8	**8.000** 0.3150	**10.000** 0.3937	**12.000** 0.4724	**3.000** 0.1181	**4.7** 0.0104

During installation of the track roller it is desirable to ensure that the cross-drilled hole is positioned in the unloaded zone of the track roller raceway. The location of the cross-drilled hole can be best recognized by its alignment with the manufacturer's stamp, parallel to the screwdriver slot (when applicable).

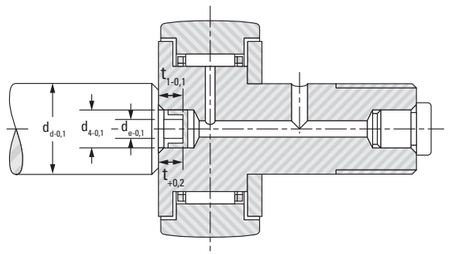


Fig. B5-13. Installation tool for metric series plug

Table B5-8. Installation tool for metric series plug

Stud-type track rollers O.D.		d_4	d_d	d_e	t	t_1
>	≤					
mm in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in
16.000 0.6299	**26.000** 1.0236	**3.900** 0.1535	**10.000** 0.3937	**2.700** 0.1063	**3.700** 0.1457	**4.500** 0.1772
30.000 1.1811	**40.000** 1.5748	**5.900** 0.2323	**12.000** 0.4724	**4.700** 0.1850	**4.700** 0.1850	**7.000** 0.2756
47.000 1.8504	**90.000** 3.5433	**7.900** 0.3110	**15.000** 0.5905	**6.700** 0.2638	**6.700** 0.2638	**10.000** 0.3937

LUBRICATION OF YOKE-TYPE TRACK ROLLERS

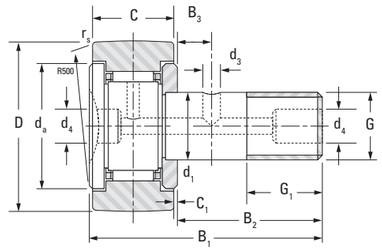
Yoke-type track rollers are produced with a lubricating hole in the inner ring so they can be re-lubricated through a cross-drilled hole in the supporting shaft or bolt. When mounting yoke-type track rollers, care should be taken that the lubrication hole is located in the unloaded raceway zone.

Oil is the preferred lubricant for yoke-type track rollers. Continuous oil lubrication, or frequent grease lubrication should be used for steady rotating conditions. Applications involving slow, intermittent oscillations are not as critical, and longer intervals between re-lubrication are permitted. Sealed yoke-type track rollers are normally supplied with an initial charge of a medium-temperature grease. Caged yoke-type track rollers have maximum grease storage capacity and, consequently, longer pregreased life than full complement types.

B

NEEDLE ROLLER AND CAGE ASSEMBLIES, STUD-TYPE (KR SERIES)

METRIC SERIES



KR.2SK
KR.SK (D≤19 mm(0.7480 in))

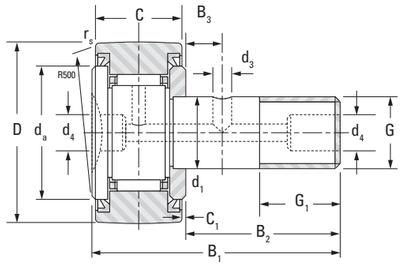
Outer Dia.	d_1 h7	D	C	$r_{s\ min.}$	B_1	B_2	B_3	G_1	d_4	d_3	Thread G	C_1	d_a
mm in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in		**mm** in	**mm** in
16 0.6299	**6** 0.2362	**16** 0.6299	**11** 0.433	**0.3** 0.012	**28.2** 1.110	**16** 0.630		**8** 0.315	**4** 0.157		M6x1	**0.6** 0.024	**11** 0.433
19 0.7480	**8** 0.3150	**19** 0.7480	**11** 0.433	**0.3** 0.012	**32.2** 1.268	**20** 0.787		**10** 0.394	**4** 0.157		M8x1.25	**0.6** 0.024	**13** 0.512
22 0.8661	**10** 0.3937	**22** 0.8661	**12** 0.472	**0.3** 0.012	**36.0** 1.417	**23** 0.906		**12** 0.472	**4** 0.157		M10x1	**0.6** 0.024	**15** 0.591
26 1.0236	**10** 0.3937	**26** 1.0236	**12** 0.472	**0.3** 0.012	**36.0** 1.417	**23** 0.906		**12** 0.472	**4** 0.157		M10x1	**0.6** 0.024	**15** 0.591
30 0.551	**12** 0.4724	**30** 1.1811	**14** 0.551	**0.6** 0.024	**40.0** 1.575	**25** 0.984	**6** 0.236	**13** 0.512	**6** 0.236	**3** 0.118	M12x1.5	**0.6** 0.024	**21** 0.827
32 0.551	**12** 0.4724	**32** 1.2598	**14** 0.551	**0.6** 0.024	**40.0** 1.575	**25** 0.984	**6** 0.236	**13** 0.512	**6** 0.236	**3** 0.118	M12x1.5	**0.6** 0.024	**21** 0.827

Crowned Designation	Load Ratings					Tightening Torque	Speed Rating Grease	Approx. Wt.
	As a Bearing		As a Track Roller					
	Dynamic	Static	Dynamic		Static			
	C	C_o	C_w	$F_{r\ perm}$	$F_{Or\ perm}$			
	kN lbf		**kN** lbf			**N-m** lb-in	min^{-1}	**kg** lbs
KR16.SK	**3.60** 810	**3.58** 800	**2.97** 670	**2.85** 640	**3.58** 800	**7** 62.0	17000	**0.019** 0.042
KR19.SK	**4.18** 940	**4.65** 1050	**3.28** 740	**3.29** 740	**4.22** 950	**16** 142	13000	**0.031** 0.068
KR22.2SK	**5.35** 1200	**6.79** 1530	**3.94** 890	**4.04** 910	**5.45** 1230	**28** 248	10000	**0.046** 0.101
KR26.2SK	**5.35** 1200	**6.79** 1530	**4.55** 1020	**6.78** 1520	**7.24** 1630	**28** 248	10000	**0.059** 0.130
KR30.2SK	**7.89** 1770	**9.79** 2200	**6.32** 1420	**7.74** 1740	**9.31** 2090	**45** 398	8200	**0.087** 0.192
KR32.2SK	**7.89** 1770	**9.79** 2200	**6.65** 1490	**9.62** 2160	**10.3** 2320	**45** 398	8200	**0.095** 0.209

B

NEEDLE ROLLER AND CAGE ASSEMBLIES, SEALED, STUD-TYPE (KR...2S SERIES)

METRIC SERIES



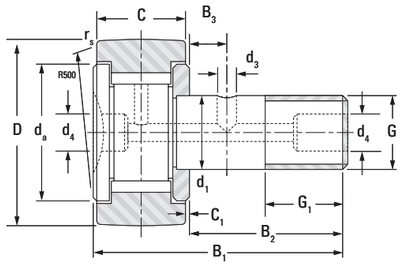
KR.2RS.2SK
KR.2RS.SK (D≤19 mm(0.7480 in))

Outer Dia.	d1 h7	D	C	rs min.	B1	B2	B3	G1	d4	d3	Thread G	C1	da
mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in		mm in	mm in
16 0.6299	**6** 0.2362	**16** 0.6299	**11** 0.433	**0.3** 0.012	**28.2** 1.110	**16** 0.630		**8** 0.315	**4** 0.157		M6x1	**0.6** 0.024	**11** 0.433
19 0.7480	**8** 0.3150	**19** 0.7480	**11** 0.433	**0.3** 0.012	**32.2** 1.268	**20** 0.787		**10** 0.394	**4** 0.157		M8x1.25	**0.6** 0.024	**13** 0.512
22 0.8661	**10** 0.3937	**22** 0.8661	**12** 0.472	**0.3** 0.012	**36.2** 1.425	**23** 0.906		**12** 0.472	**4** 0.157		M10x1	**0.6** 0.024	**15** 0.591
26 1.0236	**10** 0.3937	**26** 1.0236	**12** 0.472	**0.3** 0.012	**36.2** 1.425	**23** 0.906		**12** 0.472	**4** 0.157		M10x1	**0.6** 0.024	**15** 0.591
30 1.1811	**12** 0.4724	**30** 1.1811	**14** 0.551	**0.6** 0.024	**40.2** 1.583	**25** 0.984	**6** 0.236	**13** 0.512	**6** 0.236	**3** 0.118	M12x1.5	**0.6** 0.024	**21** 0.827
32 1.2598	**12** 0.4724	**32** 1.2598	**14** 0.551	**0.6** 0.024	**40.2** 1.583	**25** 0.984	**6** 0.236	**13** 0.512	**6** 0.236	**3** 0.118	M12x1.5	**0.6** 0.024	**21** 0.827

Crowned Designation	Load Ratings					Tightening Torque	Speed Rating Grease	Approx. Wt.
	As a Bearing		As a Track Roller					
	Dynamic	Static	Dynamic		Static			
	C	Co	Cw	Fr perm	FOr perm			
	kN lbf		kN lbf			N-m lb-in	min-1	kg lbs
KR16.2RS.SK	**3.60** 810	**3.58** 800	**2.97** 670	**2.85** 640	**3.58** 800	**7.0** 61.96	17000	**0.019** 0.042
KR19.2RS.SK	**4.18** 940	**4.65** 1050	**3.28** 740	**3.29** 740	**4.22** 950	**16** 141.61	13000	**0.031** 0.068
KR22.2RS.2SK	**5.35** 1200	**6.79** 1530	**3.94** 890	**4.04** 910	**5.45** 1230	**28** 247.82	10000	**0.046** 0.101
KR26.2RS.2SK	**5.35** 1200	**6.79** 1530	**4.55** 1020	**6.78** 1520	**7.24** 1630	**28** 247.82	10000	**0.059** 0.130
KR30.2RS.2SK	**7.89** 1770	**9.79** 2200	**6.32** 1420	**7.74** 1740	**9.31** 2090	**45** 398.28	8200	**0.087** 0.192
KR32.2RS.2SK	**7.89** 1770	**9.79** 2200	**6.65** 1490	**9.62** 2160	**10.3** 2320	**45** 398.28	8200	**0.098** 0.216

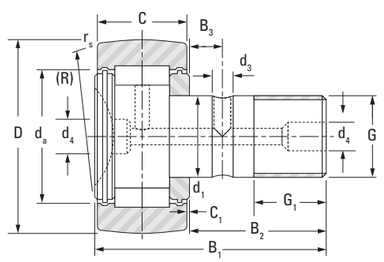
FULL COMPLEMENT WITH NEEDLE ROLLERS (KRV SERIES) OR CYLINDRICAL ROLLERS, STUD-TYPE (NUKR SERIES)

METRIC SERIES



KRV.2SK
KRV.SK (D≤19 mm(0.7480 in))

Outer Dia.	d_1 h7	D	C	$r_{s\ min.}$	B_1	B_2	B_3	G_1	d_4	d_3	Thread G	C_1	d_a
mm in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in		**mm** in	**mm** in
16 0.6299	**6** 0.2362	**16** 0.6299	**11** 0.433	**0.3** 0.012	**28.2** 1.110	**16** 0.630		**8** 0.315	**4** 0.157		M6x1	**0.6** 0.024	**11** 0.433
19 0.7480	**8** 0.3150	**19** 0.7480	**11** 0.433	**0.3** 0.012	**32.2** 1.268	**20** 0.787		**10** 0.394	**4** 0.157		M8x1.25	**0.6** 0.024	**13** 0.512
22 0.8661	**10** 0.3937	**22** 0.8661	**12** 0.472	**0.3** 0.012	**36.2** 1.425	**23** 0.906		**12** 0.472	**4** 0.157		M10x1	**0.6** 0.024	**15** 0.591
26 1.0236	**10** 0.3937	**26** 1.0236	**12** 0.472	**0.3** 0.012	**36.2** 1.425	**23** 0.906		**12** 0.472	**4** 0.157		M10x1	**0.6** 0.024	**15** 0.591
30 1.1811	**12** 0.4724	**30** 1.1811	**14** 0.551	**0.6** 0.024	**40.2** 1.583	**25** 0.984	**6** 0.236	**13** 0.512	**6** 0.236	**3** 0.118	M12x1.5	**0.6** 0.024	**21** 0.827
32 1.2598	**12** 0.4724	**32** 1.2598	**14** 0.551	**0.6** 0.024	**40.2** 1.583	**25** 0.984	**6** 0.236	**13** 0.512	**6** 0.236	**3** 0.118	M12x1.5	**0.6** 0.024	**21** 0.827
35 1.3780	**16** 0.6299	**35** 1.3780	**18** 0.709	**0.6** 0.024	**52** 2.047	**32.5** 1.280	**8** 0.315	**17** 0.669	**6** 0.236	**3** 0.118	M16x1.5	**0.8** 0.031	**25** 0.984
40 1.5748	**18** 0.7087	**40** 1.5748	**20** 0.787	**1** 0.039	**58** 2.283	**36.5** 1.437	**8** 0.315	**19** 0.748	**6** 0.236	**3** 0.118	M18x1.5	**0.8** 0.031	**27** 1.063
47 1.8504	**20** 0.7874	**47** 1.8504	**24** 0.945	**1** 0.039	**66** 2.598	**40.5** 1.594	**9** 0.354	**21** 0.827	**6** 0.236	**4** 0.157	M20x1.5	**0.8** 0.031	**33** 1.299
52 2.0472	**20** 0.7874	**52** 2.0472	**24** 0.945	**1** 0.039	**66** 2.598	**40.5** 1.594	**9** 0.354	**21** 0.827	**6** 0.236	**4** 0.157	M20x1.5	**0.8** 0.031	**37** 1.457
62 2.4409	**24** 0.9449	**62** 2.4409	**29** 1.142	**1** 0.039	**80** 3.150	**49.5** 1.949	**11** 0.433	**25** 0.984	**8** 0.315	**4** 0.157	M24x1.5	**0.8** 0.031	**45** 1.772
72 2.8346	**24** 0.9449	**72** 2.8346	**29** 1.142	**1.1** 0.043	**80** 3.150	**49.5** 1.949	**11** 0.433	**25** 0.984	**8** 0.315	**4** 0.157	M24x1.5	**0.8** 0.031	**51** 2.008
80 3.1496	**30** 1.1811	**80** 3.1496	**35** 1.378	**1.1** 0.043	**100** 3.937	**63** 2.480	**15** 0.591	**32** 1.260	**8** 0.315	**4** 0.157	M30x1.5	**1.0** 0.039	**52** 2.047
90 3.5433	**30** 1.1811	**90** 3.5433	**35** 1.378	**1.1** 0.043	**100** 3.937	**63** 2.480	**15** 0.591	**32** 1.260	**8** 0.315	**4** 0.157	M30x1.5	**1.0** 0.039	**52** 2.047

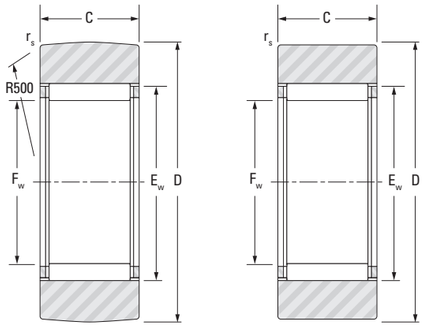


NUKR.2SK

Crowned Designation	Load Ratings					Tightening Torque	Speed Rating Grease	Approx. Wt.
	As a Bearing		As a Track Roller					
	Dynamic	Static	Dynamic		Static			
	C	C_o	C_w	$F_{r\ perm}$	$F_{0r\ perm}$			
	kN lbf		**kN** lbf			**N-m** lb-in	min^{-1}	**kg** lbs
KRV16.SK	**6.90** 1550	**8.40** 1890	**5.11** 1150	**3.49** 780	**6.28** 1410	**7** 62.0	5700	**0.019** 0.042
KRV19.SK	**8.08** 1820	**11.0** 2470	**5.66** 1270	**4.13** 930	**7.43** 1670	**16** 142	4300	**0.031** 0.068
KRV22.2SK	**9.45** 2120	**14.3** 3210	**6.32** 1420	**5.04** 1130	**9.07** 2040	**28** 248	3400	**0.046** 0.101
KRV26.2SK	**9.45** 2120	**14.3** 3210	**7.30** 1640	**8.60** 1930	**12.7** 2860	**28** 248	3400	**0.059** 0.130
KRV30.2SK	**13.4** 3010	**19.8** 4450	**9.85** 2210	**9.20** 2070	**15.7** 3530	**45** 398	2800	**0.087** 0.192
KRV32.2SK	**13.4** 3010	**19.8** 4450	**10.4** 2340	**11.3** 2540	**17.4** 3910	**45** 398	2800	**0.098** 0.216
NUKR35.2SK	**24.7** 5550	**29.4** 6610	**16.2** 3640	**10.1** 2270	**16.1** 3620	**53.2** 471	6100	**0.170** 0.375
NUKR40.2SK	**26.6** 5980	**33.3** 7490	**18.7** 4200	**15.0** 3370	**23.9** 5370	**77.5** 686	5300	**0.250** 0.551
NUKR47.2SK	**41.4** 9310	**53.2** 12000	**28.1** 6320	**20.5** 4610	**32.7** 7350	**109** 965	4500	**0.380** 0.838
NUKR52.2SK	**45.8** 10300	**63.1** 14200	**29.6** 6650	**22.2** 4990	**35.4** 7960	**109** 965	3700	**0.461** 1.016
NUKR62.2SK	**62.7** 14100	**83.1** 18700	**40.9** 9190	**29.6** 6650	**47.2** 10600	**193** 1708	3200	**0.790** 1.742
NUKR72.2SK	**68.9** 15500	**97.8** 22000	**46.1** 10400	**39.6** 8900	**63.1** 14200	**193** 1708	2600	**1.040** 2.293
NUKR80.2SK	**95.4** 21400	**130** 29200	**69.7** 15700	**63.2** 14200	**101** 22700	**390** 3452	2900	**1.550** 3.417
NUKR90.2SK	**95.4** 21400	**130** 29200	**77.8** 17500	**97.8** 22000	**128** 28800	**390** 3452	2900	**2.020** 4.453

CAGED, WITHOUT INNER RING, NO END WASHERS, YOKE-TYPE (RSTO SERIES)

METRIC SERIES

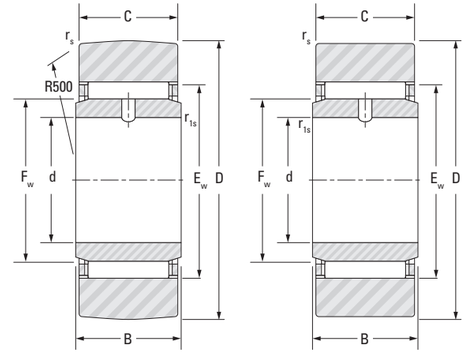


RSTO **RSTO.DZ**

Outer Dia.	D	C	F_w	E_w	$r_{s\ min.}$	Bearing Designation		Load Ratings					Speed Rating Grease	Approx. Wt.
								As a Bearing		As a Track Roller				
						Crowned Track Roller	Cylindrical Track Roller	Dynamic	Static	Dynamic		Static		
								C	C_o	C_w	$F_{r\ perm}$	$F_{0r\ perm}$		
mm in	mm in	mm in	mm in	mm in	mm in			kN lbf		kN lbf			min^{-1}	kg lbs
16 0.6299	**16** 0.6299	**7.8** 0.307	**7** 0.2756	**10** 0.394	**0.3** 0.012	RSTO5A.TN	RSTO5ADZ.TN	**2.74** 616	**2.44** 549	**2.49** 560	**2.97** 668	**2.44** 549	19000	**0.009** 0.020
19 0.7480	**19** 0.7480	**9.8** 0.386	**10** 0.3937	**13** 0.512	**0.3** 0.012	RSTO6	RSTO6DZ	**5.40** 1210	**6.43** 1450	**4.15** 933	**4.04** 908	**5.63** 1270	13000	**0.014** 0.031
24 0.9449	**24** 0.9449	**9.8** 0.386	**12** 0.4724	**15** 0.591	**0.3** 0.012	RSTO8	RSTO8DZ	**5.85** 1320	**7.51** 1690	**4.79** 1080	**6.67** 1500	**7.44** 1670	10000	**0.023** 0.051
30 1.1811	**30** 1.1811	**11.8** 0.465	**14** 0.5512	**20** 0.787	**0.3** 0.012	RSTO10	RSTO10DZ	**10.40** 2340	**10.6** 2380	**8.62** 1940	**7.69** 1730	**10.6** 2380	9400	**0.044** 0.097
32 1.2598	**32** 1.2598	**11.8** 0.465	**16** 0.6299	**22** 0.866	**0.3** 0.012	RSTO12	RSTO12DZ	**11.20** 2520	**11.9** 2680	**8.80** 1980	**7.65** 1720	**10.9** 2450	8100	**0.049** 0.108
35 1.3780	**35** 1.3780	**11.8** 0.465	**20** 0.7874	**26** 1.024	**0.3** 0.012	RSTO15	RSTO15DZ	**12.90** 2900	**15.3** 3440	**9.13** 2050	**6.95** 1560	**11.2** 2520	6300	**0.052** 0.115
40 1.5748	**40** 1.5748	**15.8** 0.622	**22** 0.8661	**29** 1.142	**0.3** 0.012	RSTO17	RSTO17DZ	**19.00** 4270	**23.3** 5240	**13.8** 3100	**11.4** 2560	**18.2** 4090	5800	**0.095** 0.209
47 1.8504	**47** 1.8504	**15.8** 0.622	**25** 0.9843	**32** 1.260	**0.3** 0.012	RSTO20	RSTO20DZ	**20.00** 4500	**25.3** 5690	**15.3** 3440	**16.5** 3710	**22.2** 4990	5000	**0.134** 0.295
52 2.0472	**52** 2.0472	**15.8** 0.622	**30** 1.1811	**37** 1.457	**0.3** 0.012	RSTO25	RSTO25DZ	**22.40** 5040	**31.0** 6970	**16.0** 3600	**16.9** 3800	**23.7** 5330	4100	**0.155** 0.342
62 2.4409	**62** 2.4409	**19.8** 0.780	**38** 1.4961	**46** 1.811	**0.6** 0.024	RSTO30	RSTO30DZ	**33.30** 7490	**51.0** 11470	**22.3** 5010	**23.2** 5220	**34.2** 7690	3200	**0.258** 0.569
72 2.8346	**72** 2.8346	**19.8** 0.780	**42** 1.6535	**50** 1.969	**0.6** 0.024	RSTO35	RSTO35DZ	**35.20** 7910	**56.6** 12720	**25.2** 5670	**33.3** 7490	**43.0** 9670	2900	**0.37** 0.816
80 3.1496	**80** 3.1496	**19.8** 0.780	**50** 1.9685	**58** 2.283	**0.6** 0.024	RSTO40	RSTO40DZ	**38.80** 8720	**67.8** 15240	**25.9** 5820	**34.7** 7800	**45.0** 10120	2400	**0.430** 0.948
85 3.3465	**85** 3.3465	**19.8** 0.780	**55** 2.1654	**63** 2.480	**0.6** 0.024	RSTO45		**40.30** 9060	**73.5** 16520	**26.0** 5850	**35.8** 8050	**45.5** 10230	2200	**0.447** 0.985
90 3.5433	**90** 3.5433	**19.8** 0.780	**60** 2.3622	**68** 2.677	**0.6** 0.024	RSTO50		**41.80** 9400	**79.2** 17800	**26.0** 5850	**37.1** 8340	**45.8** 10300	2000	**0.495** 1.091

CAGED, WITH INNER RING, NO END WASHERS YOKE-TYPE (STO SERIES)

METRIC SERIES



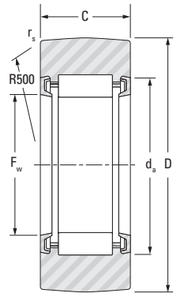
STO **STO.DZ**

Outer Dia.	D	d	B	C	F_w	E_w	r_s	$r_{1s\ min.}$	Bearing Designation		Load Ratings					Speed Rating Grease	Approx. Wt.
											As a Bearing		As a Track Roller				
									Crowned Track Roller	Cylindrical Track Roller	Dynamic	Static	Dynamic		Static		
											C	C_o	C_w	$F_{r\ perm}$	$F_{0r\ perm}$		
mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in			kN lbf		kN lbf			min^{-1}	kg lbs
19 0.7480	**19** 0.7480	**6** 0.2362	**10** 0.394	**9.8** 0.386	**10** 0.3937	**13** 0.5118	**0.3** 0.012	**0.3** 0.012	STO6	STO6DZ	**5.40** 1210	**6.43** 1450	**4.15** 933	**4.04** 908	**5.63** 1270	9400	**0.018** 0.040
24 0.9449	**24** 0.9449	**8** 0.3150	**10** 0.394	**9.8** 0.386	**12** 0.4724	**15** 0.5906	**0.3** 0.012	**0.3** 0.012	STO8	STO8DZ	**5.85** 1320	**7.51** 1690	**4.79** 1080	**6.67** 1500	**7.44** 1670	8100	**0.028** 0.062
30 1.1811	**30** 1.1811	**10** 0.3937	**12** 0.472	**11.8** 0.465	**14** 0.5512	**20** 0.7874	**0.3** 0.012	**0.3** 0.012	STO10	STO10DZ	**10.4** 2340	**10.6** 2380	**8.62** 1940	**7.69** 1730	**10.6** 2380	6300	**0.065** 0.143
32 1.2598	**32** 1.2598	**12** 0.4724	**12** 0.472	**11.8** 0.465	**16** 0.6299	**22** 0.8661	**0.3** 0.012	**0.3** 0.012	STO12	STO12DZ	**11.2** 2520	**11.9** 2680	**8.80** 1980	**7.65** 1720	**10.9** 2450	5800	**0.114** 0.251
35 1.3780	**35** 1.3780	**15** 0.5906	**12** 0.472	**11.8** 0.465	**20** 0.7874	**26** 1.0236	**0.3** 0.012	**0.3** 0.012	STO15	STO15DZ	**12.9** 2900	**15.3** 3440	**9.13** 2050	**6.95** 1560	**11.2** 2520	5000	**0.065** 0.143
40 1.5748	**40** 1.5748	**17** 0.6693	**16** 0.630	**15.8** 0.622	**22** 0.8661	**29** 1.1417	**0.3** 0.012	**0.3** 0.012	STO17	STO17DZ	**19.1** 4290	**23.3** 5240	**13.8** 3100	**11.4** 2560	**18.2** 4090	4100	**0.114** 0.251
47 1.8504	**47** 1.8504	**20** 0.7874	**16** 0.630	**15.8** 0.622	**25** 0.9843	**32** 1.2598	**0.3** 0.012	**0.3** 0.012	STO20	STO20DZ	**19.8** 4450	**25.3** 5690	**15.3** 3440	**16.5** 3710	**22.2** 4990	3200	**0.160** 0.353
52 2.0472	**52** 2.0472	**25** 0.9843	**16** 0.630	**15.8** 0.622	**30** 1.1811	**37** 1.4567	**0.3** 0.012	**0.3** 0.012	STO25	STO25DZ	**22.4** 5040	**31.0** 6970	**16.0** 3600	**16.9** 3800	**23.7** 5330	2900	**0.435** 0.959
62 2.4409	**62** 2.4409	**30** 1.1811	**20** 0.787	**19.8** 0.780	**38** 1.4961	**46** 1.8110	**0.6** 0.024	**0.6** 0.024	STO30	STO30DZ	**33.3** 7490	**51.0** 11470	**22.3** 5010	**23.2** 5220	**34.2** 7690	2400	**0.325** 0.717
72 2.8346	**72** 2.8346	**35** 1.3780	**20** 0.787	**19.8** 0.780	**42** 1.6535	**50** 1.9685	**0.6** 0.024	**0.6** 0.024	STO35	STO35DZ	**35.2** 7910	**56.6** 12720	**25.2** 5670	**33.3** 7490	**43.0** 9670	2200	**0.435** 0.959
80 3.1496	**80** 3.1496	**40** 1.5748	**20** 0.787	**19.8** 0.780	**50** 1.9685	**58** 2.2835	**0.6** 0.024	**1.0** 0.039	STO40	STO40DZ	**38.8** 8720	**67.8** 15240	**25.9** 5820	**34.7** 7800	**45.0** 10120	2400	**0.540** 1.190
85 3.3465	**85** 3.3465	**45** 1.7717	**20** 0.787	**19.8** 0.780	**55** 2.1654	**63** 2.4803	**0.6** 0.024	**1.0** 0.039	STO45	STO45DZ	**40.3** 9060	**73.5** 16520	**26.0** 5850	**35.8** 8050	**45.5** 10230	2200	**0.580** 1.279
90 3.5433	**90** 3.5433	**50** 1.9685	**20** 0.787	**19.8** 0.780	**60** 2.3622	**68** 2.6772	**0.6** 0.024	**1.0** 0.039	STO50	STO50DZ	**41.8** 9400	**79.2** 17800	**26.0** 5850	**37.1** 8340	**45.8** 10300	2000	**0.650** 1.433

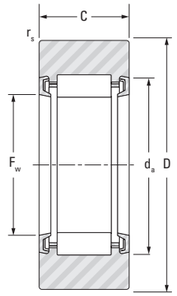
B

CAGED, WITHOUT INNER RING, NO END WASHERS, SEALED, YOKE-TYPE (RNA22 SERIES)

METRIC SERIES



RNA22.2RS

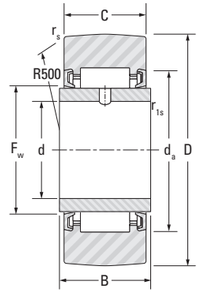


RNA22.2RS.DZ

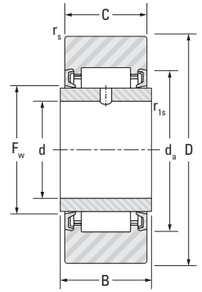
Outer Dia.	D	C	F_w	d_a	$r_{s\ min.}$	Bearing Designation		Load Ratings					Speed Rating Grease	Approx. Wt.
								As a Bearing		As a Track Roller				
						Crowned Track Roller	Cylindrical Track Roller	Dynamic	Static	Dynamic		Static		
								C	C_o	C_w	$F_{r\ perm}$	$F_{Or\ perm}$		
mm in	mm in	mm in	mm in	mm in	mm in			kN lbf					min^{-1}	kg lbs
19 0.7480	**19** 0.7480	**11.8** 0.465	**10** 0.3937	**14** 0.551	**0.3** 0.012	RNA22/6.2RS	RNA22/6.2RS.DZ	**4.70** 1060	**5.43** 1220	**4.13** 928	**3.06** 688	**4.59** 1030	13000	**0.014** 0.031
24 0.9449	**24** 0.9449	**11.8** 0.465	**12** 0.4724	**18** 0.709	**0.3** 0.012	RNA22/8.2RS	RNA22/8.2RS.DZ	**6.70** 1510	**6.08** 1370	**5.31** 1190	**3.37** 758	**5.22** 1170	11000	**0.025** 0.055
30 1.1811	**30** 1.1811	**13.8** 0.543	**14** 0.5512	**20** 0.787	**0.6** 0.024	RNA2200.2RS	RNA2200.2RS.DZ	**8.50** 1910	**9.45** 2120	**8.03** 1810	**7.85** 1760	**9.45** 2120	9400	**0.049** 0.108
32 1.2598	**32** 1.2598	**13.8** 0.543	**16** 0.6299	**22** 0.866	**0.6** 0.024	RNA2201.2RS	RNA2201.2RS.DZ	**9.00** 2020	**10.5** 2360	**8.2** 1840	**7.78** 1750	**10.1** 2270	8100	**0.053** 0.117
35 1.3780	**35** 1.3780	**13.8** 0.543	**20** 0.7874	**27** 1.063	**0.6** 0.024	RNA2202.2RS	RNA2202.2RS.DZ	**12.2** 2740	**14.5** 3260	**9.24** 2080	**6.00** 1350	**10.2** 2290	6300	**0.055** 0.121
40 1.5748	**40** 1.5748	**15.8** 0.622	**22** 0.8661	**30** 1.181	**1.0** 0.039	RNA2203.2RS	RNA2203.2RS.DZ	**16.3** 3660	**17.8** 4000	**11.9** 2680	**8.50** 1910	**13.7** 3080	5900	**0.090** 0.198
47 1.8504	**47** 1.8504	**17.8** 0.701	**25** 0.9843	**35** 1.378	**1.0** 0.039	RNA2204.2RS	RNA2204.2RS.DZ	**19.6** 4410	**20.2** 4540	**14.8** 3330	**11.0** 2470	**16.7** 3750	5200	**0.150** 0.331
52 2.0472	**52** 2.0472	**17.8** 0.701	**30** 1.1811	**40** 1.575	**1.0** 0.039	RNA2205.2RS	RNA2205.2RS.DZ	**21.6** 4860	**24.3** 5460	**15.5** 3480	**11.3** 2540	**17.7** 3980	4300	**0.171** 0.377
62 2.4409	**62** 2.4409	**19.8** 0.780	**35** 1.3780	**47** 1.850	**1.0** 0.039	RNA2206.2RS	RNA2206.2RS.DZ	**29.0** 6520	**32.8** 7370	**21.2** 4770	**15.8** 3550	**24.8** 5580	3700	**0.285** 0.628
72 2.8346	**72** 2.8346	**22.8** 0.898	**42** 1.6535	**54** 2.126	**1.1** 0.043	RNA2207.2RS	RNA2207.2RS.DZ	**40.5** 9100	**52.5** 11800	**28.6** 6430	**24.2** 5440	**37.9** 8520	3000	**0.490** 1.080
80 3.1496	**80** 3.1496	**22.8** 0.898	**48** 1.8898	**60** 2.362	**1.1** 0.043	RNA2208.2RS	RNA2208.2RS.DZ	**44.0** 9890	**60.0** 13490	**30.4** 6830	**27.8** 6250	**42.0** 9440	2600	**0.515** 1.135
85 3.3465	**85** 3.3465	**22.8** 0.898	**52** 2.0472	**64** 2.520	**1.1** 0.043	RNA2209.2RS	RNA2209.2RS.DZ	**45.6** 10250	**63.9** 14370	**30.9** 6950	**29.7** 6680	**43.7** 9820	2400	**0.565** 1.246
90 3.5433	**90** 3.5433	**22.8** 0.898	**58** 2.2835	**70** 2.756	**1.1** 0.043	RNA2210.2RS	RNA2210.2RS.DZ	**48.5** 10900	**71.3** 16030	**31.0** 6970	**29.4** 6610	**43.4** 9760	2100	**0.590** 1.301

CAGED, WITH INNER RING, NO END WASHERS, SEALED, YOKE-TYPE (NA22 SERIES)

METRIC SERIES



NA22.2RS



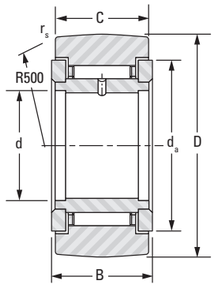
NA22.2RS.DZ

Outer Dia.	D	d	B	C	F_w	d_a	r_s	$r_{1s\ min.}$	Bearing Designation		Load Ratings					Speed Rating Grease	Approx. Wt.
											As a Bearing		As a Track Roller				
									Crowned Track Roller	Cylindrical Track Roller	Dynamic	Static	Dynamic		Static		
											C	C_o	C_w	$F_{r\ perm}$	$F_{Or\ perm}$		
mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in			kN lbf					min^{-1}	kg lbs
19 0.7480	**19** 0.7480	**6** 0.2362	**12** 0.472	**11.8** 0.465	**10** 0.3937	**14** 0.5512	**0.3** 0.012	**0.3** 0.012	NA22/6.2RS	NA22/6.2RS.DZ	**4.70** 1060	**5.43** 1220	**4.13** 928	**3.06** 688	**4.59** 1030	13000	**0.018** 0.040
24 0.9449	**24** 0.9449	**8** 0.3150	**12** 0.472	**11.8** 0.465	**12** 0.4724	**18** 0.7087	**0.3** 0.012	**0.3** 0.012	NA22/8.2RS	NA22/8.2RS.DZ	**6.70** 1510	**6.08** 1370	**5.31** 1190	**3.37** 758	**5.22** 1170	11000	**0.031** 0.068
30 1.1811	**30** 1.1811	**10** 0.3937	**14** 0.551	**13.8** 0.543	**14** 0.5512	**20** 0.7874	**0.6** 0.024	**0.3** 0.012	NA2200.2RS	NA2200.2RS.DZ	**8.50** 1910	**9.45** 2120	**8.03** 1810	**7.85** 1760	**9.45** 2120	9400	**0.057** 0.126
32 1.2598	**32** 1.2598	**12** 0.4724	**14** 0.551	**13.8** 0.543	**16** 0.6299	**22** 0.8661	**0.6** 0.024	**0.3** 0.012	NA2201.2RS	NA2201.2RS.DZ	**9.00** 2020	**10.5** 2360	**8.20** 1840	**7.78** 1750	**10.1** 2270	8100	**0.063** 0.139
35 1.3780	**35** 1.3780	**15** 0.5906	**14** 0.551	**13.8** 0.543	**20** 0.7874	**27** 1.0630	**0.6** 0.024	**0.3** 0.012	NA2202.2RS	NA2202.2RS.DZ	**12.2** 2740	**14.5** 3260	**9.24** 2080	**6.00** 1350	**10.2** 2290	6300	**0.070** 0.154
40 1.5748	**40** 1.5748	**17** 0.6693	**16** 0.630	**15.8** 0.622	**22** 0.8661	**30** 1.1811	**1.0** 0.039	**0.3** 0.012	NA2203.2RS	NA2203.2RS.DZ	**16.3** 3660	**17.8** 4000	**11.9** 2680	**8.50** 1910	**13.7** 3080	5900	**0.107** 0.236
47 1.8504	**47** 1.8504	**20** 0.7874	**18** 0.709	**17.8** 0.701	**25** 0.9843	**35** 1.3780	**1.0** 0.039	**0.3** 0.012	NA2204.2RS	NA2204.2RS.DZ	**19.6** 4410	**20.2** 4540	**14.8** 3330	**11.0** 2470	**16.7** 3750	5200	**0.175** 0.386
52 2.0472	**52** 2.0472	**25** 0.9843	**18** 0.709	**17.8** 0.701	**30** 1.1811	**40** 1.5748	**1.0** 0.039	**0.3** 0.012	NA2205.2RS	NA2205.2RS.DZ	**21.6** 4860	**24.3** 5460	**15.5** 3480	**11.3** 2540	**17.7** 3980	4300	**0.202** 0.445
62 2.4409	**62** 2.4409	**30** 1.1811	**20** 0.787	**19.8** 0.780	**35** 1.3780	**47** 1.8504	**1.0** 0.039	**0.3** 0.012	NA2206.2RS	NA2206.2RS.DZ	**29.0** 6520	**32.8** 7370	**21.2** 4770	**15.8** 3550	**24.8** 5580	3700	**0.324** 0.714
72 2.8346	**72** 2.8346	**35** 1.3780	**23** 0.906	**22.8** 0.898	**42** 1.6535	**54** 2.1260	**1.1** 0.043	**0.6** 0.024	NA2207.2RS	NA2207.2RS.DZ	**40.5** 9100	**52.5** 11800	**28.6** 6430	**24.2** 5440	**37.9** 8520	3000	**0.490** 1.080
80 3.1496	**80** 3.1496	**40** 1.5748	**23** 0.906	**22.8** 0.898	**48** 1.8898	**60** 2.3622	**1.1** 0.043	**0.6** 0.024	NA2208.2RS	NA2208.2RS.DZ	**44.0** 9890	**60.0** 13500	**30.4** 6830	**27.8** 6250	**42.0** 9440	2600	**0.615** 1.356
85 3.3465	**85** 3.3465	**45** 1.7717	**23** 0.906	**22.8** 0.898	**52** 2.0472	**64** 2.5197	**1.1** 0.043	**0.6** 0.024	NA2209.2RS	NA2209.2RS.DZ	**45.0** 10100	**63.9** 14400	**30.9** 6950	**29.7** 6680	**43.7** 9820	2400	**0.661** 1.457
90 3.5433	**90** 3.5433	**50** 1.9685	**23** 0.906	**22.8** 0.898	**58** 2.2835	**70** 2.7559	**1.1** 0.043	**0.6** 0.024	NA2210.2RS	NA2210.2RS.DZ	**48.0** 10800	**71.3** 16000	**31.0** 6970	**29.4** 6610	**43.4** 9760	2100	**0.712** 1.570

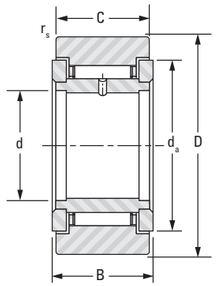
B

CAGED, WITH INNER RING, WITH END WASHERS, YOKE-TYPE (NATR, STO...ZZ SERIES)

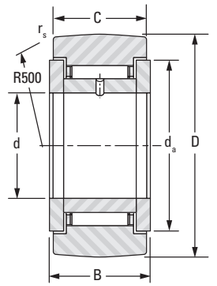
METRIC SERIES



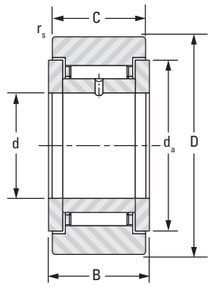
NATR



NATR.DZ



STO.ZZ

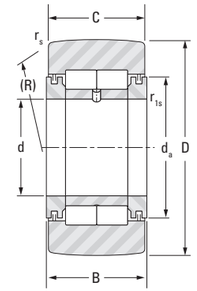


STO.ZZ.DZ

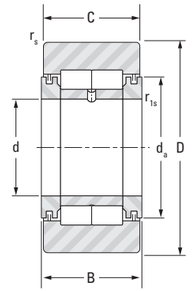
Outer Dia.	D	d	B	C	d_a	$r_{s\ min.}$	Bearing Designation		Load Ratings					Speed Rating Grease	Approx. Wt.
									As a Bearing		As a Track Roller				
							Crowned Track Roller	Cylindrical Track Roller	Dynamic	Static	Dynamic		Static		
									C	C_o	C_w	$F_{r\ perm}$	$F_{Or\ perm}$		
mm in	mm in	mm in	mm in	mm in	mm in	mm in			kN lbf		kN lbf			min^{-1}	kg lbs
16 0.6299	**16** 0.6299	**5** 0.1969	**12** 0.472	**11.0** 0.433	**13** 0.512	**0.3** 0.012	NATR5	NATR5DZ	**4.62** 1040	**5.19** 1170	**3.34** 751	**2.62** 589	**4.01** 901	13000	**0.017** 0.037
19 0.7480	**19** 0.7480	**6** 0.2362	**12** 0.472	**11.0** 0.433	**16** 0.630	**0.3** 0.012	NATR6	NATR6DZ	**4.84** 1090	**5.66** 1270	**3.84** 863	**4.28** 962	**5.28** 1190	12000	**0.022** 0.049
	19 0.7480	**6** 0.2362	**14** 0.551	**13.8** 0.543	**15** 0.591	**0.3** 0.012	STO6ZZ	STO6ZZ.DZ	**5.37** 1210	**6.47** 1450	**4.31** 969	**5.23** 1180	**6.17** 1390	12000	**0.024** 0.053
24 0.9449	**24** 0.9449	**8** 0.3150	**14** 0.551	**13.8** 0.543	**18** 0.709	**0.3** 0.012	STO8ZZ	STO8ZZ.DZ	**5.82** 1310	**7.54** 1700	**4.97** 1120	**7.54** 1700	**8.14** 1830	9900	**0.040** 0.088
	24 0.9449	**8** 0.3150	**15** 0.591	**14.0** 0.551	**20** 0.787	**0.3** 0.012	NATR8	NATR8DZ	**8.39** 1890	**8.67** 1950	**6.66** 1500	**5.79** 1300	**8.08** 1820	10000	**0.043** 0.095
30 1.1811	**30** 1.1811	**10** 0.3937	**15** 0.591	**14.0** 0.551	**24** 0.945	**0.6** 0.024	NATR10	NATR10DZ	**9.57** 2150	**9.45** 2120	**8.15** 1830	**8.58** 1930	**10.1** 2270	9400	**0.068** 0.150
	30 1.1811	**10** 0.3937	**16** 0.630	**15.8** 0.622	**23** 0.906	**0.3** 0.012	STO10ZZ	STO10ZZ.DZ	**10.4** 2340	**10.6** 2380	**8.94** 2010	**9.64** 2170	**11.4** 2560	9400	**0.071** 0.157
32 1.2598	**32** 1.2598	**12** 0.4724	**15** 0.591	**14.0** 0.551	**26** 1.024	**0.6** 0.024	NATR12	NATR12DZ	**10.2** 2290	**10.5** 2360	**8.32** 1870	**8.50** 1910	**10.4** 2340	8100	**0.075** 0.165
	32 1.2598	**12** 0.4724	**16** 0.630	**15.8** 0.622	**25** 0.984	**0.3** 0.012	STO12ZZ	STO12ZZ.DZ	**11.2** 2520	**11.9** 2680	**9.13** 2050	**9.54** 2140	**11.7** 2630	8100	**0.078** 0.172
35 1.3780	**35** 1.3780	**15** 0.5906	**16** 0.630	**15.8** 0.622	**30** 1.181	**0.3** 0.012	STO15ZZ	STO15ZZ.DZ	**12.9** 2900	**15.3** 3440	**9.47** 2130	**8.52** 1920	**12.1** 2720	6300	**0.089** 0.196
40 1.5748	**40** 1.5748	**17** 0.6693	**20** 0.787	**19.8** 0.780	**33** 1.299	**0.3** 0.012	STO17ZZ	STO17ZZ.DZ	**19.0** 4270	**23.3** 5240	**14.2** 3190	**13.4** 3010	**19.3** 4340	5600	**0.145** 0.320
47 1.8504	**47** 1.8504	**20** 0.7874	**20** 0.787	**19.8** 0.780	**37** 1.457	**0.3** 0.012	STO20ZZ	STO20ZZ.DZ	**20.0** 4500	**25.4** 5710	**15.7** 3530	**19.5** 4380	**23.5** 5280	4900	**0.200** 0.441
52 2.0472	**52** 2.0472	**25** 0.9843	**20** 0.787	**19.8** 0.780	**42** 1.654	**0.3** 0.012	STO25ZZ	STO25ZZ.DZ	**22.4** 5040	**31.1** 6990	**16.4** 3690	**19.8** 4450	**25.1** 5640	4100	**0.240** 0.529
62 2.4409	**62** 2.4409	**30** 1.1811	**25** 0.984	**24.8** 0.976	**52** 2.047	**0.6** 0.024	STO30ZZ	STO30ZZ.DZ	**33.3** 7490	**51.0** 11500	**23.0** 5170	**26.9** 6050	**36.2** 8140	3200	**0.412** 0.908
72 2.8346	**72** 2.8346	**35** 1.3780	**25** 0.984	**24.8** 0.976	**56** 2.205	**0.6** 0.024	STO35ZZ	STO35ZZ.DZ	**35.2** 7910	**56.6** 12700	**25.9** 5820	**39.2** 8810	**45.5** 10200	2900	**0.555** 1.224
80 3.1496	**80** 3.1496	**40** 1.5748	**26** 1.024	**25.8** 1.016	**64** 2.520	**0.6** 0.024	STO40ZZ	STO40ZZ.DZ	**38.8** 8720	**67.8** 15200	**26.8** 6020	**41.5** 9330	**48.1** 10800	2400	**0.700** 1.543
85 3.3465	**85** 3.3465	**45** 1.7717	**26** 1.024	**25.8** 1.016	**69** 2.717	**0.6** 0.024	STO45ZZ	STO45ZZ.DZ	**40.3** 9060	**73.5** 16500	**26.9** 6050	**42.4** 9530	**48.6** 10900	2200	**0.770** 1.698

FULL COMPLEMENT, WITH INNER RING, WITH END WASHERS, CYLINDRICAL ROLLERS, YOKE-TYPE (NUTR SERIES)

METRIC SERIES



NUTR



NUTR.DZ

Outer Dia.	D	d	B	C	d_a	r_s	$r_{1s\ min.}$	Bearing Designation		Load Ratings					Speed Rating Grease	Approx. Wt.
										As a Bearing		As a Track Roller				
								Crowned Track Roller	Cylindrical Track Roller	Dynamic	Static	Dynamic		Static		
										C	C_o	C_w	$F_{r\ perm}$	$F_{Or\ perm}$		
mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in			kN lbf		kN lbf			min^{-1}	kg lbs
35 1.3780	**35** 1.3780	**15** 0.5906	**19** 0.748	**18** 0.709	**24** 0.945	**0.6** 0.024	**0.3** 0.012	NUTR15	NUTR15DZ	**24.7** 5550	**29.3** 6590	**16.2** 3640	**10.1** 2270	**16.1** 3620	6100	**0.105** 0.231
40 1.5748	**40** 1.5748	**17** 0.6693	**21** 0.827	**20** 0.787	**27** 1.063	**1.0** 0.039	**0.3** 0.012	NUTR17	NUTR17DZ	**26.6** 5980	**33.4** 7510	**18.7** 4200	**15.0** 3370	**23.9** 5370	5300	**0.154** 0.340
42 1.6535	**42** 1.6535	**15** 0.5906	**19** 0.748	**18** 0.709	**24** 0.945	**0.6** 0.024	**0.3** 0.012	NUTR1542	NUTR1542DZ	**22.8** 5130	**29.4** 6610	**20.0** 4500	**21.2** 4770	**28.4** 6380	6100	**0.166** 0.366
47 1.8504	**47** 1.8504	**17** 0.6693	**21** 0.827	**20** 0.787	**27** 1.063	**1.0** 0.039	**0.3** 0.012	NUTR1747	NUTR1747DZ	**24.5** 5510	**33.3** 7490	**22.0** 4950	**28.1** 6320	**33.6** 7550	5300	**0.230** 0.507
	47 1.8504	**20** 0.7874	**25** 0.984	**24** 0.945	**32** 1.260	**1.0** 0.039	**0.3** 0.012	NUTR20	NUTR20DZ	**39.0** 8770	**53.2** 12000	**28.1** 6320	**20.5** 4610	**32.7** 7350	4500	**0.254** 0.560
52 2.0472	**52** 2.0472	**20** 0.7874	**25** 0.984	**24** 0.945	**32** 1.260	**1.0** 0.039	**0.3** 0.012	NUTR2052	NUTR2052DZ	**39.0** 8770	**53.2** 12000	**31.6** 7100	**31.0** 6970	**45.9** 10300	4500	**0.326** 0.719
	52 2.0472	**25** 0.9843	**25** 0.984	**24** 0.945	**37** 1.457	**1.0** 0.039	**0.3** 0.012	NUTR25	NUTR25DZ	**43.0** 9670	**63.1** 14200	**29.6** 6650	**22.2** 4990	**35.4** 7960	3700	**0.291** 0.642
62 2.4409	**62** 2.4409	**25** 0.9843	**25** 0.984	**24** 0.945	**37** 1.457	**1.0** 0.039	**0.3** 0.012	NUTR2562	NUTR2562DZ	**43.0** 9670	**63.1** 14200	**36.0** 8090	**43.9** 9870	**57.8** 13000	3700	**0.460** 1.014
	62 2.4409	**30** 1.1811	**29** 1.142	**28** 1.102	**44** 1.732	**1.0** 0.039	**0.3** 0.012	NUTR30	NUTR30DZ	**60.0** 13500	**83.1** 18700	**40.8** 9170	**29.0** 6520	**46.2** 10400	3200	**0.480** 1.058
72 2.8346	**72** 2.8346	**30** 1.1811	**29** 1.142	**28** 1.102	**44** 1.732	**1.0** 0.039	**0.3** 0.012	NUTR3072	NUTR3072DZ	**60.0** 13500	**83.1** 18700	**48.6** 10900	**53.2** 12000	**74.2** 16700	3200	**0.711** 1.567
	72 2.8346	**35** 1.3780	**29** 1.142	**28** 1.102	**50** 1.969	**1.1** 0.043	**0.6** 0.024	NUTR35	NUTR35DZ	**65.5** 14700	**97.8** 22000	**45.9** 10300	**38.7** 8700	**61.7** 13900	2600	**0.655** 1.444
80 3.1496	**80** 3.1496	**35** 1.3780	**29** 1.142	**28** 1.102	**50** 1.969	**1.1** 0.043	**0.6** 0.024	NUTR3580	NUTR3580DZ	**65.5** 14700	**97.8** 22000	**51.7** 11600	**58.7** 13200	**81.9** 18400	2600	**0.865** 1.907
	80 3.1496	**40** 1.5748	**32** 1.260	**30** 1.181	**55** 2.165	**1.1** 0.043	**0.6** 0.024	NUTR40	NUTR40DZ	**88.0** 19800	**132** 29700	**60.6** 13600	**48.0** 10800	**76.5** 17200	2500	**0.848** 1.870
85 3.3465	**85** 3.3465	**45** 1.7717	**32** 1.260	**30** 1.181	**60** 2.362	**1.1** 0.043	**0.6** 0.024	NUTR45	NUTR45DZ	**93.0** 20900	**146** 32800	**62.0** 13900	**50.2** 11300	**80.0** 18000	2200	**0.917** 2.022
90 3.5433	**90** 3.5433	**40** 1.5748	**32** 1.260	**30** 1.181	**55** 2.165	**1.1** 0.043	**0.6** 0.024	NUTR4090	NUTR4090DZ	**88.0** 19800	**132** 29700	**69.1** 15500	**75.4** 17000	**111** 25000	2500	**1.162** 2.562
	90 3.5433	**50** 1.9685	**32** 1.260	**30** 1.181	**65** 2.559	**1.1** 0.043	**0.6** 0.024	NUTR50	NUTR50DZ	**98.0** 22000	**160** 36000	**63.3** 14200	**52.9** 11900	**84.3** 19000	2000	**0.988** 2.178
100 3.9370	**100** 3.9370	**45** 1.7717	**32** 1.260	**30** 1.181	**60** 2.362	**1.1** 0.043	**0.6** 0.024	NUTR45100	NUTR45100DZ	**93.0** 20900	**146** 32800	**74.3** 16700	**92.2** 20700	**127** 28600	2200	**1.412** 3.113
110 4.3307	**110** 4.3307	**50** 1.9685	**32** 1.260	**30** 1.181	**65** 2.559	**1.1** 0.043	**0.6** 0.024	NUTR50110	NUTR50110DZ	**98.0** 22000	**160** 36000	**79.0** 17800	**110** 24700	**141** 31700	2000	**1.727** 3.807

B

STUD-TYPE AND YOKE-TYPE TRACK ROLLERS – FULL COMPLEMENT

INCH SERIES

Inch series track rollers listed in this catalog have been designed with the outer rings of large radial cross section to withstand heavy rolling or shock loads on track-type or cam-controlled equipment.

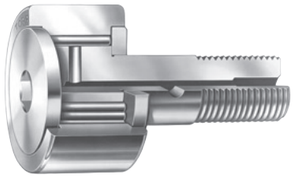


Fig. B5-14. CR with stud

REFERENCE STANDARD:

- **ANSI/ABMA Std. 18.2** – needle roller bearings – radial, inch design.

Before selecting specific inch series track rollers, the engineering section in this catalog should be reviewed.

Fig. B5-15. YCR for yoke mounting

IDENTIFICATION

The stud- and yoke-type, special construction features and size are designated by an identification code consisting of prefix letters followed by a dash and suffix numbers.

The initial prefix letters denote the type of track roller/cam follower. Additional prefix letters are used when it is necessary to denote special construction features. The suffix numbers following the prefix letters denote the size of the track roller. See Table B5-9.

The basic types are listed below:

CR – regular stud-type, full complement needle rollers, inch series

YCR – yoke-type, full complement needle rollers, inch series

Construction feature code letters – for inch series track rollers – are used as required, in the following order:

H – heavy stud
S – seals with internal thrust washers
B – hexagonal wrench socket in stud head (stud-type only)
C – crowned outer ring
E – eccentric stud (regular stud-type only)

Descriptions of typical examples, with complete letter codes, combining basic type of bearing and construction features follow. See Table B5-10.

Since the entire identification code might not appear on the bearing itself, the manufacturer's parts list or another reliable source should always be consulted when ordering bearings for field or service replacement to make certain the correct unit with the correct lubricant is specified.

Table B5-9. Identification code – inch series

Prefix letters		Suffix numbers	Complete
Type	Construction features	O.D.	Designation
CR	SBE	-16	CRSBE-16
CR		-16	CR-16

Table B5-10. Code description – inch series

Stud-types	
Description	Prefix code
With seals and internal thrust washers	CRS
With seals, internal thrust washers and heavy stud	CRHS
With seals, internal thrust washers and crowned outer ring	CRSC
With seals, internal thrust washers, hex socket and crowned outer ring	CRSBC
With seals, internal thrust washers, hex socket, crowned outer ring and eccentric stud	CRSBCE
Yoke-types	
With seals and internal thrust washers	YCRS
With seals, internal thrust washers and profiled outer ring	YCRSC

B

CONSTRUCTION

JTEKT products listed on the following pages have been designed with the outer ring of the large radial cross section to withstand heavy rolling and shock loads on track-type or cam-controlled equipment.

Regular stud-type (CR) are designed with integral studs for cantilever mounting. When a regular stud-type track roller is used within the permissible dynamic load ($F_{r\ perm}$) given in the bearing tables, the ductile core of the stud provides the necessary toughness for and resistance to shock loads. A screwdriver slot or a hexagonal wrench socket, in the head of the stud, facilitates mounting.

Yoke-type (YCR) are designed for straddle mounting. Each type is available with a full complement of needle rollers.

All inch series track rollers have a black-oxide finish on all external surfaces.

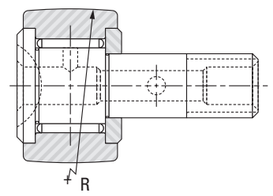


Fig. B5-16. CR with stud

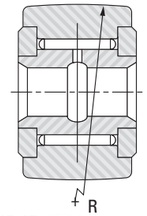


Fig. B5-17.YCR for yoke mounting

SEALED TRACK ROLLERS – INCH SERIES

Inch series sealed track rollers contain a lip-type seal and an internal thrust washer. On some sizes of track rollers, the thrust washer and seal have been incorporated into a single component. Regardless of configuration, the thrust washer fits between the shoulders of the outer ring. The inside faces the steel retaining washer and flange of the stud. These washers reduce sliding friction and serve to increase the life of the bearing – particularly when it is infrequently re-lubricated, or where misalignment occurs. In all cases, the external dimensions of the sealed bearings are the same as the unsealed bearings. The seals are thermally stable in a temperature range between -30° C and +110° C (-25° F and +225° F).

CROWNED TRACK ROLLERS

These units are available with cylindrical or crowned outer rings.

Track rollers are designed with a crowned outer ring to alleviate the uneven bearing loading – resulting from deflection, bending or misalignment in mounting.

To specify a crowned ring for any inch series track roller having a cylindrical outer ring, add the letter "C" at the end of the prefix code. For example:

prefix CR – regular stud-type, full complement of needle rollers and cylindrical outer ring

prefix CRC – same as above, but with crowned outer ring.

The O.D. tolerance of crowned track rollers is 0.000 – 0.050 mm (+0.0000 - 0.0020 in).

HEXAGONAL SOCKETS

Smaller sizes of regular inch series stud-type units have a screwdriver slot or a hexagonal socket in the flanged end of the stud to facilitate mounting. Larger sizes have a socket to accommodate a hexagonal wrench. Wrench sizes are listed in Table B5-11 on page B-5-30.

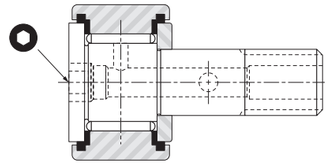


Fig. B5-18. Inch series stud-type unit with hexagonal socket

Table B5-11. Hexagonal wrench sizes – inch series

Size designation (suffix)	Wrench size	Size designation (suffix)	Wrench size
	mm in		**mm** in
-8	**3.175** 0.1250	**-28**	**7.937** 0.3125
-8-1	**3.175** 0.1250	**-30**	**7.937** 0.3125
-10	**3.175** 0.1250	**-32**	**11.112** 0.4375
-10-1	**3.175** 0.1250	**-36**	**11.112** 0.4375
-12	**4.762** 0.1875	**-40**	**12.700** 0.5000
-14	**4.762** 0.1875	**-44**	**12.700** 0.5000
-16	**6.350** 0.2500	**-48**	**19.050** 0.7500
-18	**6.350** 0.2500	**-52**	**19.050** 0.7500
-20	**6..350** 0.2500	**-56**	**19.050** 0.7500
-22	**6.350** 0.2500	**-64**	**19.050** 0.7500
-24	**7.937** 0.3125	**-80**	**22.225** 0.875
-26	**7.937** 0.3125	**-96**	**25.40** 1.000

should be exercised.

Some applications may require more secure positioning than provided by the tightened stud nut. If so, it is suggested that the housing, and eccentric bushing, be drilled at the time of installation to accept a locating dowel pin.

ECCENTRIC STUDS

To provide radial adjustment of the outer ring toward the track or cam surface at the time of installation, the regular inch series stud-types are available with eccentric studs which are specified by adding the letter "E" to the construction feature code:

prefix CRSBE – regular stud-type track roller with full complement of needle rollers, two seals, with internal thrust washers, hexagonal wrench socket in stud head, and eccentric stud.

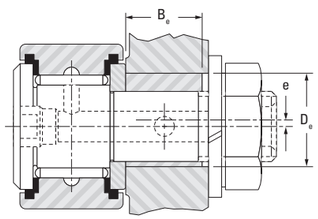


Fig. B5-19. Eccentric studs – inch series

Since a track roller with an eccentric stud is usually adjusted upon installation by turning the stud in the mounting hole, a close clearance fit between the outer diameter of the bushing and the mounting hole is necessary. For turning the stud, a hexagonal wrench is generally more convenient than a screwdriver. And an option for a hexagonal wrench socket, in the head of the stud,

LOAD RATINGS

DYNAMIC LOADING AS A TRACK ROLLER

When the outer ring of a stud-type or yoke-type track roller runs on a track, the contact under a radial load causes elastic (oval) deformation of the outer ring. As a result, a smaller zone of the raceway is loaded and the load is distributed on fewer needle rollers. This, in turn, affects the track roller's dynamic and static load ratings. Also, this deformation generates bending stress in the outer ring, which must not exceed the maximum permitted for the material of the outer ring. The maximum permissible dynamic ($F_{r\ perm}$) radial load condition is determined by this requirement.

The rating life of a stud-type or yoke-type track roller should be calculated using the dynamic load ratings, C_w, shown in the tables. The tables also show the maximum permissible radial load, $F_{r\ perm}$, that can be dynamically applied on the stud-type or yoke-type track rollers. However, to calculate the L_{10} life of a track roller, the applied radial load must not be greater than $C_w/4$ – based on ideal operating conditions of alignment, lubrication, temperature, speed and accelerations.

STATIC LOADING

In addition to the basic static load rating C_0, the tables also list the maximum permissible static radial load, $F_{0r\ perm}$, that may be applied to a stud-type or yoke-type track roller. The values of $F_{0r\ perm}$ result in a minimum static factor f_s of 0.7, for the worst condition of internal load distribution in inch series track roller operation. **The $F_{0r\ perm}$ values must not be exceeded.** Exceeding $F_{0r\ perm}$ may cause permanent damage to the track roller. A damaged track roller could cause the equipment in which the track roller is installed to malfunction. The static factor f_s can be calculated using the following formula:

$$f_s \geq 0.7 \left(\frac{F_{0r\ perm}}{P_{0r}} \right)$$

Where:

$F_{0r\ perm}$ = Maximum permissible static radial load
P_{0r} = Equivalent static load (F_{0r} for yoke-type track rollers)
F_{0r} = Static radial load
f_s = Static factor whose values should not be smaller than those suggested in Table B5-12.

Table B5-12. Suggested values for static factors f_s for inch series track rollers

Requirements for yoke – type track rollers and stud – type track rollers	Suggested f_s values	
	Max.	Min.
High shock-type loads – Quiet running	1.5	2.5
Normal loading – Normal quietness of running	1	1.5
Minor impact loads and rotary motion particularly quiet running not required	0.7	1

MOUNTING

The surface of the hole in the machine element, which supports the stud or the mounting shaft, must not deform under the expected load, and the support should be sufficiently rigid to resist bending loads.

Deformation and bending will cause uneven loading of the outer ring.

In mounting the stud-type track roller, the retaining washer must be firmly backed up by a flat shoulder which is square with the stud center line. The shoulder diameter must be no smaller than the minimum clamping diameter (d_a) listed in the bearing tables.

The maximum inherent strength of the stud is obtained when the unit is supported, as close as possible, to the retaining washer – which minimizes the bending moment. For this reason, the edge of the housing, which supports the stud shank, should be kept as sharp as possible, but free from burrs.

To minimize deflection in mounted stud-type track rollers, the stud shank should be housed with the fit (d_b) shown in the bearing tables. The clamping nut should not be tightened with a torque value higher than the maximum listed. A screwdriver slot, or hexagonal socket in the end of the stud, is provided for a tool to prevent the stud from turning when the nut is being tightened. Because the bottom of the screwdriver slot is not flat, it is helpful to put a radius on the tip of the screwdriver being used to hold the stud more securely.

When the stud shank is housed with an interference fit, installation force should be applied only to the center portion of the flanged end of the stud, preferably with an arbor press.

When the loads are high, the yoke-type track rollers should be mounted on a high strength bolt or shaft with the tight transition fit listed in the bearing tables. The bearing should be clamped between flat and parallel faces, at right angles, to the axis to prevent the retaining washers from coming off under load. If the bearing cannot be clamped, a close axial fit in the yoke is required.

When the applied loads are light to moderate, the inner ring of a yoke-type track roller may be mounted on an unhardened shaft, or a bolt with the loose transition fit listed in the bearing tables. Again, the retaining washers should be backed up axially to prevent their coming off under load.

LUBRICATION

All inch series stud-type track rollers with a screwdriver slot in the flanged end of the stud have provisions for lubrication, through the flanged end of the stud. The 12, and larger sizes of inch series stud-type track rollers with screwdriver slots, have provisions for re-lubrication through either end of the stud, and through a cross-drilled hole in the shank. The ends of the axial holes are counterbored to accept drive-type grease lubrication fittings. Hole diameters for these grease fittings are listed in the tables of dimensions.

Sizes 8 through 10-1 of the inch series stud-type track rollers, with a hexagonal socket in the flanged end of the stud, cannot be re-lubricated. Size 12 and up have re-lubrication provisions in the threaded end of the stud, and a cross-drilled hole in the shank. At the threaded end of the stud, the axial hole is counterbored to receive a drive type grease fitting. Sizes 12 through 22 and 48 through 64 of inch series stud-type track rollers, with hexagonal sockets, also have provisions for re-lubrication through the hex socket in the flanged end of the stud. Sizes 48 through 64 are supplied with lubrication fittings which may be installed in the axial hole in the bottom of the hexagonal slot in the head end of the stud – at a depth which allows the hexagonal wrench to be inserted in the wrench socket, without damaging the grease fitting.

Plugs are furnished with stud-type track rollers to close off unused holes. If the cross-drilled hole in the stud shank is not used, it will be covered when the track roller is installed properly.

Most inch series yoke-type track rollers are produced with lubrication holes and grooves in the inner ring bores, so they can be re-lubricated through axially and radially drilled holes in the supporting shaft or bolt.

Oil is the preferred lubricant for all types. Use continuous oil lubrication, or frequent grease lubrication for steady rotating conditions. Applications involving slow, intermittent oscillation are not as critical. And longer intervals between re-lubrication are permissible. Both stud- and yoke-type track rollers are normally supplied with medium temperature grease lubrication.

SPECIAL TRACK ROLLERS/ CAM FOLLOWERS

Track rollers can be obtained with dimensions different from those in the bearing tables, if the quantities permit economical production. For these and other modifications, please consult your representative.

FORKLIFT TRUCK

Yoke-type sealed units serve as high capacity and rugged guide rollers for lift trucks. Their design permits them to be mounted on studs welded to the structure. The seals exclude foreign matter and extend the time between re-lubrication periods.

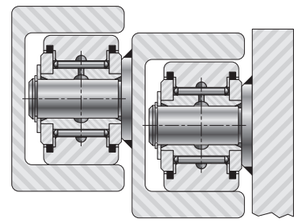


Fig. B5-20. Yoke-type sealed units

HAY BALER

Stud-types are important components on many different types of farm equipment because of their required long service life under severe loads and operating conditions. Needle roller bearings provide dependable and economical operation in the windrow pickup of hay balers.

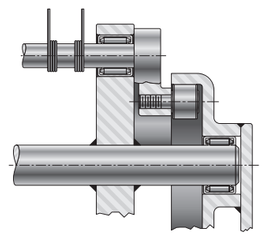


Fig. B5-21. Stud-type

MACHINE WAY

Heavily loaded machine tool tables must travel freely and accurately. Stud- and yoke-type sealed units, in combination, support and guide such tables under the most severe conditions. The high capacity and the very low wear rate permit heavy loads to be carried without impairing the accuracy of the table's travel. The seals exclude dirt and chips, and make the need for re-lubrication infrequent.

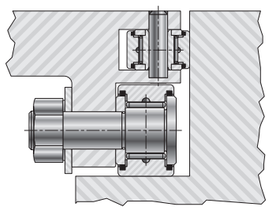


Fig. B5-22. Stud- and yoke-type sealed units

RECIPROCATING SLIDE

Stud-types find wide application in feeding and advancing mechanisms on metalworking presses. The rotary motion of an eccentric cam, rotating between two cam followers, mounted on a slide imparts reciprocating linear motion to the slide. Dwell periods, as well as accuracy in both rapid and slow linear actuation of the slide, are made possible.

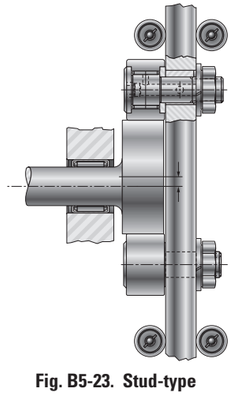
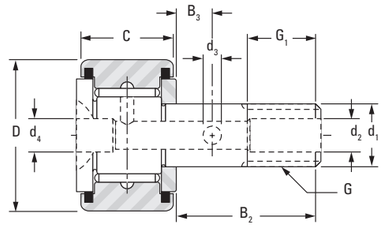


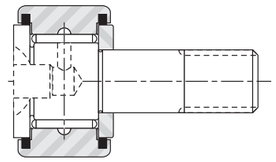
Fig. B5-23. Stud-type

STUD-TYPE TRACK ROLLERS
CR, CRS SERIES
INCH SERIES

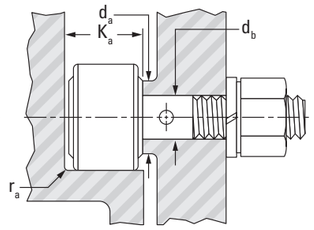
- Screwdriver slot in head facilitates mounting.
- Non-separable, sealed unit with outer ring, full complement of needle rollers, stud seals, self-lubricating resin internal thrust washers, and stud-fastened retaining washer.
- Seals help retain lubricant and exclude foreign matter (CRS Series).
- Re-lubrication via axially drilled hole through stud with cross-drilled holes in stud raceway and shank.
- Recessed axial hole accepts standard nominal inch drive-type grease lubrication fitting.
- Lubrication fitting plugs furnished to close off unused holes.
- Tolerance limits for outer diameters of stud and outer ring refer to "single mean diameter."
- A close fit between stud and hole required for mounting.
- Bore dimensions given below result in varying fit (0.025 mm tight to 0.013 mm loose [0.0010 in. tight to 0.0005 in. loose]).
- Retaining washer should be firmly backed up by flat housing shoulder (perpendicular to the stud axis).
- Shoulder diameter should be at least same size as minimum clamping diameter listed.
- May be mounted with two thin lock nuts, or nut and lock washer.



CR and CRS -12 to -64



CR and CRS -8 to -10-1



NOTE

Clamping torque is based on lubricated threads. If threads are dry, the torque values listed below may be doubled.

Outer Dia.	d_1	D	C	B_2	B_3	G_1	d_2 and d_4	d_3	G	Track Roller Designation	
	+0.025 +0.001 / 0 0	0 0 / -0.025 -0.001	0 0 / -0.13 -0.005	(nom.)		Min.			UNF	Without Seals	With Seals and Internal Thrust Washers
in	mm / in	mm / in	mm / in	mm / in	mm / in	mm / in	mm / in	mm / in	in		
1/2	**4.826** 0.1900	**12.70** 0.500	**8.74** 0.344	**12.70** 0.500	-	**6.35** 0.250	**3.18**[1][2] 0.125	-	10-32	CR-8	CRS-8
1/2	**4.826** 0.1900	**12.70** 0.500	**9.53** 0.375	**15.88** 0.625	-	**6.35** 0.250	**3.18**[1][2] 0.125	-	10-32	CR-8-1	CRS-8-1
5/8	**6.350** 0.2500	**15.88** 0.625	**10.31** 0.406	**15.90** 0.630	-	**7.90** 0.310	**3.18**[1][2] 0.125	-	1/4-28	CR-10	CRS-10
5/8	**6.350** 0.2500	**15.88** 0.625	**11.11** 0.438	**19.10** 0.750	-	**7.90** 0.310	**3.18**[1][2] 0.125	-	1/4-28	CR-10-1	CRS-10-1
3/4	**9.530** 0.3750	**19.05** 0.750	**12.70** 0.500	**22.20** 0.880	**6.35** 0.250	**9.50** 0.380	**4.78** 0.188	**2.39** 0.094	3/8-24	CR-12	CRS-12
7/8	**9.530** 0.3750	**22.23** 0.875	**12.70** 0.500	**22.20** 0.880	**6.35** 0.250	**9.50** 0.380	**4.78** 0.188	**2.39** 0.094	3/8-24	CR-14	CRS-14
1	**11.110** 0.4375	**25.40** 1.000	**15.88** 0.625	**25.40** 1.000	**6.35** 0.250	**12.70** 0.500	**4.78** 0.188	**2.39** 0.094	7/16-20	CR-16	CRS-16
1 1/8	**11.110** 0.4375	**28.58** 1.125	**15.88** 0.625	**25.40** 1.000	**6.35** 0.250	**12.70** 0.500	**4.78** 0.188	**2.39** 0.094	7/16-20	CR-18	CRS-18
1 1/4	**12.700** 0.5000	**31.75** 1.250	**19.05** 0.750	**31.75** 1.250	**7.92** 0.312	**15.90** 0.630	**4.78** 0.188	**2.39** 0.094	1/2-20	CR-20	CRS-20
1 3/8	**12.700** 0.5000	**34.93** 1.375	**19.05** 0.750	**31.80** 1.250	**7.92** 0.312	**15.90** 0.630	**4.78** 0.188	**2.39** 0.094	1/2-20	CR-22	CRS-22
1 1/2	**15.880** 0.6250	**38.10** 1.500	**22.23** 0.875	**38.10** 1.500	**9.53** 0.375	**19.10** 0.750	**4.78** 0.188	**2.39** 0.094	5/8-18	CR-24	CRS-24
1 5/8	**15.880** 0.6250	**41.28** 1.625	**22.23** 0.875	**38.10** 1.500	**9.53** 0.375	**19.10** 0.750	**4.78** 0.188	**2.39** 0.094	5/8-18	CR-26	CRS-26

[1] No lubrication hole in threaded end.
[2] Oil hole (d_4) only.
[3] UNS instead of UNF threads.

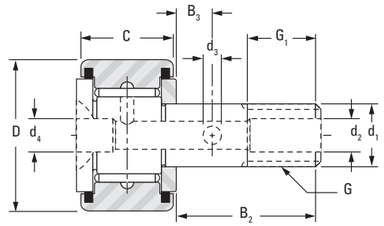
Load Rating					Speed Rating Grease	Mounting Dimensions				Clamping Torque	Approx Wt.
As a Bearing		As a Track Roller				d_b	$r_{as\ max}$	K_a	d_a		
Dynamic	Static	Dynamic		Static		Bore Dia. For Stud +0.013 +0.0005 / 0 0	Max.	Min.	Min.		
C	C_0	C_w	$F_{r\ perm}$	$F_{0r\ perm}$							
kN lbf	**kN** lbf	**kN** lbf	**kN** lbf	**kN** lbf	min^{-1}	**mm** in	**mm** in	**mm** in	**mm** in	**N-m** lb-in	**kg** lbs
4.44 999	**4.94** 1110	**3.07** 690	**1.20** 269	**2.87** 645	7000	**4.826** 0.1900	**0.25** 0.010	**10.41** 0.410	**10.41** 0.410	**1.69** 15	**0.01** 0.02
4.89 1100	**5.60** 1260	**3.39** 762	**1.36** 305	**3.25** 731	7000	**4.826** 0.1900	**0.25** 0.010	**11.20** 0.441	**10.41** 0.410	**1.69** 15	**0.01** 0.02
6.05 1360	**7.87** 1770	**4.42** 994	**2.53** 569	**6.09** 1370	5500	**6.350** 0.2500	**0.38** 0.015	**11.99** 0.472	**11.73** 0.462	**3.95** 35	**0.02** 0.04
6.54 1470	**8.72** 1960	**4.76** 1070	**2.79** 628	**6.72** 1510	5500	**6.350** 0.2500	**0.38** 0.015	**12.80** 0.504	**11.73** 0.462	**3.95** 35	**0.02** 0.05
10.14 2280	**14.68** 3300	**6.27** 1410	**2.92** 656	**6.98** 1570	3800	**9.525** 0.3750	**0.38** 0.015	**14.38** 0.566	**15.47** 0.609	**10.73** 95	**0.03** 0.08
10.14 2280	**14.68** 3300	**7.38** 1660	**4.94** 1110	**11.88** 2670	3800	**9.525** 0.3750	**0.38** 0.015	**14.38** 0.566	**15.47** 0.609	**10.73** 95	**0.04** 0.10
12.99 2920	**21.93** 4930	**8.41** 1890	**5.60** 1260	**13.43** 3020	2800	**11.112** 0.4375	**0.76** 0.030	**17.55** 0.691	**19.84** 0.781	**28.25** 250	**0.07** 0.16
12.99 2920	**21.93** 4930	**9.43** 2120	**8.18** 1840	**17.48** 3930	2800	**11.112** 0.4375	**0.76** 0.030	**17.55** 0.691	**19.84** 0.781	**28.25** 250	**0.09** 0.20
23.31 5240	**30.29** 6810	**16.06** 3610	**7.38** 1660	**17.75** 3990	2700	**12.700** 0.5000	**0.76** 0.030	**20.73** 0.816	**24.99** 0.984	**39.55** 350	**0.14** 0.30
23.31 5240	**30.29** 6810	**17.66** 3970	**10.45** 2350	**25.04** 5630	2700	**12.700** 0.5000	**0.76** 0.030	**20.73** 0.816	**24.99** 0.984	**39.55** 350	**0.16** 0.35
28.16 6330	**40.26** 9050	**20.15** 4530	**11.97** 2690	**28.74** 6460	2700	**15.872** 0.6250	**0.76** 0.030	**23.90** 0.941	**27.79** 1.094	**73.45** 650	**0.24** 0.53
28.16 6330	**40.26** 9050	**21.62** 4860	**15.66** 3520	**36.08** 8110	2300	**15.872** 0.6250	**0.76** 0.030	**23.90** 0.941	**27.79** 1.094	**73.45** 650	**0.27** 0.61

Continued on next page.

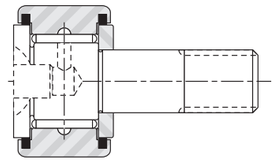
B

STUD-TYPE TRACK ROLLERS
CR, CRS SERIES
INCH SERIES

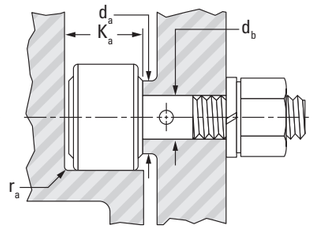
- Screwdriver slot in head facilitates mounting.
- Non-separable, sealed unit with outer ring, full complement of needle rollers, stud seals, self-lubricating resin internal thrust washers, and stud-fastened retaining washer.
- Seals help retain lubricant and exclude foreign matter (CRS Series).
- Re-lubrication via axially drilled hole through stud with cross-drilled holes in stud raceway and shank.
- Recessed axial hole accepts standard nominal inch drive-type grease lubrication fitting.
- Lubrication fitting plugs furnished to close off unused holes.
- Tolerance limits for outer diameters of stud and outer ring refer to "single mean diameter."
- A close fit between stud and hole required for mounting.
- Bore dimensions given below result in varying fit (0.025 mm tight to 0.013 mm loose [0.0010 in. tight to 0.0005 in. loose]).
- Retaining washer should be firmly backed up by flat housing shoulder (perpendicular to the stud axis).
- Shoulder diameter should be at least same size as minimum clamping diameter listed.
- May be mounted with two thin lock nuts, or nut and lock washer.



CR and CRS -12 to -64



CR and CRS -8 to -10-1



NOTE

Clamping torque is based on lubricated threads. If threads are dry, the torque values listed below may be doubled.

Outer Dia.	d_1	D	C	B_2	B_3	G_1	d_2 and d_4	d_3	G	Track Roller Designation	
	+0.025 +0.001 0 0	0 0 -0.025 -0.001	0 0 -0.13 -0.005	(nom.)		Min.			UNF	Without Seals	With Seals and Internal Thrust Washers
in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	in		
1 3/4	**19.050** 0.7500	**44.45** 1.750	**25.40** 1.000	**44.45** 1.750	**11.13** 0.438	**22.20** 0.880	**4.78** 0.188	**3.18** 0.125	3/4-16	CR-28	CRS-28
1 7/8	**19.050** 0.7500	**47.63** 1.875	**25.40** 1.000	**44.45** 1.750	**11.13** 0.438	**22.20** 0.880	**4.78** 0.188	**3.18** 0.125	3/4-16	CR-30	CRS-30
2	**22.230** 0.8750	**50.80** 2.000	**31.75** 1.250	**50.80** 2.000	**12.70** 0.500	**25.40** 1.000	**4.78** 0.188	**3.18** 0.125	7/8-14	CR-32	CRS-32
2 1/4	**22.230** 0.8750	**57.15** 2.250	**31.75** 1.250	**50.80** 2.000	**12.70** 0.500	**25.40** 1.000	**4.78** 0.188	**3.18** 0.125	7/8-14	CR-36	CRS-36
2 1/2	**25.400** 1.0000	**63.50** 2.500	**38.10** 1.500	**57.20** 2.250	**14.27** 0.562	**28.57** 1.125	**4.78** 0.188	**3.18** 0.125	1-14[3]	CR-40	CRS-40
2 3/4	**25.400** 1.0000	**69.85** 2.750	**38.10** 1.500	**57.20** 2.250	**14.27** 0.562	**28.57** 1.125	**4.78** 0.188	**3.18** 0.125	1-14[3]	CR-44	CRS-44
3	**31.750** 1.2500	**76.20** 3.000	**44.45** 1.750	**63.50** 2.500	**15.88** 0.625	**31.75** 1.250	**6.35** 0.250	**3.18** 0.125	1 1/4-12	CR-48	CRS-48
3 1/4	**31.750** 1.2500	**82.55** 3.250	**44.45** 1.750	**63.50** 2.500	**15.88** 0.625	**31.75** 1.250	**6.35** 0.250	**3.18** 0.125	1 1/4-12	CR-52	CRS-52
3 1/2	**34.930** 1.3750	**88.90** 3.500	**50.80** 2.000	**69.90** 2.750	**17.48** 0.688	**34.93** 1.375	**6.35** 0.250	**3.18** 0.125	1 3/8-12	CR-56	CRS-56
4	**38.100** 1.5000	**101.60** 4.000	**57.15** 2.250	**88.90** 3.500	**19.05** 0.750	**38.10** 1.500	**6.35** 0.250	**3.18** 0.125	1 1/2-12	CR-64	CRS-64

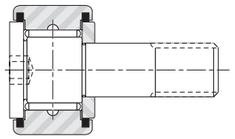
Load Rating					Speed Rating Grease	Mounting Dimensions				Clamping Torque	Approx Wt.
As a Bearing		As a Track Roller				d_b	$r_{as\ max}$	K_a	d_a		
Dynamic	Static	Dynamic		Static		Bore Dia. For Stud +0.013 +0.0005 0 0	Max.	Min.	Min.		
C	C_0	C_w	$F_{r\ perm}$	$F_{0r\ perm}$							
kN lbf	**kN** lbf	**kN** lbf	**kN** lbf	**kN** lbf	min^{-1}	**mm** in	**mm** in	**mm** in	**mm** in	**N-m** lb-in	**kg** lbs
35.50 7980	**56.49** 12700	**25.93** 5830	**19.04** 4280	**45.82** 10300	1900	**19.050** 0.7500	**1.02** 0.040	**27.08** 1.066	**31.75** 1.250	**141.25** 1250	**0.38** 0.85
35.50 7980	**56.49** 12700	**27.40** 6160	**23.66** 5320	**51.15** 11500	1900	**19.050** 0.7500	**1.02** 0.040	**27.08** 1.066	**31.75** 1.250	**141.25** 1250	**0.43** 0.95
43.19 9710	**75.62** 17000	**31.89** 7170	**28.11** 6320	**62.72** 14100	1700	**22.225** 0.8750	**1.27** 0.050	**33.43** 1.316	**35.71** 1.406	**169.5** 1500	**0.62** 1.37
43.19 9710	**75.62** 17000	**34.70** 7800	**39.86** 8960	**73.40** 16500	1700	**22.225** 0.8750	**1.27** 0.050	**33.43** 1.316	**35.71** 1.406	**169.5** 1500	**0.76** 1.67
58.27 13100	**117.43** 26400	**44.48** 10000	**54.71** 12300	**104.09** 23400	1400	**25.400** 1.0000	**2.29** 0.090	**39.78** 1.566	**42.88** 1.688	**254.25** 2250	**1.14** 2.50
58.27 13100	**117.43** 26400	**47.15** 10600	**71.17** 16000	**116.54** 26200	1400	**25.400** 1.0000	**2.29** 0.090	**39.78** 1.566	**42.88** 1.688	**254.25** 2250	**1.33** 2.93
74.29 16700	**177.93** 40000	**51.60** 11600	**68.50** 15400	**131.22** 29500	990	**31.750** 1.2500	**2.29** 0.090	**46.13** 1.816	**53.98** 2.125	**389.85** 3450	**1.91** 4.20
74.29 16700	**177.93** 40000	**54.71** 12300	**85.85** 19300	**147.24** 33100	990	**31.750** 1.2500	**2.29** 0.090	**46.13** 1.816	**53.98** 2.125	**389.85** 3450	**2.18** 4.81
109.87 24700	**225.52** 50700	**82.29** 18500	**94.75** 21300	**191.27** 43000	950	**34.925** 1.3750	**2.29** 0.090	**52.48** 2.066	**61.93** 2.438	**474.6** 4200	**2.91** 6.42
137.89 31000	**319.38** 71800	**98.75** 22200	**125.88** 28300	**250.43** 56300	780	**38.100** 1.5000	**2.29** 0.090	**58.83** 2.316	**71.04** 2.797	**565** 5000	**4.29** 9.46

(1) No lubrication hole in threaded end.
(2) Oil hole (d_4) only.
(3) UNS instead of UNF threads.

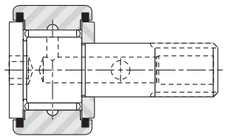
STUD-TYPE TRACK ROLLERS
CRSB SERIES
INCH SERIES

- Non-separable, sealed unit with outer ring, full complement of needle rollers, stud seals, self-lubricating resin internal thrust washers and stud-fastened retaining washer.
- Seals help retain lubricant and exclude foreign matter (CRS Series).
- Hexagonal wrench socket in stud head for mounting.
- Re-lubrication via axially drilled hole through stud with cross-drilled holes in stud raceway and shank.
- Recessed axial hole accepts standard nominal inch drive-type grease lubrication fitting.
- Lubrication fitting plugs furnished to close off unused holes.
- Tolerance limits for outer diameters of stud and outer ring refer to "single mean diameter."
- A close fit between stud and hole required for mounting.
- Bore dimensions given below result in varying fit (0.025 mm tight to 0.013 mm loose [0.0010 in. tight to 0.0005 in. loose]).
- Retaining washer should be firmly backed up by flat housing shoulder (perpendicular to the stud axis).
- Shoulder diameter should be at least same size as minimum clamping diameter listed.
- May be mounted with two thin lock nuts, or nut and lock washer.

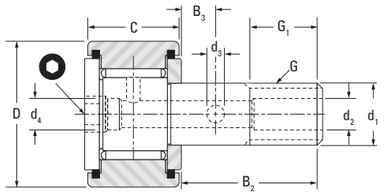
For hexagonal wrench sizes, see page B-5-30.



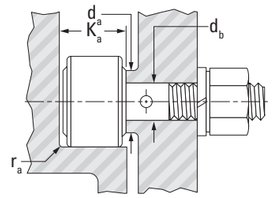
CRSB -8 to -10-1



CRSB -24 to -44



CRSB -12 to -22
CRSB -48 to -64



NOTE

Clamping torque is based on lubricated threads. If threads are dry, the torque values listed below may be doubled.

Outer Dia.	d_1	D	C	B_2	B_3	G1	d_4	d_2	d_3	G	Bearing Designation
	+0.025 +0.001 0 0	0 0 -0.025 -0.001	0 0 -0.13 -0.005	(nom.)		Min.				UNF	
in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	in	
1/2	**4.826** 0.1900	**12.70** 0.500	**8.74** 0.344	**12.70** 0.500	-	**6.35** 0.250	-	-	-	10-32	CRSB-8
1/2	**4.826** 0.1900	**12.70** 0.500	**9.53** 0.375	**15.88** 0.625	-	**6.35** 0.250	-	-	-	10-32	CRSB-8-1
5/8	**6.350** 0.2500	**15.88** 0.625	**10.31** 0.406	**15.90** 0.630	-	**7.90** 0.310	-	-	-	1/4-28	CRSB-10
5/8	**7.940** 0.3125	**15.88** 0.625	**11.11** 0.438	**19.10** 0.750	-	**7.90** 0.310	-	-	-	1/4-28	CRSB-10-1
3/4	**9.530** 0.3750	**19.05** 0.750	**12.70** 0.500	**22.20** 0.880	**6.35** 0.250	**9.50** 0.380	-	**4.78** 0.188	**2.39** 0.094	3/8-24	CRSB-12
7/8	**9.530** 0.3750	**22.23** 0.875	**12.70** 0.500	**22.20** 0.880	**6.35** 0.250	**9.50** 0.380	-	**4.78** 0.188	**2.39** 0.094	3/8-24	CRSB-14
1	**11.110** 0.4375	**25.40** 1.000	**15.88** 0.625	**25.40** 1.000	**6.35** 0.250	**12.70** 0.500	-	**4.78** 0.188	**2.39** 0.094	7/16-20	CRSB-16
1 1/8	**11.110** 0.4375	**28.58** 1.125	**15.88** 0.625	**25.40** 1.000	**6.35** 0.250	**12.70** 0.500	-	**4.78** 0.188	**2.39** 0.094	7/16-20	CRSB-18
1 1/4	**12.700** 0.5000	**31.75** 1.250	**19.05** 0.750	**31.75** 1.250	**7.92** 0.312	**15.90** 0.630	-	**4.78** 0.188	**2.39** 0.094	1/2-20	CRSB-20
1 3/8	**12.700** 0.5000	**34.93** 1.375	**19.05** 0.750	**31.80** 1.250	**7.92** 0.312	**15.90** 0.630	-	**4.78** 0.188	**2.39** 0.094	1/2-20	CRSB-22
1 1/2	**15.880** 0.6250	**38.10** 1.500	**22.23** 0.875	**38.10** 1.500	**9.53** 0.375	**19.10** 0.750	-	**4.78** 0.188	**2.39** 0.094	5/8-18	CRSB-24
1 5/8	**15.880** 0.6250	**41.28** 1.625	**22.23** 0.875	**38.10** 1.500	**9.53** 0.375	**19.10** 0.750	-	**4.78** 0.188	**2.39** 0.094	5/8-18	CRSB-26

Load Rating					Speed Rating Grease	Mounting Dimensions				Clamping Torque	Approx Wt.
As a Bearing		As a Track Roller				d_b	$r_{as\ max}$	K_a	d_a		
Dynamic	Static	Dynamic		Static		Bore Dia. For Stud +0.013 +0.0005 0 0	Max.	Min.	Min.		
C	C_0	C_w	$F_{r\ perm}$	$F_{0r\ perm}$	min^{-1}	mm in	mm in	mm in	mm in	N-m lb-in	kg lbs
4.44 999	**4.94** 1110	**3.07** 690	**1.20** 269	**2.87** 645	7000	**4.826** 0.1900	**0.25** 0.010	**10.41** 0.410	**10.41** 0.410	**1.69** 15	**0.01** 0.02
4.89 1100	**5.60** 1260	**3.39** 762	**1.36** 305	**3.25** 731	7000	**4.826** 0.1900	**0.25** 0.010	**11.20** 0.441	**10.41** 0.410	**1.69** 15	**0.01** 0.02
6.05 1360	**7.87** 1770	**4.42** 994	**2.53** 569	**6.09** 1370	5500	**6.350** 0.2500	**0.38** 0.015	**11.99** 0.472	**11.73** 0.462	**3.95** 35	**0.02** 0.04
6.54 1470	**8.72** 1960	**4.76** 1070	**2.79** 628	**6.72** 1510	5500	**6.350** 0.2500	**0.38** 0.015	**12.80** 0.504	**11.73** 0.462	**3.95** 35	**0.02** 0.05
10.14 2280	**14.68** 3300	**6.27** 1410	**2.92** 656	**6.98** 1570	3800	**9.525** 0.3750	**0.38** 0.015	**14.38** 0.566	**15.47** 0.609	**10.73** 95	**0.03** 0.08
10.14 2280	**14.68** 3300	**7.38** 1660	**4.94** 1110	**11.88** 2670	3800	**9.525** 0.3750	**0.38** 0.015	**14.38** 0.566	**15.47** 0.609	**10.73** 95	**0.04** 0.10
12.99 2920	**21.93** 4930	**8.41** 1890	**5.60** 1260	**13.43** 3020	2800	**11.112** 0.4375	**0.76** 0.030	**17.55** 0.691	**19.84** 0.781	**28.25** 250	**0.07** 0.16
12.99 2920	**21.93** 4930	**9.43** 2120	**8.18** 1840	**17.48** 3930	2800	**11.112** 0.4375	**0.76** 0.030	**17.55** 0.691	**19.84** 0.781	**28.25** 250	**0.09** 0.20
23.31 5240	**30.29** 6810	**16.06** 3610	**7.38** 1660	**17.75** 3990	2700	**12.700** 0.5000	**0.76** 0.030	**20.73** 0.816	**24.99** 0.984	**39.55** 350	**0.14** 0.30
23.31 5240	**30.29** 6810	**17.66** 3970	**10.45** 2350	**25.04** 5630	2700	**12.700** 0.5000	**0.76** 0.030	**20.73** 0.816	**24.99** 0.984	**39.55** 350	**0.16** 0.35
28.16 6330	**40.26** 9050	**20.15** 4530	**11.97** 2690	**28.74** 6460	2700	**15.872** 0.6250	**0.76** 0.030	**23.90** 0.941	**27.79** 1.094	**73.45** 650	**0.24** 0.53
28.16 6330	**40.26** 9050	**21.62** 4860	**15.66** 3520	**36.08** 8110	2300	**15.872** 0.6250	**0.76** 0.030	**23.90** 0.941	**27.79** 1.094	**73.45** 650	**0.27** 0.61

[1] UNS instead of UNF threads.
Furnished with lubrication hole in head end of stud and lubrication fitting installed below bottom of hex wrench socket.

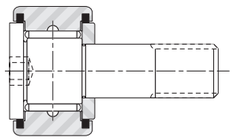
Continued on next page.

B

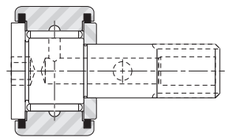
STUD-TYPE TRACK ROLLERS
CRSB SERIES
INCH SERIES

- Non-separable, sealed unit with outer ring, full complement of needle rollers, stud seals, self-lubricating resin internal thrust washers and stud-fastened retaining washer.
- Seals help retain lubricant and exclude foreign matter (CRS Series).
- Hexagonal wrench socket in stud head for mounting.
- Re-lubrication via axially drilled hole through stud with cross-drilled holes in stud raceway and shank.
- Recessed axial hole accepts standard nominal inch drive-type grease lubrication fitting.
- Lubrication fitting plugs furnished to close off unused holes.
- Tolerance limits for outer diameters of stud and outer ring refer to "single mean diameter."
- A close fit between stud and hole required for mounting.
- Bore dimensions given below result in varying fit (0.025 mm tight to 0.013 mm loose [0.0010 in. tight to 0.0005 in. loose]).
- Retaining washer should be firmly backed up by flat housing shoulder (perpendicular to the stud axis).
- Shoulder diameter should be at least same size as minimum clamping diameter listed.
- May be mounted with two thin lock nuts, or nut and lock washer.

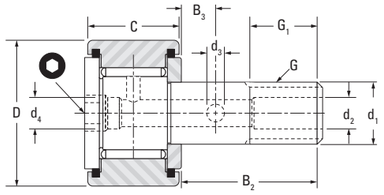
For hexagonal wrench sizes, see page B-5-30.



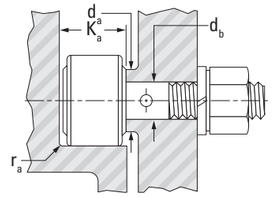
CRSB -8 to -10-1



CRSB -24 to -44



CRSB -12 to -22
CRSB -48 to -64



NOTE

Clamping torque is based on lubricated threads. If threads are dry, the torque values listed below may be doubled.

Outer Dia.	d_1	D	C	B_2	B_3	G1	d_4	d_2	d_3	G	Bearing Designation
	+0.025 +0.001 **0** 0	**0** 0 **-0.025** -0.001	**0** 0 **-0.13** -0.005	(nom.)		Min.				UNF	
in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	in	
1 3/4	**19.050** 0.7500	**44.45** 1.750	**25.40** 1.000	**44.45** 1.750	**11.13** 0.438	**22.20** 0.880	-	**4.78** 0.188	**3.18** 0.125	3/4-16	CRSB-28
1 7/8	**19.050** 0.7500	**47.63** 1.875	**25.40** 1.000	**44.45** 1.750	**11.13** 0.438	**22.20** 0.880	-	**4.78** 0.188	**3.18** 0.125	3/4-16	CRSB-30
2	**22.230** 0.8750	**50.80** 2.000	**31.75** 1.250	**50.80** 2.000	**12.70** 0.500	**25.40** 1.000	-	**4.78** 0.188	**3.18** 0.125	7/8-14	CRSB-32
2 1/4	**22.230** 0.8750	**57.15** 2.250	**31.75** 1.250	**50.80** 2.000	**12.70** 0.500	**25.40** 1.000	-	**4.78** 0.188	**3.18** 0.125	7/8-14	CRSB-36
2 1/2	**25.400** 1.0000	**63.50** 2.500	**38.10** 1.500	**57.20** 2.250	**14.27** 0.562	**28.57** 1.125	-	**4.78** 0.188	**3.18** 0.125	1-14[1]	CRSB-40
2 3/4	**25.400** 1.0000	**69.85** 2.750	**38.10** 1.500	**57.20** 2.250	**14.27** 0.562	**28.57** 1.125	-	**4.78** 0.188	**3.18** 0.125	1-14[1]	CRSB-44
3	**31.750** 1.2500	**76.20** 3.000	**44.45** 1.750	**63.50** 2.500	**15.88** 0.625	**31.75** 1.250	**6.35** 0.250	**6.35** 0.250	**3.18** 0.125	1 1/4-12	CRSB-48
3 1/4	**31.750** 1.2500	**82.55** 3.250	**44.45** 1.750	**63.50** 2.500	**15.88** 0.625	**31.75** 1.250	**6.35** 0.250	**6.35** 0.250	**3.18** 0.125	1 1/4-12	CRSB-52
3 1/2	**34.930** 1.3750	**88.90** 3.500	**50.80** 2.000	**69.90** 2.750	**17.48** 0.688	**34.93** 1.375	**6.35** 0.250	**6.35** 0.250	**3.18** 0.125	1 3/8-12	CRSB-56
4	**38.100** 1.5000	**101.60** 4.000	**57.15** 2.250	**88.90** 3.500	**19.05** 0.750	**38.10** 1.500	**6.35** 0.250	**6.35** 0.250	**3.18** 0.125	1 1/2-12	CRSB-64
5	**50.800** 2.0000	**127.00** 5.000	**69.85** 2.750	**128.57** 5.062	**22.23** 0.875	**65.10** 2.563	1/4 NPT	1/4 NPT	**4.78** 0.188	2-12	CRSB-80
6	**63.500** 2.5000	**152.40** 6.000	**82.55** 3.250	**152.40** 6.000	**25.40** 1.000	**76.20** 3.000	1/4 NPT	1/4 NPT	**4.78** 0.188	2 1/2-12	CRSB-96

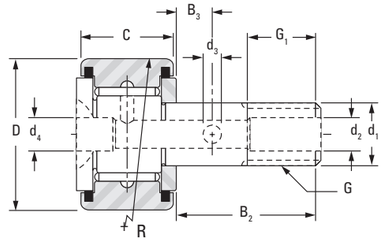
[1] UNS instead of UNF threads.
Furnished with lubrication hole in head end of stud and lubrication fitting installed below bottom of hex wrench socket.

Load Rating					Speed Rating Grease	Mounting Dimensions				Clamping Torque	Approx Wt.
As a Bearing		As a Track Roller				d_b	$r_{as\ max}$	K_a	d_a		
Dynamic	Static	Dynamic		Static		Bore Dia. For Stud **+0.013** +0.0005 **0** 0	Max.	Min.	Min.		
C	C_0	C_w	$F_{r\ perm}$	$F_{0r\ perm}$							
kN lbf	**kN** lbf	**kN** lbf	**kN** lbf	**kN** lbf	min^{-1}	**mm** in	**mm** in	**mm** in	**mm** in	**N-m** lb-in	**kg** lbs
35.50 7980	**56.49** 12700	**25.93** 5830	**19.04** 4280	**45.82** 10300	1900	**19.050** 0.7500	**1.02** 0.040	**27.08** 1.066	**31.75** 1.250	**141.25** 1250	**0.38** 0.85
35.50 7980	**56.49** 12700	**27.40** 6160	**23.66** 5320	**51.15** 11500	1900	**19.050** 0.7500	**1.02** 0.040	**27.08** 1.066	**31.75** 1.250	**141.25** 1250	**0.43** 0.95
43.19 9710	**75.62** 17000	**31.89** 7170	**28.11** 6320	**62.72** 14100	1700	**22.225** 0.8750	**1.27** 0.050	**33.43** 1.316	**35.71** 1.406	**169.5** 1500	**0.62** 1.37
43.19 9710	**75.62** 17000	**34.70** 7800	**39.86** 8960	**73.40** 16500	1700	**22.225** 0.8750	**1.27** 0.050	**33.43** 1.316	**35.71** 1.406	**169.5** 1500	**0.76** 1.67
58.27 13100	**117.43** 26400	**44.48** 10000	**54.71** 12300	**104.09** 23400	1400	**25.400** 1.0000	**2.29** 0.090	**39.78** 1.566	**42.88** 1.688	**254.25** 2250	**1.14** 2.50
58.27 13100	**117.43** 26400	**47.15** 10600	**71.17** 16000	**116.54** 26200	1400	**25.400** 1.0000	**2.29** 0.090	**39.78** 1.566	**42.88** 1.688	**254.25** 2250	**1.33** 2.93
74.29 16700	**177.93** 40000	**51.60** 11600	**68.50** 15400	**131.22** 29500	990	**31.750** 1.2500	**2.29** 0.090	**46.13** 1.816	**53.98** 2.125	**389.85** 3450	**1.91** 4.20
74.29 16700	**177.93** 40000	**54.71** 12300	**85.85** 19300	**147.24** 33100	990	**31.750** 1.2500	**2.29** 0.090	**46.13** 1.816	**53.98** 2.125	**389.85** 3450	**2.18** 4.81
109.87 24700	**225.52** 50700	**82.29** 18500	**94.75** 21300	**191.27** 43000	950	**34.925** 1.3750	**2.29** 0.090	**52.48** 2.066	**61.93** 2.438	**474.6** 4200	**2.91** 6.42
137.89 31000	**319.38** 71800	**98.75** 22200	**125.88** 28300	**250.43** 56300	780	**38.100** 1.5000	**2.29** 0.090	**58.83** 2.316	**71.04** 2.797	**565** 5000	**4.29** 9.46
210.40 47300	**484.86** 109000	**149.02** 33500	**171.70** 38600	**370.09** 83200	620	**50.800** 2.0000	**3.18** 0.125	**73.15** 2.880	**90.50** 3.563	**565** 5000	**8.90** 19.60
285.13 64100	**578.27** 130000	**201.06** 45200	**188.16** 42300	**436.37** 98100	520	**63.500** 2.5000	**3.18** 0.125	**85.85** 3.380	**113.51** 4.469	**565** 5000	**14.87** 32.76

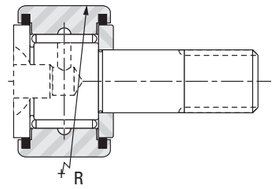
B

STUD-TYPE TRACK ROLLERS
CRSC SERIES
INCH SERIES

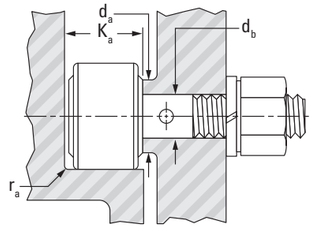
- Screwdriver slot in head facilitates mounting.
- Non-separable, sealed unit with outer ring, full complement of needle rollers, stud seals, self-lubricating resin internal thrust washers, and stud-fastened retaining washer.
- Seals help retain lubricant and exclude foreign matter (CRS Series).
- Re-lubrication via axially drilled hole through stud with cross-drilled holes in stud raceway and shank.
- Recessed axial hole accepts standard nominal inch drive-type grease lubrication fitting.
- Lubrication fitting plugs furnished to close off unused holes.
- Crowned outer ring to support uneven bearing load.
- Tolerance limits for outer diameters of stud and outer ring refer to “single mean diameter.”
- A close fit between stud and hole required for mounting.
- Bore dimensions given below result in varying fit (0.025 mm tight to 0.013 mm loose [0.0010 in. tight to 0.0005 in. loose]).
- Retaining washer should be firmly backed up by flat housing shoulder (perpendicular to the stud axis).
- Shoulder diameter should be at least same size as minimum clamping diameter listed.
- May be mounted with two thin lock nuts, or nut and lock washer.



CRSC -12 to -64



CRSC -8 to -10-1



NOTE

Clamping torque is based on lubricated threads. If threads are dry, the torque values listed below may be doubled.

Outer Dia.	d_1	D	C	R	B_2	B_3	G_1	d_2 and d_4	d_3	G	Bearing Designation
	+0.025 +0.001 0 0	0 0 -0.025 -0.001	0 0 -0.13 -0.005	Crown radius (approx.)	(nom.)		Min.			UNF	
in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	in	
1/2	**4.826** 0.1900	**12.70** 0.500	**8.74** 0.344	**152** 6	**12.70** 0.500	-	**6.35** 0.250	**3.18**[1][2] 0.125	-	10-32	CRSC-8
1/2	**4.826** 0.1900	**12.70** 0.500	**9.53** 0.375	**178** 7	**15.88** 0.625	-	**6.35** 0.250	**3.18**[1][2] 0.125	-	10-32	CRSC-8-1
5/8	**6.350** 0.2500	**15.88** 0.625	**10.31** 0.406	**178** 7	**15.90** 0.630	-	**7.90** 0.310	**3.18**[1][2] 0.125	-	1/4-28	CRSC-10
5/8	**7.940** 0.3125	**15.88** 0.625	**11.11** 0.438	**203** 8	**19.10** 0.750	-	**7.90** 0.310	**3.18**[1][2] 0.125	-	1/4-28	CRSC-10-1
3/4	**9.530** 0.3750	**19.05** 0.750	**12.70** 0.500	**254** 10	**22.20** 0.880	**6.35** 0.250	**9.50** 0.380	**4.78** 0.188	**2.39** 0.094	3/8-24	CRSC-12
7/8	**9.530** 0.3750	**22.23** 0.875	**12.70** 0.500	**254** 10	**22.20** 0.880	**6.35** 0.250	**9.50** 0.380	**4.78** 0.188	**2.39** 0.094	3/8-24	CRSC-14
1	**11.110** 0.4375	**25.40** 1.000	**15.88** 0.625	**305** 12	**25.40** 1.000	**6.35** 0.250	**12.70** 0.500	**4.78** 0.188	**2.39** 0.094	7/16-20	CRSC-16
1 1/8	**11.110** 0.4375	**28.58** 1.125	**15.88** 0.625	**305** 12	**25.40** 1.000	**6.35** 0.250	**12.70** 0.500	**4.78** 0.188	**2.39** 0.094	7/16-20	CRSC-18
1 1/4	**12.700** 0.5000	**31.75** 1.250	**19.05** 0.750	**356** 14	**31.75** 1.250	**7.92** 0.312	**15.90** 0.630	**4.78** 0.188	**2.39** 0.094	1/2-20	CRSC-20
1 3/8	**12.700** 0.5000	**34.93** 1.375	**19.05** 0.750	**356** 14	**31.80** 1.250	**7.92** 0.312	**15.90** 0.630	**4.78** 0.188	**2.39** 0.094	1/2-20	CRSC-22
1 1/2	**15.880** 0.6250	**38.10** 1.500	**22.23** 0.875	**508** 20	**38.10** 1.500	**9.53** 0.375	**19.10** 0.750	**4.78** 0.188	**2.39** 0.094	5/8-18	CRSC-24
1 5/8	**15.880** 0.6250	**41.28** 1.625	**22.23** 0.875	**508** 20	**38.10** 1.500	**9.53** 0.375	**19.10** 0.750	**4.78** 0.188	**2.39** 0.094	5/8-18	CRSC-26

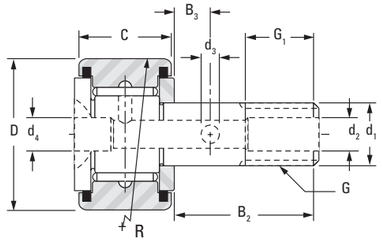
Load Rating					Speed Rating Grease	Mounting Dimensions				Clamping Torque	Approx Wt.
As a Bearing		As a Track Roller				d_b	$r_{as\ max}$	K_a	d_a		
Dynamic	Static	Dynamic		Static		Bore Dia. For Stud +0.013 +0.0005 0 0	Max.	Min.	Min.		
C	C_0	C_w	$F_{r\ perm}$	$F_{0r\ perm}$							
kN lbf	kN lbf	kN lbf	kN lbf	kN lbf	min^{-1}	mm in	mm in	mm in	mm in	N-m lb-in	kg lbs
4.44 999	**4.94** 1110	**3.07** 690	**1.20** 269	**2.87** 645	7000	**4.826** 0.1900	**0.25** 0.010	**10.41** 0.410	**10.41** 0.410	**1.69** 15	**0.01** 0.02
4.89 1100	**5.60** 1260	**3.39** 762	**1.36** 305	**3.25** 731	7000	**4.826** 0.1900	**0.25** 0.010	**11.20** 0.441	**10.41** 0.410	**1.69** 15	**0.01** 0.02
6.05 1360	**7.87** 1770	**4.42** 994	**2.53** 569	**6.09** 1370	5500	**6.350** 0.2500	**0.38** 0.015	**11.99** 0.472	**11.73** 0.462	**3.95** 35	**0.02** 0.04
6.54 1470	**8.72** 1960	**4.76** 1070	**2.79** 628	**6.72** 1510	5500	**6.350** 0.2500	**0.38** 0.015	**12.80** 0.504	**11.73** 0.462	**3.95** 35	**0.02** 0.05
10.14 2280	**14.68** 3300	**6.27** 1410	**2.92** 656	**6.98** 1570	3800	**9.525** 0.3750	**0.38** 0.015	**14.38** 0.566	**15.47** 0.609	**10.73** 95	**0.03** 0.08
10.14 2280	**14.68** 3300	**7.38** 1660	**4.94** 1110	**11.88** 2670	3800	**9.525** 0.3750	**0.38** 0.015	**14.38** 0.566	**15.47** 0.609	**10.73** 95	**0.04** 0.10
12.99 2920	**21.93** 4930	**8.41** 1890	**5.60** 1260	**13.43** 3020	2800	**11.112** 0.4375	**0.76** 0.030	**17.55** 0.691	**19.84** 0.781	**28.25** 250	**0.07** 0.16
12.99 2920	**21.93** 4930	**9.43** 2120	**8.18** 1840	**17.48** 3930	2800	**11.112** 0.4375	**0.76** 0.030	**17.55** 0.691	**19.84** 0.781	**28.25** 250	**0.09** 0.20
23.31 5240	**30.29** 6810	**16.06** 3610	**7.38** 1660	**17.75** 3990	2700	**12.700** 0.5000	**0.76** 0.030	**20.73** 0.816	**24.99** 0.984	**39.55** 350	**0.14** 0.30
23.31 5240	**30.29** 6810	**17.66** 3970	**10.45** 2350	**25.04** 5630	2700	**12.700** 0.5000	**0.76** 0.030	**20.73** 0.816	**24.99** 0.984	**39.55** 350	**0.16** 0.35
28.16 6330	**40.26** 9050	**20.15** 4530	**11.97** 2690	**28.74** 6460	2700	**15.872** 0.6250	**0.76** 0.030	**23.90** 0.941	**27.79** 1.094	**73.45** 650	**0.24** 0.53
28.16 6330	**40.26** 9050	**21.62** 4860	**15.66** 3520	**36.08** 8110	2300	**15.872** 0.6250	**0.76** 0.030	**23.90** 0.941	**27.79** 1.094	**73.45** 650	**0.27** 0.61

[1] No lubrication hole in threaded end.
[2] Oil hole (d_4) only.
[3] UNS instead of UNF threads.

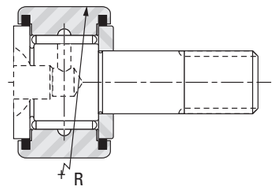
Continued on next page.

STUD-TYPE TRACK ROLLERS
CRSC SERIES
INCH SERIES

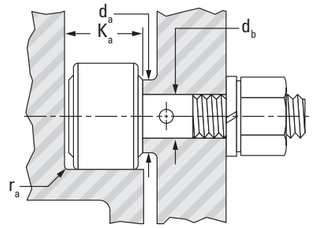
- Screwdriver slot in head facilitates mounting.
- Non-separable, sealed unit with outer ring, full complement of needle rollers, stud seals, self-lubricating resin internal thrust washers, and stud-fastened retaining washer.
- Seals help retain lubricant and exclude foreign matter (CRS Series).
- Re-lubrication via axially drilled hole through stud with cross-drilled holes in stud raceway and shank.
- Recessed axial hole accepts standard nominal inch drive-type grease lubrication fitting.
- Lubrication fitting plugs furnished to close off unused holes.
- Crowned outer ring to support uneven bearing load.
- Tolerance limits for outer diameters of stud and outer ring refer to “single mean diameter.”
- A close fit between stud and hole required for mounting.
- Bore dimensions given below result in varying fit (0.025 mm tight to 0.013 mm loose [0.0010 in. tight to 0.0005 in. loose]).
- Retaining washer should be firmly backed up by flat housing shoulder (perpendicular to the stud axis).
- Shoulder diameter should be at least same size as minimum clamping diameter listed.
- May be mounted with two thin lock nuts, or nut and lock washer.



CRSC -12 to -64



CRSC -8 to -10-1



NOTE

Clamping torque is based on lubricated threads. If threads are dry, the torque values listed below may be doubled.

Outer Dia.	d_1	D	C	R	B_2	B_3	G_1	d_2 and d_4	d_3	G	Bearing Designation
	+0.025 +0.001 0 0	0 0 -0.025 -0.001	0 0 -0.13 -0.005	Crown radius (approx.)	(nom.)		Min.			UNF	
in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	in	
1 3/4	**19.050** 0.7500	**44.45** 1.750	**25.40** 1.000	**508** 20	**44.45** 1.750	**11.13** 0.438	**22.20** 0.880	**4.78** 0.188	**3.18** 0.125	3/4-16	CRSC-28
1 7/8	**19.050** 0.7500	**47.63** 1.875	**25.40** 1.000	**508** 20	**44.45** 1.750	**11.13** 0.438	**22.20** 0.880	**4.78** 0.188	**3.18** 0.125	3/4-16	CRSC-30
2	**22.230** 0.8750	**50.80** 2.000	**31.75** 1.250	**610** 24	**50.80** 2.000	**12.70** 0.500	**25.40** 1.000	**4.78** 0.188	**3.18** 0.125	7/8-14	CRSC-32
2 1/4	**22.230** 0.8750	**57.15** 2.250	**31.75** 1.250	**610** 24	**50.80** 2.000	**12.70** 0.500	**25.40** 1.000	**4.78** 0.188	**3.18** 0.125	7/8-14	CRSC-36
2 1/2	**25.400** 1.0000	**63.50** 2.500	**38.10** 1.500	**762** 30	**57.20** 2.250	**14.27** 0.562	**28.57** 1.125	**4.78** 0.188	**3.18** 0.125	1-14[3]	CRSC-40
2 3/4	**25.400** 1.0000	**69.85** 2.750	**38.10** 1.500	**762** 30	**57.20** 2.250	**14.27** 0.562	**28.57** 1.125	**4.78** 0.188	**3.18** 0.125	1-14[3]	CRSC-44
3	**31.750** 1.2500	**76.20** 3.000	**44.45** 1.750	**762** 30	**63.50** 2.500	**15.88** 0.625	**31.75** 1.250	**6.35** 0.250	**3.18** 0.125	1 1/4-12	CRSC-48

Load Rating					Speed Rating Grease	Mounting Dimensions				Clamping Torque	Approx Wt.
As a Bearing		As a Track Roller				d_b	$r_{as\ max}$	K_a	d_a		
Dynamic	Static	Dynamic		Static		Bore Dia. For Stud +0.013 +0.0005 0 0	Max.	Min.	Min.		
C	C_0	C_w	$F_{r\ perm}$	$F_{0r\ perm}$							
kN lbf	kN lbf	kN lbf	kN lbf	kN lbf	min^{-1}	mm in	mm in	mm in	mm in	N-m lb-in	kg lbs
35.50 7980	**56.49** 12700	**25.93** 5830	**19.04** 4280	**45.82** 10300	1900	**19.050** 0.7500	**1.02** 0.040	**27.08** 1.066	**31.75** 1.250	**141.25** 1250	**0.38** 0.85
35.50 7980	**56.49** 12700	**27.40** 6160	**23.66** 5320	**51.15** 11500	1900	**19.050** 0.7500	**1.02** 0.040	**27.08** 1.066	**31.75** 1.250	**141.25** 1250	**0.43** 0.95
43.19 9710	**75.62** 17000	**31.89** 7170	**28.11** 6320	**62.72** 14100	1700	**22.225** 0.8750	**1.27** 0.050	**33.43** 1.316	**35.71** 1.406	**169.5** 1500	**0.62** 1.37
43.19 9710	**75.62** 17000	**34.70** 7800	**39.86** 8960	**73.40** 16500	1700	**22.225** 0.8750	**1.27** 0.050	**33.43** 1.316	**35.71** 1.406	**169.5** 1500	**0.76** 1.67
58.27 13100	**117.43** 26400	**44.48** 10000	**54.71** 12300	**104.09** 23400	1400	**25.400** 1.0000	**2.29** 0.090	**39.78** 1.566	**42.88** 1.688	**254.25** 2250	**1.14** 2.50
58.27 13100	**117.43** 26400	**47.15** 10600	**71.17** 16000	**116.54** 26200	1400	**25.400** 1.0000	**2.29** 0.090	**39.78** 1.566	**42.88** 1.688	**254.25** 2250	**1.33** 2.93
74.29 16700	**177.93** 40000	**51.60** 11600	**68.50** 15400	**131.22** 29500	990	**31.750** 1.2500	**2.29** 0.090	**46.13** 1.816	**53.98** 2.125	**389.85** 3450	**1.91** 4.20

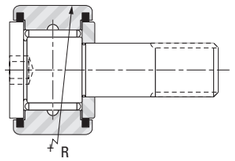
(1) No lubrication hole in threaded end.
(2) Oil hole (d_4) only.
(3) UNS instead of UNF threads.

B

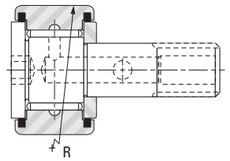
STUD-TYPE TRACK ROLLERS
CRSBC SERIES
INCH SERIES

- Non-separable, sealed unit with outer ring, full complement of needle rollers, stud seals, self-lubricating resin internal thrust washers and stud-fastened retaining washer.
- Seals help retain lubricant and exclude foreign matter (CRS Series).
- Hexagonal wrench socket in stud head for mounting.
- Re-lubrication via axially drilled hole through stud with cross-drilled holes in stud raceway and shank.
- Recessed axial hole accepts standard nominal inch drive-type grease lubrication fitting.
- Lubrication fitting plugs furnished to close off unused holes.
- Crowned outer ring to support uneven bearing load.
- Tolerance limits for outer diameters of stud and outer ring refer to "single mean diameter."
- A close fit between stud and hole required for mounting.
- Bore dimensions given below result in varying fit (0.025 mm tight to 0.013 mm loose [0.0010 in. tight to 0.0005 in. loose]).
- Retaining washer should be firmly backed up by flat housing shoulder (perpendicular to the stud axis).
- Shoulder diameter should be at least same size as minimum clamping diameter listed.
- May be mounted with two thin lock nuts, or nut and lock washer.

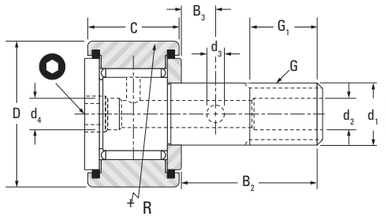
For hexagonal wrench sizes, see page B-5-30.



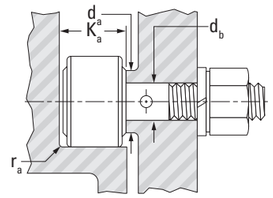
CRSBC -8 to -10-1



CRSBC -24 to -44



CRSBC -12 to -22
CRSBC -48 to -64



NOTE

Clamping torque is based on lubricated threads. If threads are dry, the torque values listed below may be doubled.

Outer Dia.	d_1	D	C	R	B_2	B_3	G_1	d_4	d_2	d_3	G	Bearing Designation
	+0.025 +0.001 0 0	0 0 -0.025 -0.001	0 0 -0.13 -0.005	Crown radius (approx.)	(nom.)		Min.				UNF	
in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	in	
1/2	**4.826** 0.1900	**12.70** 0.500	**8.74** 0.344	**152** 6	**12.70** 0.500	-	**6.35** 0.250	-	-	-	10-32	CRSBC-8
1/2	**4.826** 0.1900	**12.70** 0.500	**9.53** 0.375	**178** 7	**15.88** 0.625	-	**6.35** 0.250	-	-	-	10-32	CRSBC-8-1
5/8	**6.350** 0.2500	**15.88** 0.625	**10.31** 0.406	**178** 7	**15.90** 0.630	-	**7.90** 0.310	-	-	-	1/4-28	CRSBC-10
5/8	**7.940** 0.3125	**15.88** 0.625	**11.11** 0.438	**203** 8	**19.10** 0.750	-	**7.90** 0.310	-	-	-	1/4-28	CRSBC-10-1
3/4	**9.530** 0.3750	**19.05** 0.750	**12.70** 0.500	**254** 10	**22.20** 0.880	**6.35** 0.250	**9.50** 0.380	-	**4.78** 0.188	**2.39** 0.094	3/8-24	CRSBC-12
7/8	**9.530** 0.3750	**22.23** 0.875	**12.70** 0.500	**254** 10	**22.20** 0.880	**6.35** 0.250	**9.50** 0.380	-	**4.78** 0.188	**2.39** 0.094	3/8-24	CRSBC-14
1	**11.110** 0.4375	**25.40** 1.000	**15.88** 0.625	**305** 12	**25.40** 1.000	**6.35** 0.250	**12.70** 0.500	-	**4.78** 0.188	**2.39** 0.094	7/16-20	CRSBC-16
1 1/8	**11.110** 0.4375	**28.58** 1.125	**15.88** 0.625	**305** 12	**25.40** 1.000	**6.35** 0.250	**12.70** 0.500	-	**4.78** 0.188	**2.39** 0.094	7/16-20	CRSBC-18
1 1/4	**12.700** 0.5000	**31.75** 1.250	**19.05** 0.750	**356** 14	**31.75** 1.250	**7.92** 0.312	**15.90** 0.630	-	**4.78** 0.188	**2.39** 0.094	1/2-20	CRSBC-20
1 3/8	**12.700** 0.5000	**34.93** 1.375	**19.05** 0.750	**356** 14	**31.80** 1.250	**7.92** 0.312	**15.90** 0.630	-	**4.78** 0.188	**2.39** 0.094	1/2-20	CRSBC-22
1 1/2	**15.880** 0.6250	**38.10** 1.500	**22.23** 0.875	**508** 20	**38.10** 1.500	**9.53** 0.375	**19.10** 0.750	-	**4.78** 0.188	**2.39** 0.094	5/8-18	CRSBC-24
1 5/8	**15.880** 0.6250	**41.28** 1.625	**22.23** 0.875	**508** 20	**38.10** 1.500	**9.53** 0.375	**19.10** 0.750	-	**4.78** 0.188	**2.39** 0.094	5/8-18	CRSBC-26
1 3/4	**19.050** 0.7500	**44.45** 1.750	**25.40** 1.000	**508** 20	**44.45** 1.750	**11.13** 0.438	**22.20** 0.880	-	**4.78** 0.188	**3.18** 0.125	3/4-16	CRSBC-28

Load Rating					Speed Rating Grease	Mounting Dimensions				Clamping Torque	Approx Wt.
As a Bearing		As a Track Roller				d_b	$r_{as\ max}$	K_a	d_a		
Dynamic	Static	Dynamic		Static		Bore Dia. For Stud +0.013 +0.0005 0 0					
C	C_0	C_w	$F_{r\ perm}$	$F_{0r\ perm}$			Max.	Min.	Min.		
kN lbf	kN lbf	kN lbf	kN lbf	kN lbf	min^{-1}	mm in	mm in	mm in	mm in	N-m lb-in	kg lbs
4.44 999	**4.94** 1110	**3.07** 690	**1.20** 269	**2.87** 645	7000	**4.826** 0.1900	**0.25** 0.010	**10.41** 0.410	**10.41** 0.410	**1.69** 15	**0.01** 0.02
4.89 1100	**5.60** 1260	**3.39** 762	**1.36** 305	**3.25** 731	7000	**4.826** 0.1900	**0.25** 0.010	**11.20** 0.441	**10.41** 0.410	**1.69** 15	**0.01** 0.02
6.05 1360	**7.87** 1770	**4.42** 994	**2.53** 569	**6.09** 1370	5500	**6.350** 0.2500	**0.38** 0.015	**11.99** 0.472	**11.73** 0.462	**3.95** 35	**0.02** 0.04
6.54 1470	**8.72** 1960	**4.76** 1070	**2.79** 628	**6.72** 1510	5500	**6.350** 0.2500	**0.38** 0.015	**12.80** 0.504	**11.73** 0.462	**3.95** 35	**0.02** 0.05
10.14 2280	**14.68** 3300	**6.27** 1410	**2.92** 656	**6.98** 1570	3800	**9.525** 0.3750	**0.38** 0.015	**14.38** 0.566	**15.47** 0.609	**10.73** 95	**0.03** 0.08
10.14 2280	**14.68** 3300	**7.38** 1660	**4.94** 1110	**11.88** 2670	3800	**9.525** 0.3750	**0.38** 0.015	**14.38** 0.566	**15.47** 0.609	**10.73** 95	**0.04** 0.10
12.99 2920	**21.93** 4930	**8.41** 1890	**5.60** 1260	**13.43** 3020	2800	**11.112** 0.4375	**0.76** 0.030	**17.55** 0.691	**19.84** 0.781	**28.25** 250	**0.07** 0.16
12.99 2920	**21.93** 4930	**9.43** 2120	**8.18** 1840	**17.48** 3930	2800	**11.112** 0.4375	**0.76** 0.030	**17.55** 0.691	**19.84** 0.781	**28.25** 250	**0.09** 0.20
23.31 5240	**30.29** 6810	**16.06** 3610	**7.38** 1660	**17.75** 3990	2700	**12.700** 0.5000	**0.76** 0.030	**20.73** 0.816	**24.99** 0.984	**39.55** 350	**0.14** 0.30
23.31 5240	**30.29** 6810	**17.66** 3970	**10.45** 2350	**25.04** 5630	2700	**12.700** 0.5000	**0.76** 0.030	**20.73** 0.816	**24.99** 0.984	**39.55** 350	**0.16** 0.35
28.16 6330	**40.26** 9050	**20.15** 4530	**11.97** 2690	**28.74** 6460	2700	**15.872** 0.6250	**0.76** 0.030	**23.90** 0.941	**27.79** 1.094	**73.45** 650	**0.24** 0.53
28.16 6330	**40.26** 9050	**21.62** 4860	**15.66** 3520	**36.08** 8110	2300	**15.872** 0.6250	**0.76** 0.030	**23.90** 0.941	**27.79** 1.094	**73.45** 650	**0.27** 0.61
35.50 7980	**56.49** 12700	**25.93** 5830	**19.04** 4280	**45.82** 10300	1900	**19.050** 0.7500	**1.02** 0.040	**27.08** 1.066	**31.75** 1.250	**141.25** 1250	**0.38** 0.85

Continued on next page.

(1) UNS instead of UNF threads.
Furnished with lubrication hole in head end of stud and lubrication fitting installed below bottom of hex wrench socket.

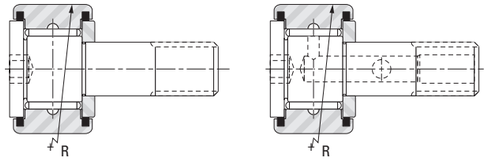
STUD-TYPE TRACK ROLLERS
CRSBC SERIES
INCH SERIES

- Non-separable, sealed unit with outer ring, full complement of needle rollers, stud seals, self-lubricating resin internal thrust washers and stud-fastened retaining washer.
- Seals help retain lubricant and exclude foreign matter (CRS Series).
- Hexagonal wrench socket in stud head for mounting.
- Re-lubrication via axially drilled hole through stud with cross-drilled holes in stud raceway and shank.
- Recessed axial hole accepts standard nominal inch drive-type grease lubrication fitting.
- Lubrication fitting plugs furnished to close off unused holes.
- Crowned outer ring to support uneven bearing load.
- Tolerance limits for outer diameters of stud and outer ring refer to "single mean diameter."
- A close fit between stud and hole required for mounting.
- Bore dimensions given below result in varying fit (0.025 mm tight to 0.013 mm loose [0.0010 in. tight to 0.0005 in. loose]).
- Retaining washer should be firmly backed up by flat housing shoulder (perpendicular to the stud axis).
- Shoulder diameter should be at least same size as minimum clamping diameter listed.
- May be mounted with two thin lock nuts, or nut and lock washer.

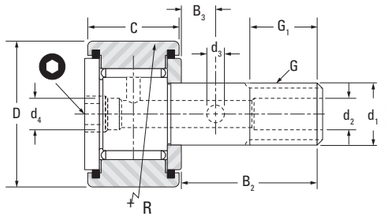
Outer Dia.	d_1	D	C	R	B_2	B_3	G_1	d_4	d_2	d_3	G	Bearing Designation
	+0.025 +0.001 **0** 0	**0** 0 **-0.025** -0.001	**0** 0 **-0.13** -0.005	Crown radius (approx.)	(nom.)		Min.				UNF	
in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	in	
1 7/8	**19.050** 0.7500	**47.63** 1.875	**25.40** 1.000	**508** 20	**44.45** 1.750	**11.13** 0.438	**22.20** 0.880	-	**4.78** 0.188	**3.18** 0.125	3/4-16	CRSBC-30
2	**22.230** 0.8750	**50.80** 2.000	**31.75** 1.250	**610** 24	**50.80** 2.000	**12.70** 0.500	**25.40** 1.000	-	**4.78** 0.188	**3.18** 0.125	7/8-14	CRSBC-32
2 1/4	**22.230** 0.8750	**57.15** 2.250	**31.75** 1.250	**610** 24	**50.80** 2.000	**12.70** 0.500	**25.40** 1.000	-	**4.78** 0.188	**3.18** 0.125	7/8-14	CRSBC-36
2 1/2	**25.400** 1.0000	**63.50** 2.500	**38.10** 1.500	**762** 30	**57.20** 2.250	**14.27** 0.562	**28.57** 1.125	-	**4.78** 0.188	**3.18** 0.125	1-14[1]	CRSBC-40
2 3/4	**25.400** 1.0000	**69.85** 2.750	**38.10** 1.500	**762** 30	**57.20** 2.250	**14.27** 0.562	**28.57** 1.125	-	**4.78** 0.188	**3.18** 0.125	1-14[1]	CRSBC-44
3	**31.750** 1.2500	**76.20** 3.000	**44.45** 1.750	**762** 30	**63.50** 2.500	**15.88** 0.625	**31.75** 1.250	**6.35** 0.250	**6.35** 0.250	**3.18** 0.125	1 1/4-12	CRSBC-48
3 1/4	**31.750** 1.2500	**82.55** 3.250	**44.45** 1.750	**762** 30	**63.50** 2.500	**15.88** 0.625	**31.75** 1.250	**6.35** 0.250	**6.35** 0.250	**3.18** 0.125	1 1/4-12	CRSBC-52
3 1/2	**34.930** 1.3750	**88.90** 3.500	**50.80** 2.000	**762** 30	**69.90** 2.750	**17.48** 0.688	**34.93** 1.375	**6.35** 0.250	**6.35** 0.250	**3.18** 0.125	1 3/8-12	CRSBC-56
4	**38.100** 1.5000	**101.60** 4.000	**57.15** 2.250	**762** 30	**88.90** 3.500	**19.05** 0.750	**38.10** 1.500	**6.35** 0.250	**6.35** 0.250	**3.18** 0.125	1 1/2-12	CRSBC-64

[1] UNS instead of UNF threads.
Furnished with lubrication hole in head end of stud and lubrication fitting installed below bottom of hex wrench socket.

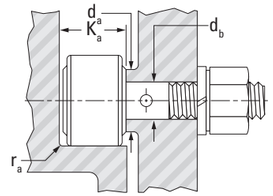
For hexagonal wrench sizes, see page B-5-30.



CRSBC -8 to -10-1 CRSBC -24 to -44



CRSBC -12 to -22
CRSBC -48 to -64



NOTE
Clamping torque is based on lubricated threads. If threads are dry, the torque values listed below may be doubled.

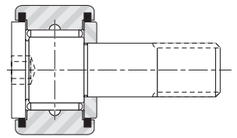
Load Rating					Speed Rating Grease	Mounting Dimensions				Clamping Torque	Approx Wt.
As a Bearing		As a Track Roller				d_b	$r_{as\ max}$	K_a	d_a		
Dynamic	Static	Dynamic		Static		Bore Dia. For Stud **+0.013** +0.0005 **0** 0	Max.	Min.	Min.		
C	C_0	C_w	$F_{r\ perm}$	$F_{0r\ perm}$							
kN lbf	**kN** lbf	**kN** lbf	**kN** lbf	**kN** lbf	min^{-1}	**mm** in	**mm** in	**mm** in	**mm** in	**N-m** lb-in	**kg** lbs
35.50 7980	**56.49** 12700	**27.40** 6160	**23.66** 5320	**51.15** 11500	1900	**19.050** 0.7500	**1.02** 0.040	**27.08** 1.066	**31.75** 1.250	**141.25** 1250	**0.43** 0.95
43.19 9710	**75.62** 17000	**31.89** 7170	**28.11** 6320	**62.72** 14100	1700	**22.225** 0.8750	**1.27** 0.050	**33.43** 1.316	**35.71** 1.406	**169.5** 1500	**0.62** 1.37
43.19 9710	**75.62** 17000	**34.70** 7800	**39.86** 8960	**73.40** 16500	1700	**22.225** 0.8750	**1.27** 0.050	**33.43** 1.316	**35.71** 1.406	**169.5** 1500	**0.76** 1.67
58.27 13100	**117.43** 26400	**44.48** 10000	**54.71** 12300	**104.09** 23400	1400	**25.400** 1.0000	**2.29** 0.090	**39.78** 1.566	**42.88** 1.688	**254.25** 2250	**1.14** 2.50
58.27 13100	**117.43** 26400	**47.15** 10600	**71.17** 16000	**116.54** 26200	1400	**25.400** 1.0000	**2.29** 0.090	**39.78** 1.566	**42.88** 1.688	**254.25** 2250	**1.33** 2.93
74.29 16700	**177.93** 40000	**51.60** 11600	**68.50** 15400	**131.22** 29500	990	**31.750** 1.2500	**2.29** 0.090	**46.13** 1.816	**53.98** 2.125	**389.85** 3450	**1.91** 4.20
74.29 16700	**177.93** 40000	**54.71** 12300	**85.85** 19300	**147.24** 33100	990	**31.750** 1.2500	**2.29** 0.090	**46.13** 1.816	**53.98** 2.125	**389.85** 3450	**2.18** 4.81
109.87 24700	**225.52** 50700	**82.29** 18500	**94.75** 21300	**191.27** 43000	950	**34.925** 1.3750	**2.29** 0.090	**52.48** 2.066	**61.93** 2.438	**474.6** 4200	**2.91** 6.42
137.89 31000	**319.38** 71800	**98.75** 22200	**125.88** 28300	**250.43** 56300	780	**38.100** 1.5000	**2.29** 0.090	**58.83** 2.316	**71.04** 2.797	**565** 5000	**4.29** 9.46

B

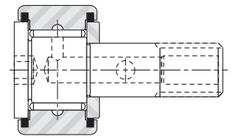
STUD-TYPE TRACK ROLLERS
CRSBE SERIES
INCH SERIES

- Non-separable, sealed unit with outer ring, full complement of needle rollers, stud seals, self-lubricating resin internal thrust washers and stud-fastened retaining washer.
- Seals help retain lubricant and exclude foreign matter (CRS Series).
- Hexagonal wrench socket in stud head for mounting.
- Re-lubrication via axially drilled hole through stud with cross-drilled holes in stud raceway and shank.
- Recessed axial hole accepts standard nominal inch drive-type grease lubrication fitting.
- Lubrication fitting plugs furnished to close off unused holes.
- Eccentric stud radial adjustment of outer ring.
- Tolerance limits for outer diameters of stud and outer ring refer to “single mean diameter.”
- A close fit between stud and hole required for mounting.
- Retaining washer should be firmly backed up by flat housing shoulder (perpendicular to the stud axis).
- Shoulder diameter should be at least same size as minimum clamping diameter listed.
- May be mounted with two thin lock nuts, or nut and lock washer.

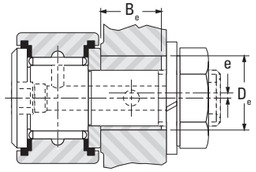
For hexagonal wrench sizes, see page B-5-30.



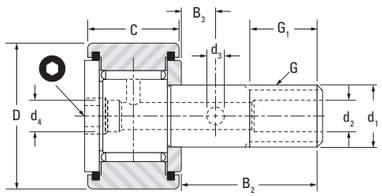
CRSBE -8 to -10-1



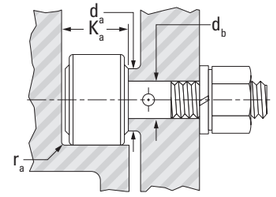
CRSBE -24 to -44



Eccentric studs



CRSBE -12 to -22
CRSBE -48 to -64



NOTE

Clamping torque is based on lubricated threads. If threads are dry, the torque values listed below may be doubled.

Outer Dia.	d_1	D	C	B_2	Eccentric Bushing			B_3	G_1	d_4	d_2	d_3	G	Bearing Designation
					De	Be	e							
					Bushing OD	Bushing width	Eccentricity							
					±0.025 ±0.001	±0.025 ±0.001	(nom.)							
in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	UNF	
1/2	**4.830** 0.1900	**12.70** 0.500	**8.74** 0.344	**12.70** 0.500	**6.35** 0.250	**6.35** 0.250	**0.25** 0.010	-	**6.40** 0.250	-	-	-	10-32	CRSBE-8
1/2	**4.830** 0.1900	**12.70** 0.500	**9.53** 0.375	**15.90** 0.630	**6.35** 0.250	**9.53** 0.375	**0.25** 0.010	-	**6.40** 0.250	-	-	-	10-32	CRSBE-8-1
5/8	**6.350** 0.2500	**15.88** 0.625	**11.11** 0.438	**19.10** 0.750	**9.53** 0.375	**11.10** 0.437	**0.38** 0.015	-	**7.90** 0.310	-	-	-	1/4-28	CRSBE-10-1
3/4	**9.530** 0.3750	**19.05** 0.750	**12.70** 0.500	**22.20** 0.880	**12.70** 0.500	**12.70** 0.500	**0.38** 0.015	**6.25** 0.250	**9.50** 0.380	-	**4.77** 0.188	**2.39** 0.094	3/8-24	CRSBE-12
7/8	**9.530** 0.3750	**22.23** 0.875	**12.70** 0.500	**22.20** 0.880	**12.70** 0.500	**12.70** 0.500	**0.38** 0.015	**6.25** 0.250	**9.50** 0.380	-	**4.77** 0.188	**2.39** 0.094	3/8-24	CRSBE-14
1	**11.110** 0.4375	**25.40** 1.000	**15.88** 0.625	**25.40** 1.000	**15.88** 0.625	**12.70** 0.500	**0.76** 0.030	**6.35** 0.250	**12.70** 0.500	-	**4.78** 0.188	**2.39** 0.094	7/16-20	CRSBE-16
1 1/8	**11.110** 0.4375	**28.58** 1.125	**15.88** 0.625	**25.40** 1.000	**15.88** 0.625	**12.70** 0.500	**0.76** 0.030	**6.35** 0.250	**12.70** 0.500	-	**4.78** 0.188	**2.39** 0.094	7/16-20	CRSBE-18
1 1/4	**12.700** 0.5000	**31.75** 1.250	**19.05** 0.750	**31.75** 1.250	**17.45** 0.687	**15.88** 0.625	**0.76** 0.030	**7.92** 0.312	**15.90** 0.630	-	**4.78** 0.188	**2.39** 0.094	1/2-20	CRSBE-20
1 3/8	**12.700** 0.5000	**34.93** 1.375	**19.05** 0.750	**31.80** 1.250	**17.45** 0.687	**15.88** 0.625	**0.76** 0.030	**7.92** 0.312	**15.90** 0.630	-	**4.78** 0.188	**2.39** 0.094	1/2-20	CRSBE-22
1 1/2	**15.880** 0.6250	**38.10** 1.500	**22.23** 0.875	**38.10** 1.500	**22.23** 0.875	**19.05** 0.750	**0.76** 0.030	**9.53** 0.375	**19.10** 0.750	-	**4.78** 0.188	**2.39** 0.094	5/8-18	CRSBE-24
1 5/8	**15.880** 0.6250	**41.28** 1.625	**22.23** 0.875	**38.10** 1.500	**22.23** 0.875	**19.05** 0.750	**0.76** 0.030	**9.53** 0.375	**19.10** 0.750	-	**4.78** 0.188	**2.39** 0.094	5/8-18	CRSBE-26
1 3/4	**19.050** 0.7500	**44.45** 1.750	**25.40** 1.000	**44.45** 1.750	**25.40** 1.000	**22.23** 0.875	**0.76** 0.030	**11.13** 0.438	**22.20** 0.880	-	**4.78** 0.188	**3.18** 0.125	3/4-16	CRSBE-28
1 7/8	**19.050** 0.7500	**47.63** 1.875	**25.40** 1.000	**44.45** 1.750	**25.40** 1.000	**22.23** 0.875	**0.76** 0.030	**11.13** 0.438	**22.20** 0.880	-	**4.78** 0.188	**3.18** 0.125	3/4-16	CRSBE-30

Load Rating					Speed Rating Grease	Mounting Dimensions				Clamping Torque	Approx Wt.
As a Bearing		As a Track Roller				d_b	$r_{as\ max}$	K_a	d_a		
Dynamic	Static	Dynamic		Static		Bore Dia. For Stud +0.050 +0.002 0 0	Max.	Min.	Min.		
C	C_0	C_w	$F_{r\ perm}$	$F_{0r\ perm}$							
kN lbf	kN lbf	kN lbf	kN lbf	kN lbf	min^{-1}	mm in	mm in	mm in	mm in	N-m lb-in	kg lbs
4.44 999	**4.94** 1110	**3.07** 690	**1.20** 269	**2.87** 645	7000	**6.400** 0.2520	**0.25** 0.010	**10.41** 0.410	**10.41** 0.410	**1.69** 15	**0.01** 0.02
4.89 1100	**5.60** 1260	**3.39** 762	**1.36** 305	**3.25** 731	7000	**6.400** 0.2520	**0.25** 0.010	**11.20** 0.441	**10.41** 0.410	**1.69** 15	**0.01** 0.02
6.05 1360	**7.87** 1770	**4.42** 994	**2.53** 569	**6.09** 1370	5500	**9.575** 0.3770	**0.38** 0.015	**12.80** 0.504	**11.73** 0.462	**3.95** 35	**0.02** 0.04
6.54 1470	**8.72** 1960	**4.76** 1070	**2.79** 628	**6.72** 1510	5500	**12.745** 0.5020	**0.38** 0.015	**14.38** 0.566	**15.47** 0.609	**3.95** 35	**0.02** 0.05
10.14 2280	**14.68** 3300	**6.27** 1410	**2.92** 656	**6.98** 1570	3800	**12.745** 0.5020	**0.38** 0.015	**14.38** 0.566	**15.47** 0.609	**10.73** 95	**0.03** 0.08
10.14 2280	**14.68** 3300	**7.38** 1660	**4.94** 1110	**11.88** 2670	3800	**15.700** 0.6270	**0.76** 0.030	**17.55** 0.691	**19.84** 0.781	**10.73** 95	**0.04** 0.10
12.99 2920	**21.93** 4930	**8.41** 1890	**5.60** 1260	**13.43** 3020	2800	**15.700** 0.6270	**0.76** 0.030	**17.55** 0.691	**19.84** 0.781	**28.25** 250	**0.07** 0.16
12.99 2920	**21.93** 4930	**9.43** 2120	**8.18** 1840	**17.48** 3930	2800	**17.495** 0.6890	**0.76** 0.030	**20.73** 0.816	**24.99** 0.984	**28.25** 250	**0.09** 0.20
23.31 5240	**30.29** 6810	**16.06** 3610	**7.38** 1660	**17.75** 3990	2700	**17.495** 0.6890	**0.76** 0.030	**20.73** 0.816	**24.99** 0.984	**39.55** 350	**0.14** 0.30
23.31 5240	**30.29** 6810	**17.66** 3970	**10.45** 2350	**25.04** 5630	2700	**22.275** 0.8770	**0.76** 0.030	**23.90** 0.941	**27.79** 1.094	**39.55** 350	**0.16** 0.35
28.16 6330	**40.26** 9050	**20.15** 4530	**11.97** 2690	**28.74** 6460	2700	**22.275** 0.8770	**0.76** 0.030	**23.90** 0.941	**27.79** 1.094	**73.45** 650	**0.24** 0.53
28.16 6330	**40.26** 9050	**21.62** 4860	**15.66** 3520	**36.08** 8110	2300	**25.445** 1.0020	**1.02** 0.040	**27.08** 1.066	**31.75** 1.250	**73.45** 650	**0.27** 0.61
35.50 7980	**56.49** 12700	**25.93** 5830	**19.04** 4280	**45.82** 10300	1900	**25.445** 1.0020	**1.02** 0.040	**27.08** 1.066	**31.75** 1.250	**141.25** 1250	**0.38** 0.85

[1] UNS instead of UNF threads.
Furnished with lubrication hole in head end of stud and lubrication fitting installed below bottom of hex wrench socket.

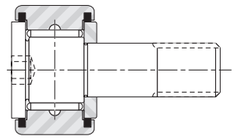
Continued on next page.

B

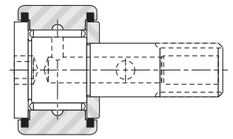
STUD-TYPE TRACK ROLLERS
CRSBE SERIES
INCH SERIES

- Non-separable, sealed unit with outer ring, full complement of needle rollers, stud seals, self-lubricating resin internal thrust washers and stud-fastened retaining washer.
- Seals help retain lubricant and exclude foreign matter (CRS Series).
- Hexagonal wrench socket in stud head for mounting.
- Re-lubrication via axially drilled hole through stud with cross-drilled holes in stud raceway and shank.
- Recessed axial hole accepts standard nominal inch drive-type grease lubrication fitting.
- Lubrication fitting plugs furnished to close off unused holes.
- Eccentric stud radial adjustment of outer ring.
- Tolerance limits for outer diameters of stud and outer ring refer to “single mean diameter.”
- A close fit between stud and hole required for mounting.
- Retaining washer should be firmly backed up by flat housing shoulder (perpendicular to the stud axis).
- Shoulder diameter should be at least same size as minimum clamping diameter listed.
- May be mounted with two thin lock nuts, or nut and lock washer.

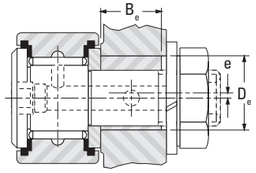
For hexagonal wrench sizes, see page B-5-30.



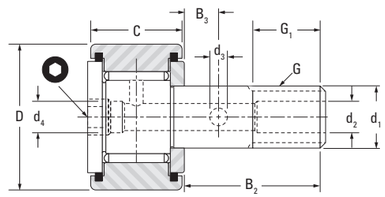
CRSBE -8 to -10-1



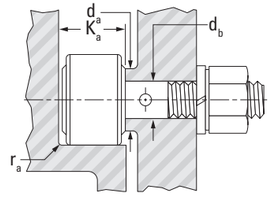
CRSBE -24 to -44



Eccentric studs



CRSBE -12 to -22
CRSBE -48 to -64



NOTE

Clamping torque is based on lubricated threads. If threads are dry, the torque values listed below may be doubled.

Outer Dia.	d_1	D	C	B_2	Eccentric Bushing			B_3	G_1	d_4	d_2	d_3	G	Bearing Designation
					De	Be	e							
	+0.025 +0.001 0 0	0 0 -0.025 -0.001	0 0 -0.13 -0.005	(nom.)	Bushing OD ±0.025 ±0.001	Bushing width ±0.025 ±0.001	Eccentricity (nom.)		Min.				UNF	
in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	in	
2	22.230 0.8750	50.80 2.000	31.75 1.250	50.80 2.000	30.15 1.187	25.40 1.000	0.76 0.030	12.70 0.500	25.40 1.000	-	4.78 0.188	3.18 0.125	7/8-14	CRSBE-32
2 1/4	22.230 0.8750	57.15 2.250	31.75 1.250	50.80 2.000	30.15 1.187	25.40 1.000	0.76 0.030	12.70 0.500	25.40 1.000	-	4.78 0.188	3.18 0.125	7/8-14	CRSBE-36
2 1/2	25.400 1.0000	63.50 2.500	38.10 1.500	57.20 2.250	34.93 1.375	28.58 1.125	0.76 0.030	14.27 0.562	28.57 1.125	-	4.78 0.188	3.18 0.125	1-14[1]	CRSBE-40
2 3/4	25.400 1.0000	69.85 2.750	38.10 1.500	57.20 2.250	34.93 1.375	28.58 1.125	0.76 0.030	14.27 0.562	28.57 1.125	-	4.78 0.188	3.18 0.125	1-14[1]	CRSBE-44
3	31.750 1.2500	76.20 3.000	44.45 1.750	63.50 2.500	44.45 1.750	31.75 1.250	0.52 0.060	15.88 0.625	31.75 1.250	6.35 0.250	6.35 0.250	3.18 0.125	1 1/4-12	CRSBE-48
3 1/4	31.750 1.2500	82.55 3.250	44.45 1.750	63.50 2.500	44.45 1.750	31.75 1.250	0.52 0.060	15.88 0.625	31.75 1.250	6.35 0.250	6.35 0.250	3.18 0.125	1 1/4-12	CRSBE-52
3 1/2	34.930 1.3750	88.90 3.500	50.80 2.000	69.90 2.750	46.02 1.812	34.93 1.375	0.52 0.060	17.48 0.688	34.93 1.375	6.35 0.250	6.35 0.250	3.18 0.125	1 3/8-12	CRSBE-56
4	38.100 1.5000	101.60 4.000	57.15 2.250	88.90 3.500	50.80 2.000	50.80 2.000	0.52 0.060	19.05 0.750	38.10 1.500	6.35 0.250	6.35 0.250	3.18 0.125	1 1/2-12	CRSBE-64

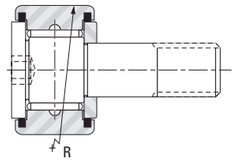
Load Rating					Speed Rating Grease	Mounting Dimensions				Clamping Torque	Approx Wt.
As a Bearing		As a Track Roller				d_b	$r_{as\ max}$	K_a	d_a		
Dynamic	Static	Dynamic		Static		Bore Dia. For Stud +0.050 +0.002 0 0					
C	C_0	C_w	$F_{r\ perm}$	$F_{0r\ perm}$			Max.	Min.	Min.		
kN lbf	kN lbf	kN lbf	kN lbf	kN lbf	min^{-1}	mm in	mm in	mm in	mm in	N-m lb-in	kg lbs
35.50 7980	56.49 12700	27.40 6160	23.66 5320	51.15 11500	1900	30.195 1.1890	1.27 0.050	33.43 1.316	35.71 1.406	141.25 1250	0.43 0.95
43.19 9710	75.62 17000	31.89 7170	28.11 6320	62.72 14100	1700	30.195 1.1890	1.27 0.050	33.43 1.316	35.71 1.406	169.5 1500	0.62 1.37
43.19 9710	75.62 17000	34.70 7800	39.86 8960	73.40 16500	1700	34.975 1.3770	2.29 0.090	39.78 1.566	42.88 1.688	169.5 1500	0.76 1.67
58.27 13100	117.43 26400	44.48 10000	54.71 12300	104.09 23400	1400	34.975 1.3770	2.29 0.090	39.78 1.566	42.88 1.688	254.25 2250	1.14 2.50
58.27 13100	117.43 26400	47.15 10600	71.17 16000	116.54 26200	1400	44.495 1.7520	2.29 0.090	46.13 1.816	53.98 2.125	254.25 2250	1.33 2.93
74.29 16700	177.93 40000	51.60 11600	68.50 15400	131.22 29500	990	44.495 1.7520	2.29 0.090	46.13 1.816	53.98 2.125	389.85 3450	1.91 4.20
74.29 16700	177.93 40000	54.71 12300	85.85 19300	147.24 33100	990	46.075 1.8140	2.29 0.090	52.48 2.066	61.93 2.438	389.85 3450	2.18 4.81
109.87 24700	225.52 50700	82.29 18500	94.75 21300	191.27 43000	950	50.825 2.0010	2.29 0.090	58.83 2.316	71.04 2.797	474.6 4200	2.91 6.42

[1] UNS instead of UNF threads.
Furnished with lubrication hole in head end of stud and lubrication fitting installed below bottom of hex wrench socket.

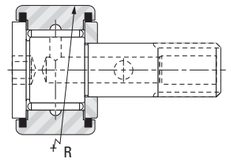
STUD-TYPE TRACK ROLLERS
CRSBCE SERIES
INCH SERIES

- Non-separable, sealed unit with outer ring, full complement of needle rollers, stud seals, self-lubricating resin internal thrust washers and stud-fastened retaining washer.
- Seals help retain lubricant and exclude foreign matter (CRS Series).
- Hexagonal wrench socket in stud head for mounting.
- Re-lubrication via axially drilled hole through stud with cross-drilled holes in stud raceway and shank.
- Recessed axial hole accepts standard nominal inch drive-type grease lubrication fitting.
- Lubrication fitting plugs furnished to close off unused holes.
- Crowned outer ring to support uneven bearing load.
- Eccentric stud for radial adjustment of outer ring.
- Tolerance limits for outer diameters of stud and outer ring refer to "single mean diameter."
- A close fit between stud and hole required for mounting.
- Retaining washer should be firmly backed up by flat housing shoulder (perpendicular to the stud axis).
- Shoulder diameter should be at least same size as minimum clamping diameter listed.
- May be mounted with two thin lock nuts, or nut and lock washer.

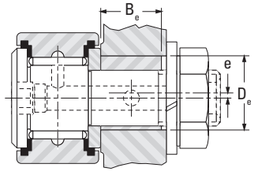
For hexagonal wrench sizes, see page B-5-30.



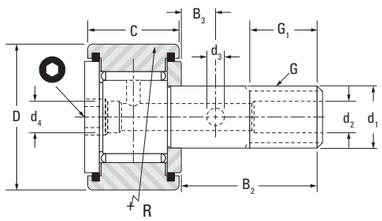
CRSBCE -8 to -10-1



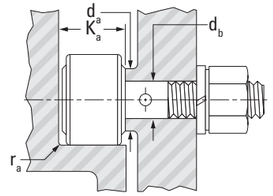
CRSBCE -24 to -44



Eccentric studs



CRSBCE -12 to -22
CRSBCE -48 to -64



NOTE

Clamping torque is based on lubricated threads. If threads are dry, the torque values listed below may be doubled.

Outer Dia.	d_1	D	C	R	B_2	Eccentric Bushing			B_3	G_1	d_4	d_2	d_3	G	Bearing Designation
						De	Be	e							
						Bushing OD	Bushing width	Eccentricity							
						±0.025 ±0.001	±0.025 ±0.001	(nom.)							
in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	in	
1/2	**4.830** 0.1900	**12.70** 0.500	**8.74** 0.344	**152** 6	**12.70** 0.500	**6.35** 0.250	**6.35** 0.250	**0.25** 0.010	-	**6.40** 0.250	-	-	-	10-32	CRSBCE-8
5/8	**6.350** 0.2500	**15.88** 0.625	**11.11** 0.438	**203** 8	**19.10** 0.750	**9.53** 0.375	**11.10** 0.437	**0.38** 0.015	-	**7.90** 0.310	-	-	-	1/4-28	CRSBCE-10-1
3/4	**9.530** 0.3750	**19.05** 0.750	**12.70** 0.500	**254** 10	**22.20** 0.880	**12.70** 0.500	**12.70** 0.500	**0.38** 0.015	**6.25** 0.250	**9.50** 0.380	-	**4.77** 0.188	**2.39** 0.094	3/8-24	CRSBCE-12
7/8	**9.530** 0.3750	**22.23** 0.875	**12.70** 0.500	**254** 10	**22.20** 0.880	**12.70** 0.500	**12.70** 0.500	**0.38** 0.015	**6.25** 0.250	**9.50** 0.380	-	**4.77** 0.188	**2.39** 0.094	3/8-24	CRSBCE-14
1	**11.110** 0.4375	**25.40** 1.000	**15.88** 0.625	**305** 12	**25.40** 1.000	**15.88** 0.625	**12.70** 0.500	**0.76** 0.030	**6.35** 0.250	**12.70** 0.500	-	**4.78** 0.188	**2.39** 0.094	7/16-20	CRSBCE-16
1 1/8	**11.110** 0.4375	**28.58** 1.125	**15.88** 0.625	**305** 12	**25.40** 1.000	**15.88** 0.625	**12.70** 0.500	**0.76** 0.030	**6.35** 0.250	**12.70** 0.500	-	**4.78** 0.188	**2.39** 0.094	7/16-20	CRSBCE-18
1 1/4	**12.700** 0.5000	**31.75** 1.250	**19.05** 0.750	**356** 14	**31.75** 1.250	**17.45** 0.687	**15.88** 0.625	**0.76** 0.030	**7.92** 0.312	**15.90** 0.630	-	**4.78** 0.188	**2.39** 0.094	1/2-20	CRSBCE-20
1 3/8	**12.700** 0.5000	**34.93** 1.375	**19.05** 0.750	**356** 14	**31.80** 1.250	**17.45** 0.687	**15.88** 0.625	**0.76** 0.030	**7.92** 0.312	**15.90** 0.630	-	**4.78** 0.188	**2.39** 0.094	1/2-20	CRSBCE-22
1 1/2	**15.880** 0.6250	**38.10** 1.500	**22.23** 0.875	**508** 20	**38.10** 1.500	**22.23** 0.875	**19.05** 0.750	**0.76** 0.030	**9.53** 0.375	**19.10** 0.750	-	**4.78** 0.188	**2.39** 0.094	5/8-18	CRSBCE-24
1 5/8	**15.880** 0.6250	**41.28** 1.625	**22.23** 0.875	**508** 20	**38.10** 1.500	**22.23** 0.875	**19.05** 0.750	**0.76** 0.030	**9.53** 0.375	**19.10** 0.750	-	**4.78** 0.188	**2.39** 0.094	5/8-18	CRSBCE-26
1 3/4	**19.050** 0.7500	**44.45** 1.750	**25.40** 1.000	**508** 20	**44.45** 1.750	**25.40** 1.000	**22.23** 0.875	**0.76** 0.030	**11.13** 0.438	**22.20** 0.880	-	**4.78** 0.188	**3.18** 0.125	3/4-16	CRSBCE-28

Load Rating					Speed Rating Grease	Mounting Dimensions				Clamping Torque	Approx Wt.
As a Bearing		As a Track Roller				d_b	$r_{as\ max}$	K_a	d_a		
Dynamic	Static	Dynamic		Static		Bore Dia. For Stud +0.050 +0.002 0 0	Max.	Min.	Min.		
C	C_0	C_w	$F_{r\ perm}$	$F_{0r\ perm}$							
kN lbf	kN lbf	kN lbf	kN lbf	kN lbf	min^{-1}	mm in	mm in	mm in	mm in	N-m lb-in	kg lbs
4.44 999	**4.94** 1110	**3.07** 690	**1.20** 269	**2.87** 645	7000	**6.400** 0.2520	**0.25** 0.010	**10.41** 0.410	**10.41** 0.410	**1.69** 15	**0.01** 0.02
4.89 1100	**5.60** 1260	**3.39** 762	**1.36** 305	**3.25** 731	7000	**6.400** 0.2520	**0.25** 0.010	**11.20** 0.441	**10.41** 0.410	**1.69** 15	**0.01** 0.02
6.05 1360	**7.87** 1770	**4.42** 994	**2.53** 569	**6.09** 1370	5500	**9.575** 0.3770	**0.38** 0.015	**12.80** 0.504	**11.73** 0.462	**3.95** 35	**0.02** 0.04
6.54 1470	**8.72** 1960	**4.76** 1070	**2.79** 628	**6.72** 1510	5500	**12.745** 0.5020	**0.38** 0.015	**14.38** 0.566	**15.47** 0.609	**3.95** 35	**0.02** 0.05
10.14 2280	**14.68** 3300	**6.27** 1410	**2.92** 656	**6.98** 1570	3800	**12.745** 0.5020	**0.38** 0.015	**14.38** 0.566	**15.47** 0.609	**10.73** 95	**0.03** 0.08
10.14 2280	**14.68** 3300	**7.38** 1660	**4.94** 1110	**11.88** 2670	3800	**15.700** 0.6270	**0.76** 0.030	**17.55** 0.691	**19.84** 0.781	**10.73** 95	**0.04** 0.10
12.99 2920	**21.93** 4930	**8.41** 1890	**5.60** 1260	**13.43** 3020	2800	**15.700** 0.6270	**0.76** 0.030	**17.55** 0.691	**19.84** 0.781	**28.25** 250	**0.07** 0.16
12.99 2920	**21.93** 4930	**9.43** 2120	**8.18** 1840	**17.48** 3930	2800	**17.495** 0.6890	**0.76** 0.030	**20.73** 0.816	**24.99** 0.984	**28.25** 250	**0.09** 0.20
23.31 5240	**30.29** 6810	**16.06** 3610	**7.38** 1660	**17.75** 3990	2700	**17.495** 0.6890	**0.76** 0.030	**20.73** 0.816	**24.99** 0.984	**39.55** 350	**0.14** 0.30
23.31 5240	**30.29** 6810	**17.66** 3970	**10.45** 2350	**25.04** 5630	2700	**22.275** 0.8770	**0.76** 0.030	**23.90** 0.941	**27.79** 1.094	**39.55** 350	**0.16** 0.35
28.16 6330	**40.26** 9050	**20.15** 4530	**11.97** 2690	**28.74** 6460	2700	**22.275** 0.8770	**0.76** 0.030	**23.90** 0.941	**27.79** 1.094	**73.45** 650	**0.24** 0.53
28.16 6330	**40.26** 9050	**21.62** 4860	**15.66** 3520	**36.08** 8110	2300	**25.445** 1.0020	**1.02** 0.040	**27.08** 1.066	**31.75** 1.250	**73.45** 650	**0.27** 0.61

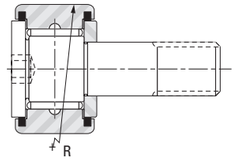
Continued on next page.

(1) UNS instead of UNF threads.
Furnished with lubrication hole in head end of stud and lubrication fitting installed below bottom of hex wrench socket.

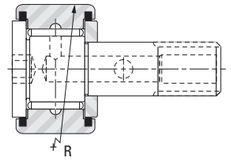
STUD-TYPE TRACK ROLLERS
CRSBCE SERIES
INCH SERIES

- Non-separable, sealed unit with outer ring, full complement of needle rollers, stud seals, self-lubricating resin internal thrust washers and stud-fastened retaining washer.
- Seals help retain lubricant and exclude foreign matter (CRS Series).
- Hexagonal wrench socket in stud head for mounting.
- Re-lubrication via axially drilled hole through stud with cross-drilled holes in stud raceway and shank.
- Recessed axial hole accepts standard nominal inch drive-type grease lubrication fitting.
- Lubrication fitting plugs furnished to close off unused holes.
- Crowned outer ring to support uneven bearing load.
- Eccentric stud for radial adjustment of outer ring.
- Tolerance limits for outer diameters of stud and outer ring refer to "single mean diameter."
- A close fit between stud and hole required for mounting.
- Retaining washer should be firmly backed up by flat housing shoulder (perpendicular to the stud axis).
- Shoulder diameter should be at least same size as minimum clamping diameter listed.
- May be mounted with two thin lock nuts, or nut and lock washer.

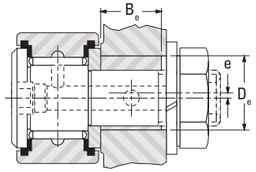
For hexagonal wrench sizes, see page B-5-30.



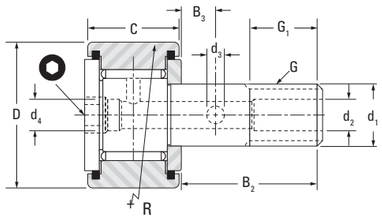
CRSBCE -8 to -10-1



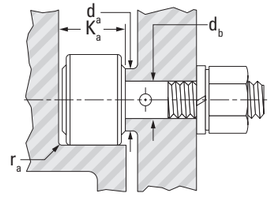
CRSBCE -24 to -44



Eccentric studs



CRSBCE -12 to -22
CRSBCE -48 to -64



NOTE

Clamping torque is based on lubricated threads. If threads are dry, the torque values listed below may be doubled.

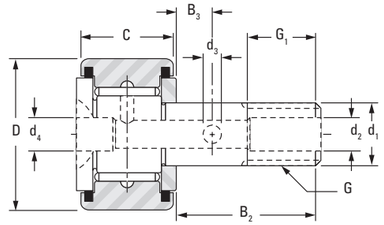
Outer Dia.	d_1	D	C	R	B_2	Eccentric Bushing			B_3	G_1	d_4	d_2	d_3	G	Bearing Designation
						De	Be	e							
						Bushing OD	Bushing width	Eccentricity							
						±0.025 ±0.001	±0.025 ±0.001	(nom.)							
in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	in	
1 7/8	**19.050** 0.7500	**47.63** 1.875	**25.40** 1.000	**508** 20	**44.45** 1.750	**25.40** 1.000	**22.23** 0.875	**0.76** 0.030	**11.13** 0.438	**22.20** 0.880	-	**4.78** 0.188	**3.18** 0.125	3/4-16	CRSBCE-30
2	**22.230** 0.8750	**50.80** 2.000	**31.75** 1.250	**610** 24	**50.80** 2.000	**30.15** 1.187	**25.40** 1.000	**0.76** 0.030	**12.70** 0.500	**25.40** 1.000	-	**4.78** 0.188	**3.18** 0.125	7/8-14	CRSBCE-32
2 1/4	**22.230** 0.8750	**57.15** 2.250	**31.75** 1.250	**610** 24	**50.80** 2.000	**30.15** 1.187	**25.40** 1.000	**0.76** 0.030	**12.70** 0.500	**25.40** 1.000	-	**4.78** 0.188	**3.18** 0.125	7/8-14	CRSBCE-36
2 1/2	**25.400** 1.0000	**63.50** 2.500	**38.10** 1.500	**762** 30	**57.20** 2.250	**34.93** 1.375	**28.58** 1.125	**0.76** 0.030	**14.27** 0.562	**28.57** 1.125	-	**4.78** 0.188	**3.18** 0.125	1-14[1]	CRSBCE-40
2 3/4	**25.400** 1.0000	**69.85** 2.750	**38.10** 1.500	**762** 30	**57.20** 2.250	**34.93** 1.375	**28.58** 1.125	**0.76** 0.030	**14.27** 0.562	**28.57** 1.125	-	**4.78** 0.188	**3.18** 0.125	1-14[1]	CRSBCE-44
3	**31.750** 1.2500	**76.20** 3.000	**44.45** 1.750	**762** 30	**63.50** 2.500	**44.45** 1.750	**31.75** 1.250	**0.52** 0.060	**15.88** 0.625	**31.75** 1.250	**6.35** 0.250	**6.35** 0.250	**3.18** 0.125	1 1/4-12	CRSBCE-48

Load Rating					Speed Rating Grease	Mounting Dimensions				Clamping Torque	Approx Wt.
As a Bearing		As a Track Roller				d_b	$r_{as\ max}$	K_a	d_a		
Dynamic	Static	Dynamic		Static		Bore Dia. For Stud +0.050 +0.002 0 0	Max.	Min.	Min.		
C	C_0	C_w	$F_{r\ perm}$	$F_{0r\ perm}$							
kN lbf	kN lbf	kN lbf	kN lbf	kN lbf	min^{-1}	mm in	mm in	mm in	mm in	N-m lb-in	kg lbs
35.50 7980	**56.49** 12700	**25.93** 5830	**19.04** 4280	**45.82** 10300	1900	**25.445** 1.0020	**1.02** 0.040	**27.08** 1.066	**31.75** 1.250	**141.25** 1250	**0.38** 0.85
35.50 7980	**56.49** 12700	**27.40** 6160	**23.66** 5320	**51.15** 11500	1900	**30.195** 1.1890	**1.27** 0.050	**33.43** 1.316	**35.71** 1.406	**141.25** 1250	**0.43** 0.95
43.19 9710	**75.62** 17000	**31.89** 7170	**28.11** 6320	**62.72** 14100	1700	**30.195** 1.1890	**1.27** 0.050	**33.43** 1.316	**35.71** 1.406	**169.5** 1500	**0.62** 1.37
43.19 9710	**75.62** 17000	**34.70** 7800	**39.86** 8960	**73.40** 16500	1700	**34.975** 1.3770	**2.29** 0.090	**39.78** 1.566	**42.88** 1.688	**169.5** 1500	**0.76** 1.67
58.27 13100	**117.43** 26400	**44.48** 10000	**54.71** 12300	**104.09** 23400	1400	**34.975** 1.3770	**2.29** 0.090	**39.78** 1.566	**42.88** 1.688	**254.25** 2250	**1.14** 2.50
58.27 13100	**117.43** 26400	**47.15** 10600	**71.17** 16000	**116.54** 26200	1400	**44.495** 1.7520	**2.29** 0.090	**46.13** 1.816	**53.98** 2.125	**254.25** 2250	**1.33** 2.93

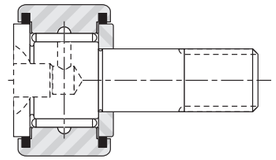
[1] UNS instead of UNF threads.
Furnished with lubrication hole in head end of stud and lubrication fitting installed below bottom of hex wrench socket.

STUD-TYPE TRACK ROLLERS
CRH, CRHS SERIES
INCH SERIES

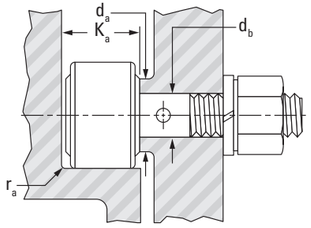
- Screwdriver slot in head facilitates mounting.
- Non-separable, sealed unit with outer ring, full complement of needle rollers, stud seals, self-lubricating resin internal thrust washers, and stud-fastened retaining washer.
- Seals help retain lubricant and exclude foreign matter (CRS Series).
- Re-lubrication via axially drilled hole through stud with cross-drilled holes in stud raceway and shank.
- Recessed axial hole accepts standard nominal inch drive-type grease lubrication fitting.
- Lubrication fitting plugs furnished to close off unused holes.
- Large diameter heavy-duty stud.
- Tolerance limits for outer diameters of stud and outer ring refer to “single mean diameter.”
- A close fit between stud and hole required for mounting.
- Bore dimensions given below result in varying fit (0.025 mm tight to 0.013 mm loose [0.0010 in. tight to 0.0005 in. loose]).
- Retaining washer should be firmly backed up by flat housing shoulder (perpendicular to the stud axis).
- Shoulder diameter should be at least same size as minimum clamping diameter listed.
- May be mounted with two thin lock nuts, or nut and lock washer.



CRH and CRHS -12 to -64



CRH and CRHS -8-1 to -10-1



NOTE

Clamping torque is based on lubricated threads. If threads are dry, the torque values listed below may be doubled.

Outer Dia.	d_1	D	C	B_2	B_3	G_1	d_2 and d_4	d_3	G	Track Roller Designation	
	+0.025 +0.001 0 0	0 0 -0.025 -0.001	0 0 -0.13 -0.005	(nom.)		Min.			UNF	Without Seals	With Seals and Internal Thrust Washers
in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	in		
1/2	**6.350** 0.2500	**12.70** 0.500	**9.53** 0.375	**15.88** 0.625	-	**6.35** 0.250	**3.18**[1][2] 0.125	-	1/4-28	CRH-8-1	CRHS-8-1
5/8	**7.940** 0.3125	**15.88** 0.625	**11.11** 0.438	**19.10** 0.750	-	**7.90** 0.310	**3.18**[1][2] 0.125	-	5/16-24	CRH-10-1	CRHS-10-1
3/4	**11.110** 0.4375	**19.05** 0.750	**12.70** 0.500	**22.20** 0.880	**6.35** 0.250	**9.50** 0.380	**4.78** 0.188	**2.39** 0.094	7/16-20	CRH-12	CRHS-12
7/8	**11.110** 0.4375	**22.23** 0.875	**12.70** 0.500	**22.20** 0.880	**6.35** 0.250	**9.50** 0.380	**4.78** 0.188	**2.39** 0.094	7/16-20	CRH-14	CRHS-14
1	**15.880** 0.6250	**25.40** 1.000	**15.88** 0.625	**25.40** 1.000	**6.35** 0.250	**12.70** 0.500	**4.78** 0.188	**2.39** 0.094	5/8-18	CRH-16	CRHS-16
1 1/8	**15.880** 0.6250	**28.58** 1.125	**15.88** 0.625	**25.40** 1.000	**6.35** 0.250	**12.70** 0.500	**4.78** 0.188	**2.39** 0.094	5/8-18	CRH-18	CRHS-18
1 1/4	**19.050** 0.7500	**31.75** 1.250	**19.05** 0.750	**31.75** 1.250	**7.92** 0.312	**15.90** 0.630	**4.78** 0.188	**2.39** 0.094	3/4-16	CRH-20	CRHS-20
1 3/8	**19.050** 0.7500	**34.93** 1.375	**19.05** 0.750	**31.80** 1.250	**7.92** 0.312	**15.90** 0.630	**4.78** 0.188	**2.39** 0.094	3/4-16	CRH-22	CRHS-22
1 1/2	**22.230** 0.8750	**38.10** 1.500	**22.23** 0.875	**38.10** 1.500	**9.53** 0.375	**19.10** 0.750	**4.78** 0.188	**2.39** 0.094	7/8-14	CRH-24	CRHS-24
1 5/8	**22.230** 0.8750	**41.28** 1.625	**22.23** 0.875	**38.10** 1.500	**9.53** 0.375	**19.10** 0.750	**4.78** 0.188	**2.39** 0.094	7/8-14	CRH-26	CRHS-26
1 3/4	**25.400** 1.0000	**44.45** 1.750	**25.40** 1.000	**44.45** 1.750	**11.13** 0.438	**22.20** 0.880	**4.78** 0.188	**3.18** 0.125	1-14[3]	CRH-28	CRHS-28
1 7/8	**25.400** 1.0000	**47.63** 1.875	**25.40** 1.000	**44.45** 1.750	**11.13** 0.438	**22.20** 0.880	**4.78** 0.188	**3.18** 0.125	1-14[3]	CRH-30	CRHS-30
2	**28.580** 1.1250	**50.80** 2.000	**31.75** 1.250	**50.80** 2.000	**12.70** 0.500	**25.40** 1.000	**4.78** 0.188	**3.18** 0.125	1 1/8-12	CRH-32	CRHS-32

Load Rating					Speed Rating Grease	Mounting Dimensions				Clamping Torque	Approx Wt.
As a Bearing		As a Track Roller				d_b	$r_{as\ max}$	K_a	d_a		
Dynamic	Static	Dynamic		Static		Bore Dia. For Stud +0.013 +0.005 0 0	Max.	Min.	Min.		
C	C_0	C_w	$F_{r\ perm}$	$F_{0r\ perm}$							
kN lbf	kN lbf	kN lbf	kN lbf	kN lbf	min^{-1}	mm in	mm in	mm in	mm in	N-m lb-in	kg lbs
4.89 1100	**5.60** 1260	**3.39** 762	**1.36** 305	**3.25** 731	7000	**6.350** 0.2500	**0.25** 0.010	**11.20** 0.44	**10.41** 0.410	**3.96** 35	**0.02** 0.04
6.54 1470	**8.72** 1960	**4.76** 1070	**2.79** 628	**6.72** 1510	5500	**7.938** 0.3125	**0.38** 0.015	**12.80** 0.50	**11.73** 0.462	**10.17** 90	**0.02** 0.05
10.14 2280	**14.68** 3300	**6.27** 1410	**2.92** 656	**6.98** 1570	3800	**11.112** 0.4375	**0.38** 0.015	**14.38** 0.57	**15.47** 0.609	**28.25** 250	**0.04** 0.08
10.14 2280	**14.68** 3300	**7.38** 1660	**4.94** 1110	**11.88** 2670	3800	**11.112** 0.4375	**0.38** 0.015	**14.38** 0.57	**15.47** 0.609	**28.25** 250	**0.05** 0.11
12.99 2920	**21.93** 4930	**8.41** 1890	**5.60** 1260	**13.43** 3020	2800	**15.875** 0.6250	**0.76** 0.030	**17.55** 0.69	**19.84** 0.781	**73.45** 650	**0.09** 0.20
12.99 2920	**21.93** 4930	**9.43** 2120	**8.18** 1840	**17.48** 3930	2800	**15.875** 0.6250	**0.76** 0.030	**17.55** 0.69	**19.84** 0.781	**73.45** 650	**0.11** 0.24
21.04 4730	**33.27** 7480	**13.88** 3120	**8.27** 1860	**19.79** 4450	2400	**19.050** 0.7500	**0.76** 0.030	**20.73** 0.82	**24.99** 0.984	**141.25** 1250	**0.17** 0.38
21.04 4730	**33.27** 7480	**15.26** 3430	**11.39** 2560	**26.56** 5970	2400	**19.050** 0.7500	**0.76** 0.030	**20.73** 0.82	**24.99** 0.984	**141.25** 1250	**0.20** 0.44
24.64 5540	**42.61** 9580	**16.95** 3810	**13.12** 2950	**30.83** 6930	2000	**22.225** 0.8750	**0.76** 0.030	**23.90** 0.94	**27.79** 1.094	**169.5** 1500	**0.31** 0.69
24.64 5540	**42.61** 9580	**18.19** 4090	**16.95** 3810	**35.27** 7930	2000	**22.225** 0.8750	**0.76** 0.030	**23.90** 0.94	**27.79** 1.094	**169.5** 1500	**0.34** 0.75
30.87 6940	**59.16** 13300	**21.66** 4870	**20.73** 4660	**44.48** 10000	1700	**25.400** 1.0000	**1.02** 0.040	**27.08** 1.07	**31.75** 1.250	**254.25** 2250	**0.45** 1.00
30.87 6940	**59.16** 13300	**22.91** 5150	**25.58** 5750	**49.38** 11100	1700	**25.400** 1.0000	**1.02** 0.040	**27.08** 1.07	**31.75** 1.250	**254.25** 2250	**0.52** 1.15
38.25 8600	**81.40** 18300	**27.05** 6080	**30.87** 6940	**61.83** 13900	1500	**28.575** 1.1250	**1.27** 0.050	**33.43** 1.32	**35.71** 1.406	**316.4** 2800	**0.71** 1.56

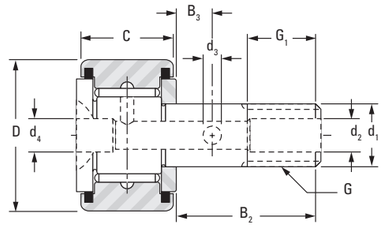
[1] No lubrication hole in threaded end.
[2] Oil hole (d_4) only.
[3] UNS instead of UNF threads.

Continued on next page.

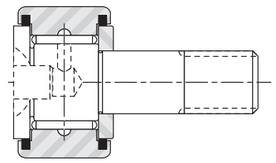
B

STUD-TYPE TRACK ROLLERS
CRH, CRHS SERIES
INCH SERIES

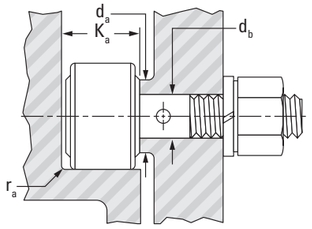
- Screwdriver slot in head facilitates mounting.
- Non-separable, sealed unit with outer ring, full complement of needle rollers, stud seals, self-lubricating resin internal thrust washers, and stud-fastened retaining washer.
- Seals help retain lubricant and exclude foreign matter (CRS Series).
- Re-lubrication via axially drilled hole through stud with cross-drilled holes in stud raceway and shank.
- Recessed axial hole accepts standard nominal inch drive-type grease lubrication fitting.
- Lubrication fitting plugs furnished to close off unused holes.
- Large diameter heavy-duty stud.
- Tolerance limits for outer diameters of stud and outer ring refer to “single mean diameter.”
- A close fit between stud and hole required for mounting.
- Bore dimensions given below result in varying fit (0.025 mm tight to 0.013 mm loose [0.0010 in. tight to 0.0005 in. loose]).
- Retaining washer should be firmly backed up by flat housing shoulder (perpendicular to the stud axis).
- Shoulder diameter should be at least same size as minimum clamping diameter listed.
- May be mounted with two thin lock nuts, or nut and lock washer.



CRH and CRHS -12 to -64



CRH and CRHS -8-1 to -10-1



NOTE

Clamping torque is based on lubricated threads. If threads are dry, the torque values listed below may be doubled.

Outer Dia.	d_1	D	C	B_2	B_3	G_1	d_2 and d_4	d_3	G	Track Roller Designation	
	+0.025 +0.001 0 0	0 0 -0.025 -0.001	0 0 -0.13 -0.005	(nom.)		Min.			UNF	Without Seals	With Seals and Internal Thrust Washers
in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	in		
2 1/4	28.580 1.1250	57.15 2.250	31.75 1.250	50.80 2.000	12.70 0.500	25.40 1.000	4.78 0.188	3.18 0.125	1 1/8-12	CRH-36	CRHS-36
2 1/2	31.750 1.2500	63.50 2.500	38.10 1.500	57.20 2.250	14.27 0.562	28.58 1.125	4.78 0.188	3.18 0.125	1 1/4-12	CRH-40	CRHS-40
2 3/4	31.750 1.2500	69.85 2.750	38.10 1.500	57.20 2.250	14.27 0.562	28.57 1.125	4.78 0.188	3.18 0.125	1 1/4-12	CRH-44	CRHS-44
3	38.100 1.5000	76.20 3.000	44.45 1.750	63.50 2.500	15.88 0.625	31.75 1.250	6.35 0.250	3.18 0.125	1 1/2-12	CRH-48	CRHS-48
3 1/4	38.100 1.5000	82.55 3.250	44.45 1.750	63.50 2.500	15.88 0.625	31.75 1.250	6.35 0.250	3.18 0.125	1 1/2-12	CRH-52	CRHS-52
3 1/2	44.450 1.7500	88.90 3.500	50.80 2.000	69.90 2.750	17.48 0.688	34.93 1.375	6.35 0.250	3.18 0.125	1 3/4-12	CRH-56	CRHS-56
4	50.800 2.0000	101.60 4.000	57.15 2.250	88.90 3.500	19.05 0.750	38.10 1.500	6.35 0.250	3.18 0.125	2/12	CRH-64	CRHS-64

Load Rating					Speed Rating Grease	Mounting Dimensions				Clamping Torque	Approx Wt.
As a Bearing		As a Track Roller				d_b	$r_{as\ max}$	K_a	d_a		
Dynamic	Static	Dynamic		Static		Bore Dia. For Stud +0.013 +0.005 0 0	Max.	Min.	Min.		
C	C_0	C_w	$F_{r\ perm}$	$F_{0r\ perm}$							
kN lbf	kN lbf	kN lbf	kN lbf	kN lbf	min^{-1}	mm in	mm in	mm in	mm in	N-m lb-in	kg lbs
38.25 8600	81.40 18300	29.40 6610	43.10 9690	72.51 16300	1500	28.575 1.1250	1.27 0.050	33.43 1.32	35.71 1.406	316.4 2800	0.85 1.88
58.27 13100	117.43 26400	44.48 10000	54.71 12300	104.09 23400	1400	31.750 1.2500	2.29 0.090	39.78 1.57	42.88 1.688	389.85 3450	1.25 2.75
58.27 13100	117.43 26400	47.15 10600	71.17 16000	116.54 26200	1400	31.750 1.2500	2.29 0.090	39.78 1.57	42.88 1.688	389.85 3450	1.45 3.19
74.29 16700	177.93 40000	51.60 11600	68.50 15400	131.22 29500	990	38.100 1.5000	2.29 0.090	46.13 1.82	53.98 2.125	565 5000	2.07 4.56
74.29 16700	177.93 40000	54.71 12300	85.85 19300	147.24 33100	990	38.100 1.5000	2.29 0.090	46.13 1.82	53.98 2.125	565 5000	2.36 5.19
109.87 24700	225.52 50700	82.29 18500	94.75 21300	191.27 43000	950	44.450 1.7500	2.29 0.090	52.48 2.07	61.93 2.438	565 5000	3.18 7.01
137.89 31000	319.38 71800	98.75 22200	125.88 28300	250.43 56300	780	50.800 2.0000	2.29 0.090	58.83 2.32	71.04 2.797	565 5000	2.23 4.91

(1) No lubrication hole in threaded end.
(2) Oil hole (d_4) only.
(3) UNS instead of UNF threads.

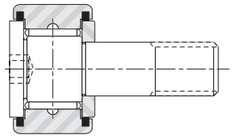
STUD-TYPE TRACK ROLLERS
CRHB,CRHSB SERIES
INCH SERIES

- Non-separable, sealed unit with outer ring, full complement of needle rollers, stud seals, self-lubricating resin internal thrust washers and stud-fastened retaining washer.
- Seals help retain lubricant and exclude foreign matter (CRS Series).
- Hexagonal wrench socket in stud head for mounting.
- Re-lubrication via axially drilled hole through stud with cross-drilled holes in stud raceway and shank.
- Recessed axial hole accepts standard nominal inch drive-type grease lubrication fitting.
- Lubrication fitting plugs furnished to close off unused holes.
- Large diameter heavy-duty stud.
- Tolerance limits for outer diameters of stud and outer ring refer to “single mean diameter.”
- A close fit between stud and hole required for mounting.
- Bore dimensions given below result in varying fit (0.025 mm tight to 0.013 mm loose [0.0010 in. tight to 0.0005 in. loose]).
- Retaining washer should be firmly backed up by flat housing shoulder (perpendicular to the stud axis).
- Shoulder diameter should be at least same size as minimum clamping diameter listed.
- May be mounted with two thin lock nuts, or nut and lock washer.

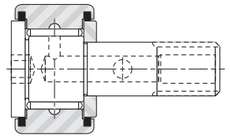
Outer Dia.	d_1	D	C	B_2	B_3	G_1	d_4	d_2	d_3	G	Track Roller Designation	
	+0.025 +0.001 0 0	0 0 -0.025 -0.001	0 0 -0.13 -0.005	(nom.)		Min.				UNF	Without Seals	With Seals and Internal Thrust Washers
in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	in		
1/2	6.350 0.2500	12.70 0.500	9.53 0.375	15.88 0.625	-	6.35 0.250	-	-	-	1/4-28	CRHB-8-1	CRHSB-8-1
5/8	7.940 0.3125	15.88 0.625	11.11 0.438	19.10 0.750	-	7.90 0.310	-	-	-	5/16-24	CRHB-10-1	CRHSB-10-1
3/4	11.110 0.4375	19.05 0.750	12.70 0.500	22.20 0.880	6.35 0.250	9.50 0.380	-	4.78 0.188	2.39 0.094	7/16-20	CRHB-12	CRHSB-12
7/8	11.110 0.4375	22.23 0.875	12.70 0.500	22.20 0.880	6.35 0.250	9.50 0.380	-	4.78 0.188	2.39 0.094	7/16-20	CRHB-14	CRHSB-14
1	15.880 0.6250	25.40 1.000	15.88 0.625	25.40 1.000	6.35 0.250	12.70 0.500	-	4.78 0.188	2.39 0.094	5/8-18	CRHB-16	CRHSB-16
1 1/8	15.880 0.6250	28.58 1.125	15.88 0.625	25.40 1.000	6.35 0.250	12.70 0.500	-	4.78 0.188	2.39 0.094	5/8-18	CRHB-18	CRHSB-18
1 1/4	19.050 0.7500	31.75 1.250	19.05 0.750	31.75 1.250	7.92 0.312	15.90 0.630	-	4.78 0.188	2.39 0.094	3/4-16	CRHB-20	CRHSB-20
1 3/8	19.050 0.7500	34.93 1.375	19.05 0.750	31.80 1.250	7.92 0.312	15.90 0.630	-	4.78 0.188	2.39 0.094	3/4-16	CRHB-22	CRHSB-22
1 1/2	22.230 0.8750	38.10 1.500	22.23 0.875	38.10 1.500	9.53 0.375	19.10 0.750	-	4.78 0.188	2.39 0.094	7/8-14	CRHB-24	CRHSB-24
1 5/8	22.230 0.8750	41.28 1.625	22.23 0.875	38.10 1.500	9.53 0.375	19.10 0.750	-	4.78 0.188	2.39 0.094	7/8-14	CRHB-26	CRHSB-26
1 3/4	25.400 1.0000	44.45 1.750	25.40 1.000	44.45 1.750	11.13 0.438	22.20 0.880	-	4.78 0.188	3.18 0.125	1-14[1]	CRHB-28	CRHSB-28
1 7/8	25.400 1.0000	47.63 1.875	25.40 1.000	44.45 1.750	11.13 0.438	22.20 0.880	-	4.78 0.188	3.18 0.125	1-14[1]	CRHB-30	CRHSB-30

[1] UNS instead of UNF threads.
Furnished with lubrication hole in head end of stud and lubrication fitting installed below bottom of hex wrench socket.

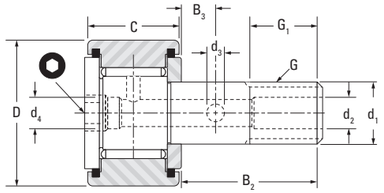
For hexagonal wrench sizes, see page B-5-30.



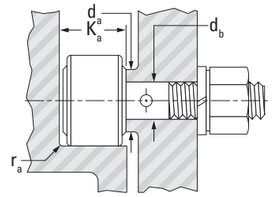
CRHB and CRHSB -8-1 to -10-1



CRHB and CRHSB -24 to -44



CRHB and CRHSB -12 to -22
CRHB and CRHSB -48 to -64



NOTE
Clamping torque is based on lubricated threads. If threads are dry, the torque values listed below may be doubled.

Load Rating					Speed Rating Grease	Mounting Dimensions				Clamping Torque	Approx Wt.
As a Bearing		As a Track Roller				d_b	$r_{as\ max}$	K_a	d_a		
Dynamic	Static	Dynamic		Static		Bore Dia. For Stud +0.013 +0.0005 0 0					
C	C_0	C_w	$F_{r\ perm}$	$F_{0r\ perm}$			Max.	Min.	Min.		
kN lbf	kN lbf	kN lbf	kN lbf	kN lbf	min^{-1}	mm in	mm in	mm in	mm in	N-m lb-in	kg lbs
4.89 1100	5.60 1260	3.39 762	1.36 305	3.25 731	7000	6.350 0.2500	0.25 0.010	11.2 0.44	10.41 0.410	3.96 35	0.02 0.04
6.54 1470	8.72 1960	4.76 1070	2.79 628	6.72 1510	5500	7.938 0.3125	0.38 0.015	12.8 0.50	11.73 0.462	10.17 90	0.02 0.05
10.14 2280	14.68 3300	6.27 1410	2.92 656	6.98 1570	3800	11.112 0.4375	0.38 0.015	14.4 0.57	15.47 0.609	28.25 250	0.04 0.08
10.14 2280	14.68 3300	7.38 1660	4.94 1110	11.88 2670	3800	11.112 0.4375	0.38 0.015	14.4 0.57	15.47 0.609	28.25 250	0.05 0.11
12.99 2920	21.93 4930	8.41 1890	5.60 1260	13.43 3020	2800	15.875 0.6250	0.76 0.030	17.6 0.69	19.84 0.781	73.45 650	0.09 0.20
12.99 2920	21.93 4930	9.43 2120	8.18 1840	17.48 3930	2800	15.875 0.6250	0.76 0.030	17.6 0.69	19.84 0.781	73.45 650	0.11 0.24
21.04 4730	33.27 7480	13.88 3120	8.27 1860	19.79 4450	2400	19.050 0.7500	0.76 0.030	20.7 0.82	24.99 0.984	141.25 1250	0.17 0.38
21.04 4730	33.27 7480	15.26 3430	11.39 2560	26.56 5970	2400	19.050 0.7500	0.76 0.030	20.7 0.82	24.99 0.984	141.25 1250	0.20 0.44
24.64 5540	42.61 9580	16.95 3810	13.12 2950	30.83 6930	2000	22.225 0.8750	0.76 0.030	23.9 0.94	27.79 1.094	169.5 1500	0.31 0.69
24.64 5540	42.61 9580	18.19 4090	16.95 3810	35.27 7930	2000	22.225 0.8750	0.76 0.030	23.9 0.94	27.79 1.094	169.5 1500	0.34 0.75
30.87 6940	59.16 13300	21.66 4870	20.73 4660	44.48 10000	1700	25.400 1.0000	1.02 0.040	27.1 1.07	31.75 1.250	254.25 2250	0.45 1.00
30.87 6940	59.16 13300	22.91 5150	25.58 5750	49.38 11100	1700	25.400 1.0000	1.02 0.040	27.1 1.07	31.75 1.250	254.25 2250	0.52 1.15

Continued on next page.

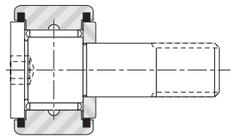
STUD-TYPE TRACK ROLLERS
CRHB,CRHSB SERIES
INCH SERIES

- Non-separable, sealed unit with outer ring, full complement of needle rollers, stud seals, self-lubricating resin internal thrust washers and stud-fastened retaining washer.
- Seals help retain lubricant and exclude foreign matter (CRS Series).
- Hexagonal wrench socket in stud head for mounting.
- Re-lubrication via axially drilled hole through stud with cross-drilled holes in stud raceway and shank.
- Recessed axial hole accepts standard nominal inch drive-type grease lubrication fitting.
- Lubrication fitting plugs furnished to close off unused holes.
- Large diameter heavy-duty stud.
- Tolerance limits for outer diameters of stud and outer ring refer to "single mean diameter."
- A close fit between stud and hole required for mounting.
- Bore dimensions given below result in varying fit (0.025 mm tight to 0.013 mm loose [0.0010 in. tight to 0.0005 in. loose]).
- Retaining washer should be firmly backed up by flat housing shoulder (perpendicular to the stud axis).
- Shoulder diameter should be at least same size as minimum clamping diameter listed.
- May be mounted with two thin lock nuts, or nut and lock washer.

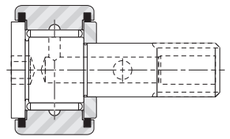
Outer Dia.	d_1	D	C	B_2	B_3	G_1	d_4	d_2	d_3	G	Track Roller Designation	
											Without Seals	With Seals and Internal Thrust Washers
in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	in		
2	**28.580** 1.1250	**50.80** 2.000	**31.75** 1.250	**50.80** 2.000	**12.70** 0.500	**25.40** 1.000	-	**4.78** 0.188	**3.18** 0.125	1 1/8-12	CRHB-32	CRHSB-32
2 1/4	**28.580** 1.1250	**57.15** 2.250	**31.75** 1.250	**50.80** 2.000	**12.70** 0.500	**25.40** 1.000	-	**4.78** 0.188	**3.18** 0.125	1 1/8-12	CRHB-36	CRHSB-36
2 1/2	**31.750** 1.2500	**63.50** 2.500	**38.10** 1.500	**57.20** 2.250	**14.27** 0.562	**28.58** 1.125	-	**4.78** 0.188	**3.18** 0.125	1 1/4-12	CRHB-40	CRHSB-40
2 3/4	**31.750** 1.2500	**69.85** 2.750	**38.10** 1.500	**57.20** 2.250	**14.27** 0.562	**28.57** 1.125	-	**4.78** 0.188	**3.18** 0.125	1 1/4-12	CRHB-44	CRHSB-44
3	**38.100** 1.5000	**76.20** 3.000	**44.45** 1.750	**63.50** 2.500	**15.88** 0.625	**31.75** 1.250	**6.35** 0.250	**6.35** 0.250	**3.18** 0.125	1 1/2-12	CRHB-48	CRHSB-48
3 1/4	**38.100** 1.5000	**82.55** 3.250	**44.45** 1.750	**63.50** 2.500	**15.88** 0.625	**31.75** 1.250	**6.35** 0.250	**6.35** 0.250	**3.18** 0.125	1 1/2-12	CRHB-52	CRHSB-52
3 1/2	**44.450** 1.7500	**88.90** 3.500	**50.80** 2.000	**69.90** 2.750	**17.48** 0.688	**34.93** 1.375	**6.35** 0.250	**6.35** 0.250	**3.18** 0.125	1 3/4-12	CRHB-56	CRHSB-56
4	**50.800** 2.0000	**101.60** 4.000	**57.15** 2.250	**88.90** 3.500	**19.05** 0.750	**38.10** 1.500	**6.35** 0.250	**6.35** 0.250	**3.18** 0.125	2/12	CRHB-64	CRHSB-64

(1) UNS instead of UNF threads.
Furnished with lubrication hole in head end of stud and lubrication fitting installed below bottom of hex wrench socket.

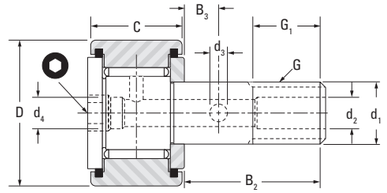
For hexagonal wrench sizes, see page B-5-30



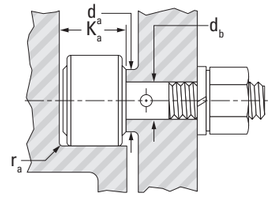
CRHB and CRHSB -8-1 to -10-1



CRHB and CRHSB -24 to -44



CRHB and CRHSB -12 to -22
CRHB and CRHSB -48 to -64



NOTE
Clamping torque is based on lubricated threads. If threads are dry, the torque values listed below may be doubled.

Load Rating					Speed Rating Grease	Mounting Dimensions				Clamping Torque	Approx Wt.
As a Bearing		As a Track Roller				d_b	$r_{as\ max}$	K_a	d_a		
Dynamic	Static	Dynamic		Static		Bore Dia. For Stud +0.013 +0.0005 0 0	Max.	Min.	Min.		
C	C_0	C_w	$F_{r\ perm}$	$F_{0r\ perm}$							
kN lbf	**kN** lbf	**kN** lbf	**kN** lbf	**kN** lbf	min^{-1}	**mm** in	**mm** in	**mm** in	**mm** in	**N-m** lb-in	**kg** lbs
38.25 8600	**81.40** 18300	**27.05** 6080	**30.87** 6940	**61.83** 13900	1500	**28.575** 1.1250	**1.27** 0.050	**33.4** 1.32	**35.71** 1.406	**316.4** 2800	**0.71** 1.56
38.25 8600	**81.40** 18300	**29.40** 6610	**43.10** 9690	**72.51** 16300	1500	**28.575** 1.1250	**1.27** 0.050	**33.4** 1.32	**35.71** 1.406	**316.4** 2800	**0.85** 1.88
58.27 13100	**117.43** 26400	**44.48** 10000	**54.71** 12300	**104.09** 23400	1400	**31.750** 1.2500	**2.29** 0.090	**39.8** 1.57	**42.88** 1.688	**389.85** 3450	**1.25** 2.75
58.27 13100	**117.43** 26400	**47.15** 10600	**71.17** 16000	**116.54** 26200	1400	**31.750** 1.2500	**2.29** 0.090	**39.8** 1.57	**42.88** 1.688	**389.85** 3450	**1.45** 3.19
74.29 16700	**177.93** 40000	**51.60** 11600	**68.50** 15400	**131.22** 29500	990	**38.100** 1.5000	**2.29** 0.090	**46.1** 1.82	**53.98** 2.125	**565** 5000	**2.07** 4.56
74.29 16700	**177.93** 40000	**54.71** 12300	**85.85** 19300	**147.24** 33100	990	**38.100** 1.5000	**2.29** 0.090	**46.1** 1.82	**53.98** 2.125	**565** 5000	**2.36** 5.19
109.87 24700	**225.52** 50700	**82.29** 18500	**94.75** 21300	**191.27** 43000	950	**44.450** 1.7500	**2.29** 0.090	**52.5** 2.07	**61.93** 2.438	**565** 5000	**3.18** 7.01
137.89 31000	**319.38** 71800	**98.75** 22200	**125.88** 28300	**250.43** 56300	780	**50.800** 2.0000	**2.29** 0.090	**58.8** 2.32	**71.04** 2.797	**565** 5000	**2.23** 4.91

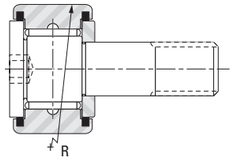
STUD-TYPE TRACK ROLLERS
CRHSBC SERIES
INCH SERIES

- Non-separable, sealed unit with outer ring, full complement of needle rollers, stud seals, self-lubricating resin internal thrust washers and stud-fastened retaining washer.
- Seals help retain lubricant and exclude foreign matter (CRS Series).
- Hexagonal wrench socket in stud head for mounting.
- Re-lubrication via axially drilled hole through stud with cross-drilled holes in stud raceway and shank.
- Recessed axial hole accepts standard nominal inch drive-type grease lubrication fitting.
- Lubrication fitting plugs furnished to close off unused holes.
- Crowned outer ring to support uneven bearing load.
- Large diameter heavy-duty stud.
- Tolerance limits for outer diameters of stud and outer ring refer to "single mean diameter."
- A close fit between stud and hole required for mounting.
- Bore dimensions given below result in varying fit (0.025 mm tight to 0.013 mm loose [0.0010 in. tight to 0.0005 in. loose]).
- Retaining washer should be firmly backed up by flat housing shoulder (perpendicular to the stud axis).
- Shoulder diameter should be at least same size as minimum clamping diameter listed.
- May be mounted with two thin lock nuts, or nut and lock washer.

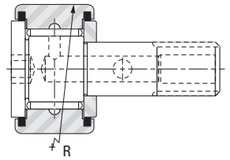
Outer Dia.	d_1	D	C	R	B_2	B_3	G_1	d_4	d_2	d_3	G	Bearing Designation
	+0.025 +0.001 **0** 0	**0** 0 **-0.025** -0.001	**0** 0 **-0.13** -0.005	Crown radius (approx.)	(nom.).		Min.				UNF	
in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	in	
1/2	**6.350** 0.2500	**12.70** 0.500	**9.53** 0.375	**178** 7	**15.88** 0.625	-	**6.35** 0.250	-	-	-	1/4-28	CRHSBC-8-1
5/8	**7.940** 0.3125	**15.88** 0.625	**11.11** 0.438	**203** 8	**19.10** 0.750	-	**7.90** 0.310	-	-	-	5/16-24	CRHSBC-10-1
3/4	**11.110** 0.4375	**19.05** 0.750	**12.7** 0.500	**254** 10	**22.20** 0.880	**6.35** 0.250	**9.50** 0.380	-	**4.78** 0.188	**2.39** 0.094	7/16-20	CRHSBC-12
7/8	**11.110** 0.4375	**22.23** 0.875	**12.70** 0.500	**254** 10	**22.20** 0.880	**6.35** 0.250	**9.50** 0.380	-	**4.78** 0.188	**2.39** 0.094	7/16-20	CRHSBC-14
1	**15.880** 0.6250	**25.40** 1.000	**15.88** 0.625	**305** 12	**25.40** 1.000	**6.35** 0.250	**12.70** 0.500	-	**4.78** 0.188	**2.39** 0.094	5/8-18	CRHSBC-16
1 1/8	**15.880** 0.6250	**28.58** 1.125	**15.88** 0.625	**305** 12	**25.40** 1.000	**6.35** 0.250	**12.70** 0.500	-	**4.78** 0.188	**2.39** 0.094	5/8-18	CRHSBC-18
1 1/4	**19.050** 0.7500	**31.75** 1.250	**19.05** 0.750	**356** 14	**31.75** 1.250	**7.92** 0.312	**15.90** 0.630	-	**4.78** 0.188	**2.39** 0.094	3/4-16	CRHSBC-20
1 3/8	**19.050** 0.7500	**34.93** 1.375	**19.05** 0.750	**356** 14	**31.80** 1.250	**7.92** 0.312	**15.90** 0.630	-	**4.78** 0.188	**2.39** 0.094	3/4-16	CRHSBC-22
1 1/2	**22.230** 0.8750	**38.10** 1.500	**22.23** 0.875	**508** 20	**38.10** 1.500	**9.53** 0.375	**19.10** 0.750	-	**4.78** 0.188	**2.39** 0.094	7/8-14	CRHSBC-24
1 5/8	**22.230** 0.8750	**41.28** 1.625	**22.23** 0.875	**508** 20	**38.10** 1.500	**9.53** 0.375	**19.10** 0.750	-	**4.78** 0.188	**2.39** 0.094	7/8-14	CRHSBC-26
1 3/4	**25.400** 1.0000	**44.45** 1.750	**25.40** 1.000	**508** 20	**44.45** 1.750	**11.13** 0.438	**22.20** 0.880	-	**4.775** 0.188	**3.18** 0.125	1-14[1]	CRHSBC-28
1 7/8	**25.400** 1.0000	**47.63** 1.875	**25.40** 1.000	**508** 20	**44.45** 1.750	**11.13** 0.438	**22.20** 0.880	-	**4.78** 0.188	**3.18** 0.125	1-14[1]	CRHSBC-30

[1] UNS instead of UNF threads.
Furnished with lubrication hole in head end of stud and lubrication fitting installed below bottom of hex wrench socket.

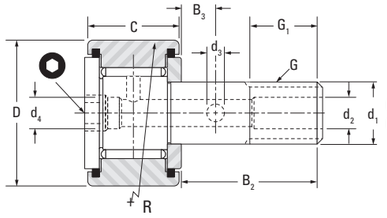
For hexagonal wrench sizes, see page B-5-30.



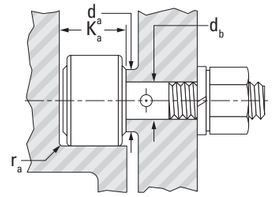
CRHSBC -8-1 to -10-1



CRHSBC -24 to -44



CRHSBC -12 to -22
CRHSBC -48 to -64



NOTE
Clamping torque is based on lubricated threads. If threads are dry, the torque values listed below may be doubled.

Load Rating					Speed Rating Grease	Mounting Dimensions				Clamping Torque	Approx Wt.
As a Bearing		As a Track Roller				d_b	$r_{as\ max}$	K_a	d_a		
Dynamic	Static	Dynamic		Static		Bore Dia. For Stud **+0.013** +0.0005 **0** 0					
C	C_0	C_w	$F_{r\ perm}$	$F_{0r\ perm}$		Max.	Min.	Min.			
kN lbf	**kN** lbf	**kN** lbf	**kN** lbf	**kN** lbf	min^{-1}	**mm** in	**mm** in	**mm** in	**mm** in	**N-m** lb-in	**kg** lbs
4.89 1100	**5.60** 1260	**3.39** 762	**1.36** 305	**3.25** 731	7000	**6.350** 0.2500	**0.25** 0.010	**11.2** 0.44	**10.41** 0.410	**3.96** 35	**0.02** 0.04
6.54 1470	**8.72** 1960	**4.76** 1070	**2.79** 628	**6.72** 1510	5500	**7.938** 0.3125	**0.38** 0.015	**12.8** 0.50	**11.73** 0.462	**10.17** 90	**0.02** 0.05
10.14 2280	**14.68** 3300	**6.27** 1410	**2.92** 656	**6.98** 1570	3800	**11.112** 0.4375	**0.38** 0.015	**14.4** 0.57	**15.47** 0.609	**28.25** 250	**0.04** 0.08
10.14 2280	**14.68** 3300	**7.38** 1660	**4.94** 1110	**11.88** 2670	3800	**11.112** 0.4375	**0.38** 0.015	**14.4** 0.57	**15.47** 0.609	**28.25** 250	**0.05** 0.11
12.99 2920	**21.93** 4930	**8.41** 1890	**5.60** 1260	**13.43** 3020	2800	**15.875** 0.6250	**0.76** 0.030	**17.6** 0.69	**19.84** 0.781	**73.45** 650	**0.09** 0.20
12.99 2920	**21.93** 4930	**9.43** 2120	**8.18** 1840	**17.48** 3930	2800	**15.875** 0.6250	**0.76** 0.030	**17.6** 0.69	**19.84** 0.781	**73.45** 650	**0.11** 0.24
21.04 4730	**33.27** 7480	**13.88** 3120	**8.27** 1860	**19.79** 4450	2400	**19.050** 0.7500	**0.76** 0.030	**20.7** 0.82	**24.99** 0.984	**141.25** 1250	**0.17** 0.38
21.04 4730	**33.27** 7480	**15.26** 3430	**11.39** 2560	**26.56** 5970	2400	**19.050** 0.7500	**0.76** 0.030	**20.7** 0.82	**24.99** 0.984	**141.25** 1250	**0.20** 0.44
24.64 5540	**42.61** 9580	**16.95** 3810	**13.12** 2950	**30.83** 6930	2000	**22.225** 0.8750	**0.76** 0.030	**23.9** 0.94	**27.79** 1.094	**169.5** 1500	**0.31** 0.69
24.64 5540	**42.61** 9580	**18.19** 4090	**16.95** 3810	**35.27** 7930	2000	**22.225** 0.8750	**0.76** 0.030	**23.9** 0.94	**27.79** 1.094	**169.5** 1500	**0.34** 0.75
30.87 6940	**59.16** 13300	**21.66** 4870	**20.73** 4660	**44.48** 10000	1700	**25.400** 1.0000	**1.02** 0.040	**27.1** 1.07	**31.75** 1.250	**254.25** 2250	**0.45** 1.00
30.87 6940	**59.16** 13300	**22.91** 5150	**25.58** 5750	**49.38** 11100	1700	**25.400** 1.0000	**1.02** 0.040	**27.1** 1.07	**31.75** 1.250	**254.25** 2250	**0.52** 1.15

Continued on next page.

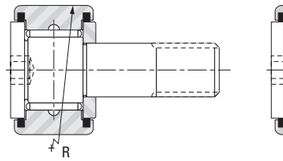
STUD-TYPE TRACK ROLLERS
CRHSBC SERIES
INCH SERIES

- Non-separable, sealed unit with outer ring, full complement of needle rollers, stud seals, self-lubricating resin internal thrust washers and stud-fastened retaining washer.
- Seals help retain lubricant and exclude foreign matter (CRS Series).
- Hexagonal wrench socket in stud head for mounting.
- Re-lubrication via axially drilled hole through stud with cross-drilled holes in stud raceway and shank.
- Recessed axial hole accepts standard nominal inch drive-type grease lubrication fitting.
- Lubrication fitting plugs furnished to close off unused holes.
- Crowned outer ring to support uneven bearing load.
- Large diameter heavy-duty stud.
- Tolerance limits for outer diameters of stud and outer ring refer to "single mean diameter."
- A close fit between stud and hole required for mounting.
- Bore dimensions given below result in varying fit (0.025 mm tight to 0.013 mm loose [0.0010 in. tight to 0.0005 in. loose]).
- Retaining washer should be firmly backed up by flat housing shoulder (perpendicular to the stud axis).
- Shoulder diameter should be at least same size as minimum clamping diameter listed.
- May be mounted with two thin lock nuts, or nut and lock washer.

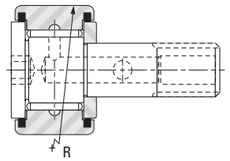
Outer Dia.	d_1	D	C	R	B_2	B_3	G_1	d_4	d_2	d_3	G	Bearing Designation
	+0.025 +0.001 **0** 0	**0** 0 **-0.025** -0.001	**0** 0 **-0.13** -0.005	Crown radius (approx.)	(nom.).		Min.				UNF	
in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	in	
2	**28.580** 1.1250	**50.80** 2.000	**31.75** 1.250	**610** 24	**50.80** 2.000	**12.70** 0.500	**25.40** 1.000	-	**4.78** 0.188	**3.18** 0.125	1 1/8-12	CRHSBC-32
2 1/4	**28.580** 1.1250	**57.15** 2.250	**31.75** 1.250	**610** 24	**50.80** 2.000	**12.70** 0.500	**25.40** 1.000	-	**4.78** 0.188	**3.18** 0.125	1 1/8-12	CRHSBC-36
2 1/2	**31.750** 1.2500	**63.50** 2.500	**38.10** 1.500	**762** 30	**57.20** 2.250	**14.27** 0.562	**28.58** 1.125	-	**4.78** 0.188	**3.18** 0.125	1 1/4-12	CRHSBC-40
2 3/4	**31.750** 1.2500	**69.85** 2.750	**38.10** 1.500	**762** 30	**57.20** 2.250	**14.27** 0.562	**28.57** 1.125	-	**4.78** 0.188	**3.18** 0.125	1 1/4-12	CRHSBC-44
3	**38.100** 1.5000	**76.20** 3.000	**44.45** 1.750	**762** 30	**63.50** 2.500	**15.88** 0.625	**31.75** 1.250	**6.35** 0.250	**6.35** 0.250	**3.18** 0.125	1 1/2-12	CRHSBC-48
3 1/4	**38.100** 1.5000	**82.55** 3.250	**44.45** 1.750	**762** 30	**63.50** 2.500	**15.88** 0.625	**31.75** 1.250	**6.35** 0.250	**6.35** 0.250	**3.18** 0.125	1 1/2-12	CRHSBC-52
3 1/2	**44.450** 1.7500	**88.90** 3.500	**50.80** 2.000	**762** 30	**69.90** 2.750	**17.48** 0.688	**34.93** 1.375	**6.35** 0.250	**6.35** 0.250	**3.18** 0.125	1 3/4-12	CRHSBC-56
4	**50.800** 2.0000	**101.60** 4.000	**57.15** 2.250	**762** 30	**88.90** 3.500	**19.05** 0.750	**38.1** 1.500	**6.35** 0.250	**6.35** 0.250	**3.18** 0.125	2/12	CRHSBC-64

(1) UNS instead of UNF threads.
Furnished with lubrication hole in head end of stud and lubrication fitting installed below bottom of hex wrench socket.

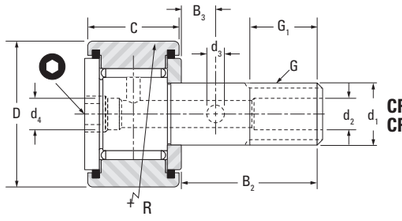
For hexagonal wrench sizes, see page B-5-30.



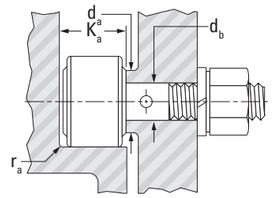
CRHSBC -8-1 to -10-1



CRHSBC -24 to -44



CRHSBC -12 to -22
CRHSBC -48 to -64

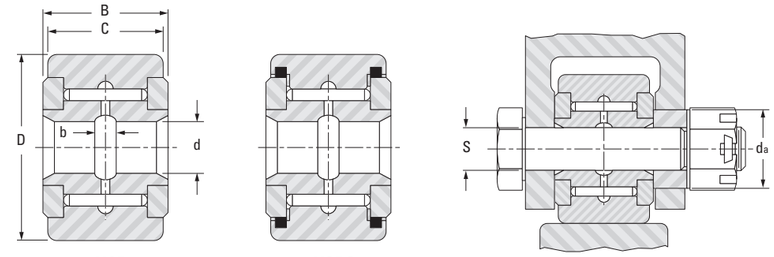


NOTE
Clamping torque is based on lubricated threads. If threads are dry, the torque values listed below may be doubled.

Load Rating					Speed Rating Grease	Mounting Dimensions				Clamping Torque	Approx Wt.
As a Bearing		As a Track Roller				d_b	$r_{as\ max}$	K_a	d_a		
Dynamic	Static	Dynamic		Static		Bore Dia. For Stud **+0.013** +0.0005 **0** 0					
C	C_0	C_w	$F_{r\ perm}$	$F_{0r\ perm}$		Max.	Min.	Min.			
kN lbf	**kN** lbf	**kN** lbf	**kN** lbf	**kN** lbf	min^{-1}	**mm** in	**mm** in	**mm** in	**mm** in	**N-m** lb-in	**kg** lbs
38.25 8600	**81.40** 18300	**27.05** 6080	**30.87** 6940	**61.83** 13900	1500	**28.575** 1.1250	**1.27** 0.050	**33.4** 1.32	**35.71** 1.406	**316.4** 2800	**0.71** 1.56
38.25 8600	**81.40** 18300	**29.40** 6610	**43.10** 9690	**72.51** 16300	1500	**28.575** 1.1250	**1.27** 0.050	**33.4** 1.32	**35.71** 1.406	**316.4** 2800	**0.85** 1.88
58.27 13100	**117.43** 26400	**44.48** 10000	**54.71** 12300	**104.09** 23400	1400	**31.750** 1.2500	**2.29** 0.090	**39.8** 1.57	**42.88** 1.688	**389.85** 3450	**1.25** 2.75
58.27 13100	**117.43** 26400	**47.15** 10600	**71.17** 16000	**116.54** 26200	1400	**31.750** 1.2500	**2.29** 0.090	**39.8** 1.57	**42.88** 1.688	**389.85** 3450	**1.45** 3.19
74.29 16700	**177.93** 40000	**51.60** 11600	**68.50** 15400	**131.22** 29500	990	**38.100** 1.5000	**2.29** 0.090	**46.1** 1.82	**53.98** 2.125	**565** 5000	**2.07** 4.56
74.29 16700	**177.93** 40000	**54.71** 12300	**85.85** 19300	**147.24** 33100	990	**38.100** 1.5000	**2.29** 0.090	**46.1** 1.82	**53.98** 2.125	**565** 5000	**2.36** 5.19
109.87 24700	**225.52** 50700	**82.29** 18500	**94.75** 21300	**191.27** 43000	950	**44.450** 1.7500	**2.29** 0.090	**52.5** 2.07	**61.93** 2.438	**565** 5000	**3.18** 7.01
137.89 31000	**319.38** 71800	**98.75** 22200	**125.88** 28300	**250.43** 56300	780	**50.800** 2.0000	**2.29** 0.090	**58.8** 2.32	**71.04** 2.797	**565** 5000	**2.23** 4.91

YOKE-TYPE TRACK ROLLERS
YCR, YCRS SERIES
INCH SERIES

- Non-separable unit with outer ring, a full complement of needle rollers, inner ring, self-lubricating resin internal thrust washers, and two retaining washers securely fastened to the inner ring.
- Seals in counterbores of outer ring seal against the retaining washers; retain lubricant and exclude foreign matter (YCRS Series).
- Dimensions shown are for unplated finished unit.
- Tolerance limits for outer diameters of stud and outer ring refer to "single mean diameter."
- The machine element with the holes in which the mounting bolt is supported must be sufficiently rigid to resist local crushing under the applied load and to resist bending which can cause uneven loading of the rollers.
- When the applied loads are high, the tight transition fit should be used in conjunction with a high strength shaft or bolt. When loads are moderate, the loose transition fit may be used with a high strength shaft or bolt. For light loads, the loose transition fit may be used with an unhardened shaft or bolt.
- The unit should be clamped endwise between parallel faces perpendicular to the axis to prevent the retaining washers from coming off under load. If the unit cannot be clamped, a close axial fit in the yoke is required.



YCR YCRS

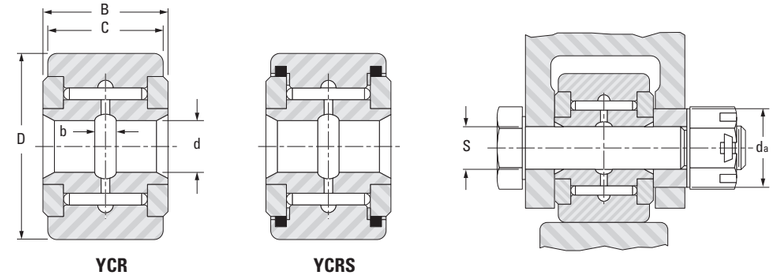
Outer Dia.	D	d		B	C	b	Track Roller Designation	
	0 -0.001	Max.	Min.	+0.13 +0.005 -0.25 -0.01	0 -0.005	(nom.)	Without Seals	With Seals and Internal Thrust Washers
in	mm in	mm in	mm in	mm in	mm in	mm in		
3/4	19.05 0.750	6.355 0.2502	6.34 0.2496	14.280 0.5625	12.70 0.500	2.95 0.116	YCR-12	YCRS-12
7/8	22.23 0.875	6.355 0.2502	6.34 0.2496	14.280 0.5625	12.70 0.500	2.95 0.116	YCR-14	YCRS-14
1	25.40 1.000	7.943 0.3127	7.927 0.3121	17.460 0.6875	15.88 0.625	3.18 0.125	YCR-16	YCRS-16
1 1/8	28.58 1.125	7.943 0.3127	7.927 0.3121	17.460 0.6875	15.88 0.625	3.18 0.125	YCR-18	YCRS-18
1 1/4	31.75 1.250	9.53 0.3752	9.515 0.3746	20.640 0.8125	19.05 0.750	3.20 0.126	YCR-20	YCRS-20
1 3/8	34.93 1.375	9.53 0.3752	9.515 0.3746	20.640 0.8125	19.05 0.750	3.20 0.126	YCR-22	YCRS-22
1 1/2	38.10 1.500	1.118 0.4377	11.102 0.4371	23.810 0.9375	22.23 0.875	3.18 0.125	YCR-24	YCRS-24
1 5/8	41.20 1.625	1.118 0.4377	11.102 0.4371	23.810 0.9375	22.23 0.875	3.18 0.125	YCR-26	YCRS-26
1 3/4	44.45 1.750	12.703 0.5001	12.687 0.4995	26.990 1.0625	25.40 1.000	3.20 0.126	YCR-28	YCRS-28
1 7/8	47.63 1.875	12.703 0.5001	12.687 0.4995	26.990 1.0625	25.40 1.000	3.20 0.126	YCR-30	YCRS-30
2	50.80 2.000	15.878 0.6251	15.862 0.6245	33.340 1.3125	31.75 1.250	3.20 0.126	YCR-32	YCRS-32
2 1/4	57.15 2.250	15.878 0.6251	15.862 0.6245	33.340 1.3125	31.75 1.250	3.20 0.126	YCR-36	YCRS-36
2 1/2	63.50 2.500	19.053 0.7501	19.037 0.7495	39.690 1.5625	38.10 1.500	3.68 0.145	YCR-40	YCRS-40

Load Rating					Speed Rating Grease	Mounting Dimensions				da	Approx Wt.
As a Bearing		As a Track Roller				Shaft Bolt Diameter (S)				Clamping Diameter Min.	
Dynamic	Static	Dynamic		Static		Loose Fit (f7)		Tight Fit (h6)			
C	C_0	C_w	$F_{r\ perm}$	$F_{0r\ perm}$		Max.	Min.	Max.	Min.		
kN lbf	kN lbf	kN lbf	kN lbf	kN lbf	min^{-1}	mm in	mm in	mm in	mm in	N-m lb-in	kg lbs
10.14 2280	14.68 3300	6.27 1410	2.92 656	6.98 1570	3800	6.342 0.2497	6.332 0.2493	6.363 0.2505	6.353 0.2501	1.55 0.610	0.03 0.06
10.14 2280	14.68 3300	7.38 1660	4.94 1110	11.88 2670	3800	6.342 0.2497	6.332 0.2493	6.363 0.2505	6.353 0.2501	1.55 0.610	0.04 0.08
12.99 2920	21.93 4930	8.41 1890	5.60 1260	13.43 3020	2800	7.930 0.3122	7.920 0.3118	7.950 0.3130	7.940 0.3126	1.98 0.780	0.07 0.15
12.99 2920	21.93 4930	9.43 2120	8.18 1840	17.48 3930	2800	7.930 0.3122	7.920 0.3118	7.950 0.3130	7.940 0.3126	1.98 0.780	0.08 0.17
23.31 5240	30.29 6810	16.06 3610	7.38 1660	17.75 3990	2700	9.517 0.3747	9.507 0.3743	9.538 0.3755	9.528 0.3751	2.49 0.980	0.11 0.24
23.31 5240	30.29 6810	17.66 3970	10.45 2350	25.04 5630	2700	9.517 0.3747	9.507 0.3743	9.538 0.3755	9.528 0.3751	2.49 0.980	0.14 0.3
28.16 6330	40.26 9050	20.15 4530	11.97 2690	28.74 6460	2700	11.105 0.4372	11.095 0.4368	11.125 0.4380	11.115 0.4376	2.77 1.090	0.19 0.41
28.16 6330	40.26 9050	21.62 4860	15.66 3520	36.08 8110	2300	11.105 0.4372	11.095 0.4368	11.125 0.4380	11.115 0.4376	2.77 1.090	0.23 0.5
35.50 7980	56.49 12700	25.93 5830	19.04 4280	45.82 10300	1900	12.692 0.4997	12.682 0.4993	12.718 0.5007	12.708 0.5003	3.18 1.250	0.29 0.64
35.50 7980	56.49 12700	27.40 6160	23.66 5320	51.15 11500	1900	12.692 0.4997	12.682 0.4993	12.718 0.5007	12.708 0.5003	3.18 1.250	0.36 0.8
43.19 9710	75.62 17000	31.89 7170	28.11 6320	62.72 14100	1700	15.867 0.6247	15.857 0.6243	15.893 0.6257	15.883 0.6253	3.58 1.410	0.48 1.05
43.19 9710	75.62 17000	34.70 7800	39.86 8960	73.40 16500	1700	15.867 0.6247	15.857 0.6243	15.893 0.6257	15.883 0.6253	3.58 1.410	0.60 1.32
58.27 13100	117.43 26400	44.48 10000	54.71 12300	104.09 23400	1400	19.042 0.7497	19.032 0.7493	19.068 0.7507	19.058 0.7503	4.29 1.690	0.82 1.8

Continued on next page.

YOKE-TYPE TRACK ROLLERS
YCR, YCRS SERIES
INCH SERIES

- Non-separable unit with outer ring, a full complement of needle rollers, inner ring, self-lubricating resin internal thrust washers, and two retaining washers securely fastened to the inner ring.
- Seals in counterbores of outer ring seal against the retaining washers; retain lubricant and exclude foreign matter (YCRS Series).
- Dimensions shown are for unplated finished unit.
- Tolerance limits for outer diameters of stud and outer ring refer to "single mean diameter."
- The machine element with the holes in which the mounting bolt is supported must be sufficiently rigid to resist local crushing under the applied load and to resist bending which can cause uneven loading of the rollers.
- When the applied loads are high, the tight transition fit should be used in conjunction with a high strength shaft or bolt. When loads are moderate, the loose transition fit may be used with a high strength shaft or bolt. For light loads, the loose transition fit may be used with an unhardened shaft or bolt.
- The unit should be clamped endwise between parallel faces perpendicular to the axis to prevent the retaining washers from coming off under load. If the unit cannot be clamped, a close axial fit in the yoke is required.



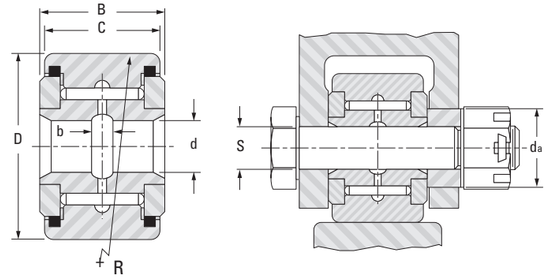
YCR YCRS

Outer Dia.	D	d		B	C	b	Track Roller Designation	
	0 0 **-0.025** -0.001	Max.	Min.	**+0.13** +0.005 **-0.25** -0.01	**0** 0 **-0.13** -0.005	(nom.)	Without Seals	With Seals and Internal Thrust Washers
in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in		
2 3/4	**69.85** 2.750	**19.053** 0.7501	**19.037** 0.7495	**39.690** 1.5625	**38.10** 1.500	**3.68** 0.145	YCR-44	YCRS-44
3	**76.20** 3.000	**25.403** 1.0001	**25.387** 0.9995	**46.040** 1.8125	**44.45** 1.750	**3.68** 0.145	YCR-48	YCRS-48
3 1/4	**82.55** 3.250	**25.403** 1.0001	**25.387** 0.9995	**46.040** 1.8125	**44.45** 1.750	**3.68** 0.145	YCR-52	YCRS-52
3 1/2	**88.90** 3.500	**28.578** 1.1251	**28.562** 1.1245	**52.390** 2.0625	**50.80** 2.000	**3.68** 0.145	YCR-56	YCRS-56
4	**101.60** 4.000	**31.753** 1.2501	**57.137** 2.2495	**58.740** 2.3125	**57.15** 2.250	**3.68** 0.145	YCR-64	YCRS-64
5	**127.00** 5.000	**44.453** 1.7501	**44.437** 1.7495	**73.030** 2.875	**69.85** 2.750	**8.66** 0.341	YCR-80	YCRS-80
6	**152.40** 6.000	**57.153** 2.2501	**57.137** 2.2495	**85.725** 3.725	**82.55** 3.250	**8.48** 0.334	YCR-96	YCRS-96

Load Rating					Speed Rating Grease	Mounting Dimensions				da	Approx Wt.
As a Bearing		As a Track Roller				Shaft Bolt Diameter (S)				Clamping Diameter Min.	
Dynamic	Static	Dynamic		Static		Loose Fit (f7)		Tight Fit (h6)			
C	C_0	C_w	$F_{r\ perm}$	$F_{0r\ perm}$		Max.	Min.	Max.	Min.		
kN lbf	**kN** lbf	**kN** lbf	**kN** lbf	**kN** lbf	min^{-1}	**mm** in	**mm** in	**mm** in	**mm** in	**N-m** lb-in	**kg** lbs
58.27 13100	**117.43** 26400	**47.15** 10600	**71.17** 16000	**116.54** 26200	1400	**19.042** 0.7497	**19.032** 0.7493	**19.068** 0.7507	**19.058** 0.7503	**4.29** 1.690	**1.02** 2.25
74.29 16700	**177.93** 40000	**51.60** 11600	**68.50** 15400	**131.22** 29500	990	**25.390** 0.9996	**25.377** 0.9991	**25.420** 1.0008	**25.408** 1.0003	**5.41** 2.130	**1.41** 3.1
74.29 16700	**177.93** 40000	**54.71** 12300	**85.85** 19300	**147.24** 33100	990	**25.390** 0.9996	**25.377** 0.9991	**25.420** 1.0008	**25.408** 1.0003	**5.41** 2.130	**1.64** 3.62
109.87 24700	**225.52** 50700	**82.29** 18500	**94.75** 21300	**191.27** 43000	950	**28.565** 1.1246	**28.552** 1.1241	**28.595** 1.1258	**28.583** 1.1253	**6.20** 2.440	**2.25** 4.95
137.89 31000	**319.38** 71800	**98.75** 22200	**125.88** 28300	**250.43** 56300	780	**31.740** 1.2496	**31.727** 1.2491	**31.770** 1.2508	**31.758** 1.2503	**7.11** 2.800	**3.20** 7.05
210.40 47300	**484.86** 109000	**149.02** 33500	**171.70** 38600	**370.09** 83200	620	**44.440** 1.7496	**44.427** 1.7491	**44.470** 1.7508	**44.458** 1.7503	**9.04** 3.560	**6.51** 14.34
285.13 64100	**578.27** 130000	**201.06** 45200	**188.16** 42300	**436.37** 98100	440	**57.140** 2.2496	**57.127** 2.2491	**57.170** 2.2508	**57.158** 2.2503	**11.35** 4.470	**9.15** 20.16

YOKE-TYPE TRACK ROLLERS
YCRSC SERIES
INCH SERIES

- Non-separable unit with outer ring, a full complement of needle rollers, inner ring, self-lubricating resin internal thrust washers, and two retaining washers securely fastened to the inner ring.
- Seals in counterbores of outer ring seal against the retaining washers; retain lubricant and exclude foreign matter (YCRS Series).
- Dimensions shown are for unplated finished unit.
- Crowned outer ring to support uneven bearing load.
- Tolerance limits for outer diameters of stud and outer ring refer to "single mean diameter."
- The machine element with the holes in which the mounting bolt is supported must be sufficiently rigid to resist local crushing under the applied load and to resist bending which can cause uneven loading of the rollers.
- When the applied loads are high, the tight transition fit should be used in conjunction with a high strength shaft or bolt. When loads are moderate, the loose transition fit may be used with a high strength shaft or bolt. For light loads, the loose transition fit may be used with an unhardened shaft or bolt.
- The unit should be clamped endwise between parallel faces perpendicular to the axis to prevent the retaining washers from coming off under load. If the unit cannot be clamped, a close axial fit in the yoke is required.



YCRSC

Outer Dia.	D	d		B	C	R	b	Bearing Designation
	0 0 **-0.025** -0.001	Max.	Min.	**+0.13** +0.005 **-0.25** -0.01	**0** 0 **-0.13** -0.005	Crown radius (approx.)	(nom.)	
in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	
3/4	**19.05** 0.750	**6.355** 0.2502	**6.34** 0.2496	**14.280** 0.5625	**12.70** 0.500	**254** 10	**2.95** 0.116	YCRSC-12
7/8	**22.23** 0.875	**6.355** 0.2502	**6.34** 0.2496	**14.280** 0.5625	**12.70** 0.500	**254** 10	**2.95** 0.116	YCRSC-14
1	**25.40** 1.000	**7.943** 0.3127	**7.927** 0.3121	**17.460** 0.6875	**15.88** 0.625	**304.8** 12	**3.18** 0.125	YCRSC-16
1 1/8	**28.58** 1.125	**7.943** 0.3127	**7.927** 0.3121	**17.460** 0.6875	**15.88** 0.625	**304.8** 12	**3.18** 0.125	YCRSC-18
1 1/4	**31.75** 1.250	**9.53** 0.3752	**9.515** 0.3746	**20.640** 0.8125	**19.05** 0.750	**355.6** 14	**3.20** 0.126	YCRSC-20
1 3/8	**34.93** 1.375	**9.53** 0.3752	**9.515** 0.3746	**20.640** 0.8125	**19.05** 0.750	**355.6** 14	**3.20** 0.126	YCRSC-22
1 1/2	**38.10** 1.500	**1.118** 0.4377	**11.102** 0.4371	**23.810** 0.9375	**22.23** 0.875	**508** 20	**3.18** 0.125	YCRSC-24
1 5/8	**41.20** 1.625	**1.118** 0.4377	**11.102** 0.4371	**23.810** 0.9375	**22.23** 0.875	**508** 20	**3.18** 0.125	YCRSC-26
1 3/4	**44.45** 1.750	**12.703** 0.5001	**12.687** 0.4995	**26.990** 1.0625	**25.40** 1.000	**508** 20	**3.20** 0.126	YCRSC-28
1 7/8	**47.63** 1.875	**12.703** 0.5001	**12.687** 0.4995	**26.990** 1.0625	**25.40** 1.000	**508** 20	**3.20** 0.126	YCRSC-30
2	**50.80** 2.000	**15.878** 0.6251	**15.862** 0.6245	**33.340** 1.3125	**31.75** 1.250	**609.6** 24	**3.20** 0.126	YCRSC-32
2 1/4	**57.15** 2.250	**15.878** 0.6251	**15.862** 0.6245	**33.340** 1.3125	**31.75** 1.250	**609.6** 24	**3.20** 0.126	YCRSC-36
2 1/2	**63.50** 2.500	**19.053** 0.7501	**19.037** 0.7495	**39.690** 1.5625	**38.10** 1.500	**762** 30	**3.68** 0.145	YCRSC-40
2 3/4	**69.85** 2.750	**19.053** 0.7501	**19.037** 0.7495	**39.690** 1.5625	**38.10** 1.500	**762** 30	**3.68** 0.145	YCRSC-44
3	**76.20** 3.000	**25.403** 1.0001	**25.387** 0.9995	**46.040** 1.8125	**44.45** 1.750	**762** 30	**3.68** 0.145	YCRSC-48
3 1/4	**82.55** 3.250	**25.403** 1.0001	**25.387** 0.9995	**46.040** 1.8125	**44.45** 1.750	**762** 30	**3.68** 0.145	YCRSC-52
3 1/2	**88.90** 3.500	**28.578** 1.1251	**28.562** 1.1245	**52.390** 2.0625	**50.80** 2.000	**762** 30	**3.68** 0.145	YCRSC-56
4	**101.60** 4.000	**31.753** 1.2501	**57.137** 2.2495	**58.740** 2.3125	**57.15** 2.250	**762** 30	**3.68** 0.145	YCRSC-64

Load Rating					Speed Rating Grease	Mounting Dimensions				da	Approx Wt.
As a Bearing		As a Track Roller				Shaft Bolt Diameter (S)					
						Loose Fit (f7)		Tight Fit (h6)			
Dynamic	Static	Dynamic		Static		Max.	Min.	Max.	Min.	Clamping Diameter Min.	
C	C_0	C_w	$F_{r\ perm}$	$F_{0r\ perm}$							
kN lbf	**kN** lbf	**kN** lbf	**kN** lbf	**kN** lbf	min^{-1}	**mm** in	**mm** in	**mm** in	**mm** in	**N-m** lb-in	**kg** lbs
10.14 2280	**14.68** 3300	**6.27** 1410	**2.92** 656	**6.98** 1570	3800	**6.342** 0.2497	**6.332** 0.2493	**6.363** 0.2505	**6.353** 0.2501	**1.55** 0.610	**0.03** 0.06
10.14 2280	**14.68** 3300	**7.38** 1660	**4.94** 1110	**11.88** 2670	3800	**6.342** 0.2497	**6.332** 0.2493	**6.363** 0.2505	**6.353** 0.2501	**1.55** 0.610	**0.04** 0.08
12.99 2920	**21.93** 4930	**8.41** 1890	**5.60** 1260	**13.43** 3020	2800	**7.930** 0.3122	**7.920** 0.3118	**7.950** 0.3130	**7.940** 0.3126	**1.98** 0.780	**0.07** 0.15
12.99 2920	**21.93** 4930	**9.43** 2120	**8.18** 1840	**17.48** 3930	2800	**7.930** 0.3122	**7.920** 0.3118	**7.950** 0.3130	**7.940** 0.3126	**1.98** 0.780	**0.08** 0.17
23.31 5240	**30.29** 6810	**16.06** 3610	**7.38** 1660	**17.75** 3990	2700	**9.517** 0.3747	**9.507** 0.3743	**9.538** 0.3755	**9.528** 0.3751	**2.49** 0.980	**0.11** 0.24
23.31 5240	**30.29** 6810	**17.66** 3970	**10.45** 2350	**25.04** 5630	2700	**9.517** 0.3747	**9.507** 0.3743	**9.538** 0.3755	**9.528** 0.3751	**2.49** 0.980	**0.14** 0.3
28.16 6330	**40.26** 9050	**20.15** 4530	**11.97** 2690	**28.74** 6460	2700	**11.105** 0.4372	**11.095** 0.4368	**11.125** 0.4380	**11.115** 0.4376	**2.77** 1.090	**0.19** 0.41
28.16 6330	**40.26** 9050	**21.62** 4860	**15.66** 3520	**36.08** 8110	2300	**11.105** 0.4372	**11.095** 0.4368	**11.125** 0.4380	**11.115** 0.4376	**2.77** 1.090	**0.23** 0.5
35.50 7980	**56.49** 12700	**25.93** 5830	**19.04** 4280	**45.82** 10300	1900	**12.692** 0.4997	**12.682** 0.4993	**12.718** 0.5007	**12.708** 0.5003	**3.18** 1.250	**0.29** 0.64
35.50 7980	**56.49** 12700	**27.40** 6160	**23.66** 5320	**51.15** 11500	1900	**12.692** 0.4997	**12.682** 0.4993	**12.718** 0.5007	**12.708** 0.5003	**3.18** 1.250	**0.36** 0.8
43.19 9710	**75.62** 17000	**31.89** 7170	**28.11** 6320	**62.72** 14100	1700	**15.867** 0.6247	**15.857** 0.6243	**15.893** 0.6257	**15.883** 0.6253	**3.58** 1.410	**0.48** 1.05
43.19 9710	**75.62** 17000	**34.70** 7800	**39.86** 8960	**73.40** 16500	1700	**15.867** 0.6247	**15.857** 0.6243	**15.893** 0.6257	**15.883** 0.6253	**3.58** 1.410	**0.60** 1.32
58.27 13100	**117.43** 26400	**44.48** 10000	**54.71** 12300	**104.09** 23400	1400	**19.042** 0.7497	**19.032** 0.7493	**19.068** 0.7507	**19.058** 0.7503	**4.29** 1.690	**0.82** 1.8
58.27 13100	**117.43** 26400	**47.15** 10600	**71.17** 16000	**116.54** 26200	1400	**19.042** 0.7497	**19.032** 0.7493	**19.068** 0.7507	**19.058** 0.7503	**4.29** 1.690	**1.02** 2.25
74.29 16700	**177.93** 40000	**51.60** 11600	**68.50** 15400	**131.22** 29500	990	**25.390** 0.9996	**25.377** 0.9991	**25.420** 1.0008	**25.408** 1.0003	**5.41** 2.130	**1.41** 3.1
74.29 16700	**177.93** 40000	**54.71** 12300	**85.85** 19300	**147.24** 33100	990	**25.390** 0.9996	**25.377** 0.9991	**25.420** 1.0008	**25.408** 1.0003	**5.41** 2.130	**1.64** 3.62
109.87 24700	**225.52** 50700	**82.29** 18500	**94.75** 21300	**191.27** 43000	950	**28.565** 1.1246	**28.552** 1.1241	**28.595** 1.1258	**28.583** 1.1253	**6.20** 2.440	**2.25** 4.95
137.89 31000	**319.38** 71800	**98.75** 22200	**125.88** 28300	**250.43** 56300	780	**31.740** 1.2496	**31.727** 1.2491	**31.770** 1.2508	**31.758** 1.2503	**7.11** 2.800	**3.20** 7.05

B

THRUST BEARINGS, ASSEMBLIES, WASHERS

Overview: Thrust needle roller and cage assemblies are complements of small diameter needle rollers, arranged in a spoke-like configuration. Needle rollers are equally spaced by means of a cage, its web section separates the rollers and provides guidance to keep them tracking in an orbital path. The purpose of these assemblies is to transmit a thrust load between two relatively rotating objects while greatly reducing friction.

Thrust needle roller and cage assemblies also can be unitized with lipped washers to serve as raceway surfaces for the needle rollers. Washers can be supplied separately or can be mechanically unitized to the thrust needle roller and cage assemblies for ease of handling.

- **Catalog range:** 6 mm – 160 mm (0.2362 in – 6.2992 in).
- **Markets:** Automotive automatic and manual transmissions, automotive accessories (compressors, steering gears, etc.) agricultural and construction equipment.
- **Features:** One-way fool-proof assembly features, anti-rotation locking features and lubrication flow enhancements.
- **Benefits:** High-speed performance and application flexibility.

Needle Roller Thrust Bearings – Metric Nominal Dimensions

Prefix
AXK, FNT thrust needle roller and cage assembly

Bore
60 = 60 mm

Outer Diameter
85 = 85 mm

AXK **60** **85**

Prefix
K.811 cylindrical roller thrust bearing
K.812 cylindrical roller thrust bearing

Bore Diameter
02 = 15 mm
03 = 17 mm
(for bore ≥ 20 mm): bore code x 5 = bore diameter
04 = 4 x 5 = 20 mm

K.811 **04** **TVP**

Suffix
TVP molded, reinforced polymer window-type cage
LPB machined, light metal window-type cage

Bearing design symbol
TP thrust needle roller and cage assembly
TPK, TVK unitized thrust bearing assembly

TVK **17** **33** **JL**

Bore diameter
17 = 17 mm

Outer diameter
33 = 33 mm

Thrust washer shape symbol
(only for unitized bearing assemblies)
JL with outer-diameter flange thrust washers and bore-diameter flange thrust washers
J with outer-diameter flange thrust washers
L with bore-diameter flange thrust washers

Thrust Washers – Metric Nominal Dimensions

Prefix
AS thin thrust washer
LS heavy thrust washer

Bore
40 = 40 mm

Outer Diameter
60 = 60 mm

LS **40** **60**

Prefix
GS.811, GS.812 housing washer
WS.812, WS.812 shaft washer

Bore Diameter

for WS.811, WS.812:
02 = 15 mm
03 = 17 mm
(for bore ≥ 20 mm):
bore code x 5 = bore diameter
04 = 4 x 5 = 20 mm

for GS.811:
02 = 16 mm
03 = 18 mm
04 = 21 mm
05 = 26 mm
(for bore ≥ 30 mm):
[bore code x 5]+2 = bore diameter
06 = [6 x 5] +2 = 32 mm

for GS.812:
02 = 16 mm
03 = 17mm
04 = 21 mm
05 = 26 mm
(for bore ≥ 30 mm):
[bore code x 5]+2 = bore diameter
06 = [6 x 5] +2 = 32 mm
(for bore > 85 mm):
[bore code x 5]+3 = bore diameter
17 = [17 x 5] +3 = 88 mm

GS.811 **04**

Prefix
W thin thrust washer
WS thick (heavy) thrust washer

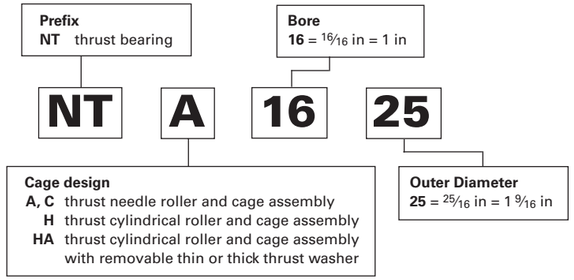
Outer diameter
16 = 16 mm

W **08** **16** **F**

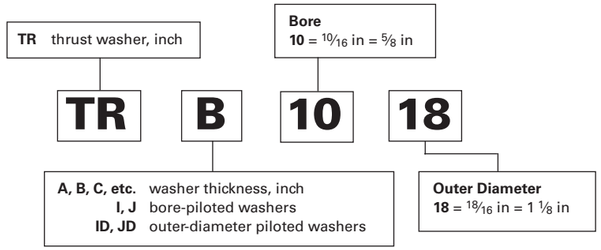
Bore diameter
08 = 8 mm

Thrust washer shape symbol
F flat thrust washer

Thrust Bearings – Inch Nominal Dimensions



Thrust Washers – Inch Nominal Dimensions



Thrust Bearings, Assemblies, Washers

THRUST NEEDLE ROLLER AND CAGE ASSEMBLIES AND THRUST WASHERS

METRIC SERIES

Thrust needle roller and cage assemblies are available in a variety of sizes. They all have very small cross sections. This catalog includes the most popular, standardized designs.

REFERENCE STANDARDS ARE:

- **ISO 3031** – rolling bearings – thrust needle roller and cage assemblies, thrust washers – dimensions and tolerances.
- **DIN 5405 Part 2** – rolling bearings – needle roller bearings – thrust needle roller and cage assemblies.
- **DIN 5405 Part 3** – rolling bearings – needle roller bearings – thrust washers.
- **ANSI/ABMA Std. 21.1-1988** – thrust needle roller and cage assemblies and thrust washers – metric design.
- **JIS B 1536** – roller bearings – boundary dimensions and tolerances of needle roller bearings.

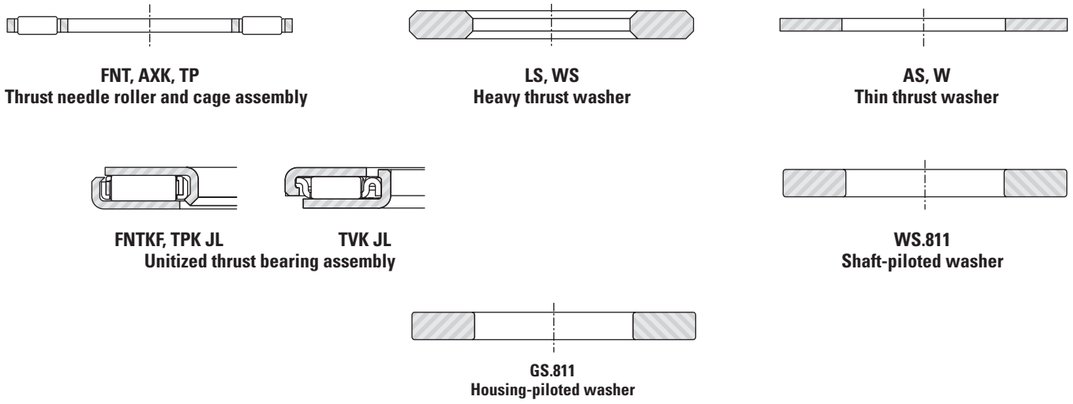


Fig. B6-1. Types of metric series thrust needle roller and cage assemblies and thrust washers

CONSTRUCTION

THRUST NEEDLE ROLLER AND CAGE ASSEMBLIES

The thrust needle roller and cage assembly (FNT and TP series) has a two-piece steel cage and through-hardened needle rollers that are precision finished to close tolerances for optimum load distribution. The cage is comprised of two mating pieces that are securely fastened together.

AXK series thrust needle roller and cage assembly, which can be used interchangeably with the FNT assembly, has a one-piece cage. The cage is similar in design to the successful profiled radial steel cages.

These cage assemblies have a very thin section and when they must run directly against the backup surface raceways, their section may be 2.000 to 5.000 mm (0.0787 to 0.1969 in) – equivalent to the diameter of the needle rollers used.

When the backup surfaces cannot be hardened and ground, hardened washers of different thicknesses are available.

UNITIZED THRUST BEARING ASSEMBLIES

Thrust bearing assemblies of the FNTK, FNTF, FNTKF, TPK and TVK series have been specially designed for use in applications where a unitized assembly allows for easy installation and eliminates the need for heat treatment and precision finishing of one or both thrust bearing backup surfaces.

Each FNTK, FNTF, FNTKF, TPK and TVK assembly consists of a FNT, TP or TV thrust needle roller and cage assembly – with one or two special-lipped washers that snap over the cage to produce a unitized thrust bearing assembly. The FNTK, FNTF, TPK J, TPK L, TVK J and TVK L assembly has one such washer. The FNTKF, TPK JL and TVK JL assembly has a washer on each side of the bearing.

The backup surfaces for these unitized thrust bearing assemblies should meet the limits of permissible out-of-squareness and coning or dishing, as shown in Fig. B6-2 on page B-6-10. Oil is the preferred lubricant for these assemblies. However they also are available pre-greased for applications that do not allow for oil lubrication.

THRUST WASHERS

Ideally, a thrust washer should be stationary with respect to, and piloted by, its supporting or backing member – whether or not this is an integral part of the shaft or housing. There should be no rubbing action between the thrust washer and any other machine member. Some thrust washers are designed for bore piloting and others may be piloted by their outer diameter.

THIN THRUST WASHERS (AS, W)

The metric series thin thrust washers are made of hardened spring steel. Thin washers are used when the supporting or backing members cannot be adequately prepared as raceways for the needle rollers. These washers are only 1.000 mm (0.0394 in) thick, and provide a very compact and cost-effective bearing arrangement. Although they are usually guided on the shaft, they may be housing-guided, when required by the application.

HEAVY THRUST WASHERS (LS, WS)

These metric series thrust washers are made of bearing quality steel, hardened and precision-ground on the flat raceway surfaces. Their bores and outer diameters are not ground, but provide satisfactory surfaces for shaft-piloting or housing-piloting arrangements.

SHAFT-PILOTED WASHERS (WS.811) AND HOUSING-PILOTED WASHERS (GS.811)

These shaft-piloted and housing-piloted metric series thrust washers are primarily for use with metric series cylindrical roller thrust bearings of series 811. They are made of bearing-quality steel with hardened and precision-ground, lapped-flat raceway surfaces. The bore and outer diameter tolerances for shaft-piloted washers and housing-piloted washers are shown in Table B6-8 and B6-9 on page B-6-28.

DIMENSIONAL ACCURACY

TOLERANCES FOR THRUST NEEDLE ROLLER AND CAGE ASSEMBLIES

Pages B-6-12 to B-6-19 list the nominal outer diameter, bore diameter and needle roller diameter for the FNT, AXK and TP series of thrust needle roller and cage assemblies and also the nominal outer diameter and bore diameter of the series AS, LS, WS.811, GS.811, W and WS thrust washers. Thickness tolerances for the AS and LS thrust washers also are included.

Tolerances for the outer and bore diameters of series FNT, AXK and TP thrust needle roller and cage assemblies are given in Table B6-1 on page B-6-7, Table B6-2 on page B-6-8 and Table B6-6 on page B-6-9.

Table B6-1. Tolerances for outer diameter (D_c) and bore diameter (D_{c1}) of series FNT and TP thrust needle roller and cage assemblies

D_c		Deviations of max. outside diameter (c12)		D_{c1}		Deviations of min. bore diameter (E11)	
>	≤	Max.	Min.	>	≤	Max.	Min.
mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in
18.000 0.7087	**30.000** 1.1811	**-0.110** -0.0043	**-0.320** -0.0126	**3.000** 0.1181	**6.000** 0.2362	**+0.095** +0.0037	**+0.020** +0.0008
30.000 1.1811	**40.000** 1.5748	**-0.120** -0.0047	**-0.370** -0.0146	**6.000** 0.2362	**10.000** 0.3937	**+0.115** +0.0045	**+0.025** +0.0010
40.000 1.5748	**50.000** 1.9685	**-0.130** -0.0051	**-0.380** -0.0150	**10.000** 0.3937	**18.000** 0.7087	**+0.142** +0.0056	**+0.032** +0.0013
50.000 1.9685	**65.000** 2.5591	**-0.140** -0.0055	**-0.440** -0.0173	**18.000** 0.7087	**30.000** 1.1811	**+0.170** +0.0067	**+0.040** +0.0016
65.000 2.5591	**80.000** 3.1496	**-0.150** -0.0059	**-0.450** -0.0177	**30.000** 1.1811	**50.000** 1.9685	**+0.210** +0.0083	**+0.050** +0.0020
80.000 3.1496	**100.000** 3.9370	**-0.170** -0.0067	**-0.520** -0.0205	**50.000** 1.9685	**80.000** 3.1496	**+0.250** +0.0098	**+0.060** +0.0024
100.000 3.9370	**120.000** 4.7244	**-0.180** -0.0071	**-0.530** -0.0209	**80.000** 3.1496	**120.000** 4.7244	**+0.292** +0.0115	**+0.072** +0.0028
120.000 4.7244	**140.000** 5.5118	**-0.200** -0.0079	**-0.600** -0.0236	**120.000** 4.7244	**180.000** 7.0866	**+0.335** +0.0132	**+0.085** +0.0033
140.000 5.5118	**160.000** 6.2992	**-0.210** -0.0083	**-0.610** -0.0240				
160.000 6.2992	**180.000** 7.0866	**-0.230** -0.0091	**-0.630** -0.0248				
180.000 7.0866	**200.000** 7.8740	**-0.240** -0.0094	**-0.700** -0.0276				

B

Table B6-2. Tolerances for outer diameter (D_c) and bore diameter (D_{c1}) of series AXK thrust needle roller and cage assemblies

D_c		Deviations of max. outside diameter (c13)		D_{c1}		Deviations of min. bore diameter (E12)	
>	≤	Max.	Min.	>	≤	Max.	Min.
mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in
18.000 0.7087	**30.000** 1.1811	**-0.110** -0.0043	**-0.440** -0.0173	**3.000** 0.1181	**6.000** 0.2362	**+0.140** +0.0055	**+0.020** +0.0008
30.000 1.1811	**40.000** 1.5748	**-0.120** -0.0047	**-0.510** -0.0201	**6.000** 0.2362	**10.000** 0.3937	**+0.175** +0.0069	**+0.025** +0.0010
40.000 1.5748	**50.000** 1.9685	**-0.130** -0.0051	**-0.520** -0.0205	**10.000** 0.3937	**18.000** 0.7087	**+0.212** +0.0083	**+0.032** +0.0013
50.000 1.9685	**65.000** 2.5591	**-0.140** -0.0055	**-0.600** -0.0236	**18.000** 0.7087	**30.000** 1.1811	**+0.250** +0.0098	**+0.040** +0.0016
65.000 2.5591	**80.000** 3.1496	**-0.150** -0.0059	**-0.610** -0.0240	**30.000** 1.1811	**50.000** 1.9685	**+0.300** +0.0118	**+0.050** +0.0020
80.000 3.1496	**100.000** 3.9370	**-0.170** -0.0067	**-0.710** -0.0280	**50.000** 1.9685	**80.000** 3.1496	**+0.360** +0.4220	**+0.060** +0.0024
100.000 3.9370	**120.000** 4.7244	**-0.180** -0.0071	**-0.720** -0.0283	**80.000** 3.1496	**120.000** 4.7244	**+0.422** +0.0166	**+0.072** +0.0028
120.000 4.7244	**140.000** 5.5118	**-0.200** -0.0079	**-0.830** -0.0327	**120.000** 4.7244	**180.000** 7.0866	**+0.485** +0.0191	**+0.085** +0.0033
140.000 5.5118	**160.000** 6.2992	**-0.210** -0.0083	**-0.840** -0.0331				
160.000 6.2992	**180.000** 7.0866	**-0.230** -0.0091	**-0.860** -0.0339				
180.000 7.0866	**200.000** 7.8740	**-0.240** -0.0094	**-0.960** -0.0378				

BORE INSPECTION PROCEDURE FOR ASSEMBLY

If an inspection of the bore diameter is desired, the bore diameter (D_{c1}) of the assembly should be checked with “go” and “no go” plug gages. The “go” plug gage size is the minimum bore diameter of the assembly. The “no go” plug gage size is the maximum bore diameter of the assembly.

The assembly, under its own weight, must fall freely from the “go” plug gage. The “no go” plug gage must not enter the bore. Where the “no go” plug gage can be forced through the bore, the assembly must not fall from the gage under its own weight.

TOLERANCES FOR THRUST WASHERS

Tolerances for the outer and bore diameters of series AS thrust washers are given in Table B6-3 on page B-6-9. Thickness tolerance for series AS thrust washers is ±0.050 mm (±0.0020 in).

Tolerances for the outer and bore diameters of series LS heavy thrust washers are given in Table B6-4 on page B-6-9.

Thickness tolerance for series LS heavy thrust washers is given in Table B6-5 on page B-6-9.

BORE INSPECTION PROCEDURE FOR SERIES AS AND LS THRUST WASHERS

If an inspection of the thrust washer bore diameter (d) is desired, it should be checked with “go” and “no go” plug gages. The “go” plug gage size is the minimum bore diameter of the thrust washer. The “no go” plug gage size is the maximum bore diameter of the thrust washer.

The thrust washer, under its own weight, must fall freely from the “go” plug gage. The “no go” plug gage must not enter the bore. Where the “no go” plug gage can be forced through the bore, the thrust washer must not fall from the gage under its own weight.

Table B6-3. Tolerances for outer diameter (d_1) and bore diameter (d) of series AS thrust washers

d_1		Deviations of max. outside diameter (e13)		d		Deviations of min. bore diameter (E13)	
>	≤	Max.	Min.	>	≤	Max.	Min.
mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in
18.000 0.7087	**30.000** 1.1811	**-0.040** -0.0016	**-0.370** -0.0146	**3.000** 0.1181	**6.000** 0.2362	**+0.200** +0.0079	**+0.020** +0.0008
30.000 1.1811	**50.000** 1.9685	**-0.050** -0.0020	**-0.440** -0.0173	**6.000** 0.2362	**10.000** 0.3937	**+0.245** +0.0096	**+0.025** +0.0010
50.000 1.9685	**80.000** 3.1496	**-0.060** -0.0024	**-0.520** -0.0205	**10.000** 0.3937	**18.000** 0.7087	**+0.302** +0.0119	**+0.032** +0.0013
80.000 3.1496	**120.000** 4.7244	**-0.072** -0.0028	**-0.612** -0.0241	**18.000** 0.7087	**30.000** 1.1811	**+0.370** +0.0146	**+0.040** +0.0016
120.000 4.7244	**180.000** 7.0866	**-0.085** -0.0034	**-0.715** -0.0282	**30.000** 1.1811	**50.000** 1.9685	**+0.440** +0.0173	**+0.050** +0.0020
180.000 7.0866	**250.000** 9.8425	**-0.100** -0.0039	**-0.820** -0.0323	**50.000** 1.9685	**80.000** 3.1496	**+0.520** +0.0205	**+0.060** +0.0024
				80.000 3.1496	**120.000** 4.7244	**+0.612** +0.0241	**+0.072** +0.0028
				120.000 4.7244	**180.000** 7.0866	**+0.715** +0.0281	**+0.085** +0.0034

Table B6-4. Tolerances for outer diameter (d_1) and bore diameter (d) of series LS heavy thrust washers

d_1		Deviations of max. outside diameter (a12)		d		Deviations of min. bore diameter (E12)	
>	≤	Max.	Min.	>	≤	Max.	Min.
mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in
18.000 0.7087	**30.000** 1.1811	**-0.300** -0.0118	**-0.510** -0.0201	**3.000** 0.1181	**6.000** 0.2362	**+0.140** +0.0055	**+0.020** +0.0008
30.000 1.1811	**40.000** 1.5748	**-0.310** -0.0122	**-0.560** -0.0221	**6.000** 0.2362	**10.000** 0.3937	**+0.175** +0.0069	**+0.025** +0.0010
40.000 1.5748	**50.000** 1.9685	**-0.320** -0.0126	**-0.570** -0.0224	**10.000** 0.3937	**18.000** 0.7087	**+0.212** +0.0084	**+0.032** +0.0013
50.000 1.9685	**65.000** 2.5591	**-0.340** -0.0134	**-0.640** -0.0252	**18.000** 0.7087	**30.000** 1.1811	**+0.250** +0.0098	**+0.040** +0.0016
65.000 2.5591	**80.000** 3.1496	**-0.360** -0.0142	**-0.660** -0.0260	**30.000** 1.1811	**50.000** 1.9685	**+0.300** +0.0118	**+0.050** +0.0020
80.000 3.1496	**100.000** 3.9370	**-0.380** -0.0150	**-0.730** -0.0290	**50.000** 1.9685	**80.000** 3.1496	**+0.360** +0.0142	**+0.060** +0.0024
100.000 3.9370	**120.000** 4.7244	**-0.410** -0.0161	**-0.760** -0.0299	**80.000** 3.1496	**120.000** 4.7244	**+0.422** +0.0166	**+0.072** +0.0028
120.000 4.7244	**140.000** 5.5118	**-0.460** -0.0181	**-0.860** -0.0339	**120.000** 4.7244	**180.000** 7.0866	**+0.485** +0.0191	**+0.085** +0.0034
140.000 5.5118	**160.000** 6.2992	**-0.520** -0.0205	**-0.920** -0.0362				
160.000 6.2992	**180.000** 7.0866	**-0.580** -0.0228	**-0.980** -0.0386				
180.000 7.0866	**200.000** 7.8740	**-0.660** -0.0260	**-1.120** -0.0441				

Table B6-5. Thickness tolerance for series LS heavy thrust washers

h		Tolerance	
>	≤	Max.	Min.
mm in		µm in	
0 0	**3** 0.1181	**0** 0	**-0.060** -0.0024
3 0.118	**6** 0.2362	**0** 0	**-0.075** -0.0030
6 0.236	**10** 0.3937	**0** 0	**-0.090** -0.0035

Table B6-6. W/WS series thrust washer tolerances and unitized thrust bearing assembly (TPK/TVK series) tolerances =JIS B 0401=

(1) Outer diameter

Nominal outer diameter d_1		Maximum actually measured outer diameter tolerance (e12)	
>	≤	Max.	Min.
mm		µm	
18	30	-40	-250
30	50	-50	-300
50	80	-60	-360
80	120	-72	-422
120	180	-85	-485

· These values correspond to the W and WS series thickness (h, h1) tolerances and to JIS B 0401-2 tolerance zone class js12.

(2) Bore diameter

Nominal bore diameter d		Minimum actually measured bore diameter tolerance (E12)	
>	≤	Max.	Min.
mm		µm	
6	10	+175	+25
10	18	+212	+32
18	30	+250	+40
30	50	+300	+50
50	80	+360	+60
80	120	+422	+72

· These values correspond to the W and WS series thickness (h, h1) tolerances and to JIS B 0401-2 tolerance zone class js12.

Table B6-7. Mounting tolerances for shafts and housings for metric series components

Bearing components	Shaft tolerance (shaft piloting)	Housing tolerance (housing piloting)
Needle roller and cage assembly. Types: AXK, FNT and TP	h8	H8
Thin thrust washer. Types: AS and W	h8	H8
Heavy thrust washer. Types: LS and WS	h8	H8
Shaft-piloted thrust washer. Type: WS.811	h6 (j6)	Clearance
Housing-piloted thrust washer. Type: GS.811	Clearance	H7 (K7)
Unitized thrust bearing assembly. Types: FNTKF (FNTK, FNTF) and TPK/TVK series	h8	H8

MOUNTING TOLERANCES

THRUST NEEDLE ROLLER AND CAGE ASSEMBLIES – METRIC SERIES

On FNT and AXK series thrust needle roller and cage assemblies, the cage bore has a closer tolerance than the outer diameter. Therefore bore piloting is preferred for these assemblies. To reduce wear, it is suggested that the piloting surface for the cage be hardened to an equivalent of at least 55 HRC. Where design requirements prevent bore piloting, the FNT or AXK series thrust needle roller and cage assemblies may be piloted on the outer diameters. For such cases, suitable O.D. piloting dimensions should be determined. Mounting tolerances are given in Table B6-7 on page B-6-10.

THRUST WASHERS

The mounting tolerances for series AS, W, LS, WS, WS.811 and GS.811 thrust washers for use with thrust needle roller and cage assemblies are given in Table B6-7 on page B-6-10.

To reduce the wear in the FNT and AXK series thrust assemblies, the piloting surface for the thrust washers should also be hardened to an equivalent of at least 55 HRC.

BACKUP SURFACES

In some applications, it is desirable to use the backup surfaces as raceways for the needle rollers of the thrust needle roller and cage assemblies. In such designs, these surfaces should be parallel and must be hardened to at least 58 HRC. If this hardness cannot be achieved and thrust washers cannot be used, the load ratings must be reduced as explained in the engineering section of this catalog.

Thrust raceway surfaces must be ground to a surface finish of 0.2 µm Ra (8 µin Ra). When this requirement cannot be met, thrust washers must be used.

The raceways against which the needle rollers operate, or the surface against which the thrust washers bear, must be square with the axis of the shaft. Equally important, the raceway or surface backing of the thrust washer must not be dished or coned. The permissible limits of out-of-squareness and dishing or coning are shown in the figures below.

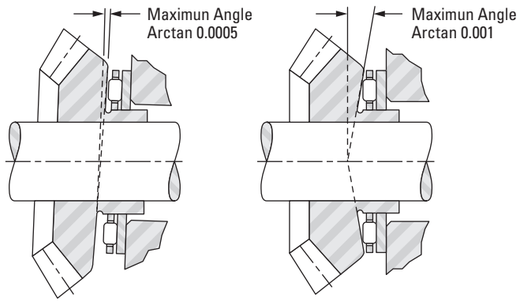


Fig. B6-2. Permissible limits

For the thin series washers AS thrust washers, full backup should be provided across the whole area of circulation of the rolling elements.

Thick series needle thrust bearings and thick thrust washers can be supported on a more restricted or discontinuous shoulder – provided that the deflection of the washer under load does not impede the smooth operation of the thrust bearing or the required axial run-out.

When an application does not involve the use of a thrust washer, the surface forming the second raceway must:

- Posess a suitable surface finish 0.2 µm Ra (8 µin Ra) and sufficient hardness in relation to the load to be supported. A minimum hardness of 58 HRC, enables thrust bearings to carry their full load capacity. Lower hardness values reduce the capacities shown in the tables of dimensions (see tabulated sizes).

LOAD RATINGS

MINIMUM AXIAL LOAD

Slippage can occur if the applied axial load is too light and the operating speed of the thrust needle roller and cage assembly is high – particularly if accompanied by inadequate lubrication. For satisfactory operation, a certain minimum load must be applied to a thrust needle roller and cage assembly which can be calculated from:

$$F_{a\,min} = C_{0a}/2200 \text{ [kN]}$$

Where:

C_{0a} = static load rating [kN]
$F_{a\,min}$ = minimum axial load [kN]

LUBRICATION

Oil is the preferred lubricant for thrust needle roller and cage assemblies and an ample oil flow is absolutely necessary for high speeds or for moderate speeds when the load is relatively high.

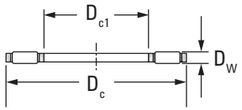
SPECIAL DESIGNS

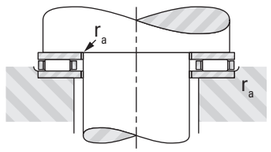
Thrust needle roller and cage assemblies and thrust washers are made to special dimensions and configurations, as well as from special materials – when quantities permit economical manufacture.

Thrust needle roller and cage assemblies are particularly adaptable to low-cost integral combination with special thrust washers. When the use of such special designs is considered, the following pages should be reviewed for evaluation of proposed arrangements.

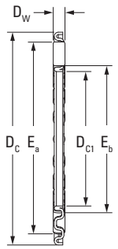
THRUST NEEDLE ROLLER AND CAGE ASSEMBLIES, THRUST WASHERS

METRIC SERIES
AXK, FNT SERIES

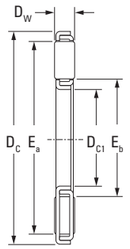




CAGE DESIGN

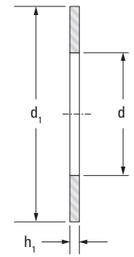


AXK



FNT

Shaft Dia.	D_{c1}	D_c	D_w	E_a	E_b	$r_{a\ max.}$	Assembly Designation	Load Ratings		Fatigue Load Limit C_u	Speed Rating	Approx. Wt.
								Dynamic	Static			
								C	C_o		Oil	
mm	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in		**kN** lbf		kN	min^{-1}	**kg** lbs
6	**6** 0.2362	**19** 0.7480	**2** 0.0787	**16.9** 0.665	**7.8** 0.307	**0.3** 0.012	AXK0619TN	**6.37** 1432	**14.3** 3215	1.40	23000	**0.001** 0.002
				18.0 0.709	**8.0** 0.315	**0.3** 0.012	FNT-619	**6.82** 1530	**15.6** 3510	1.50	21000	**0.002** 0.004
8	**8** 0.3150	**21** 0.8268	**2** 0.0787	**18.6** 0.732	**9.6** 0.378	**0.3** 0.012	AXK0821TN	**8.34** 1870	**21.1** 4740	2.00	20000	**0.001** 0.002
				20.0 0.787	**10.0** 0.394	**0.3** 0.012	FNT-821	**7.67** 1720	**19.1** 4290	1.85	20000	**0.002** 0.004
10	**10** 0.3937	**24** 0.9449	**2** 0.0787	**22.5** 0.886	**11.0** 0.433	**0.3** 0.012	AXK1024	**9.32** 2100	**25.9** 5820	2.90	17000	**0.003** 0.007
				23.0 0.906	**12.0** 0.472	**0.3** 0.012	FNT-1024	**9.14** 2060	**25.2** 5670	2.40	17000	**0.002** 0.004
12	**12** 0.4724	**26** 1.0236	**2** 0.0787	**24.5** 0.965	**13.0** 0.512	**0.3** 0.012	AXK1226	**10.8** 2430	**32.3** 7260	3.40	15000	**0.004** 0.009
				25.0 0.984	**14.0** 0.551	**0.3** 0.012	FNT-1226	**9.92** 2230	**29.0** 6520	2.75	15000	**0.004** 0.009
15	**15** 0.5906	**28** 1.1024	**2** 0.0787	**27.0** 1.063	**17.0** 0.669	**0.3** 0.012	AXK1528	**11.1** 2500	**35.2** 7910	3.35	15000	**0.004** 0.009
				27.0 1.063	**17.0** 0.669	**0.3** 0.012	FNT-1528	**10.2** 2290	**31.3** 7040	3.00	15000	**0.004** 0.009
17	**17** 0.6693	**30** 1.1811	**2** 0.0787	**28.7** 1.130	**18.3** 0.721	**0.3** 0.012	AXK1730TN	**11.7** 2630	**38.7** 8700	3.70	14000	**0.004** 0.009
				29.0 1.142	**19.0** 0.748	**0.3** 0.012	FNT-1730	**10.8** 2430	**34.8** 7820	3.35	14000	**0.004** 0.009
20	**20** 0.7874	**35** 1.3780	**2** 0.0787	**34.0** 1.339	**22.0** 0.866	**0.3** 0.012	AXK2035	**12.8** 2880	**45.4** 10200	4.40	12000	**0.006** 0.013
				34.0 1.339	**22.0** 0.866	**0.3** 0.012	FNTA-2035	**13.8** 3100	**50.7** 11400	4.80	12000	**0.005** 0.011
25	**25** 0.9843	**42** 1.6535	**2** 0.0787	**41.0** 1.614	**29.0** 1.142	**0.6** 0.024	AXK2542	**14.3** 3210	**56.8** 12800	5.50	10000	**0.007** 0.015
				41.0 1.614	**27.0** 1.063	**0.6** 0.024	FNT-2542	**18.0** 4050	**75.3** 16900	8.05	9700	**0.008** 0.018
30	**30** 1.1811	**47** 1.8504	**2** 0.0787	**46.0** 1.811	**35.0** 1.378	**0.6** 0.024	AXK3047	**16.0** 3600	**68.1** 15300	6.60	9000	**0.009** 0.020
				46.0 1.811	**32.0** 1.260	**0.6** 0.024	FNTA-3047	**18.6** 4180	**82.4** 18500	8.65	8900	**0.009** 0.020
35	**35** 1.3780	**52** 2.0472	**2** 0.0787	**51.0** 2.008	**40.0** 1.575	**0.6** 0.024	AXK3552	**17.4** 3910	**79.5** 17900	7.70	8100	**0.010** 0.022
				51.0 2.008	**37.0** 1.457	**0.6** 0.024	FNT-3552	**21.7** 4880	**104.0** 23400	11.1	7900	**0.010** 0.022



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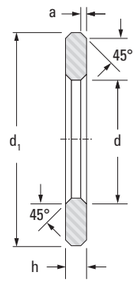
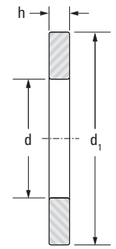


LS



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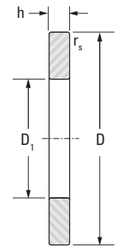

GS.811

Washer Dimensions			Thin			Heavy (LS)				Heavy				
												Washer Designation		
d	D, d_1	D_1	h_1	Washer Designation	Approx. Wt.	h	a	Washer Designation	Approx. Wt.	h	$r_{s\ min.}$	Shaft Piloted	Housing Piloted	Approx. Wt.
mm in	**mm** in	**mm** in	**mm** in		**kg** lbs	**mm** in	**mm** in		**kg** lbs	**mm** in	**mm** in			**kg** lbs
6 0.2362	**19** 0.7480		**1.00** 0.0394	AS0619	**0.001** 0.002									
8 0.3150	**21** 0.8268		**1.00** 0.0394	AS0821	**0.002** 0.004	**2.75** 0.108	**0.30** 0.012	LS0821	**0.004** 0.009					
10 0.3937	**24** 0.9449		**1.00** 0.0394	AS1024	**0.003** 0.007	**2.75** 0.108	**0.50** 0.020	LS1024	**0.008** 0.018					
12 0.4724	**26** 1.0236		**1.00** 0.0394	AS1226	**0.003** 0.007	**2.75** 0.108	**0.50** 0.020	LS1226	**0.009** 0.020					
15 0.5906	**28** 1.1024	**16** 0.6299	**1.00** 0.0394	AS1528	**0.003** 0.007	**2.75** 0.108	**0.50** 0.020	LS1528	**0.010** 0.022	**2.75** 0.108	**0.30** 0.012	WS.81102	GS.81102	**0.0100** 0.0220
17 0.6693	**30** 1.1811	**18** 0.7087	**1.00** 0.0394	AS1730	**0.003** 0.007	**2.75** 0.108	**0.50** 0.020	LS1730	**0.011** 0.024	**2.75** 0.108	**0.30** 0.012	WS.81103	GS.81103	**0.011** 0.024
20 0.7874	**35** 1.3780	**21** 0.8268	**1.00** 0.0394	AS2035	**0.005** 0.011	**2.75** 0.108	**0.50** 0.020	LS2035	**0.014** 0.031	**2.75** 0.108	**0.30** 0.012	WS.81104	GS.81104	**0.014** 0.031
25 0.9843	**42** 1.6535	**26** 1.0236	**1.00** 0.0394	AS2542	**0.007** 0.015	**3.00** 0.118	**1.00** 0.039	LS2542	**0.021** 0.046	**3.00** 0.118	**0.60** 0.024	WS.81105	GS.81105	**0.021** 0.046
30 1.1811	**47** 1.8504	**32** 1.2598	**1.00** 0.0394	AS3047	**0.008** 0.018	**3.00** 0.118	**1.00** 0.039	LS3047	**0.023** 0.051	**3.00** 0.118	**0.60** 0.024	WS.81106	GS.81106	**0.023** 0.051
35 1.3780	**52** 2.0472	**37** 1.4567	**1.00** 0.0394	AS3552	**0.009** 0.020	**3.50** 0.138	**1.00** 0.039	LS3552	**0.030** 0.066	**3.50** 0.138	**0.60** 0.024	WS.81107	GS.81107	**0.032** 0.071

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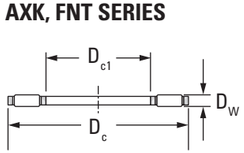
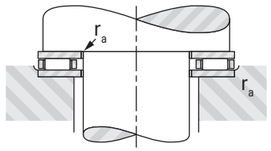
B

THRUST NEEDLE ROLLER AND CAGE ASSEMBLIES, THRUST WASHERS

METRIC SERIES
AXK, FNT SERIES





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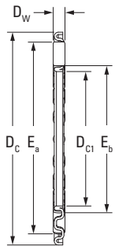
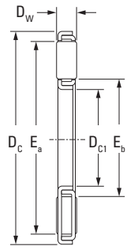
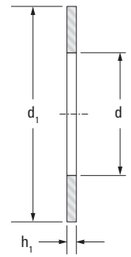


AXK



FNT

Shaft Dia.	D_{c1}	D_c	D_w	E_a	E_b	$r_{a\ max.}$	Assembly Designation	Load Ratings		Fatigue Load Limit C_u	Speed Rating	Approx. Wt.
								Dynamic	Static			
								C	C_o		Oil	
mm	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in		**kN** lbf		kN	min^{-1}	**kg** lbs
40	**40** 1.5748	**60** 2.3622	**3** 0.1181	**58.0** 2.283	**45.0** 1.772	**0.6** 0.024	AXK4060	**27.1** 6090	**110.0** 24700	11.9	7000	**0.016** 0.035
				57.0 2.244	**43.0** 1.693	**0.6** 0.024	FNT-4060	**31.5** 7080	**132.0** 29700	14.6	7100	**0.020** 0.044
45	**45** 1.7717	**65** 2.5591	**3** 0.1181	**63.0** 2.480	**50.0** 1.969	**0.6** 0.024	AXK4565	**29.0** 6520	**124.0** 27900	13.4	6500	**0.020** 0.044
				63.0 2.480	**47.0** 1.850	**0.6** 0.024	FNT-4565	**37.6** 8450	**172.0** 38700	18.5	6400	**0.024** 0.053
50	**50** 1.9685	**70** 2.7559	**3** 0.1181	**68.0** 2.677	**55.0** 2.165	**0.6** 0.024	AXK5070	**30.8** 6920	**137.0** 30800	14.9	6000	**0.020** 0.044
				68.0 2.677	**52.0** 2.047	**0.6** 0.024	FNT-5070	**37.9** 8520	**179.0** 40200	19.1	5900	**0.026** 0.057
55	**55** 2.1654	**78** 3.0709	**3** 0.1181	**76.0** 2.992	**60.0** 2.362	**0.6** 0.024	AXK5578	**39.4** 8860	**195.0** 43800	20.5	5300	**0.026** 0.057
				76.0 2.992	**57.0** 2.244	**0.6** 0.024	FNT-5578	**48.5** 10900	**254.0** 57100	26.3	5300	**0.033** 0.073
60	**60** 2.3622	**85** 3.3465	**3** 0.1181	**83.0** 3.268	**65.0** 2.559	**0.6** 0.024	AXK6085	**44.5** 10000	**234.0** 52600	24.7	4900	**0.035** 0.077
65	**65** 2.5591	**90** 3.5433	**3** 0.1181	**88.0** 3.465	**70.0** 2.756	**0.6** 0.024	AXK6590	**46.7** 10500	**254** 57100	26.8	4600	**0.036** 0.079
70	**70** 2.7559	**95** 3.7402	**4** 0.1575	**93.0** 3.661	**74.0** 2.913	**0.6** 0.024	AXK7095	**53.8** 12100	**253** 56900	28.0	4400	**0.055** 0.121
				93.0 3.661	**73.0** 2.874	**0.6** 0.024	FNTA-7095	**66.6** 15000	**333** 74900	35.3	4400	**0.057** 0.126
75	**75** 2.9528	**100** 3.9370	**4** 0.1575	**98.0** 3.858	**79.0** 3.110	**0.6** 0.024	AXK75100	**55.1** 12400	**266** 59800	29.4	4200	**0.058** 0.128
				98.0 3.858	**78.0** 3.071	**0.6** 0.024	FNT-75100	**71.6** 16100	**374** 84100	39.7	4100	**0.064** 0.141
80	**80** 3.1496	**105** 4.1339	**4** 0.1575	**103.0** 4.055	**84.0** 3.307	**0.6** 0.024	AXK80105	**56.4** 12700	**279** 62700	30.8	4000	**0.092** 0.203
				103.0 4.055	**83.0** 3.268	**0.6** 0.024	FNTA-80105	**71.3** 16100	**379** 85200	40.1	3900	**0.062** 0.137
85	**85** 3.3465	**110** 4.3307	**4** 0.1575	**108.0** 4.252	**89.0** 3.504	**0.6** 0.024	AXK85110	**57.6** 12900	**291** 65400	32.2	3800	**0.063** 0.139
90	**90** 3.5433	**120** 4.7244	**4** 0.1575	**118.0** 4.646	**94.0** 3.701	**0.6** 0.024	AXK90120	**72.9** 16400	**405** 91000	43.0	3500	**0.081** 0.179
100	**100** 3.9370	**135** 5.3150	**4** 0.1575	**133.0** 5.236	**105.0** 4.134	**0.6** 0.024	AXK100135	**90.2** 20300	**552** 124000	56.4	3100	**0.106** 0.234
110	**110** 4.3307	**145** 5.7087	**4** 0.1575	**143.0** 5.630	**115.0** 4.528	**0.6** 0.024	AXK110145	**93.2** 21000	**591** 133000	59.0	2800	**0.117** 0.258



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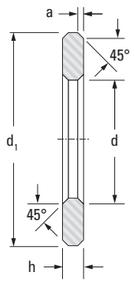
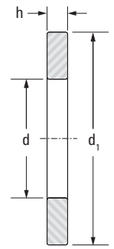


LS



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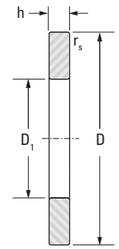

GS.811

Washer Dimensions			Thin			Heavy (LS)				Heavy				
d	D, d_1	D_1	h_1	Washer Designation	Approx. Wt.	h	a	Washer Designation	Approx. Wt.	h	$r_{s\ min.}$	Washer Designation		Approx. Wt.
												Shaft Piloted	Housing Piloted	
mm in	**mm** in	**mm** in	**mm** in		**kg** lbs	**mm** in	**mm** in		**kg** lbs	**mm** in	**mm** in			**kg** lbs
40 1.5748	**60** 2.3622	**42** 1.6535	**1.00** 0.0394	AS4060	**0.012** 0.026	**3.50** 0.138	**1.00** 0.039	LS4060	**0.041** 0.090	**3.50** 0.138	**0.60** 0.024	WS.81108	GS.81108	**0.043** 0.095
45 1.7717	**65** 2.5591	**47** 1.8504	**1.00** 0.0394	AS4565	**0.013** 0.029	**4.00** 0.157	**1.00** 0.039	LS4565	**0.052** 0.115	**4.00** 0.157	**0.60** 0.024	WS.81109	GS.81109	**0.054** 0.119
50 1.9685	**70** 2.7559	**52** 2.0472	**1.00** 0.0394	AS5070	**0.014** 0.031	**4.00** 0.157	**1.00** 0.039	LS5070	**0.0560** 0.1230	**4.00** 0.157	**0.60** 0.024	WS.81110	GS.81110	**0.059** 0.130
55 2.1654	**78** 3.0709	**57** 2.2441	**1.00** 0.0394	AS5578	**0.018** 0.040	**5.00** 0.197	**1.00** 0.039	LS5578	**0.0910** 0.2010	**5.00** 0.197	**0.60** 0.024	WS.81111	GS.81111	**0.094** 0.207
60 2.3622	**85** 3.3465	**62** 2.4409	**1.00** 0.0394	AS6085	**0.022** 0.049	**4.75** 0.187	**1.50** 0.059	LS6085	**0.102** 0.225	**4.75** 0.187	**1.00** 0.039	WS.81112	GS.81112	**0.106** 0.234
65 2.5591	**90** 3.5433	**67** 2.6378	**1.00** 0.0394	AS6590	**0.023** 0.051	**5.25** 0.207	**1.50** 0.059	LS6590	**0.121** 0.267	**5.25** 0.207	**1.00** 0.039	WS.81113	GS.81113	**0.125** 0.276
70 2.7559	**95** 3.7402	**72** 2.8346	**1.00** 0.0394	AS7095	**0.025** 0.055	**5.25** 0.207	**1.50** 0.059	LS7095	**0.1280** 0.2820	**5.25** 0.207	**1.00** 0.039	WS.81114	GS.81114	**0.133** 0.293
75 2.9528	**100** 3.9370	**77** 3.0315	**1.00** 0.0394	AS75100	**0.027** 0.060	**5.75** 0.226	**1.50** 0.059	LS75100	**0.1500** 0.3310	**5.75** 0.226	**1.00** 0.039	WS.81115	GS.81115	**0.155** 0.342
80 3.1496	**105** 4.1339	**82** 3.2283	**1.00** 0.0394	AS80105	**0.028** 0.062	**5.75** 0.226	**1.50** 0.059	LS80105	**0.1580** 0.3480	**5.75** 0.226	**1.00** 0.039	WS.81116	GS.81116	**0.165** 0.364
85 3.3465	**110** 4.3307	**87** 3.4252	**1.00** 0.0394	AS85110	**0.028** 0.062	**5.75** 0.226	**1.50** 0.059	LS85110	**0.166** 0.366	**5.75** 0.226	**1.00** 0.039	WS.81117	GS.81117	**0.173** 0.381
90 3.5433	**120** 4.7244	**92** 3.6220	**1.00** 0.0394	AS90120	**0.038** 0.084	**6.50** 0.256	**1.50** 0.059	LS90120	**0.245** 0.540	**6.50** 0.256	**1.00** 0.039	WS.81118	GS.81118	**0.253** 0.558
100 3.9370	**135** 5.3150		**1.00** 0.0394	AS100135	**0.050** 0.110									
110 4.3307	**145** 5.7087		**1.00** 0.0394	AS110145	**0.055** 0.121	**7.00** 0.276	**1.50** 0.059	LS110145	**0.373** 0.822	**7.00** 0.276				

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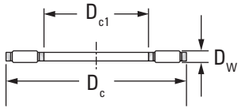
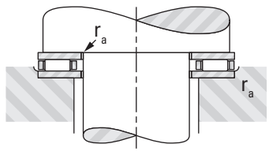
B

THRUST NEEDLE ROLLER AND CAGE ASSEMBLIES, THRUST WASHERS

METRIC SERIES
AXK, FNT SERIES





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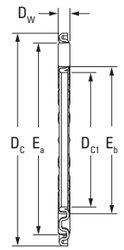
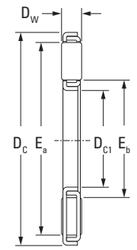
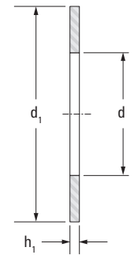


AXK



FNT

Shaft Dia.	D_{c1}	D_c	D_w	E_a	E_b	$r_{a\ max.}$	Assembly Designation	Load Ratings		Fatigue Load Limit C_u	Speed Rating	Approx. Wt.
								Dynamic	Static			
								C	C_o		Oil	
mm	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in		**kN** lbf		kN	min^{-1}	**kg** lbs
120	**120** 4.7244	**155** 6.1024	**4** 0.1575	**153.0** 6.024	**125.0** 4.921	**0.6** 0.024	AXK120155	**98.5** 22100	**650** 146000	63.5	2700	**0.126** 0.278
130	**130** 5.1181	**170** 6.6929	**5** 0.1969	**167.0** 6.575	**136.0** 5.354	**0.6** 0.024	AXK130170	**132** 29700	**829** 186000	78.7	2400	**0.198** 0.437
140	**140** 5.5118	**180** 7.0866	**5** 0.1969	**177.0** 6.969	**146.0** 5.748	**0.6** 0.024	AXK140180	**136** 30600	**887** 199000	82.5	2300	**0.221** 0.487
150	**150** 5.9055	**190** 7.4803	**5** 0.1969	**187.0** 7.362	**156.0** 6.142	**0.6** 0.024	AXK150190	**141** 31700	**944** 212000	86.2	2200	**0.225** 0.496
160	**160** 6.2992	**200** 7.8740	**5** 0.1969	**197.0** 7.756	**166.0** 6.535	**0.6** 0.024	AXK160200	**146** 32800	**1000** 225000	89.9	2100	**0.249** 0.549



AS
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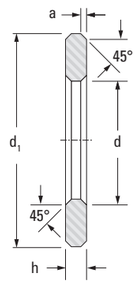
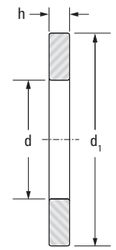
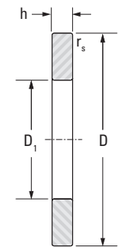


LS



WS.811



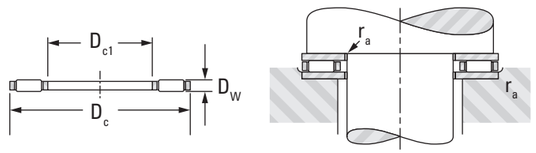
GS.811

Washer Dimensions			Thin			Heavy (LS)				Heavy				
d	D, d_1	D_1	h_1	Washer Designation	Approx. Wt.	h	a	Washer Designation	Approx. Wt.	h	$r_{s\ min.}$	Washer Designation		Approx. Wt.
												Shaft Piloted	Housing Piloted	
mm in	**mm** in	**mm** in	**mm** in		**kg** lbs	**mm** in	**mm** in		**kg** lbs	**mm** in	**mm** in			**kg** lbs
120 4.7244	**155** 6.1024		**1.00** 0.0394	AS120155	**0.059** 0.130									
130 5.1181	**170** 6.6929		**1.00** 0.0394	AS130170	**0.074** 0.163	**9.00** 0.354	**1.50** 0.059	LS130170	**0.649** 1.431					
140 5.5118	**180** 7.0866		**1.00** 0.0394	AS140180	**0.078** 0.172									
150 5.9055	**190** 7.4803		**1.00** 0.0394	AS150190	**0.083** 0.183									
160 6.2992	**200** 7.8740		**1.00** 0.0394	AS160200	**0.089** 0.196									

B

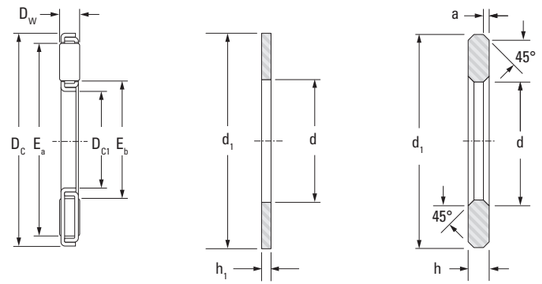
THRUST NEEDLE ROLLER AND CAGE ASSEMBLIES, THRUST WASHERS

METRIC SERIES
TP SERIES



Shaft Dia.	D_{c1}	D_c	D_w	E_a	E_b	$r_{a\ max.}$	Assembly Designation	Load Ratings		Fatigue Load Limit C_u	Speed Rating	Approx. Wt.
								Dynamic	Static			
								C	C_o		Oil	
mm	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in		**kN** lbf		kN	min^{-1}	**kg** lbs
15	**15**	**32.3**	**2**	**31**	**22**		TP1532-1	**12.7**	**44.7**	4.50	13000	**0.006**
18	**18**	**31**	**2**	**29**	**20**		TP1831	**10.6**	**34.4**	3.30	14000	**0.005**
20	**20**	**34.72**	**2**	**32**	**22**		TP2035	**15.3**	**57.4**	5.70	12000	**0.006**
20.9	**20.9**	**32**	**2**	**30**	**23**		TP2132D	**9.20**	**29.7**	2.85	13000	**0.005**
21.9	**21.9**	**34**	**2**	**32**	**25**		TP2234	**8.85**	**28.6**	2.75	13000	**0.005**
25	**25**	**42**	**2**	**40**	**28**		TP2542	**16.2**	**66.2**	6.90	10000	**0.009**
30	**30**	**47**	**2**	**45**	**34**		TP3047-1	**17.9**	**78.6**	8.20	9000	**0.010**
33.49	**33.49**	**45.13**	**2**	**43**	**37**		TP3445A	**9.35**	**34.3**	4.85	9000	**0.007**
39.6	**39.6**	**58.24**	**3**	**56**	**43**		TP4058-1	**29.2**	**120**	12.9	7000	**0.022**
41	**41**	**68.05**	**9**	**64**	**45**		TP4168	**86.6**	**233**	26.5	6000	**0.104**
42	**42**	**62**	**3**	**57**	**47**		TP4262	**19.3**	**71.4**	7.00	7000	**0.023**
45	**45**	**56**	**2**	**54**	**47**		TP4556	**9.90**	**39.6**	3.80	7000	**0.008**
46.4	**46.4**	**68**	**3.5**	**65**	**49**		TP4668-2	**42.2**	**182**	19.3	6000	**0.035**
50	**50**	**70**	**3**	**66**	**54**		TP5070	**29.4**	**129**	14.2	6000	**0.028**
70	**70**	**95**	**4**	**91**	**74**		TP7095	**57.3**	**275**	29.2	4000	**0.070**

CAGE DESIGN

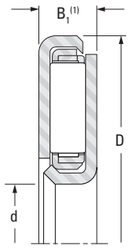


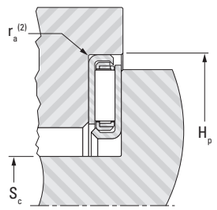
TP **W F (h_1 = 1.0)** **WS F**

Washer Dimensions			Thin			Heavy (WS)				Heavy				
d	D, d_1	D_1	h_1	Washer Designation	Approx. Wt.	h	a	Washer Designation	Approx. Wt.	h	$r_{s\ min.}$	Washer Designation		Approx. Wt.
												Shaft Piloted	Housing Piloted	
mm in	**mm** in	**mm** in	**mm** in		**kg** lbs	**mm** in	**mm** in		**kg** lbs	**mm** in	**mm** in			**kg** lbs
15	**32**		**1.00**	W1532F	**0.005**									
18	**31**		**1.00**	W1831F	**0.004**									
25	**42**		**1.00**	W2542F	**0.007**	**3.00**		WS2542KF	**0.021**					
70	**95**					**3.00**		WS7095F	**0.075**					

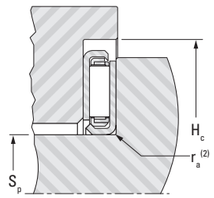
UNITIZED THRUST BEARING

METRIC SERIES
FNTKF SERIES



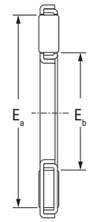


Housing Piloting



Shaft Piloting

CAGE DESIGN



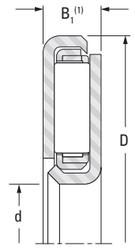
FNT

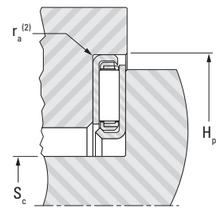
Shaft Dia.	d	D	B_1	Assembly Designation	Load Ratings		Fatigue Load Limit C_u	Speed Rating	Mounting Dimensions				Contact Dimensions Nominal		Approx. Wt
					Dynamic	Static			Housing Piloting		Shaft Piloting				
	(E13)	(e13)	(-0.2)		C	C_o		Oil	H_p —	S_c[3] Max.	S_p —	H_c[3] Min.	E_a	E_b	
mm	mm in	mm in	mm in		kN lbf		kN	min^{-1}	mm in	mm in	mm in	mm in	mm in	mm in	kg lbs
10	10 0.3937	28 1.1024	3.7[1] 0.146	FNTKF-1028	9.88 2220	29.0 6520	2.75	16000	28 1.102	8 0.31496	10 0.394	30 1.181	25 0.984	14 0.551	0.010
13	13 0.5118	30 1.1811	3.7[1] 0.146	FNTKF-1330	10.1 2270	31.3 7040	3.00	15000	30 1.181	11 0.433	13 0.512	32 1.260	27 1.063	17 0.669	0.011
15	15 0.5906	32 1.2598	3.7[1] 0.146	FNTKF-1532	10.8 2430	34.8 7820	3.35	14000	32 1.260	13 0.512	15 0.591	34 1.339	29 1.142	19 0.748	0.012
18	18 0.7087	37 1.4567	3.7[1] 0.146	FNTKF-1837	13.8 3100	50.3 11300	4.80	12000	37 1.457	16 0.630	18 0.709	39 1.535	34 1.339	22 0.866	0.017
23	23 0.9055	44 1.7323	3.7[1] 0.146	FNTKF-2344	18.0 4050	75.3 16900	8.05	9700	44 1.732	21 0.827	23 0.906	46 1.811	41 1.614	27 1.063	0.021
28	28 1.1024	49 1.9291	3.7[1] 0.146	FNTKF-2849	18.6 4180	82.4 18500	8.65	8900	49 1.929	26 1.024	28 1.102	51 2.008	46 1.811	32 1.260	0.024
33	33 1.2992	54 2.126	3.7[1] 0.146	FNTKF-3354	21.6 4860	104 23400	11.1	7900	54 2.126	31 1.220	33 1.299	56 2.205	51 2.008	37 1.457	0.029
38	38 1.4961	62 2.4409	4.7[1] 0.185	FNTKF-3862	31.4 7060	132 29700	14.6	7100	62 2.441	36 1.417	38 1.496	64 2.520	57 2.244	43 1.693	0.047
43	43 1.6929	67 2.6378	4.7[1] 0.185	FNTKF-4367	37.8 8500	173 38900	18.5	6400	67 2.638	41 1.614	43 1.693	69 2.717	63 2.480	47 1.850	0.051
48	48 1.890	72 2.8346	4.7[1] 0.185	FNTKF-4872	37.9 8520	179 40200	19.1	5900	72 2.835	46 1.811	48 1.890	74 2.913	68 2.677	52 2.047	0.056
53	53 2.0866	80 3.150	4.7[1] 0.185	FNTKF-5380	48.5 10900	254 57100	26.3	5300	80 3.150	51 2.008	53 2.087	82 3.228	76 2.992	57 2.244	0.070

(1) To be measured under a 2.0 kN (450 lbf) load.
(2) r_a = 0.500 mm max. (0.0197 in max.).
(3) S_c=d-2mm, H_c=D+2mm

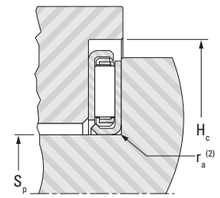
UNITIZED THRUST BEARING

METRIC SERIES
TPK JL,
TVK JL SERIES



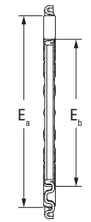


Housing Piloting

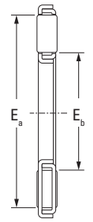


Shaft Piloting

CAGE DESIGN



TVK



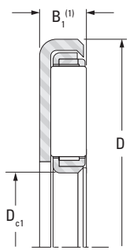
TPK

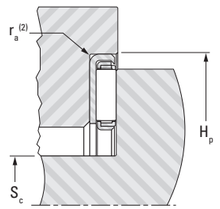
Shaft Dia.	d	D	B_1	Assembly Designation	Load Ratings		Fatigue Load Limit C_u	Speed Rating	Mounting Dimensions				Contact Dimensions Nominal		Approx. Wt.
					Dynamic	Static			Housing Piloting		Shaft Piloting				
					C	C_o		Oil	H_p —	S_c[3] Max.	S_p —	H_c[3] Min.	E_a	E_b	
mm	mm in	mm in	mm in		kN lbf		kN	min^{-1}	mm in	mm in	mm in	mm in	mm in	mm in	kg lbs
16.987	16.987	33	3.4	TVK1733JL	8.95	27.7	2.80	14000	33	15	17	35	30	21	0.011
22.6	22.6	40	3.6	TVK2340JL-3	11.8	43.1	4.35	11000	40	20.6	22.6	42	36	28	0.016
30.7	30.7	47.15	4.184	TPK3147JL-2	14.4	59.6	6.00	9000	47.1	28.7	30.7	49.1	43	34	0.024
34	34	51.4	3.6	TPK3451JL	14.5	61.6	6.20	9000	51.4	32	34	53.4	47	38	0.023
38	38	53	3.6	TPK3853JL	13.5	57.9	5.55	8000	53	36	38	55	49	42	0.022
	38	58	4.8	TPK3858JL	24.7	95.8	9.35	8000	58	36	38	60	54	43	0.041
54	54	77	6	TVK5477JL	31.4	144	15.7	6000	77	52	54	79	72	60	0.076
55.9	55.9	76	3.584	TVK5676JL	18.5	96.6	9.00	6000	76	53.9	55.9	78	70	60	0.040
60.4	60.4	77.9	3.8	TVK6078JL	15.8	80.1	8.05	5000	78	58.4	60.4	80	74	65	0.037
	60.4	78.0	3.6	TPK6078JL	20.6	114	11.5	5000	77.9	58.4	60.4	79.9	74	65	0.038
63.8	63.8	83.6	4.6	TPK6484JL	29.9	141	13.3	5000	83.6	61.8	63.8	85.6	79	69	0.054
67.6	67.6	92	5.4	TVK6892JL-1	34.7	175	19.0	5000	92	65.6	67.6	94	86	74	0.086
73.6	73.6	89.6	3.6	TPK7490JL	11.7	56.7	5.45	5000	89.6	71.6	73.6	91.6	85	78	0.041
110	110	132.2	4.3	TPK110132JL-1	22.9	131	11.6	3000	132.2	108	110	134.2	126	116	0.091

(1) To be measured under a 2.0 kN (450 lbf) load.
(2) r_a = 0.500 mm max. (0.0197 in max.).
(3) S_c=d-2mm, H_c=D+2mm

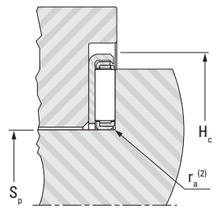
UNITIZED THRUST BEARING

METRIC SERIES
FNTK SERIES



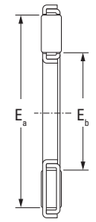


Housing Piloting



Shaft Piloting

CAGE DESIGN



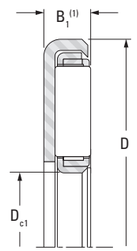
FNT

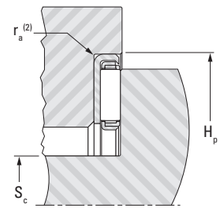
Shaft Dia.	D_{c1}	D	B_1	Assembly Designation	Load Ratings		Fatigue Load Limit C_u	Speed Rating	Mounting Dimensions				Contact Dimensions Nominal		Approx. Wt.
					Dynamic	Static		Oil	Housing Piloting H_p	Housing Piloting S_c(3)	Shaft Piloting S_p	Shaft Piloting H_c(3)	E_a	E_b	
	(E11)	(e13)	(-0.1)		C	C_o			—	Max.	—	Min.			
mm	**mm** in	**mm** in	**mm** in		**kN** lbf		kN	min^{-1}	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**kg** lbs
12	**12** 0.4724	**28** 1.1024	**2.85**(1) 0.1122	FNTK-1228	**9.88** 2220	**29.0** 6520	2.75	16000	**28** 1.102	**10.5** 0.413	**12** 0.4724	**29.5** 1.161	**25** 0.9843	**14** 0.5512	**0.007**
15	**15** 0.5906	**30** 1.1811	**2.85**(1) 0.1122	FNTK-1530	**10.1** 2270	**31.3** 7040	3.00	15000	**30** 1.181	**13.5** 0.531	**15** 0.5906	**31.5** 1.240	**27** 1.063	**17** 0.6693	**0.008**
17	**17** 0.6693	**32** 1.260	**2.85**(1) 0.1122	FNTK-1732	**10.8** 2430	**34.8** 7820	3.35	14000	**32** 1.260	**15.5** 0.610	**17** 0.6693	**33.5** 1.319	**29** 1.1417	**19** 0.748	**0.008**
20	**20** 0.7874	**37** 1.4567	**2.85**(1) 0.1122	FNTK-2037	**13.8** 3100	**50.3** 11300	4.80	12000	**37** 1.457	**18.5** 0.728	**20** 0.7874	**38.5** 1.516	**34** 1.3386	**22** 0.8661	**0.012**
25	**25** 0.9843	**44** 1.7323	**2.85**(1) 0.1122	FNTK-2544	**18.0** 4050	**75.3** 16900	8.05	9700	**44** 1.732	**23.5** 0.925	**25** 0.9843	**45.5** 1.791	**41** 1.6142	**27** 1.063	**0.015**
30	**30** 1.1811	**49** 1.9291	**2.85**(1) 0.1122	FNTK-3049	**18.6** 4180	**82.4** 18500	8.65	8900	**49** 1.929	**28.5** 1.122	**30** 1.1811	**50.5** 1.988	**46** 1.811	**32** 1.260	**0.018**
35	**35** 1.378	**54** 2.126	**2.85**(1) 0.1122	FNTK-3554	**21.6** 4860	**104** 23400	11.1	7900	**54** 2.126	**33.5** 1.319	**35** 1.378	**55.5** 2.185	**51** 2.0079	**37** 1.4567	**0.021**
40	**40** 1.5748	**62** 2.4409	**3.85**(1) 0.1516	FNTK-4062	**31.4** 7060	**132** 29700	14.6	7100	**62** 2.441	**38.5** 1.516	**40** 1.5748	**63.5** 2.500	**57** 2.2441	**43** 1.6929	**0.035**
45	**45** 1.7717	**67** 2.6378	**3.85**(1) 0.1516	FNTK-4567	**37.8** 8500	**173** 38900	18.5	6400	**67** 2.638	**43.5** 1.713	**45** 1.7717	**68.5** 2.697	**63** 2.480	**47** 1.850	**0.039**
50	**50** 1.9685	**72** 2.8346	**3.85**(1) 0.1516	FNTK-5072	**37.9** 8520	**179** 40200	19.1	5900	**72** 2.835	**48.5** 1.909	**50** 1.9685	**73.5** 2.894	**68** 2.6772	**52** 2.0472	**0.042**
55	**55** 2.1654	**80** 3.150	**3.85**(1) 0.1516	FNTK-5580	**48.5** 10900	**254** 57100	26.3	5300	**80** 3.150	**53.5** 2.106	**55** 2.1654	**81.5** 3.209	**76** 2.9921	**57** 2.2441	**0.053**

(1) To be measured under a 2.0 kN (450 lbf) load.
(2) r_a = 0.500 mm max. (0.0197 in max.).
(3) $S_c=D_{c1}$-1.5mm, H_c=D+1.5mm

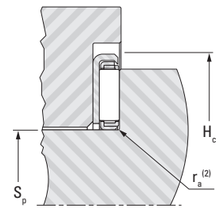
UNITIZED THRUST BEARING

METRIC SERIES
TPK J,
TVK J SERIES



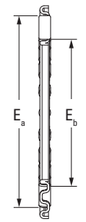


Housing Piloting

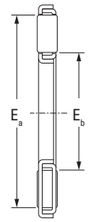


Shaft Piloting

CAGE DESIGN



TVK



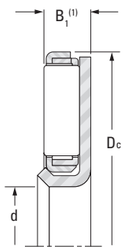
TPK

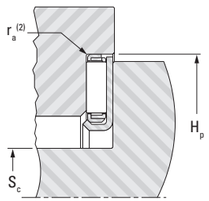
Shaft Dia.	D_{c1}	D	B_1	Assembly Designation	Load Ratings		Fatigue Load Limit C_u	Speed Rating	Mounting Dimensions				Contact Dimensions Nominal		Approx. Wt.
					Dynamic	Static		Oil	Housing Piloting H_p	Housing Piloting S_c(3)	Shaft Piloting S_p	Shaft Piloting H_c(3)	E_a	E_b	
					C	C_o			—	Max.	—	Min.			
mm	**mm** in	**mm** in	**mm** in		**kN** lbf		kN	min^{-1}	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**kg** lbs
25	**25**	**39.5**	**3.3**	TVK2540J	**16**	**54.1**	5.10	11000	**39.5**	**23.5**			**36**	**26**	**0.012**
25.8	**25.8**	**42**	**2.784**	TVK2642J	**14.6**	**57**	5.65	11000	**42**	**24.3**			**37**	**27**	**0.013**
33.7	**33.7**	**48.2**	**2.784**	TVK3448J-1	**15.6**	**66.2**	6.15	9000	**48.2**	**32.2**			**45**	**35**	**0.014**
35	**35**	**53**	**2.8**	TVK3553J-1	**13.8**	**57.2**	5.95	5000	**53**	**33.5**			**49**	**37**	**0.017**
38	**38**	**52**	**2.8**	TVK3852J-1	**13.9**	**58.5**	5.90	8000	**52**	**36.5**			**48**	**39**	**0.015**

(1) To be measured under a 2.0 kN (450 lbf) load.
(2) r_a = 0.500 mm max. (0.0197 in max.).
(3) $S_c=D_{c1}$-1.5mm, H_c=D+1.5mm

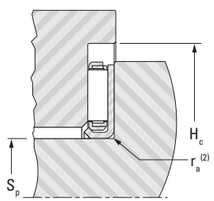
UNITIZED THRUST BEARING

METRIC SERIES
FNTF SERIES





Housing Piloting



Shaft Piloting

CAGE DESIGN

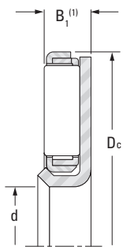
FNT

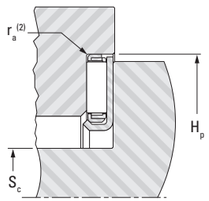
Shaft Dia.	d	D_c	B_1	Assembly Designation	Load Ratings		Fatigue Load Limit C_u	Speed Rating	Mounting Dimensions				Contact Dimensions Nominal		Approx. Wt.
					Dynamic	Static		Oil	Housing Piloting		Shaft Piloting				
									H_p	S_c(3)	S_p	H_c(3)	E_a	E_b	
	(E13)	(c12)	(-0.1)		C	C_o			—	Max.	—	Min.			
mm	**mm** in	**mm** in	**mm** in		**kN** lbf		kN	min^{-1}	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**kg** lbs
10	**10** 0.394	**26** 1.024	**2.85**(1) 0.112	FNTF-1026	**9.88** 2220	**29.0** 6520	2.75	16000	**26** 1.024	**8.5** 0.335	**10** 0.394	**27.5** 1.083	**25** 0.984	**14** 0.551	**0.006**
13	**13** 0.512	**28** 1.102	**2.85**(1) 0.112	FNTF-1328	**10.1** 2270	**31.3** 7040	3.00	15000	**28** 1.102	**11.5** 0.453	**13** 0.512	**29.5** 1.161	**27** 1.063	**17** 0.669	**0.007**
15	**15** 0.591	**30** 1.181	**2.85**(1) 0.112	FNTF-1530	**10.8** 2430	**34.8** 7820	3.35	14000	**30** 1.181	**13.5** 0.531	**15** 0.591	**31.5** 1.240	**29** 1.142	**19** 0.748	**0.008**
18	**18** 0.709	**35** 1.378	**2.85**(1) 0.112	FNTF-1835	**13.8** 3100	**50.3** 11300	4.80	12000	**35** 1.378	**16.5** 0.650	**18** 0.709	**36.5** 1.437	**34** 1.339	**22** 0.866	**0.011**
23	**23** 0.906	**42** 1.654	**2.85**(1) 0.112	FNTF-2342	**18.0** 4050	**75.3** 16900	8.05	9700	**42** 1.654	**21.5** 0.846	**23** 0.906	**43.5** 1.713	**41** 1.614	**27** 1.063	**0.014**
28	**28** 1.102	**47** 1.850	**2.85**(1) 0.112	FNTF-2847	**18.6** 4180	**82.4** 18500	8.65	8900	**47** 1.850	**26.5** 1.043	**28** 1.102	**48.5** 1.909	**46** 1.811	**32** 1.260	**0.017**
33	**33** 1.299	**52** 2.047	**2.85**(1) 0.112	FNTF-3352	**21.6** 4860	**104** 23400	11.1	7900	**52** 2.047	**31.5** 1.240	**33** 1.299	**53.5** 2.106	**51** 2.008	**37** 1.457	**0.019**
38	**38** 1.496	**60** 2.362	**3.85**(1) 0.152	FNTF-3860	**31.4** 7060	**132** 29700	14.6	7100	**60** 2.362	**36.5** 1.437	**38** 1.496	**61.5** 2.421	**57** 2.244	**43** 1.693	**0.033**
43	**43** 1.693	**65** 2.559	**3.85**(1) 0.152	FNTF-4365	**37.8** 8500	**173** 38900	18.5	6400	**65** 2.559	**41.5** 1.634	**43** 1.693	**66.5** 2.618	**63** 2.480	**47** 1.850	**0.038**
48	**48** 1.890	**70** 2.756	**3.85**(1) 0.152	FNTF-4870	**37.9** 8520	**179** 40200	19.1	5900	**70** 2.756	**46.5** 1.831	**48** 1.890	**71.5** 2.815	**68** 2.677	**52** 2.047	**0.041**
53	**53** 2.087	**78** 3.071	**3.85**(1) 0.152	FNTF-5378	**48.5** 10900	**254** 57100	26.3	5300	**78** 3.071	**51.5** 2.028	**53** 2.087	**79.5** 3.130	**76** 2.992	**57** 2.244	**0.053**

(1) To be measured under a 2.0 kN (450 lbf) load.
(2) r_a = 0.500 mm max. (0.0197 in max.).
(3) S_c=d-1.5mm, H_c=D_c+1.5mm

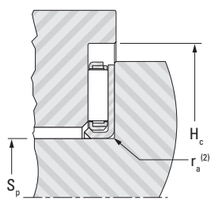
UNITIZED THRUST BEARING

METRIC SERIES
TPK L,
TVK L SERIES



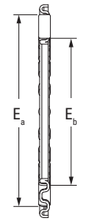


Housing Piloting



Shaft Piloting

CAGE DESIGN



TVK

TPK

Shaft Dia.	d	D_c	B_1	Assembly Designation	Load Ratings		Fatigue Load Limit C_u	Speed Rating	Mounting Dimensions				Contact Dimensions Nominal		Approx. Wt.
					Dynamic	Static		Oil	Housing Piloting		Shaft Piloting				
									H_p	S_c(3)	S_p	H_c(3)	E_a	E_b	
					C	C_o			—	Max.	—	Min.			
mm	**mm** in	**mm** in	**mm** in		**kN** lbf		kN	min^{-1}	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**kg** lbs
18.1	**18.1**	**31.6**	**2.8**	TPK1832L	**8.70**	**27.1**	2.60	14000			**18.1**	**33.1**	**30**	**22**	**0.008**
22	**22**	**41**	**2.8**	TPK2241L	**15.0**	**59.4**	5.90	10000			**22**	**42.5**	**38**	**28**	**0.015**
29	**29**	**49**	**3.8**	TVK2949L	**24.7**	**90.8**	9.80	8000			**29**	**50.5**	**47**	**35**	**0.022**
30.1	**30.1**	**45.5**	**2.784**	TPK3046L-3	**13.7**	**55.9**	5.20	9000			**30.1**	**47**	**43**	**35**	**0.014**
30.5	**30.5**	**55.68**	**5.3**	TPK3156L	**40.7**	**135**	15.4	8000			**30.5**	**57.18**	**53**	**38**	**0.050**
32.9	**32.9**	**53.1**	**2.784**	TVK3353L	**20.8**	**101**	10.5	8000			**32.9**	**54.6**	**52**	**39**	**0.020**
37.4	**37.4**	**57.3**	**2.784**	TVK3757L	**21.9**	**110**	11.5	7000			**37.4**	**58.8**	**56**	**44**	**0.023**
57	**57**	**71**	**2.784**	TVK5771L	**16.8**	**85.6**	8.60	6000			**57**	**72.5**	**70**	**61**	**0.020**
63	**63**	**78**	**2.8**	TVK6378L	**15.7**	**80.1**	8.05	5000			**63**	**79.5**	**76**	**68**	**0.023**

(1) To be measured under a 2.0 kN (450 lbf) load.
(2) r_a = 0.500 mm max. (0.0197 in max.).
(3) S_c=d-1.5mm, H_c=D_c+1.5mm

B

CYLINDRICAL ROLLER THRUST BEARINGS AND THEIR COMPONENTS

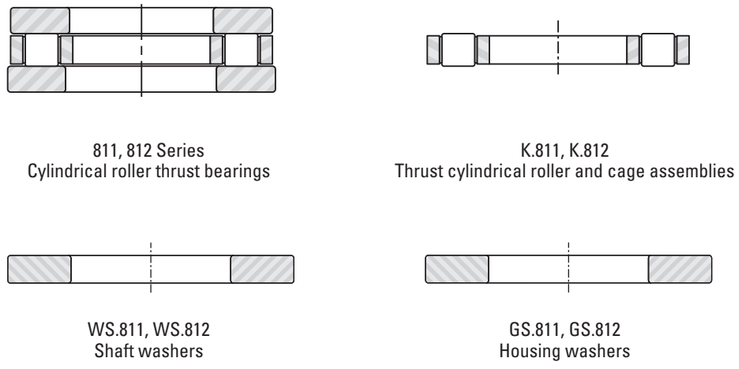
METRIC SERIES

Cylindrical roller thrust bearings provide rolling bearing arrangements that accommodate high-dynamic axial loads. The simple geometry of the bearing components allows the use of many design arrangements. As an example, for less demanding applications, it is possible to combine metric series, thrust cylindrical roller and cage assemblies, including the metric series heavy thrust washers (LS) and even the metric series thin thrust washers (AS). These two thrust washer types are more commonly used with thrust needle roller and cage assemblies. Thrust cylindrical roller and cage assemblies also can be used without bearing thrust washers if the adjacent machine components can be prepared to serve as suitable raceways.

Cylindrical roller thrust bearings may be used where the load carrying capability of thrust needle roller and cage assemblies is insufficient. Also, the bearings can accommodate high-dynamic and static axial loads in one direction, but they are not suitable to transmit radial loads.

REFERENCE STANDARDS ARE:

- **ISO 104** – rolling bearings – thrust bearings – boundary dimensions, general plan.
- **ISO 199** – rolling bearings – thrust bearings – tolerances.
- **DIN 616** – rolling bearings – general plan for boundary dimensions.
- **DIN 722** – rolling bearing – thrust cylindrical roller bearings – single direction.



811, 812 Series
Cylindrical roller thrust bearings

K.811, K.812
Thrust cylindrical roller and cage assemblies

WS.811, WS.812
Shaft washers

GS.811, GS.812
Housing washers

Fig. B6-3. Types of metric series cylindrical roller thrust bearings and their components

Suffixes	
LPB	Machined light metal window-type cage.
TVP	Molded window-type cage of glass reinforced nylon.

CONSTRUCTION

BASIC DESIGNS

Cylindrical roller thrust bearings of dimension series 811 and 812 comprise a thrust cylindrical roller and cage assembly (K), a shaft washer (WS) and a housing washer (GS). Providing the backup surfaces can be hardened and ground, they can be used as raceways for the cylindrical rollers of the thrust cylindrical roller and cage assembly resulting in a compact bearing arrangement.

CAGE DESIGNS

Metric series 811 and 812 cylindrical roller thrust bearings use molded cages of glass-fiber reinforced-nylon (suffix TVP) or machined cages of light metal (suffix LPB). The cages are designed to be piloted on the shaft. The reinforced nylon cages can be used at temperatures up to 120° C (250˚ F) continuously for extended periods. When lubricating these bearings with oil, it should be ensured that the oil does not contain additives detrimental to the cage over extended life at operating temperatures higher than 100° C (212˚ F). Also, care should be exercised that oil change intervals are observed as old oil may reduce cage life at such temperatures.

BEARING THRUST WASHERS

SHAFT WASHERS AND HOUSING WASHERS

Shaft washers of types WS.811 and WS.812, as well as housing washers of types GS.811 and GS.812, are components of the metric series cylindrical roller thrust bearings of series 811 and 812. They are made of bearing-quality steel – with hardened, precision- ground and lapped-flat raceway surfaces. The tolerances of the thrust bearing bore and outer diameter shown in Table B6-9 and Table B6-10 (see next page) apply to shaft-piloted and housing-piloted metric series washers.

HEAVY THRUST WASHERS (LS), THIN THRUST WASHERS (AS)

These thrust washers are more frequently used with thrust needle roller and cage assemblies of metric series FNT or AXK. They also are suitable for use with the thrust cylindrical roller and cage assemblies K.811. The heavy thrust washer of series LS are made of bearing-quality steel – hardened and precision-ground on the flat raceway surfaces. The bore and outer diameters of the heavy thrust washers are not ground. Therefore, when used with K.811 type assemblies, they are only suggested where accurate centering is not required. The thin thrust washers of series AS may be used in applications where the loads are light. Both types of these washers are listed in the tabular part of the metric series thrust needle roller and cage assemblies section.

B

DIMENSIONAL ACCURACY

The tolerances for the metric series cylindrical roller thrust bearing bore and outer diameter shown in Table B6-8 and B6-9 apply to shaft-piloted washers of series WS.811 and WS.812, as well as housing-piloted washers of series GS.811 and GS.812. Tolerances for the bore diameter of series K.811 and K.812 thrust assemblies are given on page B-6-30.

The tolerances for the bore and outer diameter of series AS thrust washers are shown in Table B6-10 below. The tolerances for the bore and outer diameter of series LS thrust washers are given in Table B6-11 on page B-6-29. Bore inspection procedures for thin thrust washers (AS) and heavy thrust washers (LS) are given on page B-6-8.

Table B6-8. Tolerances of cylindrical roller thrust bearings - shaft piloted washer - metric series

Nominal bore diameter d		Tolerance class P0 (normal tolerance)				Tolerance class P6				Tolerance class P5			
		Deviations		Variation	Wall thickness variation	Deviations		Variation	Wall thickness variation	Deviations		Variation	Wall thickness variation
		Δ_{dmp}		V_{dsp}	S_i[1]	Δ_{dmp}		V_{dsp}	S_i[1]	Δ_{dmp}		V_{dsp}	S_i[1]
>	≤	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in
	18.000 0.7087	**0.000** 0.0000	**-0.008** -0.0003	**0.006** 0.0002	**0.010** 0.0004	**0.000** 0.0000	**-0.008** -0.0003	**0.006** 0.0002	**0.005** 0.0002	**0.000** 0.0000	**-0.008** -0.0003	**0.006** 0.0002	**0.003** 0.0001
18.000 0.7087	**30.000** 1.1811	**0.000** 0.0000	**-0.010** -0.0004	**0.008** 0.0003	**0.010** 0.0004	**0.000** 0.0000	**-0.010** -0.0004	**0.008** 0.0003	**0.005** 0.0002	**0.000** 0.0000	**-0.010** -0.0004	**0.008** 0.0003	**0.003** 0.0001
30.000 1.1811	**50.000** 1.9685	**0.000** 0.0000	**-0.012** -0.0005	**0.009** 0.00035	**0.010** 0.0004	**0.000** 0.0000	**-0.012** -0.0005	**0.009** 0.00035	**0.006** 0.0002	**0.000** 0.0000	**-0.012** -0.0005	**0.009** 0.00035	**0.003** 0.0001
50.000 1.9685	**80.000** 3.1496	**0.000** 0.0000	**-0.015** -0.0006	**0.011** 0.0004	**0.010** 0.0004	**0.000** 0.0000	**-0.015** -0.0006	**0.011** 0.0004	**0.007** 0.0003	**0.000** 0.0000	**-0.015** -0.0006	**0.011** 0.0004	**0.004** 0.0002
80.000 3.1496	**120.000** 4.7244	**0.000** 0.0000	**-0.020** -0.0008	**0.015** 0.0006	**0.015** 0.0006	**0.000** 0.0000	**-0.020** -0.0008	**0.015** 0.0006	**0.008** 0.0003	**0.000** 0.0000	**-0.020** -0.0008	**0.015** 0.0006	**0.004** 0.0002
120.000 4.7244	**180.000** 7.0866	**0.000** 0.0000	**-0.025** -0.0010	**0.019** 0.00075	**0.015** 0.0006	**0.000** 0.0000	**-0.025** -0.0010	**0.019** 0.00075	**0.009** 0.00035	**0.000** 0.0000	**-0.025** -0.0010	**0.019** 0.00075	**0.005** 0.0002
180.000 7.0866	**250.000** 9.8425	**0.000** 0.0000	**-0.030** -0.0012	**0.023** 0.0009	**0.020** 0.0008	**0.000** 0.0000	**-0.030** -0.0012	**0.023** 0.0009	**0.010** 0.0004	**0.000** 0.0000	**-0.030** -0.0012	**0.023** 0.0009	**0.005** 0.0002
250.000 9.8425	**315.000** 12.4016	**0.000** 0.0000	**-0.035** -0.0014	**0.026** 0.0010	**0.025** 0.0010	**0.000** 0.0000	**-0.035** -0.0014	**0.026** 0.0010	**0.013** 0.0005	**0.000** 0.0000	**-0.035** -0.0014	**0.026** 0.0010	**0.007** 0.0003
315.000 12.4016	**400.000** 15.7480	**0.000** 0.0000	**-0.040** -0.0016	**0.030** 0.0012	**0.030** 0.0012	**0.000** 0.0000	**-0.040** -0.0016	**0.030** 0.0012	**0.015** 0.0006	**0.000** 0.0000	**-0.040** -0.0016	**0.030** 0.0012	**0.007** 0.0003
400.000 15.7480	**500.000** 19.6850	**0.000** 0.0000	**-0.045** -0.0018	**0.034** 0.0013	**0.030** 0.0012	**0.000** 0.0000	**-0.045** -0.0018	**0.034** 0.0013	**0.018** 0.0007	**0.000** 0.0000	**-0.045** -0.0018	**0.034** 0.0013	**0.009** 0.00035

*The values of the wall thickness variation Se, for the housing piloted washer are identical to Si for the shaft - piloted washers.

Table B6-9. Tolerances of cylindrical roller thrust bearings - housing piloted washer - metric series

Nominal outside diameter D		Tolerance class P0 (normal tolerance)			Tolerance class P6			Tolerance class P5		
		Deviations		Variation	Deviations		Variation	Deviations		Variation
		Δ_{Dmp}		V_{Dsp}	Δ_{Dmp}		V_{Dsp}	Δ_{Dmp}		V_{Dsp}
>	≤	Max.	Min.	Max.	Max.	Min.	Max.	Max.	Min.	Max.
mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in
	30.000 1.1811	**0.000** 0.0000	**-0.013** -0.0005	**0.010** 0.0004	**0.000** 0.0000	**-0.013** -0.0005	**0.010** 0.0004	**0.000** 0.0000	**-0.013** -0.0005	**0.010** 0.0004
30.000 1.1811	**50.000** 1.9685	**0.000** 0.0000	**-0.016** -0.0006	**0.012** 0.0005	**0.000** 0.0000	**-0.016** -0.0006	**0.012** 0.0005	**0.000** 0.0000	**-0.016** -0.0006	**0.012** 0.0005
50.000 1.9685	**80.000** 3.1496	**0.000** 0.0000	**-0.019** -0.00075	**0.014** 0.00055	**0.000** 0.0000	**-0.019** -0.00075	**0.014** 0.00055	**0.000** 0.0000	**-0.019** -0.00075	**0.014** 0.00055
80.000 3.1496	**120.000** 4.7244	**0.000** 0.0000	**-0.022** -0.0009	**0.017** 0.0007	**0.000** 0.0000	**-0.022** -0.0009	**0.017** 0.0007	**0.000** 0.0000	**-0.022** -0.0009	**0.017** 0.0007
120.000 4.7244	**180.000** 7.0866	**0.000** 0.0000	**-0.025** -0.0010	**0.019** 0.00075	**0.000** 0.0000	**-0.025** -0.0010	**0.019** 0.00075	**0.000** 0.0000	**-0.025** -0.0010	**0.019** 0.00075
180.000 7.0866	**250.000** 9.8425	**0.000** 0.0000	**-0.030** -0.0012	**0.023** 0.0009	**0.000** 0.0000	**-0.030** -0.0012	**0.023** 0.0009	**0.000** 0.0000	**-0.030** -0.0012	**0.023** 0.0009
250.000 9.8425	**315.000** 12.4016	**0.000** 0.0000	**-0.035** -0.0014	**0.026** 0.0010	**0.000** 0.0000	**-0.035** -0.0014	**0.026** 0.0010	**0.000** 0.0000	**-0.035** -0.0014	**0.026** 0.0010
315.000 12.4016	**400.000** 15.7480	**0.000** 0.0000	**-0.040** -0.0016	**0.030** 0.0012	**0.000** 0.0000	**-0.040** -0.0016	**0.030** 0.0012	**0.000** 0.0000	**-0.040** -0.0016	**0.030** 0.0012
400.000 15.7480	**500.000** 19.6850	**0.000** 0.0000	**-0.045** -0.0018	**0.034** 0.0013	**0.000** 0.0000	**-0.045** -0.0018	**0.034** 0.0013	**0.000** 0.0000	**-0.045** -0.0018	**0.034** 0.0013

Table B6-10. Tolerances for outer diameter (d_1) and bore diameter (d) of series AS thrust washers

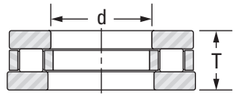
d_1		Deviations of max. O.D. (e13)		d		Deviations of min. bore diameter (E13)	
>	≤	Max.	Min.	>	≤	Max.	Min.
mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in
18.000 0.7087	**30.000** 1.1811	**-0.040** -0.0016	**-0.370** -0.0146	**3.000** 0.1181	**6.000** 0.2362	**+0.200** +0.0079	**+0.020** +0.0008
30.000 1.1811	**50.000** 1.9685	**-0.050** -0.0020	**-0.440** -0.0173	**6.000** 0.2362	**10.000** 0.3937	**+0.245** +0.0096	**+0.025** +0.0010
50.000 1.9685	**80.000** 3.1496	**-0.060** -0.0024	**-0.520** -0.0205	**10.000** 0.3937	**18.000** 0.7087	**+0.302** +0.0119	**+0.032** +0.0013
80.000 3.1496	**120.000** 4.7244	**-0.072** -0.0028	**-0.612** -0.0241	**18.000** 0.7087	**30.000** 1.1811	**+0.370** +0.0146	**+0.040** +0.0016
120.000 4.7244	**180.000** 7.0866	**-0.085** -0.0034	**-0.715** -0.0282	**30.000** 1.1811	**50.000** 1.9685	**+0.440** +0.0173	**+0.050** +0.0020
180.000 7.0866	**250.000** 9.8425	**-0.100** -0.0039	**-0.820** -0.0323	**50.000** 1.9685	**80.000** 3.1496	**+0.520** +0.0205	**+0.060** +0.0024
				80.000 3.1496	**120.000** 4.7244	**+0.612** +0.0241	**+0.072** +0.0028
				120.000 4.7244	**180.000** 7.0866	**+0.715** +0.0281	**+0.085** +0.0034

Table B6-11. Tolerances for outer diameter (d_1) and bore diameter (d) of series LS heavy thrust washers

d1		Deviations of max. O.D. (a12)		d		Deviations of min. bore diameter (E12)	
>	≤	Max.	Min.	>	≤	Max.	Min.
mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in
18.000 0.7087	**30.000** 1.1811	**-0.300** -0.0118	**-0.510** -0.0201	**3.000** 0.1181	**6.000** 0.2362	**+0.140** +0.0055	**+0.020** +0.0008
30.000 1.1811	**40.000** 1.5748	**-0.310** -0.0122	**-0.560** -0.0221	**6.000** 0.2362	**10.000** 0.3937	**+0.175** +0.0069	**+0.025** +0.0010
40.000 1.5748	**50.000** 1.9685	**-0.320** -0.0126	**-0.570** -0.0224	**10.000** 0.3937	**18.000** 0.7087	**+0.212** +0.0084	**+0.032** +0.0013
50.000 1.9685	**65.000** 2.5591	**-0.340** -0.0134	**-0.640** -0.0252	**18.000** 0.7087	**30.000** 1.1811	**+0.250** +0.0098	**+0.040** +0.0016
65.000 2.5591	**80.000** 3.1496	**-0.360** -0.0142	**-0.660** -0.0260	**30.000** 1.1811	**50.000** 1.9685	**+0.300** +0.0118	**+0.050** +0.0020
80.000 3.1496	**100.000** 3.9370	**-0.380** -0.0150	**-0.730** -0.0290	**50.000** 1.9685	**80.000** 3.1496	**+0.360** +0.0142	**+0.060** +0.0024
100.000 3.9370	**120.000** 4.7244	**-0.410** -0.0161	**-0.760** -0.0299	**80.000** 3.1496	**120.000** 4.7244	**+0.422** +0.0166	**+0.072** +0.0028
120.000 4.7244	**140.000** 5.5118	**-0.460** -0.0181	**-0.860** -0.0339	**120.000** 4.7244	**180.000** 7.0866	**+0.485** +0.0191	**+0.085** +0.0034
140.000 5.5118	**160.000** 6.2992	**-0.520** -0.0205	**-0.920** -0.0362				
160.000 6.2992	**180.000** 7.0866	**-0.580** -0.0228	**-0.980** -0.0386				
180.000 7.0866	**200.000** 7.8740	**-0.660** -0.0260	**-1.120** -0.0441				

Thickness tolerances for series LS heavy thrust washers are given in bearing tables.

Table B6-12. Tolerances of width T of thrust cylindrical roller bearings (811 and 812 series)



Nominal bore diameter of shaft piloted washer **d**		Deviations of width **T**	
>	≤	Max.	Min.
mm	mm	mm	mm
-	30	+0.02	-0.25
30	50	+0.02	-0.25
50	80	+0.02	-0.30
80	120	+0.02	-0.30

MOUNTING TOLERANCES

Shaft and housing tolerances for mounting metric series thrust cylindrical roller and cage assemblies are given in Table B6-13, shown below. If the cylindrical rollers of the thrust cylindrical roller and cage assemblies are to run directly on the adjacent support surfaces, they must be hardened to at least 58 HRC.

Table B6-13. Mounting tolerances for shafts and housings for metric series components

Bearing components	Shaft tolerance (shaft piloting)	Housing tolerance (housing piloting)	Piloting member
Thrust cylindrical roller and cage assembly. Types: K.811 and K.812	h8	H10	Shaft
Thin thrust washer. Type: AS	h10	H11	Shaft
Heavy thrust washer. Type: LS	h10	H11	Shaft
Shaft-piloted thrust washer. Type: WS.811, WS.812	h6 (j6)	Clearance	Shaft
Housing-piloted thrust washer. Type: GS.811, GS.812	Clearance	H7 (K7)	Housing

The backup surfaces for the shaft washers WS.811 and WS.812 as well as the housing washers GS.811 and GS.812 of cylindrical roller thrust bearings must be square with the axis of the shaft. Equally important, the raceway or the surface backing the thrust washer must not be dished or coned. The permissible limits of the squareness and dishing or coning are shown in figures below. When using the thin (AS) thrust washers the cylindrical rollers of the thrust cage assembly must be supported over their entire length.

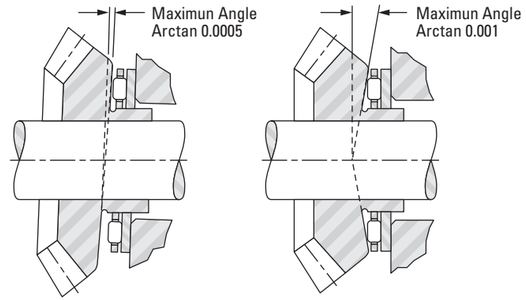


Fig. B6-4. Permissible limits

Bearing thrust washers should make close contact with the shaft or housing shoulder and must not touch the fillet radius. Therefore, the maximum fillet radius $r_{a\ max.}$ must be no greater than the minimum chamfer $r_{s\ min.}$ of the shaft washer (WS) and the housing washer (GS). See tabular pages B-6-31 and B-6-33.

Since roller thrust bearings generally run under considerable loads their incorporated washer (and thrust washer) should be supported on a shoulder covering the whole area of circulation of the rollers.

LOAD RATINGS

MINIMUM AXIAL LOAD

To prevent slippage, a cylindrical roller thrust bearing must always be axially loaded. For satisfactory operation, a certain minimum load must be applied between the cylindrical rollers and their raceways. This can be calculated from:

$F_{a\ min.}$ = $C_{0a}/2200$ [kN]

Where:

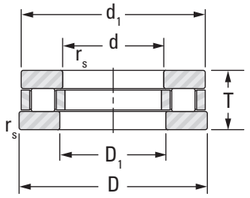
C_{0a} = static load rating [kN]
$F_{a\ min.}$ = minimum axial load [kN]

B

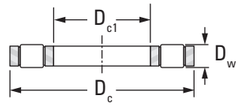
B

THRUST CYLINDRICAL ROLLER AND CAGE ASSEMBLIES, THRUST WASHERS

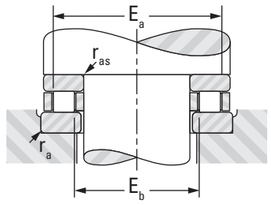
METRIC SERIES



811, 812

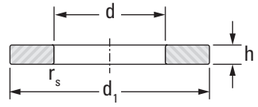


K.811, K.812

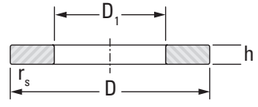


Shaft Dia.	Assembly Dimensions							Assembly Designation	Load Ratings		Fatigue Load Limit	Speed Rating
	D_{c1} [1]	D_c	D_w	T	$E_{b\,max.}$	$E_{a\,min.}$	$r_{as\,max.}$ $r_{a\,max.}$		Dynamic	Static		
		(a13)							C	C_o		
mm	mm in	mm in	mm in	mm in	mm in	mm in	mm in		kN lbf		kN	min^{-1}
15	15 0.5906	28 1.1024	3.5 0.1378	9 0.354	18 0.709	25 0.984	0.3 0.012	K.81102LPB	12.1 2720	26.3 5910	3.70	12000
	15 0.5906	28 1.1024	3.5 0.1378	9 0.354	18 0.709	25 0.984	0.3 0.012	K.81102TVP	12.8 2880	28.6 6430	4.05	12000
17	17 0.6693	30 1.1811	3.5 0.1378	– –	20 0.787	27 1.063	0.3 0.012	K.81103LPB	12.6 2830	28.6 6430	4.05	11000
	17 0.6693	30 1.1811	3.5 0.1378	9 0.354	20 0.787	27 1.063	0.3 0.012	K.81103TVP	14.2 3190	33.4 7510	4.70	11000
20	20 0.7874	35 1.3780	4.5 0.1772	10 0.394	23 0.906	32 1.260	0.3 0.012	K.81104TVP	23.6 5310	56.8 12800	6.85	9500
25	25 0.9843	42 1.6535	5.0 0.1969	11 0.433	28 1.102	39 1.535	0.6 0.024	K.81105TVP	31.2 7010	81.0 18200	11.4	8000
30	30 1.1811	47 1.8504	5.0 0.1969	– –	33 1.299	44 1.732	0.6 0.024	K.81106LPB	28.5 6410	69.5 15600	10.7	6700
	30 1.1811	47 1.8504	5.0 0.1969	11 0.433	33 1.299	44 1.732	0.6 0.024	K.81106TVP	33.0 7420	91.1 20500	12.8	6700
	30 1.1811	52 2.0472	7.5 0.2953	– –	33 1.299	49 1.929	0.6 0.024	K.81206LPB	53.4 12000	129 29000	13.9	6300
	30 1.1811	52 2.0472	7.5 0.2953	16 0.630	33 1.299	49 1.929	0.6 0.024	K.81206TVP	56.9 12800	141 31700	15.2	6300
35	35 1.3780	52 2.0472	5.0 0.1969	– –	38 1.496	49 1.929	0.6 0.024	K.81107LPB	30.8 6920	86.0 19300	12.1	6000
	35 1.3780	52 2.0472	5.0 0.1969	12 0.472	38 1.496	49 1.929	0.6 0.024	K.81107TVP	34.8 7820	101 22700	14.2	6000
	35 1.3780	62 2.4409	7.5 0.2953	– –	41 1.614	56 2.205	1.0 0.039	K.81207LPB	58.3 13100	152 34200	16.5	5300
	35 1.3780	62 2.4409	7.5 0.2953	18 0.709	41 1.614	56 2.205	1.0 0.039	K.81207TVP	61.6 13800	164 36900	17.7	5300
40	40 1.5748	60 2.3622	6.0 0.2362	– –	44 1.732	56 2.205	0.6 0.024	K.81108LPB	44.2 9940	126 28300	12.0	5300
	40 1.5748	60 2.3622	6.0 0.2362	13 0.512	44 1.732	56 2.205	0.6 0.024	K.81108TVP	49.8 11200	148 33300	14.1	5300
	40 1.5748	68 2.6772	9.0 0.3543	19 0.748	45 1.772	63 2.480	1.0 0.039	K.81208TVP	86.8 19500	233 52400	26.9	4800
45	45 1.7717	65 2.5591	6.0 0.2362	– –	49 1.929	61 2.402	0.6 0.024	K.81109LPB	47.0 10600	140 31500	13.4	4800
	45 1.7717	65 2.5591	6.0 0.2362	14 0.551	49 1.929	61 2.402	0.6 0.024	K.81109TVP	52.3 11800	163 36600	15.5	4800
	45 1.7717	73 2.8740	9.0 0.3543	– –	50 1.969	68 2.677	1.0 0.039	K.81209TVP	94.2 21200	266 59800	30.8	4500

1) D_{c1} bore tolerance is applied E11 for *LPB. B13 for *TVP. (ISO tolerance see on page A-26.)



WS.811, WS.812



GS.811, GS.812

Approx. Wt.	Washer Dimensions			h		$r_{s\,min.}$	Washer Designation		Approx. Wt.	Shaft Dia.
	d	D_1	D, d_1	Max.	Min.					
kg lbs	mm in	mm in	mm in	mm in	mm in	mm in	Shaft Piloted	Housing Piloted	kg lbs	mm
0.006 0.013	15 0.591	16 0.630	28 1.102	2.75 0.108	2.64 0.104	0.3 0.012	WS.81102	GS.81102	0.010 0.022	15
0.006 0.013	15 0.591	16 0.630	28 1.102	2.75 0.108	2.64 0.104	0.3 0.012	WS.81102	GS.81102	0.010 0.022	
0.008 0.018	17 0.669	18 0.709	30 1.181	2.75 0.108	2.64 0.104	0.3 0.012	WS.81103	GS.81103	0.011 0.024	17
0.008 0.018	17 0.669	18 0.709	30 1.181	2.75 0.108	2.64 0.104	0.3 0.012	WS.81103	GS.81103	0.011 0.024	
0.009 0.020	20 0.787	21 0.827	35 1.378	2.75 0.108	2.62 0.103	0.3 0.012	WS.81104	GS.81104	0.014 0.031	20
0.014 0.031	25 0.984	26 1.024	42 1.654	3.00 0.118	2.87 0.113	0.6 0.024	WS.81105	GS.81105	0.021 0.046	25
0.026 0.057	30 1.181	32 1.260	47 1.850	3.00 0.118	2.87 0.113	0.6 0.024	WS.81106	GS.81106	0.023 0.051	30
0.016 0.035	30 1.181	32 1.260	47 1.850	3.00 0.118	2.87 0.113	0.6 0.024	WS.81106	GS.81106	0.023 0.051	
0.052 0.115	30 1.181	32 1.260	52 2.047	4.25 0.167	4.12 0.162	0.6 0.024	WS.81206	GS.81206	0.047 0.104	
0.034 0.075	30 1.181	32 1.260	52 2.047	4.25 0.167	4.12 0.162	0.6 0.024	WS.81206	GS.81206	0.047 0.104	
0.025 0.055	35 1.378	37 1.457	52 2.047	3.50 0.138	3.34 0.131	0.6 0.024	WS.81107	GS.81107	0.032 0.071	35
0.020 0.044	35 1.378	37 1.457	52 2.047	3.50 0.138	3.34 0.131	0.6 0.024	WS.81107	GS.81107	0.032 0.071	
0.073 0.161	35 1.378	37 1.457	62 2.441	5.25 0.207	5.09 0.200	1.0 0.039	WS.81207	GS.81207	0.085 0.187	
0.055 0.121	35 1.378	37 1.457	62 2.441	5.25 0.207	5.09 0.200	1.0 0.039	WS.81207	GS.81207	0.085 0.187	
0.044 0.097	40 1.575	42 1.654	60 2.362	3.50 0.138	3.34 0.131	0.6 0.024	WS.81108	GS.81108	0.043 0.095	40
0.031 0.068	40 1.575	42 1.654	60 2.362	3.50 0.138	3.34 0.131	0.6 0.024	WS.81108	GS.81108	0.043 0.095	
0.076 0.168	40 1.575	42 1.654	68 2.677	5.00 0.197	4.84 0.191	1.0 0.039	WS.81208	GS.81208	0.093 0.205	
0.035 0.077	45 1.772	47 1.850	65 2.559	4.00 0.157	3.84 0.151	0.6 0.024	WS.81109	GS.81109	0.054 0.119	45
0.035 0.077	45 1.772	47 1.850	65 2.559	4.00 0.157	3.84 0.151	0.6 0.024	WS.81109	GS.81109	0.054 0.119	
0.083 0.183	45 1.772	47 1.850	73 2.874	5.50 0.217	5.34 0.210	1.0 0.039	WS.81209	GS.81209	0.112 0.247	

Continued on next page.

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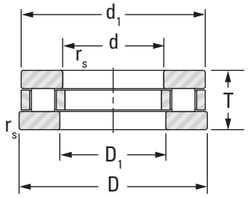
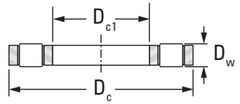
THRUST CYLINDRICAL ROLLER AND CAGE ASSEMBLIES, THRUST WASHERS

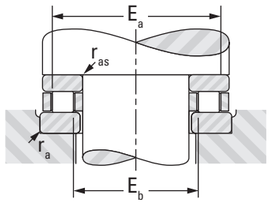
METRIC SERIES

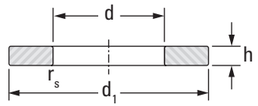


811, 812

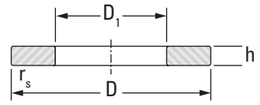


K.811, K.812





WS.811, WS.812



GS.811, GS.812

Shaft Dia.	Assembly Dimensions							Assembly Designation	Load Ratings		Fatigue Load Limit	Speed Rating Oil
	D_{c1} [1]	D_c	D_w	T	$E_{b\,max.}$	$E_{a\,min.}$	$r_{as\,max.}$ $r_{a\,max.}$		Dynamic	Static		
		(a13)							C	C_o		
mm	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in		**kN** lbf		kN	min^{-1}
50	**50** 1.9685	**70** 2.7559	**6.0** 0.2362	**14** 0.551	**54** 2.126	**66** 2.598	**0.6** 0.024	K.81110LPB	**49.7** 11200	**155** 34800	14.8	4300
	50 1.9685	**70** 2.7559	**6.0** 0.2362	**14** 0.551	**54** 2.126	**66** 2.598	**0.6** 0.024	K.81110TVP	**54.8** 12300	**177** 39800	17.0	4300
	50 1.9685	**78** 3.0709	**9.0** 0.3543	**22** 0.866	**55** 2.165	**73** 2.874	**1.0** 0.039	K.81210TVP	**101** 22700	**299** 67200	34.6	4000
55	**55** 2.1654	**78** 3.0709	**6.0** 0.2362	**16** 0.630	**60** 2.362	**73** 2.874	**0.6** 0.024	K.81111TVP	**60.3** 13600	**207** 46500	19.8	4000
	55 2.1654	**90** 3.5433	**11.0** 0.4331	**–** –	**61** 2.402	**84** 3.307	**1.0** 0.039	K.81211LPB	**127** 28600	**359** 80700	39.6	3600
	55 2.1654	**90** 3.5433	**11.0** 0.4331	**25** 0.984	**61** 2.402	**84** 3.307	**1.0** 0.039	K.81211TVP	**138** 31000	**403** 90600	45.2	3600
60	**60** 2.3622	**85** 3.3465	**7.5** 0.2953	**17** 0.669	**65** 2.559	**80** 3.150	**1.0** 0.039	K.81112TVP	**84.4** 19000	**281** 63200	30.4	3600
	60 2.3622	**95** 3.7402	**11.0** 0.4331	**26** 1.024	**66** 2.598	**89** 3.504	**1.0** 0.039	K.81212LPB	**129** 29000	**378** 85000	42.4	3400
65	**65** 2.5591	**90** 3.5433	**7.5** 0.2953	**18** 0.709	**70** 2.756	**85** 3.346	**1.0** 0.039	K.81113TVP	**88.3** 19900	**305** 68600	33.0	3400
	65 2.5591	**100** 3.9370	**11.0** 0.4331	**27** 1.063	**71** 2.795	**94** 3.701	**1.0** 0.039	K.81213LPB	**134** 30100	**403** 90600	45.2	3200
70	**70** 2.7559	**95** 3.7402	**7.5** 0.2953	**18** 0.709	**75** 2.953	**90** 3.543	**1.0** 0.039	K.81114TVP	**92.1** 20700	**328** 73700	35.5	3200
	70 2.7559	**105** 4.1339	**11.0** 0.4331	**27** 1.063	**76** 2.992	**99** 3.898	**1.0** 0.039	K.81214LPB	**138** 31000	**428** 96200	48.0	3000
75	**75** 2.9528	**100** 3.9370	**7.5** 0.2953	**19** 0.748	**80** 3.150	**95** 3.740	**1.0** 0.039	K.81115LPB	**86.1** 19400	**305** 68600	33.0	3000
	75 2.9528	**110** 4.3307	**11.0** 0.4331	**27** 1.063	**81** 3.189	**104** 4.094	**1.0** 0.039	K.81215LPB	**143** 32100	**453** 101800	50.9	2800
80	**80** 3.1496	**105** 4.1339	**7.5** 0.2953	**19** 0.748	**85** 3.346	**100** 3.937	**1.0** 0.039	K.81116LPB	**87.5** 19700	**316** 71000	34.2	2800
	80 3.1496	**115** 4.5276	**11.0** 0.4331	**28** 1.102	**86** 3.386	**109** 4.291	**1.0** 0.039	K.81216LPB	**147** 33000	**478** 107500	53.7	2600
85	**85** 3.3465	**110** 4.3307	**7.5** 0.2953	**19** 0.748	**90** 3.543	**105** 4.134	**1.0** 0.039	K.81117LPB	**88.9** 20000	**328** 73700	35.5	2600
	85 3.3465	**125** 4.9213	**12.0** 0.4724	**31** 1.220	**93** 3.661	**117** 4.606	**1.0** 0.039	K.81217LPB	**174** 39100	**572** 128600	65.5	2400
90	**90** 3.5433	**120** 4.7244	**9.0** 0.3543	**22** 0.866	**96** 3.780	**114** 4.488	**1.0** 0.039	K.81118LPB	**119** 26800	**432** 97100	49.3	2400
	90 3.5433	**135** 5.3150	**14.0** 0.5512	**35** 1.378	**98** 3.858	**127** 5.000	**1.0** 0.039	K.81218LPB	**215** 48300	**691** 155300	81.5	2400

1) D_{c1} bore tolerance is applied E11 for *LPB. B13 for *TVP. (ISO tolerance see on page A-26.)

Approx. Wt.	Washer Dimensions			h		$r_{s\,min.}$	Washer Designation		Approx. Wt.	Shaft Dia.
	d	D_1	D, d_1	Max.	Min.					
kg lbs	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	Shaft Piloted	Housing Piloted	**kg** lbs	**mm**
0.052 0.115	**50** 1.969	**52** 2.047	**70** 2.756	**4.00** 0.157	**3.84** 0.151	**0.6** 0.024	WS.81110	GS.81110	**0.059** 0.130	**50**
0.042 0.093	**50** 1.969	**52** 2.047	**70** 2.756	**4.00** 0.157	**3.84** 0.151	**0.6** 0.024	WS.81110	GS.81110	**0.059** 0.130	
0.089 0.196	**50** 1.969	**52** 2.047	**78** 3.071	**6.5** 0.256	**6.34** 0.250	**1.0** 0.039	WS.81210	GS.81210	**0.144** 0.317	**55**
0.066 0.146	**55** 2.165	**57** 2.244	**78** 3.071	**5.00** 0.197	**4.81** 0.189	**0.6** 0.024	WS.81111	GS.81111	**0.094** 0.207	
0.156 0.344	**55** 2.165	**57** 2.244	**90** 3.543	**7.00** 0.276	**6.81** 0.268	**1.0** 0.039	WS.81211	GS.81211	**0.219** 0.483	
0.140 0.309	**55** 2.165	**57** 2.244	**90** 3.543	**7.00** 0.276	**6.81** 0.268	**1.0** 0.039	WS.81211	GS.81211	**0.219** 0.483	
0.103 0.227	**60** 2.362	**62** 2.441	**85** 3.346	**4.75** 0.187	**4.56** 0.180	**1.0** 0.039	WS.81112	GS.81112	**0.106** 0.234	**60**
0.166 0.366	**60** 2.362	**62** 2.441	**95** 3.740	**7.50** 0.295	**7.31** 0.288	**1.0** 0.039	WS.81212	GS.81212	**0.251** 0.553	
0.109 0.240	**65** 2.559	**67** 2.638	**90** 3.543	**5.25** 0.207	**5.06** 0.199	**1.0** 0.039	WS.81113	GS.81113	**0.125** 0.276	**65**
0.176 0.388	**65** 2.559	**67** 2.638	**100** 3.937	**8.00** 0.315	**7.81** 0.307	**1.0** 0.039	WS.81213	GS.81213	**0.285** 0.628	
0.056 0.123	**70** 2.756	**72** 2.835	**95** 3.740	**5.25** 0.207	**5.06** 0.199	**1.0** 0.039	WS.81114	GS.81114	**0.133** 0.293	**70**
0.186 0.410	**70** 2.756	**72** 2.835	**105** 4.134	**8.00** 0.315	**7.81** 0.307	**1.0** 0.039	WS.81214	GS.81214	**0.302** 0.666	
0.091 0.201	**75** 2.953	**77** 3.031	**100** 3.937	**5.75** 0.226	**5.56** 0.219	**1.0** 0.039	WS.81115	GS.81115	**0.155** 0.342	**75**
0.197 0.434	**75** 2.953	**77** 3.031	**110** 4.331	**8.00** 0.315	**7.81** 0.307	**1.0** 0.039	WS.81215	GS.81215	**0.319** 0.703	
0.103 0.227	**80** 3.150	**82** 3.228	**105** 4.134	**5.75** 0.226	**5.56** 0.219	**1.0** 0.039	WS.81116	GS.81116	**0.165** 0.364	**80**
0.208 0.459	**80** 3.150	**82** 3.228	**115** 4.528	**8.50** 0.335	**8.31** 0.327	**1.0** 0.039	WS.81216	GS.81216	**0.357** 0.787	
0.108 0.238	**85** 3.346	**87** 3.425	**110** 4.331	**5.75** 0.226	**5.53** 0.218	**1.0** 0.039	WS.81117	GS.81117	**0.173** 0.381	**85**
0.376 0.829	**85** 3.346	**88** 3.465	**125** 4.921	**9.50** 0.374	**9.28** 0.365	**1.0** 0.039	WS.81217	GS.81217	**0.492** 1.085	
0.156 0.344	**90** 3.543	**92** 3.622	**120** 4.724	**6.50** 0.256	**6.28** 0.247	**1.0** 0.039	WS.81118	GS.81118	**0.253** 0.558	**90**
0.540 1.190	**90** 3.543	**93** 3.661	**135** 5.315	**10.50** 0.413	**10.28** 0.405	**1.1** 0.043	WS.81218	GS.81218	**0.655** 1.444	

THRUST ASSEMBLIES AND THRUST BEARINGS – INCH SERIES

Thrust assemblies and thrust bearings of inch series are available in a variety of sizes. This catalog includes the most popular, standardized designs. If the backup surfaces cannot be used as raceways, hardened thrust washers are available.

REFERENCE STANDARDS ARE:

- **ANSI/ABMA Std. 21.2** – thrust needle roller and case assemblies and thrust washers – inch design.
- **ANSI/ABMA Std. 24.2** – thrust bearings of ball and cylindrical roller types – inch design.

NTA
Thrust needle roller and cage assembly

NTH
Thrust cylindrical roller and cage assembly

NTHA
Cylindrical roller thrust bearing

TRA…TRD
Thrust washers

Fig. B6-5. Types of inch series thrust assemblies, thrust bearings and thrust washers

IDENTIFICATION

NTA is the complete prefix code for a thrust needle roller and cage assembly with inch nominal dimensions using needle rollers of the smallest practical diameter.

Thrust cylindrical roller and cage assemblies with inch nominal dimensions are identified by the prefix letters NTH. They use large diameter cylindrical rollers, providing higher load ratings.

Thrust washers of inch nominal dimensions are identified by the prefix letters TR followed by another letter such as A, B or C etc. – indicating washer thickness. TRA is the complete prefix code for the thinnest thrust washer made to inch nominal dimensions.

Most thrust washers are intended to be piloted on their bores. Some washers, however, are designed to be piloted on their outer diameters. Such washers are identified by the letter D, following the thickness code letter. Thus TRJD is the complete prefix code for a thrust washer with inch nominal dimensions of J thickness and designed to be piloted by its outer diameter.

Cylindrical roller thrust bearings, with prefix code NTHA, are made up of one NTH assembly – one TRI or TRJ bore-piloted washer and one TRID or TRJD outer-diameter piloted washer.

Because the bearing designation for thrust assemblies does not appear on the bearing itself, the manufacturer's parts list or another reliable source should always be consulted when ordering bearings for service or field replacement – to make certain that the correct bearing with the correct lubricant is used.

CONSTRUCTION

Thrust needle roller and cage assemblies (NTA) and thrust cylindrical roller and cage assemblies (NTH) have hardened cages and through-hardened, precision-ground rollers. The cages are securely fastened assemblies of two mating pieces. This construction minimizes cage stress and assures that the roller retaining function of the cage is unaffected by normal wear. The needle rollers and the cylindrical rollers are precision ground and lapped to close tolerance for optimum load distribution.

Thrust washers for the thrust needle roller and cage assemblies are designed for bore piloting. The thinner thrust washers are tumble burnished and may be out-of-flat due to heat treatment – but will flatten under load. The raceway surfaces of thick thrust washers are ground and lapped.

Thrust washers for the thrust cylindrical roller and cage assemblies are available in both bore-piloted and outer-diameter piloted types. Their piloting surfaces are ground and raceway surfaces are ground and lapped.

DIMENSIONAL ACCURACY

TOLERANCES FOR THRUST NEEDLE ROLLER AND CAGE ASSEMBLIES

Pages B-6-38 to B-6-47, list the nominal outer diameter, bore diameter and the needle roller diameter for the inch thrust needle roller and cage assemblies and their corresponding thrust washers appear in the bearing tables.

Tolerances for the bore diameters and outer diameters of inch thrust assemblies are given in Table B6-14.

Table B6-14. Tolerances for bore (D_{c1}) and outer (D_c) diameters of nominal inch thrust needle (NTA) and cylindrical (NTH) roller and cage assemblies

NTA thrust needle roller and cage assemblies				
Needle roller diameter (nominal)	Deviations			
	Bore diameter D_{c1}		Outer diameter D_c	
D_w	Max.	Min.	Max.	Min.
mm **in**	mm **in**	mm **in**	mm **in**	mm **in**
1.984 **0.0781**	+0.178 **+0.007**	+0.051 **+0.002**	-0.254 **-0.010**	-0.508 **-0.020**
3.175 **0.1250**	+0.254 **+0.010**	+0.051 **+0.002**	-0.254 **-0.010**	-0.635 **-0.025**
NTH thrust cylindrical roller and cage assemblies				
All diameters	+0.381 **+0.015**	0.000 **0.000**	-0.127 **-0.005**	-0.508 **-0.020**

BORE INSPECTION PROCEDURE FOR ASSEMBLY

The bore diameter (D_{c1}) of the assembly should be checked with "go" and "no go" plug gages. The "go" plug gage size is the minimum bore diameter of the assembly. The "no go" plug gage size is the maximum bore diameter of the assembly.

The assembly must fall freely from the "go" plug gage under its own free weight. The "no go" plug gage must not enter the bore. Where the "no go" plug gage can be forced through the bore, the assembly must not fall from the gage under its own weight.

TOLERANCES FOR THRUST WASHERS

Tolerances for the outer diameters and bore diameters of nominal inch thrust washers are given in Tables B6-15 and B6-16.

Table B6-15. Tolerances for outer diameter (d_1) of nominal inch (TRA, TRB, etc.) thrust washers

d_1:Nominal outer diameter				Deviations			
>		≤		Max.		Min.	
mm	**in**	mm	**in**	mm	**in**	mm	**in**
6.000	**0.24**	133.400	**5.25**	-0.254	**-0.010**	-0.762	**-0.030**

Table B6-16. Tolerances for bore diameter (d) of nominal inch (TRA, TRB, etc.) thrust washers

d:Nominal bore diameter				Deviations			
>		≤		Max.		Min.	
mm	**in**	mm	**in**	mm	**in**	mm	**in**
6.000	**0.24**	57.200	**2.25**	+0.300	**+0.012**	+0.050	**+0.002**
57.200	**2.25**	133.400	**5.25**	+0.430	**+0.017**	+0.050	**+0.002**

BORE INSPECTION PROCEDURE FOR THRUST WASHER

The bore diameter (d) of the thrust washer should be checked with "go" and "no go" plug gages. The "go" plug gage size is the minimum bore diameter of the thrust washer. The "no go" plug gage size is the maximum bore diameter of the thrust washer.

The thrust washer, under its own weight, must fall freely from the "go" plug gage. The "no go" plug gage must not enter the bore. Where the "no go" plug gage can be forced through the bore, the thrust washer must not fall from the gage under its own weight.

TOLERANCES FOR CYLINDRICAL ROLLER THRUST BEARINGS

The tolerances for inch series cylindrical roller thrust bearings, cylindrical roller cage and thrust assemblies and their corresponding component thrust washers appear in the bearing tables.

MOUNTING TOLERANCES

THRUST NEEDLE ROLLER AND CAGE ASSEMBLIES

On NTA inch type thrust needle roller and cage assemblies, the cage bore has a larger contact area and a closer tolerance than the outer diameter. Therefore, bore piloting is preferred for these assemblies. To reduce wear, it is suggested that the piloting surface for the cage be hardened to an equivalent of at least 55 HRC.

Where design requirements prevent bore piloting, the NTA thrust needle roller and cage assemblies may be piloted on the outer diameters. It should be noted that the "diameter to clear washer O.D." given in the bearing tables is not suitable for outer diameter piloting. For such cases, suitable O.D. piloting dimensions should be determined in consultation with your representative.

THRUST WASHERS FOR USE WITH NTA THRUST NEEDLE ROLLER AND CAGE ASSEMBLIES

Ideally, a thrust washer should be stationary with respect to and piloted by its supporting or backing member – whether or not this is an integral part of the shaft or housing. There should be no rubbing action between the thrust washer and any other machine member. The economics of design, however, often preclude these ideal conditions and thrust washers must be employed in another manner. In such cases, design details should be determined in consultation with your representative.

THRUST CYLINDRICAL ROLLER AND CAGE ASSEMBLIES

Type NTH assembly cage has a relatively large contact area on both the bore and the outer diameter. Thus, these assemblies can be piloted by either the shaft or the housing. In order to reduce wear, it is suggested that the piloting surface for the cage be hardened to an equivalent of at least 55 HRC.

When the shaft is used as the piloting surface the outer diameter of the cage must clear the housing under all conditions. Conversely, when the housing is the piloting surface, the shaft must clear the cage bore under all conditions. The mounting dimensions are given in the bearing tables for both shaft and housing piloting. Bore inspection procedure for the assembly given on page B-6-35 should be used for checking the bore of NTH assemblies.

THRUST WASHERS FOR USE WITH THRUST CYLINDRICAL ROLLER AND CAGE ASSEMBLIES

Types TRID and TRJD thrust washers for use with thrust cylindrical roller and cage assemblies are designed to pilot from the housing and to clear the shaft. Types TRI and TRJ thrust washers are designed to pilot from the shaft and clear the housing. The thrust washers should be stationary with respect to their piloting (or locating) machine members. There should be no rubbing action between the washer and any other machine member.

BACKUP SURFACES

In some applications, it is desirable to use the backup surfaces as raceways for the rollers of the thrust assemblies. When this is done, these surfaces must be hardened to an equivalent of at least 58 HRC. If this hardness cannot be achieved and thrust washers cannot be used, the load ratings must be reduced as explained in the engineering section of this catalog.

Thrust raceway surfaces must be ground to a surface of 8 µin Ra (0.20 µm Ra). When this requirement cannot be met, thrust washers must be used.

The raceways against which the rollers operate or the surfaces against which the thrust washers bear must be square with the axis of the shaft. Equally important, the raceway or surface backing the thrust washer must not be dished or coned. The permissible limits of out-of-squareness and dishing or coning are shown in the figures below.

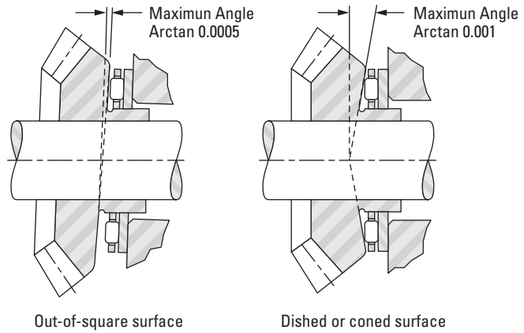


Fig. B6-6. Permissible limits

TYPE NTHA CYLINDRICAL ROLLER THRUST BEARING

The NTHA cylindrical roller thrust bearing consists of the NTH thrust cylindrical roller and cage assembly and two thrust washers. This bearing is sold as a unit.

A typical mounting of the thrust bearing on a rotating shaft is shown in Fig. B6-7. The bore of the rotating shaft supported thrust washer is ground for an accurate fit on the shaft. The outer diameter of the stationary housing supported thrust washer is ground for a proper fit in the housing.

The NTHA cylindrical roller thrust bearing cage is normally shaft piloted. In the event it is necessary to pilot the cage by the housing – Fig. B6-8 illustrates a possible mounting arrangement. When other mounting arrangements are dictated by the application, they should be determined in consultation with your representative.

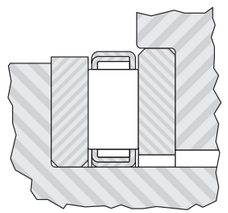


Fig. B6-7.
Typical mounting of a thrust bearing when the shaft rotates

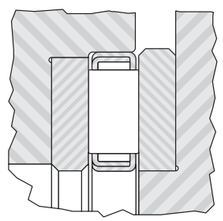


Fig. B6-8.
NTHA possible mounting arrangement

LOAD RATINGS

MINIMUM AXIAL LOAD

Slippage can occur if the applied axial load is too light and the operating speed of the thrust needle roller and cage assembly is high – particularly if accompanied by inadequate lubrication. For satisfactory operation, a certain minimum load must be applied to a thrust needle roller and cage assembly which can be calculated from:

$$F_{a\ min.} = C_{0a}/2200\ [kN]$$

Where:

C_{0a} = static load rating [kN]
$F_{a\ min.}$ = minimum axial load [kN]

LUBRICATION

Oil is the preferred lubricant for thrust needle or cylindrical roller and cage assemblies. An ample oil flow is absolutely necessary for high speeds or for moderate speeds when the load is relatively high.

SPECIAL DESIGNS

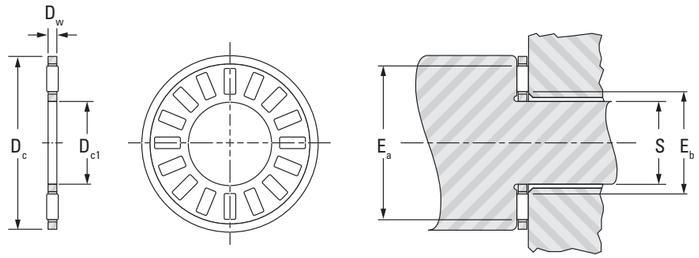
Thrust needle roller and cage assemblies and thrust washers are also made to special dimensions and configurations, as well as from special materials – when quantities permit economical manufacture.

Thrust needle roller and cage assemblies are particularly adaptable to low-cost integral combinations, with special thrust washers. When the use of such special designs are considered, the following pages should be reviewed for evaluation of proposed arrangements.

THRUST NEEDLE ROLLER AND CAGE ASSEMBLIES, THRUST WASHERS

INCH SERIES

- Dimensions for bore and O.D. of thrust assemblies and washers are nominal.
- See page B-6-36 for details on piloting and backup surfaces.
- Thrust washers burnished at least one-quarter of bore area (remainder is rough breakaway finish).
- O.D. finish of washers will be as blanked.

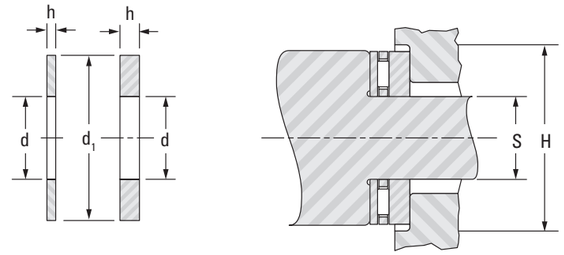


NTA

Raceway hardness to be 58 HRC or equivalent

Shaft Dia.	Assembly Dimensions					Assembly Designation	Load Ratings		Fatigue Load Limit C_u	Speed Rating[1]
	D_{c1}	D_c	D_w	E_b	E_a		Dynamic C	Static C_o		
in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in		**kN** lbf		kN	min^{-1}
1/4	**6.35** 0.250	**17.45** 0.687	**1.984** 0.0781	**8.636** 0.340	**14.732** 0.580	NTA-411	**5.12** 1150	**10.76** 2420	1.05	26000
5/16	**7.92** 0.312	**19.05** 0.75	**1.984** 0.0781	**10.16** 0.400	**16.256** 0.640	NTA-512	**5.83** 1310	**13.17** 2 960	1.30	24000
3/8	**9.53** 0.375	**20.625** 0.812	**1.984** 0.0781	**11.68** 0.460	**18.034** 0.710	NTA-613	**6.05** 1360	**14.32** 3220	1.40	22000
1/2	**12.70** 0.500	**23.80** 0.937	**1.984** 0.0781	**14.99** 0.590	**21.08** 0.830	NTA-815	**7.16** 1610	**19.13** 4300	1.85	19000
9/16	**14.275** 0.562	**25.40** 1.000	**1.984** 0.0781	**16.51** 0.650	**22.606** 0.890	NTA-916	**7.70** 1730	**21.53** 4840	2.10	18000
5/8	**15.88** 0.625	**28.575** 1.125	**1.984** 0.0781	**18.03** 0.710	**25.908** 1.020	NTA-1018	**9.79** 2200	**30.38** 6830	2.85	15000

[1]Speed ratings listed are based on adequate oil lubrication. See page B-6-37 for lubrication information.
Suggestions for an application requiring O.D. piloting should be determined in consultation with your representative.



Approx. Wt.	Thrust Washer Designation	Washer Dimensions				Piloting Dimensions		Dia. To Clear O.D.	Washer Wt.	Shaft Dia.
		d	d_1	h		S				
				Max.	Min.	Max.	Min.	H [2]		
kg lbs		**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**kg** lbs	in
0.001 0.003	TRA-411	**6.35** 0.250	**17.45** 0.687	**0.81** 0.032	**0.76** 0.030	**6.35** 0.250	**6.27** 0.247	**18.26** 0.719	**0.001** 0.003	1/4
	TRB-411	**6.35** 0.250	**17.45** 0.687	**1.60** 0.063	**1.52** 0.060	**6.35** 0.250	**6.27** 0.247	**18.26** 0.719	**0.002** 0.005	
	TRC-411	**6.35** 0.250	**17.45** 0.687	**2.41** 0.095	**2.34** 0.092	**6.35** 0.250	**6.27** 0.247	**18.26** 0.719	**0.004** 0.008	
0.002 0.004	TRA-512	**7.92** 0.312	**19.05** 0.750	**0.81** 0.032	**0.76** 0.030	**7.92** 0.312	**7.85** 0.309	**19.84** 0.781	**0.001** 0.003	5/16
	TRB-512	**7.92** 0.312	**19.05** 0.750	**1.60** 0.063	**1.52** 0.060	**7.92** 0.312	**7.85** 0.309	**19.84** 0.781	**0.003** 0.006	
0.002 0.004	TRA-613	**9.53** 0.375	**20.62** 0.812	**0.81** 0.032	**0.76** 0.030	**9.53** 0.375	**9.45** 0.372	**21.44** 0.844	**0.001** 0.003	3/8
	TRB-613	**9.53** 0.375	**20.62** 0.812	**1.60** 0.063	**1.52** 0.060	**9.53** 0.375	**9.45** 0.372	**21.44** 0.844	**0.003** 0.006	
	TRC-613	**9.53** 0.375	**20.62** 0.812	**2.41** 0.095	**2.34** 0.092	**9.53** 0.375	**9.45** 0.372	**21.44** 0.844	**0.004** 0.009	
0.002 0.005	TRA-815	**12.70** 0.500	**23.80** 0.937	**0.81** 0.032	**0.76** 0.030	**12.70** 0.500	**12.62** 0.497	**24.61** 0.969	**0.002** 0.004	1/2
	TRB-815	**12.70** 0.500	**23.80** 0.937	**1.60** 0.063	**1.52** 0.060	**12.70** 0.500	**12.62** 0.497	**24.61** 0.969	**0.004** 0.008	
	TRC-815	**12.70** 0.500	**23.80** 0.937	**2.41** 0.095	**2.34** 0.092	**12.70** 0.500	**12.62** 0.497	**24.61** 0.969	**0.005** 0.012	
0.003 0.006	TRA-916	**14.27** 0.562	**25.40** 1.000	**0.81** 0.032	**0.76** 0.030	**14.27** 0.562	**14.20** 0.559	**26.19** 1.031	**0.002** 0.005	9/16
	TRB-916	**14.27** 0.562	**25.40** 1.000	**1.60** 0.063	**1.52** 0.060	**14.27** 0.562	**14.20** 0.559	**26.19** 1.031	**0.004** 0.008	
	TRC-916	**14.27** 0.562	**25.40** 1.000	**2.41** 0.095	**2.34** 0.092	**14.27** 0.562	**14.20** 0.559	**26.19** 1.031	**0.006** 0.013	
0.003 0.007	TRA-1018	**15.88** 0.625	**28.58** 1.125	**0.81** 0.032	**0.76** 0.030	**15.88** 0.625	**15.80** 0.622	**29.36** 1.156	**0.003** 0.006	5/8
	TRB-1018	**15.88** 0.625	**28.58** 1.125	**1.60** 0.063	**1.52** 0.060	**15.88** 0.625	**15.80** 0.622	**29.36** 1.156	**0.005** 0.012	
	TRC-1018	**15.88** 0.625	**28.58** 1.125	**2.41** 0.095	**2.34** 0.092	**15.88** 0.625	**15.80** 0.622	**29.36** 1.156	**0.008** 0.018	
	TRD-1018	**15.88** 0.625	**28.58** 1.125	**3.20** 0.126	**3.12** 0.123	**15.88** 0.625	**15.80** 0.622	**29.36** 1.156	**0.011** 0.024	
	TRE-1018	**15.88** 0.625	**28.58** 1.125	**3.99** 0.157	**3.91** 0.154	**15.88** 0.625	**15.80** 0.622	**29.36** 1.156	**0.013** 0.029	

Continued on next page.

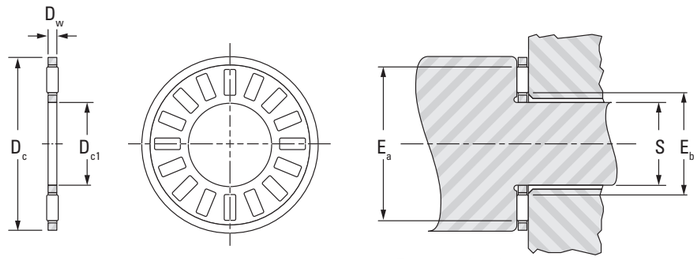
[2]If the shaft and the housing adjacent to the bearing O.D. are not concentric, the T.I.R. between the shaft and housing should be added to this dimension.

B

THRUST NEEDLE ROLLER AND CAGE ASSEMBLIES, THRUST WASHERS

INCH SERIES

- Dimensions for bore and O.D. of thrust assemblies and washers are nominal.
- See page B-6-36 for details on piloting and backup surfaces.
- Thrust washers burnished at least one-quarter of bore area (remainder is rough breakaway finish).
- O.D. finish of washers will be as blanked.

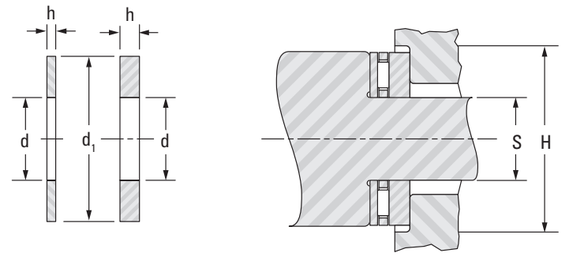


NTA

Raceway hardness to be 58 HRC or equivalent

Shaft Dia.	Assembly Dimensions					Assembly Designation	Load Ratings		Fatigue Load Limit C_u	Speed Rating[1]
	D_{c1}	D_c	D_w	E_b	E_a		Dynamic C	Static C_o		
in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in		**kN** lbf		kN	min^{-1}
3/4	**19.05** 0.750	**31.75** 1.250	**1.984** 0.0781	**21.34** 0.840	**28.956** 1.140	NTA-1220	**10.90** 2450	**36.48** 8200	3.40	14000
7/8	**22.23** 0.875	**36.50** 1.437	**1.984** 0.0781	**24.38** 0.960	**33.782** 1.330	NTA-1423	**13.43** 3020	**49.82** 11200	4.65	12000
7/8	**22.23** 0.875	**42.85** 1.687	**1.984** 0.0781	**25.91** 1.020	**39.878** 1.570	NTC-1427	**18.46** 4150	**78.29** 17600	8.05	9800
1	**25.40** 1.000	**39.675** 1.562	**1.984** 0.0781	**27.69** 1.090	**36.83** 1.450	NTA-1625	**13.83** 3110	**53.82** 12100	5.00	11000
1 1/8	**28.58** 1.125	**44.45** 1.75	**1.984** 0.0781	**30.73** 1.210	**41.656** 1.640	NTA-1828	**16.68** 3750	**71.17** 16000	7.30	9600

[1]Speed ratings listed are based on adequate oil lubrication. See page B-6-37 for lubrication information.
Suggestions for an application requiring O.D. piloting should be determined in consultation with your representative.



Approx. Wt.	Thrust Washer Designation	Washer Dimensions				Piloting Dimensions		Dia. To Clear O.D.	Washer Wt.	Shaft Dia.
		d	d_1	h		S				
				Max.	Min.	Max.	Min.	H [2]		
kg lbs		**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**kg** lbs	in
0.004 0.009	TRA-1220	**19.05** 0.750	**31.75** 1.250	**0.81** 0.032	**0.76** 0.030	**19.05** 0.750	**18.97** 0.747	**32.54** 1.281	**0.003** 0.007	3/4
	TRB-1220	**19.05** 0.750	**31.75** 1.250	**1.60** 0.063	**1.52** 0.060	**19.05** 0.750	**18.97** 0.747	**32.54** 1.281	**0.006** 0.013	
	TRC-1220	**19.05** 0.750	**31.75** 1.250	**2.41** 0.095	**2.34** 0.092	**19.05** 0.750	**18.97** 0.747	**32.54** 1.281	**0.010** 0.021	
	TRD-1220	**19.05** 0.750	**31.75** 1.250	**3.20** 0.126	**3.12** 0.123	**19.05** 0.750	**18.97** 0.747	**32.54** 1.281	**0.012** 0.026	
	TRE-1220	**19.05** 0.750	**31.75** 1.250	**3.99** 0.157	**3.91** 0.154	**19.05** 0.750	**18.97** 0.747	**32.54** 1.281	**0.015** 0.033	
0.005 0.011	TRA-1423	**22.23** 0.875	**36.50** 1.437	**0.81** 0.032	**0.76** 0.030	**22.23** 0.875	**22.15** 0.872	**37.31** 1.469	**0.004** 0.009	7/8
	TRB-1423	**22.23** 0.875	**36.50** 1.437	**1.60** 0.063	**1.52** 0.060	**22.23** 0.875	**22.15** 0.872	**37.31** 1.469	**0.008** 0.017	
	TRC-1423	**22.23** 0.875	**36.50** 1.437	**2.41** 0.095	**2.34** 0.092	**22.23** 0.875	**22.15** 0.872	**37.31** 1.469	**0.012** 0.026	
	TRD-1423	**22.23** 0.875	**36.50** 1.437	**3.20** 0.126	**3.12** 0.123	**22.23** 0.875	**22.15** 0.872	**37.31** 1.469	**0.015** 0.034	
0.008 0.017	TRB-1427	**22.23** 0.875	**42.86** 1.688	**1.60** 0.063	**1.52** 0.060	**22.23** 0.875	**22.15** 0.872	**43.66** 1.719	**0.013** 0.029	
	TRC-1427	**22.23** 0.875	**42.86** 1.688	**2.41** 0.095	**2.34** 0.092	**22.23** 0.875	**22.15** 0.872	**43.66** 1.719	**0.020** 0.044	
	TRD-1427	**22.23** 0.875	**42.86** 1.688	**3.20** 0.126	**3.12** 0.123	**22.23** 0.875	**22.15** 0.872	**43.66** 1.719	**0.026** 0.057	
0.006 0.013	TRA-1625	**25.40** 1.000	**39.67** 1.562	**0.81** 0.032	**0.76** 0.030	**25.40** 1.000	**25.32** 0.997	**40.49** 1.594	**0.005** 0.010	1
	TRB-1625	**25.40** 1.000	**39.67** 1.562	**1.60** 0.063	**1.52** 0.060	**25.40** 1.000	**25.32** 0.997	**40.49** 1.594	**0.009** 0.019	
	TRD-1625	**25.40** 1.000	**39.67** 1.562	**3.20** 0.126	**3.12** 0.123	**25.40** 1.000	**25.32** 0.997	**40.49** 1.594	**0.017** 0.038	
	TRE-1625	**25.40** 1.000	**39.67** 1.562	**3.99** 0.157	**3.91** 0.154	**25.40** 1.000	**25.32** 0.997	**40.49** 1.594	**0.021** 0.047	
0.009 0.019	TRA-1828	**28.58** 1.125	**44.45** 1.750	**0.81** 0.032	**0.76** 0.030	**28.58** 1.125	**28.50** 1.122	**45.24** 1.781	**0.006** 0.013	1 1/8
	TRB-1828	**28.58** 1.125	**44.45** 1.750	**1.60** 0.063	**1.52** 0.060	**28.58** 1.125	**28.50** 1.122	**45.24** 1.781	**0.011** 0.024	
	TRC-1828	**28.58** 1.125	**44.45** 1.750	**2.41** 0.095	**2.34** 0.092	**28.58** 1.125	**28.50** 1.122	**45.24** 1.781	**0.017** 0.037	

Continued on next page.

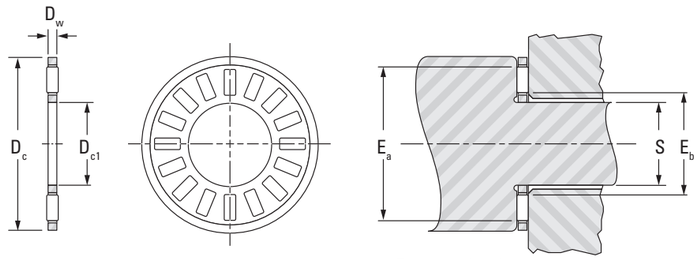
[2]If the shaft and the housing adjacent to the bearing O.D. are not concentric, the T.I.R. between the shaft and housing should be added to this dimension.

B

THRUST NEEDLE ROLLER AND CAGE ASSEMBLIES, THRUST WASHERS

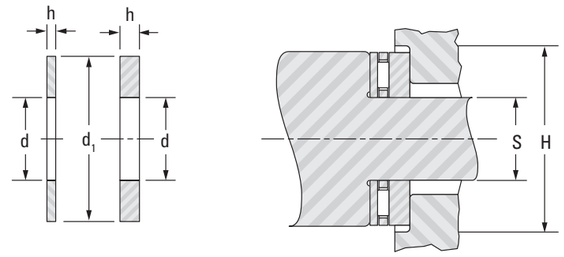
INCH SERIES

- Dimensions for bore and O.D. of thrust assemblies and washers are nominal.
- See page B-6-36 for details on piloting and backup surfaces.
- Thrust washers burnished at least one-quarter of bore area (remainder is rough breakaway finish).
- O.D. finish of washers will be as blanked.



NTA

Raceway hardness to be 58 HRC or equivalent



Shaft Dia.	Assembly Dimensions					Assembly Designation	Load Ratings		Fatigue Load Limit C_u	Speed Rating[1]
	D_{c1}	D_c	D_w	E_b	E_a		Dynamic	Static		
							C	C_o		
in	mm in	mm in	mm in	mm in	mm in		kN lbf		kN	min^{-1}
1 1/4	**31.75** 1.250	**49.20** 1.937	**1.984** 0.0781	**34.04** 1.340	**46.228** 1.820	NTA-2031	**20.15** 4530	**93.41** 21000	9.55	8600
1 3/8	**34.93** 1.375	**52.375** 2.062	**1.984** 0.0781	**37.08** 1.460	**49.53** 1.950	NTA-2233	**21.35** 4800	**103.20** 23200	10.5	8000
1 1/2	**38.10** 1.500	**55.55** 2.187	**1.984** 0.0781	**40.39** 1.590	**52.578** 2.070	NTA-2435	**23.22** 5220	**117.88** 26500	12.0	7600
1 3/4	**44.45** 1.750	**63.50** 2.500	**1.984** 0.0781	**46.74** 1.840	**58.928** 2.320	NTA-2840	**25.31** 5690	**137.45** 30900	14.0	6800

[1]Speed ratings listed are based on adequate oil lubrication. See page B-6-37 for lubrication information.
Suggestions for an application requiring O.D. piloting should be determined in consultation with your representative.

Approx. Wt.	Thrust Washer Designation	Washer Dimensions				Piloting Dimensions		Dia. To Clear O.D.	Washer Wt.	Shaft Dia.
		d	d_1	h		S				
				Max.	Min.	Max.	Min.	H [2]		
kg lbs		mm in	mm in	mm in	mm in	mm in	mm in	mm in	kg lbs	in
	TRD-1828	**28.58** 1.125	**44.45** 1.750	**3.20** 0.126	**3.12** 0.123	**28.58** 1.125	**28.50** 1.122	**45.24** 1.781	**0.022** 0.048	
0.010 0.021	TRA-2031	**31.75** 1.250	**49.20** 1.937	**0.81** 0.032	**0.76** 0.030	**31.75** 1.250	**31.67** 1.247	**50.01** 1.969	**0.007** 0.015	1 1/4
	TRB-2031	**31.75** 1.250	**49.20** 1.937	**1.60** 0.063	**1.52** 0.060	**31.75** 1.250	**31.67** 1.247	**50.01** 1.969	**0.014** 0.030	
	TRC-2031	**31.75** 1.250	**49.20** 1.937	**2.41** 0.095	**2.34** 0.092	**31.75** 1.250	**31.67** 1.247	**50.01** 1.969	**0.020** 0.044	
	TRD-2031	**31.75** 1.250	**49.20** 1.937	**3.20** 0.126	**3.12** 0.123	**31.75** 1.250	**31.67** 1.247	**50.01** 1.969	**0.026** 0.058	
	TRF-2031	**31.75** 1.250	**49.20** 1.937	**4.78** 0.188	**4.70** 0.185	**31.75** 1.250	**31.67** 1.247	**50.01** 1.969	**0.041** 0.090	
0.010 0.023	TRA-2233	**34.93** 1.375	**52.37** 2.062	**0.81** 0.032	**0.76** 0.030	**34.93** 1.375	**34.85** 1.372	**53.19** 2.094	**0.007** 0.016	1 3/8
	TRB-2233	**34.93** 1.375	**52.37** 2.062	**1.60** 0.063	**1.52** 0.060	**34.93** 1.375	**34.85** 1.372	**53.19** 2.094	**0.015** 0.033	
	TRC-2233	**34.93** 1.375	**52.37** 2.062	**2.41** 0.095	**2.34** 0.092	**34.93** 1.375	**34.85** 1.372	**53.19** 2.094	**0.018** 0.040	
	TRD-2233	**34.93** 1.375	**52.37** 2.062	**3.20** 0.126	**3.12** 0.123	**34.93** 1.375	**34.85** 1.372	**53.19** 2.094	**0.029** 0.065	
	TRE-2233	**34.93** 1.375	**52.37** 2.062	**3.99** 0.157	**3.91** 0.154	**34.93** 1.375	**34.85** 1.372	**53.19** 2.094	**0.037** 0.081	
	TRF-2233	**34.93** 1.375	**52.37** 2.062	**4.78** 0.188	**4.70** 0.185	**34.93** 1.375	**34.85** 1.372	**53.19** 2.094	**0.044** 0.097	
0.011 0.025	TRA-2435	**38.10** 1.500	**55.55** 2.187	**0.81** 0.032	**0.76** 0.030	**38.10** 1.500	**38.02** 1.497	**56.36** 2.219	**0.008** 0.017	1 1/2
	TRB-2435	**38.10** 1.500	**55.55** 2.187	**1.60** 0.063	**1.52** 0.060	**38.10** 1.500	**38.02** 1.497	**56.36** 2.219	**0.015** 0.034	
	TRC-2435	**38.10** 1.500	**55.55** 2.187	**2.41** 0.095	**2.34** 0.092	**38.10** 1.500	**38.02** 1.497	**56.36** 2.219	**0.023** 0.050	
	TRD-2435	**38.10** 1.500	**55.55** 2.187	**3.20** 0.126	**3.12** 0.123	**38.10** 1.500	**38.02** 1.497	**56.36** 2.219	**0.030** 0.067	
	TRF-2435	**38.10** 1.500	**55.55** 2.187	**4.78** 0.188	**4.70** 0.185	**38.10** 1.500	**38.02** 1.497	**56.36** 2.219	**0.045** 0.100	
0.014 0.031	TRA-2840	**44.45** 1.750	**63.50** 2.500	**0.81** 0.032	**0.76** 0.030	**44.45** 1.750	**44.37** 1.747	**64.29** 2.531	**0.010** 0.021	1 3/4
	TRB-2840	**44.45** 1.750	**63.50** 2.500	**1.60** 0.063	**1.52** 0.060	**44.45** 1.750	**44.37** 1.747	**64.29** 2.531	**0.020** 0.044	

Continued on next page.

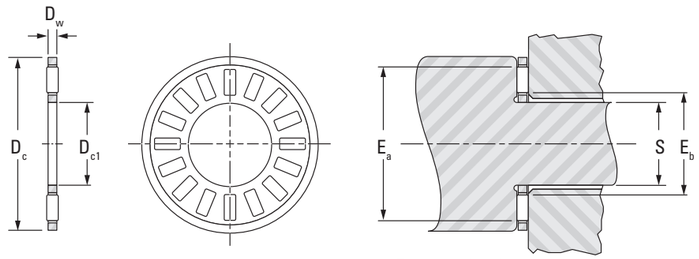
[2]If the shaft and the housing adjacent to the bearing O.D. are not concentric, the T.I.R. between the shaft and housing should be added to this dimension.

B

THRUST NEEDLE ROLLER AND CAGE ASSEMBLIES, THRUST WASHERS

INCH SERIES

- Dimensions for bore and O.D. of thrust assemblies and washers are nominal.
- See page B-6-36 for details on piloting and backup surfaces.
- Thrust washers burnished at least one-quarter of bore area (remainder is rough breakaway finish).
- O.D. finish of washers will be as blanked.

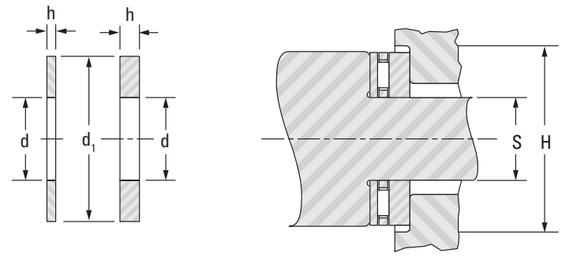


NTA

Raceway hardness to be 58 HRC or equivalent

Shaft Dia.	Assembly Dimensions					Assembly Designation	Load Ratings		Fatigue Load Limit C_u	Speed Rating[1]
	D_{c1}	D_c	D_w	E_b	E_a		Dynamic	Static		
							C	C_o		
in	mm in	mm in	mm in	mm in	mm in		kN lbf		kN	min^{-1}
2	**50.80** 2.000	**69.85** 2.750	**1.984** 0.0781	**53.09** 2.090	**65.278** 2.570	NTA-3244	**24.02** 5400	**132.56** 29800	13.5	6100
2 1/8	**53.98** 2.125	**73.025** 2.875	**1.984** 0.0781	**56.39** 2.220	**68.58** 2.700	NTA-3446	**24.42** 5490	**137.45** 30900	14.0	5800
2 1/4	**57.15** 2.250	**76.20** 3.000	**1.984** 0.0781	**59.44** 2.340	**71.628** 2.820	NTA-3648	**24.78** 5570	**142.34** 32000	14.6	5600
2 1/4	**57.15** 2.250	**79.375** 3.125	**3.175** 0.1250	**59.94** 2.360	**75.184** 2.960	NTA-3650	**37.68** 8470	**177.04** 39800	18.6	5300
2 1/2	**63.50** 2.500	**82.55** 3.250	**1.984** 0.0781	**65.79** 2.590	**77.978** 3.070	NTA-4052	**25.53** 5740	**152.13** 34200	15.6	5100

[1]Speed ratings listed are based on adequate oil lubrication. See page B-6-37 for lubrication information.
Suggestions for an application requiring O.D. piloting should be determined in consultation with your representative.



Approx. Wt.	Thrust Washer Designation	Washer Dimensions				Piloting Dimensions		Dia. To Clear O.D.	Washer Wt.	Shaft Dia.
		d	d_1	h		S				
				Max.	Min.	Max.	Min.	H [2]		
kg lbs		mm in	mm in	mm in	mm in	mm in	mm in	mm in	kg lbs	in
	TRC-2840	**44.45** 1.750	**63.50** 2.500	**2.41** 0.095	**2.34** 0.092	**44.45** 1.750	**44.37** 1.747	**64.29** 2.531	**0.029** 0.063	
	TRD-2840	**44.45** 1.750	**63.50** 2.500	**3.20** 0.126	**3.12** 0.123	**44.45** 1.750	**44.37** 1.747	**64.29** 2.531	**0.038** 0.084	
	TRF-2840	**44.45** 1.750	**63.50** 2.500	**4.78** 0.188	**4.70** 0.185	**44.45** 1.750	**44.37** 1.747	**64.29** 2.531	**0.057** 0.126	
0.015 0.033	TRA-3244	**50.80** 2.000	**69.85** 2.750	**0.81** 0.032	**0.76** 0.030	**50.80** 2.000	**50.72** 1.997	**70.64** 2.781	**0.011** 0.024	2
	TRB-3244	**50.80** 2.000	**69.85** 2.750	**1.60** 0.063	**1.52** 0.060	**50.80** 2.000	**50.72** 1.997	**70.64** 2.781	**0.022** 0.048	
	TRC-3244	**50.80** 2.000	**69.85** 2.750	**2.41** 0.095	**2.34** 0.092	**50.80** 2.000	**50.72** 1.997	**70.64** 2.781	**0.033** 0.072	
	TRD-3244	**50.80** 2.000	**69.85** 2.750	**3.20** 0.126	**3.12** 0.123	**50.80** 2.000	**50.72** 1.997	**70.64** 2.781	**0.044** 0.096	
	TRF-3244	**50.80** 2.000	**69.85** 2.750	**4.78** 0.188	**4.70** 0.185	**50.80** 2.000	**50.72** 1.997	**70.64** 2.781	**0.066** 0.145	
0.016 0.036	TRA-3446	**53.98** 2.125	**73.03** 2.875	**0.81** 0.032	**0.76** 0.030	**53.98** 2.125	**53.90** 2.122	**73.81** 2.906	**0.012** 0.026	2 1/8
	TRB-3446	**53.98** 2.125	**73.03** 2.875	**1.60** 0.063	**1.52** 0.060	**53.98** 2.125	**53.90** 2.122	**73.81** 2.906	**0.024** 0.052	
	TRC-3446	**53.98** 2.125	**73.03** 2.875	**2.41** 0.095	**2.34** 0.092	**53.98** 2.125	**53.90** 2.122	**73.81** 2.906	**0.035** 0.078	
	TRD-3446	**53.98** 2.125	**73.03** 2.875	**3.20** 0.126	**3.12** 0.123	**53.98** 2.125	**53.90** 2.122	**73.81** 2.906	**0.047** 0.103	
0.017 0.038	TRA-3648	**57.15** 2.250	**76.20** 3.000	**0.81** 0.032	**0.76** 0.030	**57.15** 2.250	**57.07** 2.247	**76.99** 3.031	**0.012** 0.026	2 1/4
	TRB-3648	**57.15** 2.250	**76.20** 3.000	**1.60** 0.063	**1.52** 0.060	**57.15** 2.250	**57.07** 2.247	**76.99** 3.031	**0.022** 0.048	
	TRC-3648	**57.15** 2.250	**76.20** 3.000	**2.41** 0.095	**2.34** 0.092	**57.15** 2.250	**57.07** 2.247	**76.99** 3.031	**0.037** 0.081	
	TRD-3648	**57.15** 2.250	**76.20** 3.000	**3.20** 0.126	**3.12** 0.123	**57.15** 2.250	**57.07** 2.247	**76.99** 3.031	**0.048** 0.105	
	TRF-3648	**57.15** 2.250	**76.20** 3.000	**4.78** 0.188	**4.70** 0.185	**57.15** 2.250	**57.07** 2.247	**76.99** 3.031	**0.071** 0.157	
0.029 0.064	TRC-3650	**57.15** 2.250	**79.38** 3.125	**2.41** 0.095	**2.34** 0.092	**57.15** 2.250	**57.07** 2.247	**80.16** 3.156	**0.043** 0.095	2 1/4
0.019 0.041	TRA-4052	**63.50** 2.500	**82.55** 3.250	**0.81** 0.032	**0.76** 0.030	**63.50** 2.500	**63.42** 2.497	**83.34** 3.281	**0.013** 0.029	2 1/2
	TRB-4052	**63.50** 2.500	**82.55** 3.250	**1.60** 0.063	**1.52** 0.060	**63.50** 2.500	**63.42** 2.497	**83.34** 3.281	**0.027** 0.059	

Continued on next page.

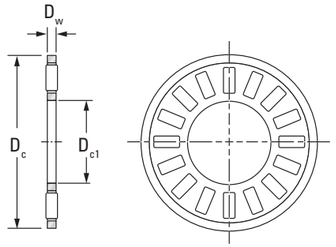
[2]If the shaft and the housing adjacent to the bearing O.D. are not concentric, the T.I.R. between the shaft and housing should be added to this dimension.

B

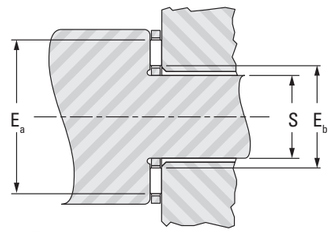
THRUST NEEDLE ROLLER AND CAGE ASSEMBLIES, THRUST WASHERS

INCH SERIES

- Dimensions for bore and O.D. of thrust assemblies and washers are nominal.
- See page B-6-36 for details on piloting and backup surfaces.
- Thrust washers burnished at least one-quarter of bore area (remainder is rough breakaway finish).
- O.D. finish of washers will be as blanked.



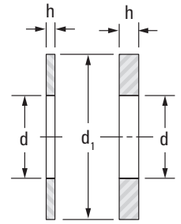
NTA

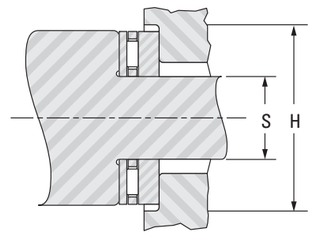


Raceway hardness to be 58 HRC or equivalent

Shaft Dia.	Assembly Dimensions					Assembly Designation	Load Ratings		Fatigue Load Limit C_u	Speed Rating[1]
	D_{c1}	D_c	D_w	E_b	E_a		Dynamic C	Static C_o		
in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in		**kN** lbf		kN	min^{-1}
2 3/4	**69.85** 2.750	**92.075** 3.625	**3.175** 0.1250	**72.64** 2.860	**87.884** 3.460	NTA-4458	**47.60** 10700	**255.8** 57500	26.8	4600
3	**76.20** 3.000	**95.25** 3.750	**1.984** 0.0781	**78.49** 3.090	**90.678** 3.570	NTA-4860	**26.96** 6060	**172.1** 38700	17.6	4400
3 1/4	**82.55** 3.250	**104.78** 4.125	**3.175** 0.1250	**85.34** 3.360	**100.58** 3.960	NTA-5266	**51.60** 11600	**294.9** 66300	30.9	4000
3 3/4	**95.25** 3.750	**117.48** 4.625	**3.175** 0.1250	**98.04** 3.860	**113.28** 4.460	NTA-6074	**56.05** 12600	**344.3** 77400	35.5	3500
4 1/8	**104.78** 4.125	**128.57** 5.062	**3.175** 0.1250	**107.44** 4.230	**124.46** 4.900	NTA-6681	**63.61** 14300	**414.6** 93200	41.3	3200

[1]Speed ratings listed are based on adequate oil lubrication. See page B-6-37 for lubrication information.
Suggestions for an application requiring O.D. piloting should be determined in consultation with your representative.





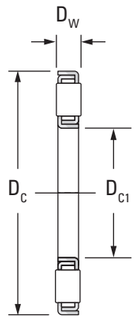
Approx. Wt.	Thrust Washer Designation	Washer Dimensions				Piloting Dimensions		Dia. To Clear O.D.	Washer Wt.	Shaft Dia.
		d	d_1	h		S				
				Max.	Min.	Max.	Min.	H [2]		
kg lbs		**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**kg** lbs	in
	TRC-4052	**63.50** 2.500	**82.55** 3.250	**2.41** 0.095	**2.34** 0.092	**63.50** 2.500	**63.42** 2.497	**83.34** 3.281	**0.041** 0.09	
	TRD-4052	**63.50** 2.500	**82.55** 3.250	**3.20** 0.126	**3.12** 0.123	**63.50** 2.500	**63.42** 2.497	**83.34** 3.281	**0.054** 0.119	
0.037 0.082	TRA-4458	**69.85** 2.750	**92.08** 3.625	**0.81** 0.032	**0.76** 0.030	**69.85** 2.750	**69.77** 2.747	**92.86** 3.656	**0.018** 0.039	2 3/4
	TRB-4458	**69.85** 2.750	**92.08** 3.625	**1.60** 0.063	**1.52** 0.060	**69.85** 2.750	**69.77** 2.747	**92.86** 3.656	**0.035** 0.077	
	TRC-4458	**69.85** 2.750	**92.08** 3.625	**2.41** 0.095	**2.34** 0.092	**69.85** 2.750	**69.77** 2.747	**92.86** 3.656	**0.051** 0.113	
	TRD-4458	**69.85** 2.750	**92.08** 3.625	**3.20** 0.126	**3.12** 0.123	**69.85** 2.750	**69.77** 2.747	**92.86** 3.656	**0.069** 0.152	
	TRF-4458	**69.85** 2.750	**92.08** 3.625	**4.78** 0.188	**4.70** 0.185	**69.85** 2.750	**69.77** 2.747	**92.86** 3.656	**0.104** 0.229	
0.022 0.048	TRA-4860	**76.20** 3.000	**95.25** 3.750	**0.81** 0.032	**0.76** 0.030	**76.20** 3.000	**76.12** 2.997	**96.04** 3.781	**0.015** 0.034	3
	TRB-4860	**76.20** 3.000	**95.25** 3.750	**1.60** 0.063	**1.52** 0.060	**76.20** 3.000	**76.12** 2.997	**96.04** 3.781	**0.032** 0.07	
	TRD-4860	**76.20** 3.000	**95.25** 3.750	**3.20** 0.126	**3.12** 0.123	**76.20** 3.000	**76.12** 2.997	**96.04** 3.781	**0.061** 0.135	
0.042 0.092	TRA-5266	**82.55** 3.250	**104.78** 4.125	**0.81** 0.032	**0.76** 0.030	**82.55** 3.250	**82.47** 3.247	**105.56** 4.156	**0.020** 0.044	3 1/4
	TRD-5266	**82.55** 3.250	**104.78** 4.125	**3.20** 0.126	**3.12** 0.123	**82.55** 3.250	**82.47** 3.247	**105.56** 4.156	**0.080** 0.176	
0.050 0.11	TRA-6074	**95.25** 3.750	**117.48** 4.625	**0.81** 0.032	**0.76** 0.030	**95.25** 3.750	**95.17** 3.747	**118.26** 4.656	**0.023** 0.05	3 3/4
	TRB-6074	**95.25** 3.750	**117.48** 4.625	**1.60** 0.063	**1.52** 0.060	**95.25** 3.750	**95.17** 3.747	**118.26** 4.656	**0.046** 0.101	
	TRC-6074	**95.25** 3.750	**117.48** 4.625	**2.41** 0.095	**2.34** 0.092	**95.25** 3.750	**95.17** 3.747	**118.26** 4.656	**0.069** 0.152	
	TRD-6074	**95.25** 3.750	**117.48** 4.625	**3.20** 0.126	**3.12** 0.123	**95.25** 3.750	**95.17** 3.747	**118.26** 4.656	**0.092** 0.202	
0.062 0.136	TRA-6681	**104.78** 4.125	**128.57** 5.062	**0.81** 0.032	**0.76** 0.030	**104.78** 4.125	**104.70** 4.122	**129.39** 5.094	**0.027** 0.059	4 1/8
	TRC-6681	**104.78** 4.125	**128.57** 5.062	**2.41** 0.095	**2.34** 0.092	**104.78** 4.125	**104.70** 4.122	**129.39** 5.094	**0.081** 0.178	
	TRD-6681	**104.78** 4.125	**128.57** 5.062	**3.20** 0.126	**3.12** 0.123	**104.78** 4.125	**104.70** 4.122	**129.39** 5.094	**0.109** 0.24	
	TRF-6681	**104.78** 4.125	**128.57** 5.062	**4.78** 0.188	**4.70** 0.185	**104.78** 4.125	**104.70** 4.122	**129.39** 5.094	**0.161** 0.354	

[2]If the shaft and the housing adjacent to the bearing O.D. are not concentric, the T.I.R. between the shaft and housing should be added to this dimension.

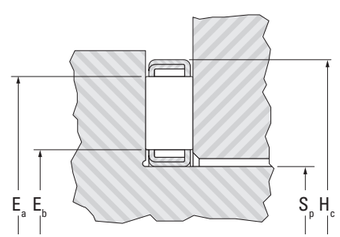
THRUST CYLINDRICAL ROLLER AND CAGE ASSEMBLIES

INCH SERIES

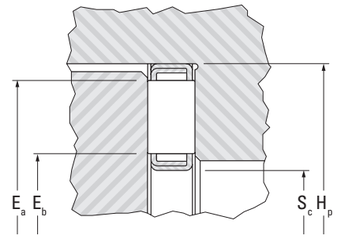
- Backup surfaces should be flat and square with the centerline of the shaft.
- See pages B-6-36 for details on piloting and backup surfaces.



NTH



Shaft Piloted



Housing Piloted

Shaft Dia.	D_{c1}	D_c	D_w	Assembly Designation	Load Ratings		Fatigue Load Limit C_u	Speed Rating[1]
					Dynamic	Static		
					C	C_o		
in	**mm** in	**mm** in	**mm** in		**kN** lbf		kN	min^{-1}
$1\frac{1}{2}$	**38.15** 1.502	**75.44** 2.970	**6.350** 0.2500	NTH-2448	**81.8** 18400	**280** 62900	29.5	5700
2	**50.85** 2.002	**91.31** 3.595	**9.525** 0.3750	NTH-3258	**129** 29000	**407** 91600	45.7	4700
$2\frac{1}{8}$	**54.03** 2.127	**94.49** 3.720	**9.525** 0.3750	NTH-3460	**133** 30000	**433** 97400	48.6	4500
$2\frac{1}{4}$	**57.20** 2.252	**97.66** 3.845	**9.525** 0.3750	NTH-3662	**138** 31100	**458** 103000	51.4	4400
$2\frac{3}{8}$	**60.38** 2.377	**100.84** 3.970	**9.525** 0.3750	NTH-3864	**143** 32100	**484.9** 109000	54.3	4200
$2\frac{1}{2}$	**63.55** 2.502	**104.01** 4.095	**9.525** 0.3750	NTH-4066	**147** 33000	**511** 115000	57.1	4100
$2\frac{5}{8}$	**66.73** 2.627	**109.60** 4.315	**9.525** 0.3750	NTH-4270	**156** 35100	**556** 125000	63.1	3900
$2\frac{3}{4}$	**69.98** 2.755	**112.78** 4.440	**9.525** 0.3750	NTH-4472	**161** 36100	**587** 132000	66.3	3800
3	**76.33** 3.005	**119.13** 4.690	**9.525** 0.3750	NTH-4876	**169** 38000	**641** 144000	72.6	3600
$3\frac{1}{4}$	**82.68** 3.255	**125.48** 4.940	**9.525** 0.3750	NTH-5280	**178** 39900	**698** 157000	78.0	3400
$3\frac{1}{2}$	**89.03** 3.505	**132.26** 5.207	**9.525** 0.3750	NTH-5684	**180** 40500	**725** 163000	81.1	3200

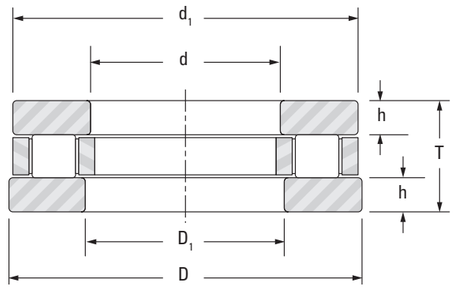
[1]Speed ratings listed are based on adequate oil lubrication. See page B-6-37 for lubrication information.

Assembly Wt.	Piloting Dimensions						Shaft Dia.
	Shaft Piloting		Housing Piloting		Raceway Contact		
	S_p	H_c	S_c	H_p	E_b	E_a	
	+0, +0.000			**+0.13,** +0.005			
	-0.13, -0.005	Min.	Max.	**-0,** -0.000			
kg lbs	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	in
0.10 0.23	**38.10** 1.500	**76.96** 3.030	**36.63** 1.442	**75.57** 2.975	**44.70** 1.760	**68.83** 2.710	$1\frac{1}{2}$
0.21 0.47	**50.80** 2.000	**92.84** 3.655	**49.33** 1.942	**91.44** 3.600	**57.40** 2.260	**84.33** 3.320	2
0.22 0.49	**53.98** 2.125	**96.01** 3.780	**52.5** 2.067	**94.62** 3.725	**60.71** 2.390	**87.38** 3.440	$2\frac{1}{8}$
0.24 0.52	**57.15** 2.250	**99.19** 3.905	**55.68** 2.192	**97.79** 3.850	**63.75** 2.510	**90.68** 3.570	$2\frac{1}{4}$
0.24 0.54	**60.33** 2.375	**102.36** 4.030	**58.85** 2.317	**100.97** 3.975	**67.06** 2.640	**93.73** 3.690	$2\frac{3}{8}$
0.26 0.57	**63.50** 2.500	**105.54** 4.155	**62.03** 2.442	**104.14** 4.100	**70.10** 2.760	**97.03** 3.820	$2\frac{1}{2}$
0.28 0.62	**66.68** 2.625	**111.13** 4.375	**65.2** 2.567	**109.73** 4.320	**73.41** 2.890	**102.36** 4.030	$2\frac{5}{8}$
0.29 0.64	**69.85** 2.750	**114.30** 4.500	**68.45** 2.695	**112.90** 4.445	**76.45** 3.010	**105.66** 4.160	$2\frac{3}{4}$
0.31 0.69	**76.20** 3.000	**120.65** 4.750	**74.8** 2.945	**119.25** 4.695	**82.80** 3.260	**112.01** 4.410	3
0.34 0.75	**82.55** 3.250	**127.00** 5.000	**81.15** 3.195	**125.60** 4.945	**89.15** 3.510	**118.36** 4.660	$3\frac{1}{4}$
0.37 0.81	**88.90** 3.500	**133.78** 5.267	**87.5** 3.445	**132.38** 5.212	**95.76** 3.770	**125.73** 4.950	$3\frac{1}{2}$

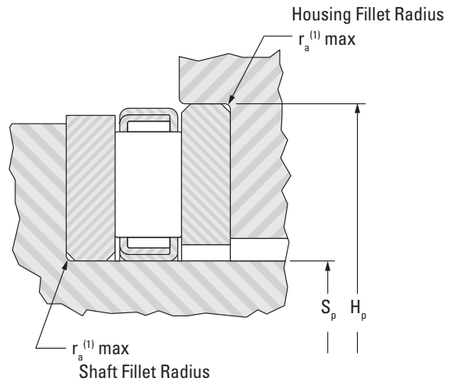
B

CYLINDRICAL ROLLER THRUST BEARINGS

- The NTHA thrust cylindrical roller bearing consists of an NTH roller and cage assembly, one bore piloted washer and one O.D. piloted washer. The NTHA bearing is identified and sold as a unit and is manufactured to inch-nominal dimensions only.
- Load ratings given are identical to the corresponding NTH thrust cylindrical roller and cage assembly.
- It is suggested that the roller and cage assembly be bore piloted when applying NTHA bearings. When different arrangements of piloting are required, please contact your representative.
- Backup surfaces should be flat and square with the center line of the shaft.
- To order individual thrust washers, see washer designation below.



NTHA



Shaft Dia.	Shaft-Piloted Washer			Housing-Piloted Washer			T +0.000 −0.006	Bearing Designation	Bearing Wt.
	d		d_1	D		D_1			
	Max.	Min.	Nom.	Max.	Min.	Nom.			
in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in	**mm** in		**kg** lbs
$1\frac{1}{2}$	**38.100** 1.5000	**38.082** 1.4993	**74.613** $2\frac{15}{16}$	**76.218** 3.0007	**76.200** 3.0000	**39.688** $1\frac{9}{16}$	**20.62** 0.812	NTHA-2448	**0.47** 1.03
2	**50.800** 2.0000	**50.775** 1.9990	**90.488** $3\frac{9}{16}$	**92.098** 3.6259	**92.075** 3.6250	**52.388** $2\frac{1}{16}$	**25.40** 1.000	NTHA-3258	**0.76** 1.68
$2\frac{1}{8}$	**53.975** 2.1250	**53.950** 2.1240	**93.663** $3\frac{11}{16}$	**95.278** 3.7511	**95.250** 3.7500	**55.563** $2\frac{3}{16}$	**25.40** 1.000	NTHA-3460	**0.80** 1.76
$2\frac{1}{4}$	**57.150** 2.2500	**57.122** 2.2489	**96.838** $3\frac{13}{16}$	**98.453** 3.8761	**98.425** 3.8750	**58.738** $2\frac{5}{16}$	**25.40** 1.000	NTHA-3662	**0.83** 1.84
$2\frac{3}{8}$	**60.325** 2.3750	**60.297** 2.3739	**100.013** $3\frac{15}{16}$	**101.628** 4.0011	**101.600** 4.0000	**61.913** $2\frac{7}{16}$	**25.40** 1.000	NTHA-3864	**0.87** 1.91
$2\frac{1}{2}$	**63.500** 2.5000	**63.472** 2.4989	**103.188** $4\frac{1}{16}$	**104.808** 4.1263	**104.775** 4.1250	**65.088** $2\frac{9}{16}$	**25.40** 1.000	NTHA-4066	**0.90** 1.99
$2\frac{5}{8}$	**66.675** 2.6250	**66.645** 2.6238	**108.744** $4\frac{9}{32}$	**110.345** 4.3443	**110.312** 4.3430	**68.263** $2\frac{11}{16}$	**25.40** 1.000	NTHA-4270	**1.01** 2.22
$2\frac{3}{4}$	**69.850** 2.7500	**69.820** 2.7488	**111.919** $4\frac{13}{32}$	**113.520** 4.4693	**113.487** 4.4680	**71.438** $2\frac{13}{16}$	**25.40** 1.000	NTHA-4472	**1.04** 2.29
3	**76.200** 3.0000	**76.170** 2.9988	**118.269** $4\frac{21}{32}$	**119.875** 4.7195	**119.837** 4.7180	**77.788** $3\frac{1}{16}$	**25.40** 1.000	NTHA-4876	**1.12** 2.46
$3\frac{1}{4}$	**82.550** 3.2500	**82.517** 3.2487	**124.619** $4\frac{29}{32}$	**126.225** 4.9695	**126.187** 4.9680	**84.138** $3\frac{5}{16}$	**25.40** 1.000	NTHA-5280	**1.19** 2.62
$3\frac{1}{2}$	**88.900** 3.5000	**88.867** 3.4987	**130.969** $5\frac{5}{32}$	**132.575** 5.2195	**132.537** 5.2180	**90.488** $3\frac{9}{16}$	**25.40** 1.000	NTHA-5684	**1.27** 2.80

(1) $r_{a\ max}$ is equal to minimum washer chamfer $r_{s\ min}$.

Load Ratings		Fatigue Load Limit C_u	Speed Rating Oil	Piloting Dimensions				Bore Piloted Washer	Washer Wt.	O.D. Piloted Washer	Washer Wt.	Shaft Dia.
				S_p	H_p	$r_{s\ min.}$	h					
Dynamic	Static			**+0,** +0.000	**+0.13,** +0.005		**+0,** +0.000					
C	C_o			**-0.13,** -0.005	**-0,** -0.000		**-0.076,** -0.0030					
kN lbf		kN	min^{-1}	**mm** in	**mm** in	**mm** in	**mm** in		**kg** lbs		**kg** lbs	in
81.8 18400	**280** 62900	29.5	5700	**38.082** 1.4993	**76.218** 3.0007	**0.81** 0.032	**7.137** 0.2810	TRI-2448	**0.18** 0.39	TRID-2448	**0.18** 0.39	$1\frac{1}{2}$
129 29000	**408** 91600	45.7	4700	**50.775** 1.9990	**92.098** 3.6259	**1.57** 0.062	**7.938** 0.3125	TRJ-3258	**0.26** 0.57	TRJD-3258	**0.27** 0.59	2
133 30000	**433** 97400	48.6	4500	**53.950** 2.1240	**95.278** 3.7511	**1.57** 0.062	**7.938** 0.3125	TRJ-3460	**0.27** 0.60	TRJD-3460	**0.28** 0.61	$2\frac{1}{8}$
138 31100	**458** 103000	51.4	4400	**57.122** 2.2489	**98.453** 3.8761	**1.57** 0.062	**7.938** 0.3125	TRJ-3662	**0.28** 0.62	TRJD-3662	**0.29** 0.64	$2\frac{1}{4}$
143 32100	**485** 109000	54.3	4200	**60.297** 2.3739	**101.628** 4.0011	**1.57** 0.062	**7.938** 0.3125	TRJ-3864	**0.29** 0.65	TRJD-3864	**0.30** 0.66	$2\frac{3}{8}$
147 33000	**512** 115000	57.1	4100	**63.472** 2.4989	**104.808** 4.1263	**1.57** 0.062	**7.938** 0.3125	TRJ-4066	**0.30** 0.67	TRJD-4066	**0.31** 0.69	$2\frac{1}{2}$
156 35100	**556** 125000	63.1	3900	**66.645** 2.6238	**110.345** 4.3443	**1.57** 0.062	**7.938** 0.3125	TRJ-4270	**0.34** 0.75	TRJD-4270	**0.35** 0.77	$2\frac{5}{8}$
161 36100	**587** 132000	66.3	3800	**69.820** 2.7488	**113.520** 4.4693	**1.57** 0.062	**7.938** 0.3125	TRJ-4472	**0.35** 0.78	TRJD-4472	**0.36** 0.80	$2\frac{3}{4}$
169 38000	**641** 144000	72.6	3600	**76.170** 2.9988	**119.875** 4.7195	**1.57** 0.062	**7.938** 0.3125	TRJ-4876	**0.38** 0.83	TRJD-4876	**0.39** 0.85	3
177 39900	**698** 157000	78.0	3400	**82.517** 3.2487	**126.225** 4.9695	**1.57** 0.062	**7.938** 0.3125	TRJ-5280	**0.40** 0.89	TRJD-5280	**0.41** 0.91	$3\frac{1}{4}$
180 40500	**725** 163000	81.1	3200	**88.867** 3.4987	**132.575** 5.2195	**1.57** 0.062	**7.938** 0.3125	TRJ-5684	**0.43** 0.94	TRJD-5284	**0.43** 0.96	$3\frac{1}{2}$

NOTES

B

COMBINED NEEDLE ROLLER BEARINGS

Overview: Combined bearings incorporate a radial needle roller bearing and a thrust ball or roller bearing into a convenient unitized package.

- **Catalog range:** 10.000 mm – 70.000 mm (0.3940 in – 2.7560 in) bore.
- **Markets:** Industrial applications, machine tools, and automotive transmissions.
- **Features:** Available with ball, needle roller or cylindrical roller thrust component, machined and drawn outer rings are available, some sizes available with integral dust caps.
- **Benefits:** An effective alternative to separate radial and thrust bearings.

Combined Needle Roller Bearings – Metric Nominal Dimensions

Prefix
NAXR machined outer ring thrust cylindrical roller and radial needle roller bearing without inner ring
NAXK machined outer ring thrust ball and radial needle roller bearing without inner ring

NAXR **20** **Z.TN**

Bore Diameter
20 = 20 mm

Suffix
TN molded polymer retainer
Z thrust washer retaining dust cap

Inner Rings for Combined Needle Roller Bearings – Metric Nominal Dimensions

Prefix
JR inner ring for use with NAXR series bearings

JR **25** x **30** x **18**

Bore Diameter
25 = 25 mm

Outer Diameter
14 = 14 mm

Width
18 = 18 mm

Combined Needle Roller Bearings

B

COMBINED BEARINGS

METRIC SERIES

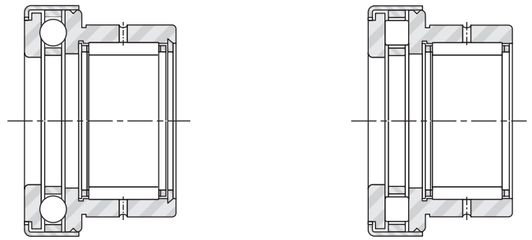
Combined bearings consist of a radial bearing (needle roller bearing) and a thrust bearing (ball, roller or needle bearing). The thrust roller bearing is usually a cylindrical roller thrust bearing.

Combined bearings make an effective alternative in place of two separate bearings – in terms of cost, handling and packaging. Combined bearings can be used with or without matching inner rings and thrust washers – though these are listed opposite the bearing part numbers, where possible, on the following pages of tables for convenience.

REFERENCE STANDARDS ARE:

- **DIN 5429, Part 1** – needle roller – thrust cylindrical roller bearings, series NAXR, NAXR.Z.
- **DIN 5429, Part 1** – needle roller – thrust ball bearings, series NAXK, NAXK.Z.
- **ISO 1206** – needle roller bearings – light and medium series – dimensions and tolerances.

Needle roller-ball thrust bearing **Needle roller-cylindrical roller thrust bearings**



NAXK.Z **NAXR.Z**

Fig. B7-1. Types of metric series combined bearings

Suffixes

TN	molded cage of reinforced engineered polymer
Z	retained with a dust cap
Z.TN	retained with a dust cap, molded cage of reinforced engineered polymer

CONSTRUCTION

Needle roller-cylindrical roller thrust bearings of series NAXR is available with dust caps. They have the highest axial load-carrying capability of all combined bearings. The NAXR and NAXR.Z Series have the same dimensions as needle roller-ball thrust bearings (series NAXK and NAXK.Z).

The previous bearing types may be best used without inner rings because the radial internal clearances are smaller if the needle roller and cage assemblies operate directly on a hardened and ground shaft. Tolerance class F6 is the normal specification for the needle roller complement bore diameters of the unmounted bearings.

Quality requirements for shafts, when used as a bearing raceway, are given in the engineering section of this catalog. When it becomes impractical to meet the shaft raceway design requirements, standard inner rings may be used with these bearings.

DIMENSIONAL ACCURACY

TOLERANCES

Metric series combined bearings are manufactured to the normal tolerances which apply to the metric series radial bearings and standard thrust bearings, as shown in the engineering section. The only exceptions are the diameter tolerances of the shaft-piloted washer and the bearing width tolerances. The shaft-piloted washer bore tolerance is E7 for the NAXK, NAXR, NAXK.Z and NAXR.Z Series bearings. The thickness tolerance of the combined bearings thrust component (C_1) can be found in Table B7-2 The matching thrust washer thickness tolerance may be found in the metric unitized thrust bearing section of this catalog.

BEARING MOUNTING

MOUNTING DIMENSIONS

Simple, through-bored housings are adequate for combined bearings. The mounting tolerances for the mechanical-ring combined bearings are provided in Table B7-1.

The shaft-piloted washers of combined bearings must be supported, at least over half of their width. Other quality requirements for shafts and housings are given in the engineering section. Requirements for fillets, recesses and shoulder heights are the same as for needle roller bearings, as shown in the Mounting Dimensions paragraph on pages B-4-9 and B-4-10.

When mounting these bearings in their housings with a tight fit, relatively high press-in forces will be required which may brinell the raceways of the thrust bearing arrangements. Particular care should be exercised when installing needle roller-cylindrical roller thrust bearings with dust caps – and where the roller assembly of the thrust bearings cannot be removed. In order to avoid brinelling of the thrust bearing raceways, the bearings should be installed with uniform, continuous pressure against the installation tool, avoiding sudden impact forces. At times it may even be desirable to heat the housing before bearing mounting.

Table B7-1. Mounting tolerances

Rotation conditions	ISO tolerance zone for housing	Nominal shaft diameters d		With inner ring	Without inner ring
		>	≤	ISO tolerances zone for shaft	
		mm in	**mm** in		
Load stationary relative to housing	K6 (M6)[1]	**10.000** 0.3937	**40.000** 1.5748	k6	h6
		40.000 1.5748	**70.000** 2.7559	m6	h6
Load rotates relative to housing	M6 (N6)[1]	All diameters		g6	f6

[1] Tighter fit for more secure arrangement.

Table B7-2. Thrust component thickness (C_1) tolerances

Bearing series	Tolerances	
	Max.	Min.
	mm in	**mm** in
NAXK, NAXK.Z	**+0.000** +0.000	**-0.200** -0.0078
NAXR, NAXR.Z		

LUBRICATION

When the applied axial loads are relatively high and the application allows the use of oil as the desired method of lubrication, bearing types NAXR and NAXK should be given consideration. Combined bearings with a dust cap may use oil lubrication, although their design makes them better suited for use with grease lubrication.

Combined bearings are typically shipped protected with a corrosion-preventive compound that is not a lubricant. The bearings may be used in oil- or grease-lubricated applications, without removal of the corrosion-preventive compound. However, it may be advisable to remove the corrosion-preventive compound before packing the bearings (with a suitable grease) to obtain optimum grease performance and to minimize the possibility of confusing grease bearings with bearings containing corrosion preventive.

LOAD RATINGS

Minimum axial load for combined bearings:

The minimum axial load $F_{a\ min.} = C_{0a}/2200$ (kN)

Where:

C_{0a} = static load rating (kN)

DYNAMIC EQUIVALENT LOAD

Combined bearings can accommodate radial and axial loads.

Radial needle roller complement

$P = F_r$ (kN)

Cylindrical or needle roller thrust complement

$P_a = F_a$ (kN)

STATIC EQUIVALENT LOAD

For all combined bearings series:

Radial needle roller complement

$P_0 = F_r$ (kN)

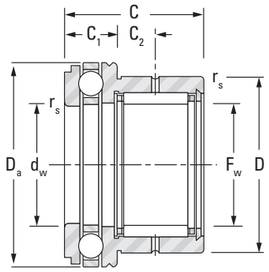
Cylindrical or needle roller thrust complement

$P_{0a} = F_a$ (kN)

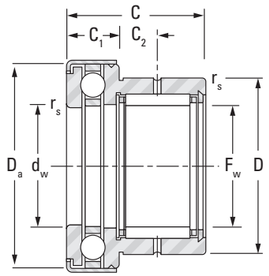
B

BALL THRUST SERIES

METRIC SERIES



NAXK



NAXK.Z

Shaft Diameter	F_w	D	C	d_w E7	D_a	C_1	C_2	$r_{s\ min.}$
mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in
10 0.394	**10** 0.394	**19** 0.748	**23** 0.906	**10** 0.394	**24** 0.945	**9** 0.354	**6.5** 0.256	**0.3** 0.012
	10 0.394	**19** 0.748	**23** 0.906	**10** 0.394	**25** 0.984	**9** 0.354	**6.5** 0.256	**0.3** 0.012
12 0.472	**12** 0.472	**21** 0.827	**23** 0.906	**12** 0.472	**26** 1.024	**9** 0.354	**6.5** 0.256	**0.3** 0.012
	12 0.472	**21** 0.827	**23** 0.906	**12** 0.472	**27** 1.063	**9** 0.354	**6.5** 0.256	**0.3** 0.012
15 0.591	**15** 0.591	**24** 0.945	**23** 0.906	**15** 0.591	**28** 1.102	**9** 0.354	**6.5** 0.256	**0.3** 0.012
	15 0.591	**24** 0.945	**23** 0.906	**15** 0.591	**29** 1.142	**9** 0.354	**6.5** 0.256	**0.3** 0.012
17 0.669	**17** 0.669	**26** 1.024	**25** 0.984	**17** 0.669	**30** 1.181	**9** 0.354	**8** 0.315	**0.3** 0.012
	17 0.669	**26** 1.024	**25** 0.984	**17** 0.669	**31** 1.220	**9** 0.354	**8** 0.315	**0.3** 0.012
20 0.787	**20** 0.787	**30** 1.181	**30** 1.181	**20** 0.787	**35** 1.378	**10** 0.394	**10.5** 0.413	**0.3** 0.012
	20 0.787	**30** 1.181	**30** 1.181	**20** 0.787	**36** 1.417	**10** 0.394	**10.5** 0.413	**0.3** 0.012
25 0.984	**25** 0.984	**37** 1.457	**30** 1.181	**25** 0.984	**42** 1.654	**11** 0.433	**9.5** 0.374	**0.6** 0.024
	25 0.984	**37** 1.457	**30** 1.181	**25** 0.984	**43** 1.693	**11** 0.433	**9.5** 0.374	**0.6** 0.024
30 1.181	**30** 1.181	**42** 1.654	**30** 1.181	**30** 1.181	**47** 1.850	**11** 0.433	**9.5** 0.374	**0.6** 0.024
	30 1.181	**42** 1.654	**30** 1.181	**30** 1.181	**48** 1.890	**11** 0.433	**9.5** 0.374	**0.6** 0.024
35 1.378	**35** 1.378	**47** 1.850	**30** 1.181	**35** 1.378	**52** 2.047	**12** 0.472	**9** 0.354	**0.6** 0.024
	35 1.378	**47** 1.850	**30** 1.181	**35** 1.378	**53** 2.087	**12** 0.472	**9** 0.354	**0.6** 0.024
40 1.575	**40** 1.575	**52** 2.047	**32** 1.260	**40** 1.575	**60** 2.362	**13** 0.512	**10** 0.394	**0.6** 0.024
	40 1.575	**52** 2.047	**32** 1.260	**40** 1.575	**61** 2.402	**13** 0.512	**10** 0.394	**0.6** 0.024
45 1.772	**45** 1.772	**58** 2.283	**32** 1.260	**45** 1.772	**65** 2.559	**14** 0.551	**9** 0.354	**0.6** 0.024
	45 1.772	**58** 2.283	**32** 1.260	**45** 1.772	**66.5** 2.618	**14** 0.551	**9** 0.354	**0.6** 0.024

Bearing Designation	Speed Rating Oil	Load Ratings				Fatigue Load Limits C_u		Approx. Wt.	Matching Inner ring Designation	Shaft Diameter
		Radial		Thrust						
		Dynamic	Static	Dynamic	Static					
		C	C_0	C_a	C_{0a}	Radial	Thrust			
	min^{-1}	kN lbf		kN lbf		kN		kg		mm in
NAXK10	9500	**7.9** 1780	**8.7** 1960	**10.4** 2340	**14** 3150	1.35	0.630	0.04	JR7x10x16	**10** 0.394
NAXK10Z	9500	**7.9** 1780	**8.7** 1960	**10.4** 2340	**14** 3150	1.35	0.630	0.04	JR7x10x16	
NAXK12	9000	**7.5** 1690	**8.5** 1910	**10.7** 2410	**15.4** 3460	1.30	0.70	0.046	JR9x12x16	**12** 0.472
NAXK12Z	9000	**7.5** 1690	**8.5** 1910	**10.7** 2410	**15.4** 3460	1.30	0.70	0.047	JR9x12x16	
NAXK15	8500	**9.7** 2180	**12.6** 2830	**10.9** 2450	**16.8** 3780	1.90	0.760	0.047	JR12x15x16	**15** 0.591
NAXK15Z	8500	**9.7** 2180	**12.6** 2830	**10.9** 2450	**16.8** 3780	1.90	0.760	0.05	JR12x15x16	
NAXK17	8500	**11.4** 2560	**16.1** 3620	**11.8** 2650	**19.6** 4410	2.50	0.880	0.06	JR14x17x17	**17** 0.669
NAXK17Z	8500	**11.4** 2560	**16.1** 3620	**11.8** 2650	**19.6** 4410	2.50	0.880	0.064	JR14x17x17	
NAXK20	7000	**14.8** 3330	**23.7** 5330	**15.5** 3480	**26.6** 5980	3.65	1.20	0.089	JR17x20x20	**20** 0.787
NAXK20Z	7000	**14.8** 3330	**23.7** 5330	**15.5** 3480	**26.6** 5980	3.65	1.20	0.094	JR17x20x20	
NAXK25	6300	**18.9** 4250	**29.8** 6700	**18.8** 4230	**35.5** 7980	4.60	1.60	0.134	JR20x25x20	**25** 0.984
NAXK25Z	6300	**18.9** 4250	**29.8** 6700	**18.8** 4230	**35.5** 7980	4.60	1.60	0.141	JR20x25x20	
NAXK30	5600	**20.3** 4560	**34.6** 7780	**19.5** 4380	**40** 8990	5.35	2.15	0.146	JR25x30x20	**30** 1.181
NAXK30Z	5600	**20.3** 4560	**34.6** 7780	**19.5** 4380	**40** 8990	5.35	2.15	0.154	JR25x30x20	
NAXK35	5300	**22.1** 4970	**40.8** 9170	**20.8** 4680	**46.6** 10500	6.35	2.10	0.176	JR30x35x20	**35** 1.378
NAXK35Z	5300	**22.1** 4970	**40.8** 9170	**20.8** 4680	**46.6** 10500	6.35	2.10	0.184	JR30x35x20	
NAXK40	4500	**25** 5620	**51** 11500	**28** 6290	**63** 14200	7.30	2.85	0.224	JR35x40x20	**40** 1.575
NAXK40Z	4500	**25** 5620	**51** 11500	**28** 6290	**63** 14200	7.30	2.85	0.233	JR35x40x20	
NAXK45	4500	**24.9** 5600	**51.8** 11600	**29** 6520	**69.2** 15600	8.05	3.10	0.262	JR40x45x20	**45** 1.772
NAXK45Z	4500	**24.9** 5600	**51.8** 11600	**29** 6520	**69.2** 15600	8.05	3.10	0.275	JR40x45x20	

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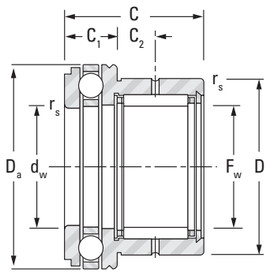
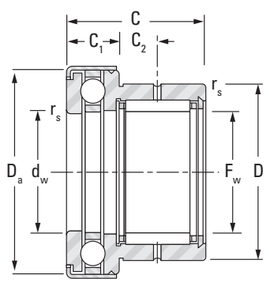
BALL THRUST SERIES

METRIC SERIES



NAXK

Shaft Diameter	F_w	D	C	d_w E7	D_a	C_1	C_2	$r_{s\ min.}$
mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in
50 1.969	**50** 1.969	**62** 2.441	**35** 1.378	**50** 1.969	**70** 2.756	**14** 0.551	**10** 0.394	**0.6** 0.024
	50 1.969	**62** 2.441	**35** 1.378	**50** 1.969	**71.5** 2.815	**14** 0.551	**10** 0.394	**0.6** 0.024
60 2.362	**60** 2.362	**72** 2.835	**40** 1.575	**60** 2.362	**85** 3.346	**17** 0.669	**12** 0.472	**1** 0.039
70 2.756	**70** 2.756	**85** 3.346	**40** 1.575	**70** 2.756	**95** 3.740	**18** 0.709	**11** 0.433	**1** 0.039



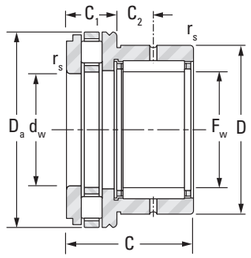
NAXK.Z

Bearing Designation	Speed Rating Oil	Load Ratings				Fatigue Load Limits C_u		Approx. Wt.	Matching Inner ring Designation	Shaft Diameter
		Radial		Thrust						
		Dynamic	Static	Dynamic	Static					
		C	C_0	C_a	C_{0a}	Radial	Thrust			
	min^{-1}	kN lbf		kN lbf		kN		kg		mm in
NAXK50	4300	**30.2** 6790	**68.5** 15400	**28.8** 6470	**75.4** 17000	10.7	3.40	0.316	JR45x50x25	**50** 1.969
NAXK50Z	4300	**30.2** 6790	**68.5** 15400	**28.8** 6470	**75.4** 17000	10.7	3.40	0.332	JR45x50x25	
NAXK60	3600	**31.9** 7170	**78.1** 17600	**41.4** 9310	**113** 25400	12.2	5.10	0.48	JR50x60x25	**60** 2.362
NAXK70	3400	**44.9** 10100	**87.1** 19600	**40.0** 8990	**110** 24700	13.9	4.95	0.659	JR60x70x25	**70** 2.756

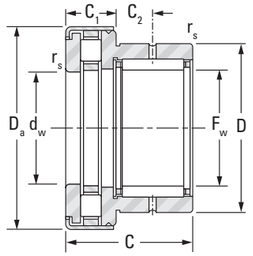
B

CYLINDRICAL ROLLER THRUST SERIES

METRIC SERIES



NAXR



NAXR.Z

Shaft Diameter	F_w	D	C	d_w E7	D_a	C_1	C_2	$r_{s\ min.}$
mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in
15 0.591	**15** 0.591	**24** 0.945	**23** 0.906	**15** 0.591	**28** 1.102	**9** 0.354	**6.5** 0.256	**0.3** 0.012
	15 0.591	**24** 0.945	**23** 0.906	**15** 0.591	**29** 1.142	**9** 0.354	**6.5** 0.256	**0.3** 0.012
17 0.669	**17** 0.669	**26** 1.024	**25** 0.984	**17** 0.669	**30** 1.181	**9** 0.354	**8.0** 0.315	**0.3** 0.012
	17 0.669	**26** 1.024	**25** 0.984	**17** 0.669	**31** 1.220	**9** 0.354	**8.0** 0.315	**0.3** 0.012
20 0.787	**20** 0.787	**30** 1.181	**30** 1.181	**20** 0.787	**35** 1.378	**10** 0.394	**10.5** 0.413	**0.3** 0.012
	20 0.787	**30** 1.181	**30** 1.181	**20** 0.787	**36** 1.417	**10** 0.394	**10.5** 0.413	**0.3** 0.012
25 0.984	**25** 0.984	**37** 1.457	**30** 1.181	**25** 0.984	**42** 1.654	**11** 0.433	**9.5** 0.374	**0.6** 0.024
	25 0.984	**37** 1.457	**30** 1.181	**25** 0.984	**43** 1.693	**11** 0.433	**9.5** 0.374	**0.6** 0.024
30 1.181	**30** 1.181	**42** 1.654	**30** 1.181	**30** 1.181	**47** 1.850	**11** 0.433	**9.5** 0.374	**0.6** 0.024
	30 1.181	**42** 1.654	**30** 1.181	**30** 1.181	**48** 1.890	**11** 0.433	**9.5** 0.374	**0.6** 0.024
35 1.378	**35** 1.378	**47** 1.850	**30** 1.181	**35** 1.378	**52** 2.047	**12** 0.472	**9.0** 0.354	**0.6** 0.024
	35 1.378	**47** 1.850	**30** 1.181	**35** 1.378	**53** 2.087	**12** 0.472	**9.0** 0.354	**0.6** 0.024
40 1.575	**40** 1.575	**52** 2.047	**32** 1.260	**40** 1.575	**60** 2.362	**13** 0.512	**10.0** 0.394	**0.6** 0.024
	40 1.575	**52** 2.047	**32** 1.260	**40** 1.575	**61** 2.402	**13** 0.512	**10.0** 0.394	**0.6** 0.024
45 1.772	**45** 1.772	**58** 2.283	**32** 1.260	**45** 1.772	**65** 2.559	**14** 0.551	**9.0** 0.354	**0.6** 0.024
	45 1.772	**58** 2.283	**32** 1.260	**45** 1.772	**66** 2.598	**14** 0.551	**9.0** 0.354	**0.6** 0.024
50 1.969	**50** 1.969	**62** 2.441	**35** 1.378	**50** 1.969	**70** 2.756	**14** 0.551	**10.0** 0.394	**0.6** 0.024
	50 1.969	**62** 2.441	**35** 1.378	**50** 1.969	**71** 2.795	**14** 0.551	**10.0** 0.394	**0.6** 0.024

Bearing Designation		Speed Rating	Load Ratings				Fatigue Load Limits C_u		Approx. Wt.	Matching Inner Ring Designation	Shaft Diameter
			Radial		Thrust						
			Dynamic	Static	Dynamic	Static					
NAXR	NAXR.Z		C	C_0	C_a	C_{0a}	Radial	Thrust			
		min^{-1}	kN lbf		kN lbf		kN		kg lbs		mm in
NAXR15		12000	**12.4** 2790	**15.0** 3370	**12.0** 2700	**26.3** 5910	2.30	3.70	**0.032** 0.071	JR12x15x16	**15** 0.591
	NAXR15.Z	12000	**12.4** 2790	**15.0** 3370	**12.0** 2700	**26.3** 5910	2.30	3.70	**0.035** 0.077	JR12x15x16	
NAXR17		11000	**13.7** 3080	**17.5** 3930	**12.6** 2830	**28.6** 6430	2.70	4.05	**0.050** 0.110	JR14x17x17	**17** 0.669
	NAXR17.Z	11000	**13.7** 3080	**17.5** 3930	**12.6** 2830	**28.6** 6430	2.70	4.05	**0.053** 0.117	JR14x17x17	
NAXR20TN		9500	**17.5** 3930	**25.3** 5690	**23.5** 5280	**56.8** 12800	4.00	8.00	**0.090** 0.198	JR17x20x20	**20** 0.787
	NAXR20Z.TN	9500	**17.5** 3930	**25.3** 5690	**23.5** 5280	**56.8** 12800	4.00	8.00	**0.095** 0.209	JR17x20x20	
NAXR25TN		8000	**19.2** 4320	**30.4** 6830	**31.2** 7010	**81.0** 18200	4.80	11.4	**0.146** 0.322	JR20x25x20	**25** 0.984
	NAXR25Z.TN	8000	**19.2** 4320	**30.4** 6830	**31.2** 7010	**81.0** 18200	4.80	11.4	**0.152** 0.335	JR20x25x20	
NAXR30TN		6700	**24.2** 5440	**38.3** 8610	**33.0** 7420	**91.1** 20500	6.10	12.8	**0.162** 0.357	JR25x30x20	**30** 1.181
	NAXR30Z.TN	6700	**24.2** 5440	**38.3** 8610	**33.0** 7420	**91.1** 20500	6.10	12.8	**0.169** 0.373	JR25x30x20	
NAXR35		6000	**26.1** 5870	**44.4** 9980	**30.8** 6920	**86.0** 19300	7.05	12.1	**0.186** 0.410	JR30x35x20	**35** 1.378
	NAXR35.Z	6000	**26.1** 5870	**44.4** 9980	**30.8** 6920	**86.0** 19300	7.05	12.1	**0.195** 0.430	JR30x35x20	
NAXR40		5300	**27.9** 6270	**50.4** 11300	**44.1** 9910	**126.0** 28300	8.05	12.0	**0.288** 0.635	JR35x40x20	**40** 1.575
	NAXR40.Z	5300	**27.9** 6270	**50.4** 11300	**44.1** 9910	**126.0** 28300	8.05	12.0	**0.299** 0.659	JR35x40x20	
NAXR45TN		4800	**29.5** 6630	**56.4** 12700	**52.3** 11800	**163.0** 36600	9.00	15.5	**0.360** 0.794	JR40x45x20	**45** 1.772
	NAXR45Z.TN	4800	**29.5** 6630	**56.4** 12700	**52.3** 11800	**163.0** 36600	9.00	15.5	**0.370** 0.816	JR40x45x20	
NAXR50		4300	**40.8** 9170	**79.3** 17800	**49.6** 11200	**155.0** 34800	12.5	14.8	**0.432** 0.952	JR45x50x25	**50** 1.969
	NAXR50.Z	4300	**40.8** 9170	**79.3** 17800	**49.6** 11200	**155.0** 34800	12.5	14.8	**0.452** 0.996	JR45x50x25	

NOTES

NEEDLE ROLLERS, ACCESSORIES

NEEDLE/CYLINDRICAL ROLLERS

Overview: Loose needle and cylindrical rollers are mainly used as bearing rolling elements to reduce friction and torque in rotating and pivoting applications. However, these precision rollers have many other uses, such as shafts or locating pins.

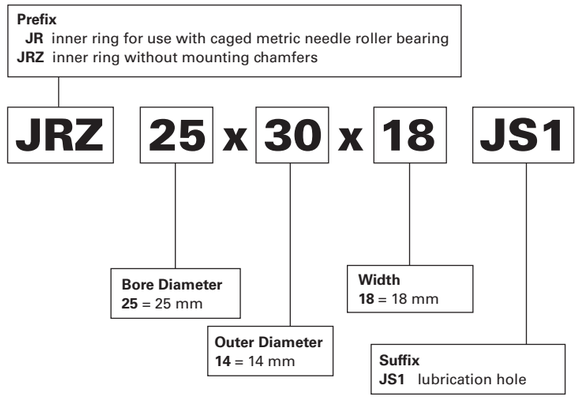
- **Catalog range:** Diameters from 1.5 mm (0.0591 in) to 14 mm (0.5512 in). Lengths from 5 mm (0.1969 in) to 63.5 mm (2.5 in).
- **Markets:** Vehicle and industrial transmissions, universal joints, and two-cycle engines.
- **Features:** Cylindrical and needle sizes are available. Needle rollers are available with flat and rounded-ends; metric series needle rollers available in Grade 2, 3 or 5.
- **Benefits:** Provide the maximum load-carrying capacity, within the smallest envelope, at a low cost.

METRIC INNER RINGS

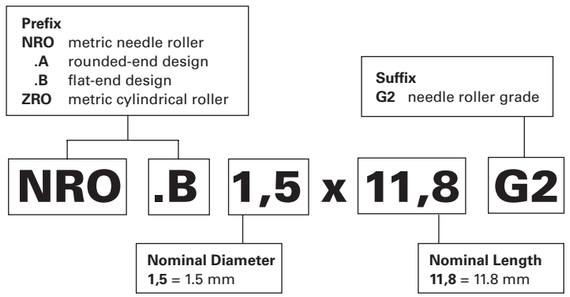
Overview: Inner rings are made from bearing-quality steel, and their O.D. and bore are precision-ground. They function as the inner raceway for a needle roller bearing by providing a surface that meets all shaft raceway design requirements (hardness, surface finish, roundness, etc.).

- **Catalog range:** 5 mm (0.1969 in) bore to 180 mm (7.0866 in) bore.
- **Markets:** Automotive, truck, power transmissions, and industrial applications.
- **Features:** Available with and without chamfers, some are available with a profiled outer diameter.
- **Benefits:** When it is not practical to manufacture the shaft to raceway quality, an inner ring allows a customer to obtain acceptable bearing performance.

Standard Inner Rings for Needle Roller Bearings – Metric Nominal Dimensions



Loose Rollers – Metric Nominal Dimensions



Needle Rollers, Accessories

B

NEEDLE ROLLERS – METRIC SERIES

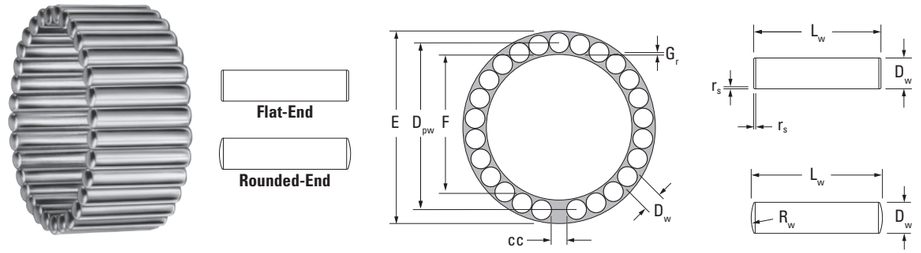


Fig. B8-1. Metric Series needle rollers

Needle rollers are made from rolling bearing-quality steel, hardened to 60-64 HRC or equivalent. Nominal metric needle rollers in various grades are standardized at national and international levels. The grades determine the dimensional and form tolerances of the needle rollers. Metric series needle rollers may differ by their end form: type A has rounded-end and type B has flat-ends. JTEKT prefers to supply needle roller in the most economical flat-end, or type B design, in G2 grade. Metric series needle rollers of type A also may be made available on request and in other G3 or G5 grades.

METRIC SERIES NEEDLE ROLLER DIMENSIONS

Nominally metric needle rollers, conforming to the International Standard ISO 3096, are shown in Table B8-2 on page B-8-6. The symbols used in Table B8-2 on page B-8-6, as well as in subsequent tables and figures, are summarized in Table B8-5 on page B-8-8. Needle rollers with flat-ends, which are the preferred design, are shown in Table B8-2 on page B-8-6. Chamfer dimension limits are also shown, the use of which results in the maximum possible effective contact length between roller and raceway. Yet, the relief at the needle roller ends help to reduce stress concentration – resulting in more uniform stress distribution, optimum load ratings, and longer life.

Every needle roller gage is separately packed, and packages are marked accordingly.

REFERENCE STANDARDS ARE:

- **ISO 3096** – rolling bearings – needle rollers – dimensions and tolerances.
- **DIN 5402** – rolling bearing components – needle rollers.

EXAMPLE OF METRIC SERIES NEEDLE ROLLER DESIGNATION AND PACKAGE MARKING:

NRO.B1,5x13,8G2
M2M4

NRO – Needle roller
.B – Flat-end needle rollers
1,5 – Nominal diameter D_w = 1.500 mm
13,8 – Nominal length L_w = 13.800 mm
G2 – Needle roller grade
M2M4 – Deviation of needle roller gage -2.000/-4.000 µm

The actual finished diameter is between 1.496 and 1.498 mm.

In the marking of the needle roller gage, P identifies zero (0) or plus (+), and M identifies minus (-). If a shipment of needle rollers of the same size comprises several boxes, each box contains needle rollers of the same grade. The gage may vary from box to box. Each individual box, however, contains needle rollers of the particular gage identified on the box.

METRIC SERIES NEEDLE ROLLER TOLERANCES

Table B8-1. Variation of Gage Lot Diameter, Preferred Gages and Circularity Deviation (values in µm)

Grade	Variation of Gage Lot Diameter V_{DwL} Max.	Gages High/Low Deviation of Mean Diameters D_{wmp}										Circularity Deviation Max.
2	2	Max.	0	-1	-2	-3	-4	-5	-6	-7	-8	1
		Min.	-2	-3	-4	-5	-6	-7	-8	-9	-10	
3	3	Max.	0		-1.5	-3		-4.5	-6		-7	1.5
		Min.	-3		-4.5	-6		-7.5	-9		-10	
5	5	Max.	0			-3			-5			2.5
		Min.	-5			-8			-10			

Note 1 - Tolerance values apply only at the middle of the needle roller length.
Note 2 - Needle rollers of any nominal dimensions and any of the quoted grades will be supplied sub-divided into the gages listed in Table B8-1 at our option, if nothing to the contrary is agreed upon at the time of ordering.

B

Table B8-2. Dimensions of metric series needle rollers

D_w Dia.	L_w Length	Needle Roller Designation	Wt. 1000 pcs Approx.	$r_{s\,min.}$ Chamfer Dimension Limits		
					Rad.	Axial
mm in	mm in		kg lbs	mm in	mm in	mm in
1.5 0.0591	**5.8** 0.228	NRO.B1,5x5,8G2	**0.080** 0.176	**0.1** 0.004	**0.6** 0.024	**0.8** 0.031
1.5 0.0591	**6.8** 0.268	NRO.B1.5x6,8G2	**0.094** 0.207	**0.1** 0.004	**0.6** 0.024	**0.8** 0.031
1.5 0.0591	**7.8** 0.307	NRO.B1.5x7,8G2	**0.108** 0.238	**0.1** 0.004	**0.6** 0.024	**0.8** 0.031
1.5 0.0591	**9.8** 0.386	NRO.B1,5x9,8G2	**0.136** 0.300	**0.1** 0.004	**0.6** 0.024	**0.8** 0.031
1.5 0.0591	**11.8** 0.465	NRO.B1,5x11,8G2	**0.164** 0.362	**0.1** 0.004	**0.6** 0.024	**0.8** 0.031
1.5 0.0591	**13.8** 0.543	NRO.B1,5x13,8G2	**0.191** 0.421	**0.1** 0.004	**0.6** 0.024	**0.8** 0.031
2 0.0787	**7.8** 0.307	NRO.B2x7,8G2	**0.190** 0.419	**0.2** 0.008	**0.6** 0.024	**0.8** 0.031
2 0.0787	**9.8** 0.386	NRO.B2x9,8G2	**0.240** 0.529	**0.2** 0.008	**0.6** 0.024	**0.8** 0.031
2 0.0787	**11.8** 0.465	NRO.B2x11,8G2	**0.290** 0.639	**0.2** 0.008	**0.6** 0.024	**0.8** 0.031
2 0.0787	**13.8** 0.543	NRO.B2x13,8G2	**0.340** 0.750	**0.2** 0.008	**0.6** 0.024	**0.8** 0.031
2 0.0787	**15.8** 0.622	NRO.B2x15,8G2	**0.390** 0.860	**0.2** 0.008	**0.6** 0.024	**0.8** 0.031
2 0.0787	**17.8** 0.701	NRO.B2x17,8G2	**0.440** 0.970	**0.2** 0.008	**0.6** 0.024	**0.8** 0.031
2 0.0787	**19.8** 0.780	NRO.B2x19,8G2	**0.490** 1.080	**0.2** 0.008	**0.6** 0.024	**0.8** 0.031
2 0.0787	**21.8** 0.858	NRO.B2x21,8G2	**0.540** 1.190	**0.2** 0.008	**0.6** 0.024	**0.8** 0.031
2.5 0.0984	**7.8** 0.307	NRO.B2,5x7,8G2	**0.300** 0.661	**0.2** 0.008	**0.6** 0.024	**0.8** 0.031
2.5 0.0984	**9.8** 0.386	NRO.B2,5x9,8G2	**0.380** 0.838	**0.2** 0.008	**0.6** 0.024	**0.8** 0.031
2.5 0.0984	**11.8** 0.465	NRO.B2,5x11,8G2	**0.450** 0.992	**0.2** 0.008	**0.6** 0.024	**0.8** 0.031
2.5 0.0984	**13.8** 0.543	NRO.B2,5x13,8G2	**0.530** 1.168	**0.2** 0.008	**0.6** 0.024	**0.8** 0.031
2.5 0.0984	**15.8** 0.622	NRO.B2,5x15,8G2	**0.610** 1.345	**0.2** 0.008	**0.6** 0.024	**0.8** 0.031
2.5 0.0984	**17.8** 0.701	NRO.B2,5x17,8G2	**0.690** 1.521	**0.2** 0.008	**0.6** 0.024	**0.8** 0.031
2.5 0.0984	**19.8** 0.780	NRO.B2,5x19,8G2	**0.760** 1.676	**0.2** 0.008	**0.6** 0.024	**0.8** 0.031
2.5 0.0984	**21.8** 0.858	NRO.B2,5x21,8G2	**0.840** 1.852	**0.2** 0.008	**0.6** 0.024	**0.8** 0.031
2.5 0.0984	**23.8** 0.937	NRO.B2,5x23,8G2	**0.920** 2.028	**0.2** 0.008	**0.6** 0.024	**0.8** 0.031
3 0.1181	**9.8** 0.386	NRO.B3x9,8G2	**0.540** 1.190	**0.2** 0.008	**0.6** 0.024	**0.8** 0.031
3 0.1181	**11.8** 0.465	NRO.B3x11,8G2	**0.650** 1.433	**0.2** 0.008	**0.6** 0.024	**0.8** 0.031
3 0.1181	**13.8** 0.543	NRO.B3x13,8G2	**0.760** 1.676	**0.2** 0.008	**0.6** 0.024	**0.8** 0.031
3 0.1181	**15.8** 0.622	NRO.B3x15,8G2	**0.870** 1.918	**0.2** 0.008	**0.6** 0.024	**0.8** 0.031
3 0.1181	**17.8** 0.701	NRO.B3x17,8G2	**0.990** 2.183	**0.2** 0.008	**0.6** 0.024	**0.8** 0.031
3 0.1181	**19.8** 0.780	NRO.B3x19,8G2	**1.100** 2.425	**0.2** 0.008	**0.6** 0.024	**0.8** 0.031
3 0.1181	**21.8** 0.858	NRO.B3x21,8G2	**1.210** 2.668	**0.2** 0.008	**0.6** 0.024	**0.8** 0.031
3 0.1181	**23.8** 0.937	NRO.B3x23,8G2	**1.320** 2.910	**0.2** 0.008	**0.6** 0.024	**0.8** 0.031
3 0.1181	**25.8** 1.016	NRO.B3x25,8G2	**1.430** 3.153	**0.2** 0.008	**0.6** 0.024	**0.8** 0.031
3 0.1181	**27.8** 1.094	NRO.B3x27,8G2	**1.540** 3.395	**0.2** 0.008	**0.6** 0.024	**0.8** 0.031
3.5 0.1378	**11.8** 0.465	NRO.B3,5x11,8G2	**0.910** 2.006	**0.3** 0.012	**0.8** 0.031	**1.0** 0.039
3.5 0.1378	**13.8** 0.543	NRO.B3,5x13,8G2	**1.040** 2.293	**0.3** 0.012	**0.8** 0.031	**1.0** 0.039
3.5 0.1378	**15.8** 0.622	NRO.B3,5x15,8G2	**1.190** 2.624	**0.3** 0.012	**0.8** 0.031	**1.0** 0.039
3.5 0.1378	**17.8** 0.701	NRO.B3,5x17,8G2	**1.340** 2.954	**0.3** 0.012	**0.8** 0.031	**1.0** 0.039
3.5 0.1378	**21.8** 0.858	NRO.B3,5x21,8G2	**1.640** 3.616	**0.3** 0.012	**0.8** 0.031	**1.0** 0.039
3.5 0.1378	**23.8** 0.937	NRO.B3,5x23,8G2	**1.850** 4.079	**0.3** 0.012	**0.8** 0.031	**1.0** 0.039
3.5 0.1378	**25.8** 1.016	NRO.B3,5x25,8G2	**1.950** 4.299	**0.3** 0.012	**0.8** 0.031	**1.0** 0.039
3.5 0.1378	**29.8** 1.173	NRO.B3,5x29,8G2	**2.250** 4.960	**0.3** 0.012	**0.8** 0.031	**1.0** 0.039
3.5 0.1378	**34.8** 1.370	NRO.B3,5x34,8G2	**2.650** 5.842	**0.3** 0.012	**0.8** 0.031	**1.0** 0.039
4 0.1575	**11.8** 0.465	NRO.B4x11,8G2	**1.600** 3.527	**0.3** 0.012	**0.8** 0.031	**1.0** 0.039
4 0.1575	**13.8** 0.543	NRO.B4x13,8G2	**1.360** 2.998	**0.3** 0.012	**0.8** 0.031	**1.0** 0.039
4 0.1575	**15.8** 0.622	NRO.B4x15,8G2	**1.550** 3.417	**0.3** 0.012	**0.8** 0.031	**1.0** 0.039
4 0.1575	**17.8** 0.701	NRO.B4x17,8G2	**1.750** 3.858	**0.3** 0.012	**0.8** 0.031	**1.0** 0.039
4 0.1575	**19.8** 0.780	NRO.B4x19,8G2	**1.950** 4.299	**0.3** 0.012	**0.8** 0.031	**1.0** 0.039
4 0.1575	**21.8** 0.858	NRO.B4x21,8G2	**2.150** 4.740	**0.3** 0.012	**0.8** 0.031	**1.0** 0.039
4 0.1575	**23.8** 0.937	NRO.B4x23,8G2	**2.350** 5.181	**0.3** 0.012	**0.8** 0.031	**1.0** 0.039
4 0.1575	**25.8** 1.016	NRO.B4x25,8G2	**2.550** 5.622	**0.3** 0.012	**0.8** 0.031	**1.0** 0.039
4 0.1575	**27.8** 1.094	NRO.B4x27,8G2	**2.740** 6.041	**0.3** 0.012	**0.8** 0.031	**1.0** 0.039
4 0.1575	**29.8** 1.173	NRO.B4x29,8G2	**2.950** 6.504	**0.3** 0.012	**0.8** 0.031	**1.0** 0.039
4 0.1575	**34.8** 1.370	NRO.B4x34,8G2	**3.400** 7.496	**0.3** 0.012	**0.8** 0.031	**1.0** 0.039
4 0.1575	**39.8** 1.567	NRO.B4x39,8G2	**3.900** 8.598	**0.3** 0.012	**0.8** 0.031	**1.0** 0.039
5 0.1969	**15.8** 0.622	NRO.B5x15,8G2	**2.430** 5.357	**0.3** 0.012	**0.8** 0.031	**1.0** 0.039
5 0.1969	**19.8** 0.780	NRO.B5x19,8G2	**3.050** 6.724	**0.3** 0.012	**0.8** 0.031	**1.0** 0.039
5 0.1969	**21.8** 0.858	NRO.B5x21,8G2	**3.360** 7.408	**0.3** 0.012	**0.8** 0.031	**1.0** 0.039
5 0.1969	**23.8** 0.937	NRO.B5x23,8G2	**3.670** 8.091	**0.3** 0.012	**0.8** 0.031	**1.0** 0.039
5 0.1969	**25.8** 1.016	NRO.B5x25,8G2	**3.980** 8.774	**0.3** 0.012	**0.8** 0.031	**1.0** 0.039
5 0.1969	**27.8** 1.094	NRO.B5x27,8G2	**4.290** 9.458	**0.3** 0.012	**0.8** 0.031	**1.0** 0.039
5 0.1969	**29.8** 1.173	NRO.B5x29,8G2	**4.600** 10.141	**0.3** 0.012	**0.8** 0.031	**1.0** 0.039
5 0.1969	**34.8** 1.370	NRO.B5x34,8G2	**5.400** 11.905	**0.3** 0.012	**0.8** 0.031	**1.0** 0.039
5 0.1969	**39.8** 1.567	NRO.B5x39,8G2	**6.150** 13.558	**0.3** 0.012	**0.8** 0.031	**1.0** 0.039
5 0.1969	**49.8** 1.961	NRO.B5x49,8G2	**7.500** 16.535	**0.3** 0.012	**0.8** 0.031	**1.0** 0.039
6 0.2362	**17.8** 0.701	NRO.B6x17,8G2	**3.950** 8.708	**0.3** 0.012	**0.8** 0.031	**1.0** 0.039

END FORM TOLERANCES

Table B8-3 specifies the applicable end configuration for rounded end and flat end needle rollers of all grades.

Table B8-3. End configuration limits for metric needle rollers

Rounded End Needle Rollers End Radius R_w[1]		Nominal Diameters of Needle Roller D_w		Flat End Needle Rollers Chamfer Dimension Limits (Dimensions in millimeters)		
				$r_{s\,min.}$[1]	$r_{s\,max.}$	
Min.	Max.	>	≤		Radial	Axial
$\frac{D_w}{2}$	$\frac{L_w}{2}$	—	1	0.1	0.6	0.8
		1	1.5	0.1	0.6	0.8
		1.5	3	0.2	0.6	0.8
		3	6	0.3	0.8	1

[1] The chamfer of a needle roller shall clear a fillet radius equal to $r_{s\,min.}$, which should also be considered for designs using rounded end needle rollers.

NEEDLE ROLLER LENGTH TOLERANCE

Tolerances on the length L_w for needle rollers of all grades: h13, see Table B8-4.

Table B8-4. Tolerances for needle roller length, nominal metric needle rollers

Nominal Length, L_w mm		Tolerance Limits mm (ISO h13)	
>	≤	Max.	Min.
3	6	0	-0.18
6	10	0	-0.22
10	18	0	-0.27
18	30	0	-0.33
30	50	0	-0.39

DESIGN CALCULATIONS FOR NEEDLE ROLLER BEARING COMPLEMENTS

In the majority of full complement needle roller applications, needle roller complements of less than 35 needle rollers per row and a ratio of length to diameter between 4:1 and 8:1, is advantageous. Other combinations of quantity and length-to-diameter ratios of needle rollers have been used successfully. Specific design requirements usually dictate the appropriate selection.

In general, needle roller complements for rotating motion should employ a smaller number of large diameter needle rollers, while needle roller complements subjected to oscillating motion (especially under high loads) should employ a large number of smaller diameter needle rollers.

Oscillating applications with small angular travel encourage the development of fretting corrosion. The best performance under these conditions has been achieved by using the largest practical number of small diameter needle rollers.

CALCULATION OF RACEWAY DIAMETERS

The calculation of inner and outer raceway diameters may be carried out using either the formula given in Table B8-5 on page B-8-8 or the raceway calculation form in Table B8-6 on page B-8-8. To assist the designer in making these calculations, the values of K, required for calculation of needle roller complements of six through 60 needle rollers, are listed in Table B8-7 on page B-8-8. Values of K, for other numbers of needle rollers, can be calculated using the formulas given in Table B8-5 on page B-8-8.

Table B8-8 on page B-8-9 lists the suggested values for minimum radial internal clearance ($G_{r\,min.}$) and the minimum circumferential clearance divided by π ($cc_{min.}/\pi$), to be used for calculating needle roller complements for normal rotating applications – where the speeds, loads and shaft deflections are moderate.

Applications with poor lubrication, unusual motion, large misalignment, raceway distortions, load reversals, high speeds, etc., cannot be characterized as normal rotating applications. These miscellaneous applications require adjustment of the minimum clearances, listed in Table B8-8 on page B-8-10. The factors in Table B8-9 on page B-8-10 may be used for general guidance in the adjustment of minimal clearances. For any of the listed miscellaneous applications or any application where abnormal factors such as those listed above exist, and particularly when the inner raceway diameter will exceed 50.000 mm (1.9685 in), consult your representative for design assistance.

B

Table B8-5. Design factors for needle rollers

Z	Number of needle rollers per bearing path
K	Chordal factor, K = 1/sin (180°/Z)
cc	Total circumferential clearance. See Tables B8-8 and B8-9 on page B-8-9 for cc_{min}/π values.
G_r	Radial internal clearance. See Tables B8-8 and B8-9 on page B-8-9 for $G_{r\,min}$ values
D_{pw}	Pitch diameter: $D_{pw} = KD_{w\,max.} + (cc_{min.}/\pi) = E_{min.} - D_{w\,max.}$ $= F_{max.} + G_{r\,min.} + D_{w\,max.}$
E	Outer raceway bore diameter: $E_{min.} = D_{pw} + D_{w\,max.} = (K + 1)D_{w\,max.} + (cc_{min.}/\pi)$ $= F_{max.} + G_{r\,min.} + 2D_{w\,max.}$
F	Inner raceway diameter: $F_{max.} = D_{pw} - D_{w\,max.} - G_{r\,min.}$ $= (K-1)D_{w\,max.} + (cc_{min.}/\pi) - G_{r\,min.}$ $= E_{min.} - 2D_{w\,max.} - G_{r\,min.}$
D_w	Nominal needle roller diameter
D_{we}	Needle roller diameter applicable in the calculation of load ratings: $D_{we} = D_{pw} - F_{max.} - G_{r\,min.} = \frac{D_{pw} - cc_{min.}/\pi}{K}$ $= \frac{F_{max.} + G_{r\,min.} - (cc_{min.}/\pi)}{(K-1)}$ $= E_{min.} - D_{pw} = \frac{E_{min.} - cc_{min.}/\pi}{(K+1)}$
L_w	Overall needle roller length
R_w	End radius, rounded-end needle roller
r_s	Corner rounding, flat-end needle roller
L_{we}	Needle roller length applicable in the calculation of load ratings, for rounded-end needle rollers: $L_{we} = L_{w\,max.} - (L_{w\,max.} - \sqrt{L_{w\,max.}^2 - D_{we}^2})$ For flat-end needle rollers: $L_{we} = L_{w\,max.} - (2r_{s\,min.})$

Note: If length of contact of the needle roller with the raceway is reduced because of undercuts, chamfers, etc. — L_{we} must be reduced correspondingly

RACEWAY DIAMETER TOLERANCES

Tables B8-10 and B8-11 on page B-8-9 lists the recommended tolerances that should be applied to the dimensions for the maximum inner raceway and minimum outer raceway diameter after they have been calculated using the information given in Table B8-5 or Table B8-6.

Table B8-6. Raceway calculation form

Step	Source	Design factor	**mm** (in)
1	Given	Dw, needle roller diameter	**3.000** max. (0.1181 max.)
2	Table B8-7	K, for 30 needle rollers	**9.56677**
3	(1)×(2)	KD_w	**28.700** (1.1299)
4	Table B8-8 on page B-8-11	cc_{min}/π = 0.127 mm (0.005 in)	**0.127** min. (0.005 min.)
5	(3) + (4)	Dpw pitch diameter	**28.827** (1.1349)
6	Given	Dw, needle roller diameter	**3.000** max. (0.1181 max.)
7	(5) - (6)		**25.827** (1.0168)
8	Table B8-8 on page B-8-11	Gr, radial clearance	**0.013** min. (0.0005 min.)
9	(7) - (8)	F, inner raceway diameter	**25.814** max. (1.0163 max.) **25.805** min.(1) (1.0159 min.)
10	(5) + (6)	E, outer raceway diameter	**31.827** min. (1.2530 min.) **31.843** max.(1) (1.2536 max.)

(1) Tolerance from Tables B8-10 and B8-11 on page B-8-9.

Table B8-7. K values

K values		K values		K values		K values		K values		K values	
Z	K	Z	K	Z	K	Z	K	Z	K	Z	K
6	2.00000	16	5.12583	26	8.29623	36	11.47371	46	14.65364	56	17.86471
7	2.30476	17	5.44219	27	8.61379	37	11.79163	47	14.97171	57	18.15285
8	2.61313	18	5.75877	28	8.93140	38	12.10957	48	15.28979	58	18.47100
9	2.92380	19	6.07553	29	9.24907	39	12.42752	49	15.60788	59	18.78916
10	3.23607	20	6.39245	30	9.56677	40	12.74549	50	15.92597	60	19.10732
11	3.54947	21	6.70951	31	9.88452	41	13.06348	51	16.24408		
12	3.86370	22	7.02667	32	10.20230	42	13.38149	52	16.56219		
13	4.17858	23	7.34394	33	10.52011	43	13.69951	53	16.88031		
14	4.49396	24	7.66130	34	10.83795	44	14.01754	54	17.19843		
15	4.80973	25	7.97873	35	11.15582	45	14.33559	55	17.51657		

CLEARANCES IN NEEDLE ROLLER COMPLEMENTS

Needle rollers, supplied in bulk, are generally used for full complement assemblies. Successful operation of a full complement of needle rollers not only requires careful selection of radial internal clearance, but more importantly, depends on proper circumferential clearance – or the total clearance between needle rollers.

Needle roller guidance, in a full complement assembly, depends largely on contact between needle rollers. Too little circumferential clearance causes overheating. Too much circumferential clearance in a heavily loaded full complement of needle rollers causes loss of needle roller guidance and results in needle roller skew and resultant end thrusting.

Control of radial clearance and circumferential clearance is influenced by the needle roller diameter tolerance, as well as the tolerances of the inner and outer raceway diameters.

Table B8-8. Minimum clearances, normal rotating applications

F Nominal Inner Raceway Diameter **mm** in		CC_{min}/π	$G_{r\,min.}$
>	≤	**mm** in	**mm** in
-	**3**	**0.025**	**0.006**
-	0.1181	0.0010	0.0002
3	**6**	**0.102**	**0.008**
0.1181	0.2362	0.0040	0.0003
6	**10**	**0.127**	**0.009**
0.2362	0.3937	0.0050	0.0004
10	**18**	**0.127**	**0.011**
0.3937	0.7087	0.0050	0.0004
18	**30**	**0.127**	**0.013**
0.7087	1.1811	0.0050	0.0005
30	**50**	**0.127**	**0.016**
1.1811	1.9685	0.0050	0.0006
50	**80**	**0.127**	**0.019**
1.9685	3.1496	0.0050	0.0007
80	**120**	**0.127**	**0.022**
3.1496	4.7244	0.0050	0.0009

Table B8-9. Minimum clearances, miscellaneous applications

Application	cc_{min}/π	$G_{r\,min.}$
universal joint	1/3 • normal	1/2 • normal
transmission pilot	normal	3 • normal
constant mesh gear	0.2 • roller dia.	normal
transmission planet	normal	normal
crank pin for two cycle engine	5 • normal	7 • normal

END CLEARANCE

The total needle roller end clearance, or endplay, normally should be 0.20 mm (0.008 in) minimum per path of needle rollers.

Table B8-10. Recommended inner raceway diameter tolerances

F Nominal Inner Raceway Diameter **mm** in		Tolerance Limits (ISO h5) **mm** in	
>	≤	Max.	Min.
3	**6**	**0**	**-0.005**
0.1181	0.2362	0	-0.0002
6	**10**	**0**	**-0.006**
0.2362	0.3937	0	-0.0002
10	**18**	**0**	**-0.008**
0.3937	0.7087	0	-0.0003
18	**30**	**0**	**-0.009**
0.7087	1.1811	0	-0.0004
30	**50**	**0**	**-0.011**
1.1811	1.9685	0	-0.0004
50	**80**	**0**	**-0.013**
1.9685	3.1496	0	-0.0005
80	**120**	**0**	**-0.015**
3.1496	4.7244	0	-0.0006

Table B8-11. Recommended outer raceway bore diameter tolerances

E Nominal Outer Raceway Bore Diameter **mm** in		Tolerance Limits (ISO H6) **mm** in	
>	≤	Max.	Min.
3	**6**	**0.008**	**0**
0.1181	0.2362	0.0003	0
6	**10**	**0.009**	**0**
0.2362	0.3937	0.0004	0
10	**18**	**0.011**	**0**
0.3937	0.7087	0.0004	0
18	**30**	**0.013**	**0**
0.7087	1.1811	0.0005	0
30	**50**	**0.016**	**0**
1.1811	1.9685	0.0006	0
50	**80**	**0.019**	**0**
1.9685	3.1496	0.0007	0
80	**120**	**0.022**	**0**
3.1496	4.7244	0.0009	0

LOAD RATING AND LIFE CALCULATIONS FOR FULL COMPLEMENTS OF NEEDLE ROLLERS

Before selecting the quantity and size of needle rollers to be used in a needle roller complement, it is usually necessary to calculate the load rating required using the applied load, speed and desired life. For a review of bearing size selection, see the engineering section of the this catalog.

Because it is not practical to tabulate the dynamic and static load ratings for the great number of needle roller complements that can be assembled by using different quantities, diameters and lengths of rollers, formulae are provided for the necessary calculations. See Tables B8-3 and B8-4 on page B-8-7 and Table B8-5 on page B-8-8 for calculation of Lwe.

For convenience, values of f_c and values of $Z^{3/4}$ have been combined into single factors ($f_c Z^{3/4}$). These factors, for a wide range of roller complements, are tabulated in Table B8-12.

Table B8-12. Values of fc $Z^{3/4}$ for metric units

Z	$f_c Z^{3/4}$ kN - units **mm** in	Z	$f_c Z^{3/4}$ kN - units **mm** in
6	**0.267** 0.0105	34	**1.288** 0.0507
7	**0.336** 0.0132	35	**1.310** 0.0516
8	**0.400** 0.0158	36	**1.331** 0.0524
9	**0.459** 0.0181	37	**1.353** 0.0533
10	**0.514** 0.0202	38	**1.374** 0.0541
11	**0.565** 0.0222	39	**1.394** 0.0549
12	**0.613** 0.0241	40	**1.415** 0.0557
13	**0.658** 0.0259	41	**1.435** 0.0565
14	**0.701** 0.0276	42	**1.454** 0.0572
15	**0.742** 0.0292	43	**1.474** 0.0580
16	**0.781** 0.0308	44	**1.493** 0.0588
17	**0.818** 0.0322	45	**1.512** 0.0595
18	**0.853** 0.0336	46	**1.531** 0.0603
19	**0.887** 0.0349	47	**1.549** 0.0610
20	**0.919** 0.0362	48	**1.568** 0.0617
21	**0.951** 0.0374	49	**1.586** 0.0624
22	**0.981** 0.0386	50	**1.604** 0.0632
23	**1.011** 0.0398	51	**1.621** 0.0638
24	**1.039** 0.0409	52	**1.639** 0.0645
25	**1.067** 0.0420	53	**1.656** 0.0652
26	**1.094** 0.0430	54	**1.673** 0.0659
27	**1.120** 0.0441	55	**1.690** 0.0665
28	**1.145** 0.0451	56	**1.707** 0.0672
29	**1.170** 0.0461	57	**1.724** 0.0679
30	**1.195** 0.0471	58	**1.740** 0.0685
31	**1.219** 0.0480	59	**1.757** 0.0692
32	**1.242** 0.0489	60	**1.773** 0.0698
33	**1.265** 0.0498		

BASIC DYNAMIC LOAD RATINGS

The basic dynamic load rating C, for any roller bearing, can be calculated from the formula:

$$C = f_c(iL_{we}\cos\alpha)^{7/9} Z^{3/4} D_{we}^{29/27}$$

Where:

f_c = a factor which depends on the geometry of the bearing components, the accuracy to which the various components are made, and the material. Maximum values are listed in such standards as ISO 281 and USA ANSI-ABMA Standard 11.

i = number of rows of rollers in any one bearing.

α = nominal angle of contact. Since $\alpha = 0$ for a radial roller bearing, $\cos\alpha = 1$.

Other symbols are explained in Table B8-5 on page B-8-8.

For single-path radial roller bearings, where i = 1 and $\cos\alpha = 1$, the basic dynamic load rating formula can be written as:

$$C = f_c Z^{3/4} L_{we}^{7/9} D_{we}^{29/27}$$

Example:

Calculate the basic dynamic load rating for a full complement of 28 flat-end rollers, 3.000 mm (0.1181 in) diameter and 17.800 mm (0.7008 in) length.

$C = f_c Z^{3/4} L_{we}^{7/9} D_{we}^{29/27}$

$f_c Z^{3/4}$ from Table B8-12 on page B-8-12 = 1.145

$D_{we}^{29/27} = 3^{29/27} = 3.254$

L_{we} = 17.8- 0.4 = 17.4 mm (see Table B8-5 on page B-8-8)

$L_{we}^{7/9} = 17.4^{7/9} = 9.223$

$C = 1.145 \times 9.223 \times 3.254 = 34.4$ kN

When a couple load (overturning moment) is imposed on a single row of needle rollers, the resulting uneven distribution of load can seriously affect bearing life. In such cases, two rows of needle rollers are generally suggested.

Your representative should be consulted before a final selection of a needle roller complement is made.

BASIC STATIC LOAD RATING

The basic static load rating (C_0) for any roller bearing, including needle roller bearings, can be calculated from the following formula included in ISO 76, USA ANSI-ABMA Standard 11, and other Standards:

$$C_o = f_0\left(1 - \frac{D_{we}\cos\alpha}{D_{pw}}\right) iZL_{we}D_{we}\cos\alpha$$

Where:

f_0 = 0.044 when kilo-newton and millimeter units are used.

D_{pw} = pitch diameter of the needle roller complement (mm).

i = number of rows of rollers in any one bearing.

α = nominal angle of contact. Since $\alpha = 0$ for radial roller bearing, $\cos\alpha = 1$.

The other symbols are described in Table B8-5 on page B-8-8.

NEEDLE ROLLERS – INCH SERIES

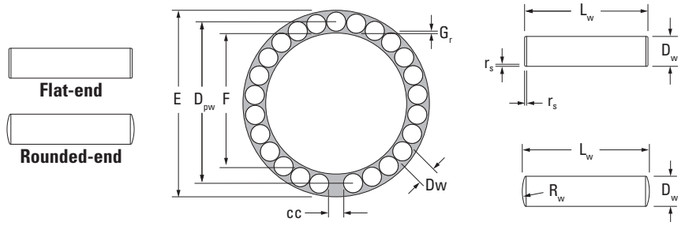


Fig. B8-2. Inch series needle rollers

INTRODUCTION

Before selecting a specific needle roller complement, the engineering section should be reviewed for detailed information concerning:

- Bearing type selection.
- Bearing life and reliability.
- Definition of load ratings.
- Life and load relationships.
- Effect of raceway hardness.
- Example of life calculation.
- Lubrication.
- Shaft design.
- Housing design.

In addition to these general considerations, material which follows should also be reviewed when selecting a needle roller complement.

Standard inch series needle rollers are furnished in two styles – rounded-end or the most economical design: flat-end. Materials, dimensions and tolerances for standard needle rollers are specified in this section.

When required, needle rollers having spherical ends, conical ends, trunnion ends or crank pin ends, as well as other end designs, can be furnished. Your representative should be consulted before final needle roller selection is made.

INCH SERIES – NEEDLE ROLLER DIMENSIONS

Needle rollers are made from rolling-bearing-quality steel hardened to 60-64 HRC or equivalent. Nominally inch needle rollers are given in Table B8-13. Your representative should be consulted for availability. The symbols used in Tables B8-13, as well as in subsequent tables and figures, are summarized in Table B8-14 on page B-8-14.

Needle rollers with rounded-ends permit the use of a more generous fillet between the raceway and the locating shoulder than is possible with flat-end rollers. Also, due to the length of the rounded-end, the possibility of the roller's cylindrical surface operating over the edge of the raceway is less – reducing the chance of occurrence of harmful stress concentrations. On the other hand, where design considerations permit their use, flat-end rollers achieve the maximum possible effective contact length between roller and raceway along with maximum load ratings and longer life.

Table B8-13. Preferred needle roller sizes

D_w	L_w																					
Nominal dia.	Nominal length																					
mm	**3.048**	**4.064**	**4.826**	**5.588**	**6.350**	**7.112**	**7.874**	**9.652**	**11.176**	**12.700**	**14.224**	**15.748**	**19.050**	**22.352**	**25.400**	**28.448**	**31.750**	**35.052**	**38.100**	**44.450**	**50.800**	**57.150**	**63.500**
in	0.12	0.16	0.19	0.22	0.25	0.28	0.31	0.38	0.44	0.5	0.56	0.62	0.75	0.88	1	1.12	1.25	1.38	1.5	1.75	2	2.25	2.5
1.588 0.0625					•	•	•	•	•	•	•	•	•										
1.984 0.0781							•	•	•	•	•	•	•	•									
2.383 0.0938								•	•	•	•	•	•	•	•								
3.175 0.1250										•	•	•	•	•	•	•	•	•					
3.967 0.1562												•	•	•	•	•	•	•	•				
4.763 0.1875													•	•	•	•	•	•	•	•			
5.558 0.2188														•	•	•	•	•	•	•	•		
6.350 0.2500															•	•	•	•	•	•	•	•	•

• Indicates preferred needle roller sizes. Consult with your representative.

CLEARANCES IN NEEDLE ROLLER COMPLEMENTS

Needle rollers, supplied in bulk, are generally used to assemble full complement bearings. Successful operation of a full complement of rollers not only requires careful selection of radial clearance, but more importantly, depends on proper circumferential clearance – or the total clearance between rollers.

Circumferential guidance in a full complement of needle rollers depends largely on roller-to-roller contact. Too little circumferential clearance causes overheating. Too much circumferential clearance, in a heavily loaded full complement of needle rollers, causes loss of roller guidance and results in roller skew and heavy end thrust.

Control of radial clearance and circumferential clearance is influenced by the roller diameter tolerance, as well as the tolerances of the inner and outer raceway diameters.

END CLEARANCE

The total needle roller end clearance, or endplay, normally should be 0.20 mm (0.008 in) minimum per path of needle rollers.

NOMINAL-INCH NEEDLE ROLLER TOLERANCES

Unless otherwise specified, inch needle rollers are normally manufactured with a tolerance of +0.000 mm -0.005 mm (+0.0000 in -0.0002 in). This tolerance has proven acceptable and ensures satisfactory control of circumferential clearance. The needle roller length tolerance may vary with the end configuration. The normal roller length tolerance for rounded-end rollers is +0.000 mm -0.508 mm (+0.0000 in -0.0200 in) .

JTEKT also manufactures needle rollers with 0.0025 mm (0.0001 in) diameter tolerance. These offer enhanced load-carrying capability and improved control of circumferential clearance. For needle rollers of greater precision, please consult with your representative.

Nominal dimensions for typical inch series needle rollers are shown in Table B8-13 on page B-8-12. JTEKT can supply rollers with smaller and larger length-to-diameter ratios for special applications. Rollers with dimensions other than those shown in Table B8-13 on page B-8-12 can be obtained, provided the quantities permit economical production. For example, although the largest needle rollers shown in Table B8-13 on page B-8-12 are 6.35 mm (0.2500 in) [the usual limits for needle rollers], JTEKT can produce quantities of rollers as large as 15.900 mm (0.6250 in) diameter.

Your representative should be contacted with the following information about the required needle rollers:

- Nominal metric or inch.
- Diameter and tolerance (e.g., 3.175 mm, + 0.000 mm, -0.005 mm [0.1250 in, + 0.0000 in, -0.0002 in]).
- Length and tolerance (e.g., 14.224 mm, + 0.000 mm, -0.508 mm [0.5600 in, + 0.0000 in, -0.0200 in]).
- End form (e.g., rounded-end or flat-end).
- Material (e.g., high-carbon chrome steel).
- Special features required (e.g., controlled stress).
- Quantity required.

DESIGN CALCULATIONS FOR NEEDLE ROLLER BEARING COMPLEMENTS

In the majority of full complement needle roller applications, roller complements of less than 35 needle rollers per row and a ratio of roller length to roller diameter between 8:1 and 4:1 is advantageous. Other combinations of quantity and length-to-diameter ratios of needle rollers have been used successfully. Specific design requirements usually dictate the appropriate selection.

In general, roller complements for rotating motion should employ a smaller number of larger-diameter needle rollers, while roller complements subjected to oscillating motion (especially under high loads) should employ a larger number of smaller-diameter needle rollers.

Oscillating applications with small angular travel encourage the development of fretting corrosion. The best performance under these conditions has been achieved by using the largest practical number of small-diameter needle rollers.

CALCULATION OF RACEWAY DIAMETERS

It may be convenient to use the Bearing Calculation Form in Table B8-15 on page B-8-14 to calculate the maximum inner raceway and the minimum outer raceway diameters of a bearing. The formula given in Table B8-14 on page B-8-14 can also be used. To assist the designer in making these calculations, the values of K, required for calculation of needle roller complements of 6 through 60 needle rollers, are listed in Table B8-18 on page B-8-15. Values of K for other numbers of needle rollers will be furnished on request or can be calculated from the formula given in Table B8-14 on page B-8-14.

Table B8-16 on page B-8-14 lists the suggested values for minimum radial clearance and ($G_{r\ min.}$) minimum circumferential clearance divided by π ($cc_{\ min./\pi}$), to be used for calculating needle roller complements for normal rotating applications where the speeds, loads and shaft deflections are moderate.

Applications with poor lubrication, unusual motion, large misalignment, raceway distortions, load reversals, high speeds, etc., can not be characterized as normal rotating applications. These miscellaneous applications require adjustment of the minimum clearances listed in Table B8-16 on page B-8-14. The factors in Tables B8-17 on page B-8-14 may be used for general guidance in the adjustment of the minimal clearances. For any of the listed miscellaneous applications or any application where abnormal factors such as those listed above exist – and particularly when the inner raceway diameter will exceed 50.800 mm (2.0000 in) – your representative should be consulted for design assistance.

Table B8-14. Design factors for needle rollers

Z	Number of needle rollers per bearing path
K	Chordal factor, K = 1/sin (180°/ Z)
cc	Total circumferential clearance. See Tables B8-16 and B8-17 for $cc_{min.}/\pi$ values.
G_r	Radial internal clearance. See Tables B8-16 and B8-17 for $G_{r\,min.}$ values
D_{pw}	Pitch diameter: $D_{pw} = KD_{w\,max.} + (cc_{min.}/\pi) = E_{min.} - D_{w\,max.}$ $= F_{max.} + G_{r\,min.} + D_{w\,max.}$
E	Outer raceway bore diameter: $E_{min.} = D_{pw} + D_{w\,max.} = (K + 1)D_{w\,max.} + (cc_{min.}/\pi)$ $= F_{max.} + G_{r\,min.} + 2D_{w\,max.}$
F	Inner raceway diameter: $F_{max.} = D_{pw} - D_{w\,max.} - G_{r\,min.}$ $= (K\text{-}1)\,D_{w\,max.} + (cc_{min.}/\pi) - G_{r\,min.}$ $= E_{min.} - 2D_{w\,max.} - G_{r\,min.}$
D_w	Nominal needle roller diameter
D_{we}	Needle roller diameter applicable in the calculation of load ratings: $D_{we} = D_{pw} - F_{max.} - G_{r\,min.} = \dfrac{D_{pw} - cc_{min.}/\pi}{K}$ $= \dfrac{F_{max.} + G_{r\,min.} - (cc_{min.}/\pi)}{(K\text{-}1)}$ $= E_{min.} - D_{pw} = \dfrac{E_{min.} - cc_{min.}/\pi}{(K+1)}$
L_w	Overall needle roller length
R_w	End radius, rounded-end needle roller
r_s	Corner rounding, flat-end needle roller
L_{we}	Needle roller length applicable in the calculation of load ratings, for rounded-end needle rollers: $L_{we} = L_{w\,max.} - (0.4D_{we})$ For flat-end needle rollers: $L_{we} = L_{w\,max.} - (2r_{s\,min.})$

Note: If length of contact of the needle roller with the raceway is reduced because of undercuts, chamfers, etc. – L_{we} must be reduced correspondingly.

RACEWAY DIAMETER TOLERANCE LIMITS

Tables B8-19 and B8-20 on page B-8-15 lists the recommended tolerances that should be applied to the dimensions for the maximum inner raceway and the minimum outer raceway diameter after they have been calculated using the Bearing Calculation Form, Table B8-15.

Table B8-15. Bearing calculation form

Step	Source	Design factor	mm (in)	
1	Given	D_w, roller diameter	**3.175** (0.1250) max.	Min.
2	Table B8-18	K, for 30 rollers	**9.56677**	
3	(1)×(2)	KD_w	**30.374** (1.1958)	
4	Table B8-16	cc_{min}/π = 0.127 mm (0.005 in)	**0.127** (0.005) min.	Max.
5	(3) + (4)	D_{pw}, pitch diameter	**30.501** (1.2008)	
6	Given	D_w, roller diameter	**3.175** (0.1250) max.	Min.
7	(5) - (6)		**27.326** (1.0758)	
8	Table B8-16	G_r , radial clearance	**0.013** (0.0005) min.	Max.
9	(7) - (8)	F, inner raceway diameter	**27.349** (1.0753) max.	**27.340** (1.0749) min.(1)
10	(5) + (6)	E, outer raceway diameter	**33.676** (1.3258) min.	**33.692** (1.3264) max.(1)

(1) From Tables B8-19 and B8-20 on page B-8-15.

Table B8-16. Minimum clearances, normal rotating applications

F Nominal Inner Raceway Diameter mm **in**		$cc_{min.}/\pi$	$G_{r\,min.}$
>	≤	mm **in**	mm **in**
- **-**	3 **0.1181**	0.025 **0.0010**	0.006 **0.0002**
3 **0.1181**	6 **0.2362**	0.102 **0.0040**	0.008 **0.0003**
6 **0.2362**	10 **0.3937**	0.127 **0.0050**	0.009 **0.0004**
10 **0.3937**	18 **0.7087**	0.127 **0.0050**	0.011 **0.0004**
18 **0.7087**	30 **1.1811**	0.127 **0.0050**	0.013 **0.0005**
30 **1.1811**	50 **1.9685**	0.127 **0.0050**	0.016 **0.0006**
50 **1.9685**	80 **3.1496**	0.127 **0.0050**	0.019 **0.0007**
80 **3.1496**	120 **4.7244**	0.127 **0.0050**	0.022 **0.0009**

Table B8-17. Minimum clearances, miscellaneous applications

Application	$cc_{min.}/\pi$	$G_{r\,min.}$
universal joint	1/3 • normal	1/2 • normal
transmission pilot	normal	3 • normal
constant mesh gear	0.2 • roller dia.	normal
transmission planet	normal	normal
crank pin for two cycle engine	5 • normal	7 • normal

Table B8-18. K values

Z	K	Z	K	Z	K	Z	K
6	2.00000	21	6.70951	36	11.47371	51	16.24408
7	2.30476	22	7.02667	37	11.79163	52	16.56219
8	2.61313	23	7.34394	38	12.10957	53	16.88031
9	2.92380	24	7.66130	39	12.42752	54	17.19843
10	3.23607	25	7.97873	40	12.74549	55	17.51657
11	3.54947	26	8.29623	41	13.06348	56	17.83471
12	3.86370	27	8.61379	42	13.38149	57	18.15285
13	4.17858	28	8.93140	43	13.69951	58	18.47100
14	4.49396	29	9.24907	44	14.01754	59	18.78916
15	4.80973	30	9.56677	45	14.33559	60	19.10732
16	5.12583	31	9.88452	46	14.65364		
17	5.44219	32	10.20230	47	14.97171		
18	5.75877	33	10.52011	48	15.28979		
19	6.07553	34	10.83795	49	15.60788		
20	6.39245	35	11.15582	50	15.92597		

Table B8-19. Recommended inner raceway diameter tolerances

F Nominal Inner Raceway Diameter mm **in**		Tolerance Limits (ISO h5) mm **in**	
>	≤	Max.	Min.
3 **0.1181**	6 **0.2362**	0 **0**	-0.005 **-0.0002**
6 **0.2362**	10 **0.3937**	0 **0**	-0.006 **-0.0002**
10 **0.3937**	18 **0.7087**	0 **0**	-0.008 **-0.0003**
18 **0.7087**	30 **1.1811**	0 **0**	-0.009 **-0.0004**
30 **1.1811**	50 **1.9685**	0 **0**	-0.011 **-0.0004**
50 **1.9685**	80 **3.1496**	0 **0**	-0.013 **-0.0005**
80 **3.1496**	120 **4.7244**	0 **0**	-0.015 **-0.0006**

Table B8-20. Recommended outer raceway bore diameter tolerances

E Nominal Outer Raceway Bore Diameter mm **in**		Tolerance Limits (ISO H6) mm **in**	
>	≤	Max.	Min.
3 **0.1181**	6 **0.2362**	0.008 **0.0003**	0 **0**
6 **0.2362**	10 **0.3937**	0.009 **0.0004**	0 **0**
10 **0.3937**	18 **0.7087**	0.011 **0.0004**	0 **0**
18 **0.7087**	30 **1.1811**	0.013 **0.0005**	0 **0**
30 **1.1811**	50 **1.9685**	0.016 **0.0006**	0 **0**
50 **1.9685**	80 **3.1496**	0.019 **0.0007**	0 **0**
80 **3.1496**	120 **4.7244**	0.022 **0.0009**	0 **0**

KEYSTONED ROLLER ASSEMBLIES

Retention of the rollers in the outer raceway by keystoning can be helpful in assembly operations. The following formula may be used to check the bearing design to be sure that a given number of rollers, Z, will keystone.

$$YD_{w\,min.} > E_{max.} = \text{keystone condition}$$

That is, the product of the keystone constant Y, given below, and the minimum roller diameter $D_{w\,min.}$, must be greater than the maximum outer race bore, $E_{max.}$.

Roller complements with 14 or more rollers usually will not keystone unless steps are taken to reduce the circumferential clearance. It is suggested that your representative be consulted when designing a keystoned roller complement with 14 or more rollers.

Table B8-21. Keystone constant

Z	Y	Z	Y
8	3.67633	14	5.51128
9	3.97094	15	5.82467
10	4.27277	16	6.13885
11	4.57895	17	6.45365
12	4.88797	18	6.76893
13	5.19892	19	7.08461

B

LOAD RATING AND LIFE CALCULATIONS FOR FULL COMPLEMENTS OF NEEDLE ROLLERS

Before selecting the quantity and size of needle rollers to be used in a needle roller complement, it is usually necessary to calculate the load rating required using the applied load, speed and desired life.

Since it is not practical to tabulate the dynamic and static load ratings for the great number of needle roller complements that can be assembled by using different quantities, diameters and lengths of rollers, formulae are provided for the necessary calculations.

For convenience, values of f_c and values of $Z^{3/4}$ have been combined into single factors ($f_c Z^{3/4}$). These factors for a wide range of needle roller complements are contained in Table B8-22.

Table B8-22. Values of $f_c Z^{3/4}$ for inch units

Z	$f_c Z^{3/4}$ lbf - units	Z	$f_c Z^{3/4}$ lbf - units
	in		in
6	24000	36	119600
7	30200	37	121500
8	35900	38	123400
9	41200	39	125200
10	46100	40	127100
11	50700	41	128900
12	55100	42	130600
13	59100	43	132400
14	63000	44	134100
15	66600	45	135800
16	70100	46	137500
17	73400	47	139200
18	76600	48	140800
19	79700	49	142400
20	82600	50	144000
21	85400	51	145600
22	88100	52	147200
23	90800	53	148800
24	93300	54	150300
25	95800	55	151800
26	98200	56	153300
27	100600	57	154800
28	102900	58	156300
29	105100	59	157800
30	107300	60	159200
31	109500		
32	111600		
33	113600		
34	115600		
35	117600		

BASIC DYNAMIC LOAD RATINGS

The basic dynamic load rating, C, for any roller bearing can be calculated from the formula:

$$C = f_c (i\ L_w \cos\alpha)^{7/9} Z^{3/4} D_w^{29/27}$$

Where:

f_c = a factor which depends on the geometry of the bearing components, the accuracy to which the various components are made, and the material. Maximum values are listed in such standards as ISO 281 and USA ANSI-ABMA Standard 11.
i = number of rows of needle rollers in any one bearing.
α = nominal angle of contact. Since $\alpha = 0$ for a radial needle roller bearing, $\cos\alpha = 1$.

Other symbols are explained in Table B8-14 on page B-8-14.

For single-path radial needle roller bearings, where i = 1 and $\cos\alpha = 1$, the basic dynamic load rating formula can be written as:

$$C_r = f_c Z^{3/4} L_{we}^{7/9} D_w^{29/27}$$

Example:

Calculate the basic dynamic load rating in lbf for a full complement of 28 rounded-end rollers, 0.1250 inch diameter and 0.750 inch length.

$C = f_c Z^{3/4} L_{we}^{7/9} D_{we}^{29/27}$
$f_c Z^{3/4}$ from Table B8-22 = 102900

Where:

$D_{we}^{29/27} = 0.1250^{29/27} = 0.1072$
L_{we} = 0.750 - (0.4) 0.1250 = 0.700 (see Table B8-14 on page B-8-14)
$L_{we}^{7/9} = 0.700^{7/9} = 0.758$
$C = 102900 \times 0.1072 \times 0.758 = 8360$ lbf

When a couple load (overturning moment) is imposed on a single row of needle rollers, the resulting uneven distribution of load can seriously affect bearing life. In such cases, two rows of needle rollers are generally suggested.

Your representative should be consulted before a final selection of a needle roller complement is made.

BASIC STATIC LOAD RATING

The basic static load rating (C_0) for any roller bearing, including needle roller bearings, can be calculated from the following formula included in ISO 76, USA ANSI-ABMA Standard 11 and other Standards:

$$C_o = f_0 \left(1 - \frac{D_{we}\cos\alpha}{D_{pw}}\right) i Z L_{we} D_{we} \cos\alpha$$

Where:

f_0 = 6430 when pound-force and inch units are used
D_{pw} = pitch diameter of the needle roller complement (inch).
i = number of rows of rollers in any one bearing.
α = nominal angle of contact. Since $\alpha = 0$ for radial roller bearing, $\cos\alpha = 1$.

The other symbols are described in Table B8-14 on page B-8-14.

B

CYLINDRICAL ROLLERS – METRIC SERIES

JTEKT cylindrical rollers are made from bearing-quality steel and hardened to 58-65 HRC or equivalent. Nominal metric cylindrical rollers are sorted into gages based on the mean deviation from nominal diameter and nominal length. The relieved ends of the cylindrical rollers, when used in bearing complements, help to reduce stress concentration at the ends of rollers, both under misalignment or ideal alignment. This results in a more uniform stress distribution along the roller-raceway contact length and optimum bearing performance.

METRIC SERIES CYLINDRICAL ROLLER DIMENSIONS

Nominally metric cylindrical rollers conforming to DIN 5402 sheet 1 are shown in Table B8-23. Chamfer dimension limits of these cylindrical rollers with flat-ends are also shown in Table B8-23. The use of these chamfer limits results in the maximum possible effective contact length between roller and raceway, along with the already mentioned relieved ends, producing the maximum possible load ratings and longer life.

Each cylindrical roller gage is packed separately, and the mean deviations of diameter and length gages are shown on the package (below the roller designation).

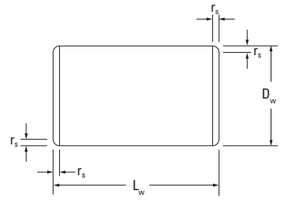


Fig. B8-3. Metric series cylindrical rollers

Table B8-23. Dimensions of metric series cylindrical rollers

D_w Nominal diameter	L_w Nominal length	$r_{s\ min.}$	$r_{s\ max.}$ (radial)	$r_{s\ max.}$ (axial)	Cylindrical roller designation	Wt. 100 pieces approx.
mm in	mm in	mm in	mm in	mm in		kg lbs
3 0.1181	**5** 0.1969	**0.2** 0.0079	**0.4** 0.0158	**0.7** 0.0276	ZRO.3x5	**0.027** 0.060
3.5 0.1378	**5** 0.1969	**0.2** 0.0079	**0.4** 0.0158	**0.7** 0.0276	ZRO.3,5x5	**0.037** 0.082
4 0.1575	**4** 0.1575	**0.2** 0.0079	**0.4** 0.0158	**0.7** 0.0276	ZRO.4x4	**0.039** 0.086
4 0.1575	**6** 0.2362	**0.2** 0.0079	**0.4** 0.0158	**0.7** 0.0276	ZRO.4x6	**0.058** 0.128
4 0.1575	**8** 0.3150	**0.2** 0.0079	**0.4** 0.0158	**0.7** 0.0276	ZRO.4x8	**0.078** 0.172
5 0.1969	**5** 0.1969	**0.2** 0.0079	**0.6** 0.236	**0.7** 0.0276	ZRO.5x5	**0.075** 0.165
5 0.1969	**8** 0.3150	**0.2** 0.0079	**0.6** 0.0236	**0.7** 0.0276	ZRO.5x8	**0.121** 0.267
5.5 0.2165	**8** 0.3150	**0.2** 0.0079	**0.6** 0.0236	**0.7** 0.0276	ZRO.5,5x8	**0.146** 0.322
6 0.2362	**6** 0.2362	**0.2** 0.0079	**0.6** 0.0236	**0.7** 0.0276	ZRO.6x6	**0.13** 0.287
6 0.2362	**12** 0.4724	**0.2** 0.0079	**0.6** 0.0236	**0.7** 0.0276	ZRO.6x12	**0.261** 0.575
6.5 0.2559	**9** 0.3543	**0.2** 0.0079	**0.6** 0.0236	**0.7** 0.0276	ZRO.6,5x9	**0.23** 0.507
7 0.2756	**7** 0.2756	**0.2** 0.0079	**0.6** 0.0236	**0.7** 0.0276	ZRO.7x7	**0.206** 0.454
7 0.2756	**10** 0.3937	**0.2** 0.0079	**0.6** 0.0236	**0.7** 0.0276	ZRO.7x10	**0.296** 0.653
7 0.2756	**14** 0.5512	**0.2** 0.0079	**0.6** 0.0236	**0.7** 0.0276	ZRO.7x14	**0.417** 0.919
7.5 0.2953	**7.5** 0.2953	**0.2** 0.0079	**0.6** 0.0236	**0.7** 0.0276	ZRO.7,5x7.5	**0.254** 0.560

D_w Nominal diameter	L_w Nominal length	$r_{s\ min.}$	$r_{s\ max.}$ (radial)	$r_{s\ max.}$ (axial)	Cylindrical roller designation	Wt. 100 pieces approx.
mm in	mm in	mm in	mm in	mm in		kg lbs
7.5 0.2953	**9** 0.3543	**0.2** 0.0079	**0.6** 0.0236	**0.7** 0.0276	ZRO.7,5x9	**0.312** 0.688
7.5 0.2953	**11** 0.4331	**0.2** 0.0079	**0.6** 0.0236	**0.7** 0.0276	ZRO.7,5x11	**0.374** 0.825
8 0.3150	**8** 0.3150	**0.2** 0.0079	**0.6** 0.0236	**0.7** 0.0276	ZRO.8x8	**0.308** 0.679
8 0.3150	**12** 0.4724	**0.2** 0.0079	**0.6** 0.0236	**0.7** 0.0276	ZRO.8x12	**0.465** 1.025
9 0.3543	**10** 0.3937	**0.3** 0.0118	**0.7** 0.0276	**1.0** 0.0394	ZRO.9x10	**0.5** 1.102
9 0.3543	**14** 0.5512	**0.3** 0.0118	**0.7** 0.0276	**1.0** 0.0394	ZRO.9x14	**0.68** 1.499
10 0.3937	**10** 0.3937	**0.3** 0.0118	**0.7** 0.0276	**1.0** 0.0394	ZRO.10x10	**0.6** 1.323
10 0.3937	**11** 0.4331	**0.3** 0.0118	**0.7** 0.0276	**1.0** 0.0394	ZRO.10x11	**0.68** 1.499
10 0.3937	**14** 0.5512	**0.3** 0.0118	**0.7** 0.0276	**1.0** 0.0394	ZRO.10x14	**0.85** 1.874
11 0.4331	**15** 0.5906	**0.3** 0.0118	**0.7** 0.0276	**1.0** 0.0394	ZRO.11x15	**1.1** 2.425
12 0.4724	**14** 0.5512	**0.3** 0.0118	**0.7** 0.0276	**1.0** 0.0394	ZRO.12x14	**1.23** 2.712
13 0.5118	**20** 0.7874	**0.4** 0.0158	**0.8** 0.0315	**1.2** 0.0472	ZRO.13x20	**2.04** 4.497
14 0.5512	**14** 0.5512	**0.4** 0.0158	**0.8** 0.0315	**1.2** 0.0472	ZRO.14x14	**1.66** 3.660
14 0.5512	**20** 0.7874	**0.4** 0.0158	**0.8** 0.0315	**1.2** 0.0472	ZRO.14x20	**2.38** 5.247

Note: Mass in accordance with DIN 5402.

EXAMPLE OF METRIC SERIES CYLINDRICAL ROLLER DESIGNATION AND PACKAGE MARKING:

ZRO.6 x 8
P0/M6
Nominal diameter: D_w = 6.000 mm
Nominal length: L_w = 8.000 mm
Mean deviation of the diameter +0.000 mm (see Table B8-24)
Mean deviation of the length -0.006 mm (see Table B8-25)
The actual finished diameter is between 5.999 and 6.001 mm
The actual finished length is between 7.991 and 7.997 mm

In the marking of the cylindrical roller gage, P identifies zero (0) or plus (+), M identifies minus (-). If a shipment of cylindrical rollers of the same size comprises several boxes, each box contains cylindrical rollers of the identical gage, although the gage may vary from box to box.

Table B8-24. Diameter and form accuracy of metric series cylindrical rollers

Nominal Diameter D_w		Total Diameter Deviation		Variation of Gage	Mean Deviation of Gage DIN/ISO 1101													Circularity Deviation
>	≤	Max.	Min.															Max.
mm	mm	µm	µm	µm	µm													µm
—	20	+7	-9	2	+6	+5	+4	+3	+2	+1	0	-1	-2	-3	-4	-5	-6	-7	-8	0.8

Table B8-25. Length gages of metric series cylindrical rollers

Nominal Diameter L_w		Total Length Deviation		Variation of Gage	ean Deviation of Gage				Axial Runout DIN/ISO 1101
>	≤	Max.	Min.						
mm	mm	µm	µm	µm	µm				µm
—	48	+9	-15	6	+6	0	-6	-12	6

INNER RINGS – METRIC SERIES

When it is impractical to meet the shaft raceway design requirements (hardness, surface finish, case depth, etc.) outlined in the engineering section of this catalog, standard inner rings may be used.

Inner rings are made of rolling bearing steel and after hardening, their bores, raceways and end surfaces are ground. Metric series inner rings may be used to provide inner raceway surfaces for metric series radial needle roller and cage assemblies, metric series needle roller bearings and metric series drawn cup needle roller bearings. The extended inner rings are suitable for use with bearings containing lip contact seals and for applications in which axial movement may be present.

CONSTRUCTION

Metric series inner rings are available with combinations of three primary design features. The inner rings may be purchased: without chamfers at the end of the raceway surface to allow for maximum possible raceway contact area, with lubrication holes to allow for increased lubrication to the bearing area, or with a profiled outer diameter for use in applications having a greater degree of misalignment. Table B8-26 outlines the features offered in the different series.

Table B8-26. Outline of features

Series	Lube Hole	Chamfers	Raceway Profile
JR		X	
JR.JS1	X	X	
JRZ.JS1	X		

The lubrication holes are located nominally at the center of the inner ring width. The nominal diameters for the lubrication holes for inner rings listed in this section are shown in Table B8-27.

Table B8-27. Nominal diameters for the lubrication holes for inner ring

Series Designation	Inner Ring Bore Diameter		Nominal Lubrication Hole Diameter
	mm		mm
	>	≤	
		20	2.0
JR.JS1	20	40	2.5
JRZ.JS1	40	80	3.0
	80		3.5

DIMENSIONAL ACCURACY

The tolerances of size, form, and runout for metric series inner rings meet the requirements of ISO normal tolerance class for radial bearings (see the engineering section of this catalog). Most metric series inner rings are produced with outer diameter raceway tolerance in accordance with h5 which, in most cases, is suitable for combining the metric series needle roller bearings to give the normal clearance class and for use with metric caged drawn cup bearings. An exception is the inner rings for metric, full complement drawn cup needle roller bearings; these inner rings are produced with outside diameter raceway tolerance in accordance with g5. Other raceway tolerances may also be found on inner rings for combining with needle roller bearings to give one of the clearance classes, or other specially requested radial internal clearance requirement.

Table B8-28 lists the dimensional accuracy of inner rings.

Table B8-28. Dimensional accuracy of inner ring

Part Designation	OD Tolerance	Other Feature Tolerances
JR & JRZ	h5	ISO 492 Normal Tolerance Class

MOUNTING OF INNER RINGS

Inner rings may be mounted on the shaft with either a loose transition fit or an interference fit. These fits, used in conjunction with the proper fit of the bearing outer ring, will provide the correct operating clearances for most applications.

Regardless of the fit of the inner ring on the shaft, the inner ring should be axially located by shaft shoulders or other positive means. The shaft shoulder diameter adjacent to the inner ring must not exceed the inner ring outer diameter (per suggestions on page B-4-9 of the metric series needle roller bearing section).

When metric series inner rings are to be used with the metric series needle roller bearings, appropriate shaft tolerances should be selected from Table B4-3 on page B-4-9 in the heavy-duty needle roller bearing section. When metric series inner rings are to be used with drawn- cup bearings, the suggested shaft tolerances are given in the “inner rings” discussion on page B-2-8 of the metric series drawn cup needle roller bearings section of this catalog.

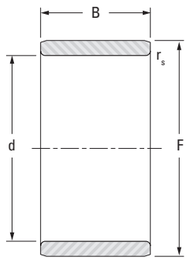
INCH SERIES INNER RINGS

Inch series inner rings for use with inch series drawn cup bearings are tabulated on page B-2-68 of this catalog. See page B-4-48 for inch series inner rings for use with inch series heavy-duty needle roller bearings.

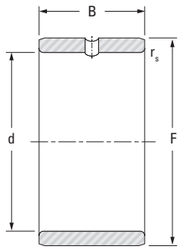
END WASHERS – METRIC SERIES

When the metric series radial needle roller and cage assembly used in series NAO and RNAO needle roller bearings without flanges cannot be axially located by suitable shoulders or side faces, end washers of series SNSH may be used. These end washers, which are made of spring steel, are designed to be guided in the housing bore. They are tabulated on page B-8-30.

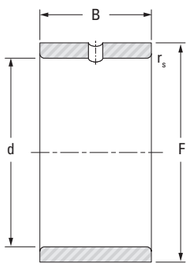
INNER RINGS
METRIC SERIES



JR



JR.JS1

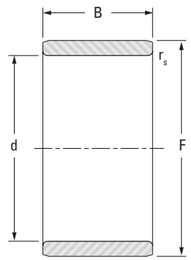


JRZ.JS1

Shaft Dia.	d	F [1]	B	$r_{s\ min.}$	Inner Ring Designation	Approx. Wt.
mm in	mm in	mm in	mm in	mm in		kg lbs
5 0.1969	**5** 0.1969	**8** 0.3150	**8** 0.3150	**0.3** 0.01	JR5x8x8JS1	**0.002** 0.004
	5 0.1969	**8** 0.3150	**12** 0.4724	**0.3** 0.01	JR5x8x12	**0.003** 0.007
	5 0.1969	**8** 0.3150	**16** 0.630	**0.3** 0.01	JR5x8x16	**0.004** 0.009
6 0.2362	**6** 0.2362	**9** 0.3543	**8** 0.315	**0.3** 0.01	JR6x9x8JS1	**0.002** 0.004
	6 0.2362	**9** 0.3543	**12** 0.4724	**0.3** 0.01	JR6x9x12	**0.003** 0.007
	6 0.2362	**9** 0.3543	**16** 0.630	**0.3** 0.01	JR6x9x16	**0.004** 0.009
	6 0.2362	**10** 0.3937	**10** 0.394	**0.3** 0.01	JR6x10x10	**0.004** 0.009
	6 0.2362	**10** 0.3937	**10** 0.394	**0.3** 0.01	JR6x10x10JS1	**0.004** 0.009
	6 0.2362	**10** 0.3937	**12** 0.4724	**0.3** 0.01	JRZ6x10x12JS1	**0.005** 0.011
7 0.2756	**7** 0.2756	**10** 0.3937	**10.5** 0.413	**0.3** 0.01	JR7x10x10,5	**0.003** 0.007
	7 0.2756	**10** 0.3937	**12** 0.4724	**0.3** 0.01	JR7x10x12	**0.004** 0.009
	7 0.2756	**10** 0.3937	**16** 0.630	**0.3** 0.01	JR7x10x16	**0.005** 0.011
8 0.3150	**8** 0.3150	**12** 0.4724	**10** 0.394	**0.3** 0.01	JR8x12x10	**0.005** 0.011
	8 0.3150	**12** 0.4724	**10** 0.394	**0.3** 0.01	JR8x12x10JS1	**0.005** 0.011
	8 0.3150	**12** 0.4724	**10.5** 0.413	**0.3** 0.01	JR8x12x10,5	**0.005** 0.011
	8 0.3150	**12** 0.4724	**12** 0.472	**0.3** 0.01	JRZ8xI2x12JS1	**0.006** 0.013
	8 0.3150	**12** 0.4724	**12.5** 0.492	**0.3** 0.01	JR8x12x12,5	**0.006** 0.013
9 0.3543	**9** 0.3543	**12** 0.4724	**12** 0.4724	**0.3** 0.01	JR9x12x12	**0.005** 0.011
	9 0.3543	**12** 0.4724	**16** 0.630	**0.3** 0.01	JR9x12x16	**0.006** 0.013
10 0.3937	**10** 0.3937	**13** 0.5118	**12.5** 0.492	**0.3** 0.01	JR10x13x12,5	**0.005** 0.011
	10 0.3937	**14** 0.5512	**11** 0.433	**0.3** 0.01	JR10x14x11JS1	**0.007** 0.015
	10 0.3937	**14** 0.5512	**12** 0.4724	**0.3** 0.01	JR10x14x12	**0.007** 0.015
	10 0.3937	**14** 0.5512	**12** 0.4724	**0.3** 0.01	JR10x14x12JS1	**0.007** 0.015
	10 0.3937	**14** 0.5512	**13** 0.512	**0.3** 0.01	JR10x14x13	**0.007** 0.015

[1] See Table B8-28 on page B-8-19 for outside diameter tolerance.

INNER RINGS
METRIC SERIES



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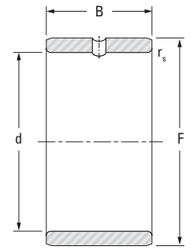
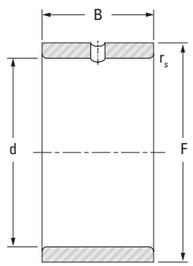


JR.JS1



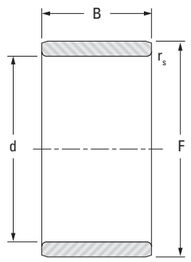
JRZ.JS1

Shaft Dia.	d	F [1]	B	$r_{s\ min.}$	Inner Ring Designation	Approx. Wt.
mm in	mm in	mm in	mm in	mm in		kg lbs
10 0.3937	**10** 0.3937	**14** 0.5512	**14** 0.551	**0.3** 0.01	JRZ10x14x14JS1	**0.008** 0.018
	10 0.3937	**14** 0.5512	**16** 0.630	**0.3** 0.01	JR10x14x16	**0.009** 0.020
	10 0.3937	**14** 0.5512	**20** 0.787	**0.3** 0.01	JR10x14x20	**0.012** 0.026
12 0.4724	**12** 0.4724	**15** 0.5906	**12.5** 0.492	**0.3** 0.01	JR12x15x12,5	**0.006** 0.013
	12 0.4724	**15** 0.5906	**16** 0.630	**0.3** 0.01	JR12x15x16	**0.008** 0.018
	12 0.4724	**15** 0.5906	**16.5** 0.650	**0.3** 0.01	JR12x15x16,5	**0.008** 0.018
	12 0.4724	**15** 0.5906	**18.5** 0.728	**0.3** 0.01	JR12x15x18,5	**0.009** 0.020
	12 0.4724	**15** 0.5906	**22.5** 0.886	**0.3** 0.01	JR12x15x22,5	**0.011** 0.024
	12 0.4724	**16** 0.6299	**12** 0.472	**0.3** 0.01	JR12x16x12	**0.008** 0.018
	12 0.4724	**16** 0.6299	**12** 0.472	**0.3** 0.01	JR12x16x12JS1	**0.008** 0.018
	12 0.4724	**16** 0.6299	**13** 0.512	**0.3** 0.01	JR12x16x13	**0.008** 0.018
	12 0.4724	**16** 0.6299	**14** 0.551	**0.3** 0.01	JRZ12x16x14JS1	**0.010** 0.022
	12 0.4724	**16** 0.6299	**16** 0.630	**0.3** 0.01	JR12x16x16	**0.011** 0.024
	12 0.4724	**16** 0.6299	**20** 0.787	**0.3** 0.01	JR12x16x20	**0.014** 0.031
	12 0.4724	**16** 0.6299	**22** 0.866	**0.3** 0.01	JR12x16x22	**0.015** 0.033
14 0.5512	**14** 0.5512	**17** 0.6693	**17** 0.669	**0.3** 0.01	JR14x17x17	**0.009** 0.020
15 0.5906	**15** 0.5906	**18** 0.7087	**16.5** 0.650	**0.3** 0.01	JR15x18x16,5	**0.010** 0.022
	15 0.5906	**19** 0.7480	**16** 0.630	**0.3** 0.01	JR15x19x16	**0.013** 0.029
	15 0.5906	**19** 0.7480	**20** 0.787	**0.3** 0.01	JR15x19x20	**0.017** 0.037
	15 0.5906	**20** 0.7874	**12** 0.472	**0.3** 0.01	JR15x20x12	**0.012** 0.026
	15 0.5906	**20** 0.7874	**12** 0.472	**0.3** 0.01	JR15x20x12JS1	**0.012** 0.026
	15 0.5906	**20** 0.7874	**13** 0.512	**0.3** 0.01	JR15x20x13	**0.014** 0.031
	15 0.5906	**20** 0.7874	**14** 0.551	**0.3** 0.01	JRZ15x20x14JS1	**0.015** 0.033
	15 0.5906	**20** 0.7874	**16** 0.630	**0.3** 0.01	JR15x20x16	**0.017** 0.037

[1] See Table B8-28 on page B-8-19 for outside diameter tolerance.

Continued on next page.

INNER RINGS
METRIC SERIES



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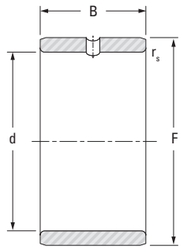
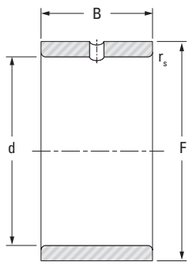


JR.JS1

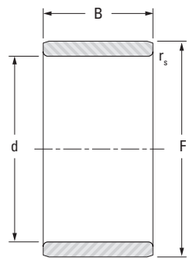


JRZ.JS1

Shaft Dia.	d	F [1]	B	$r_{s\ min.}$	Inner Ring Designation	Approx. Wt.
mm in	**mm** in	**mm** in	**mm** in	**mm** in		**kg** lbs
15 0.5906	**15** 0.5906	**20** 0.7874	**23** 0.906	**0.3** 0.01	JR15x20x23	**0.025** 0.055
	15 0.5906	**20** 0.7874	**26** 1.024	**0.3** 0.01	JR15x20x26	**0.028** 0.062
17 0.6693	**17** 0.6693	**20** 0.7874	**16.5** 0.650	**0.3** 0.01	JR17x20x16,5	**0.011** 0.024
	17 0.6693	**20** 0.7874	**20** 0.787	**0.3** 0.01	JR17x20x20	**0.014** 0.031
	17 0.6693	**20** 0.7874	**20.5** 0.807	**0.3** 0.01	JR17x20x20,5	**0.014** 0.031
	17 0.6693	**20** 0.7874	**30.5** 1.201	**0.3** 0.01	JR17x20x30,5	**0.021** 0.046
	17 0.6693	**21** 0.8268	**16** 0.630	**0.3** 0.01	JR17x21x16	**0.015** 0.033
	17 0.6693	**21** 0.8268	**20** 0.787	**0.3** 0.01	JR17x21x20	**0.019** 0.042
	17 0.6693	**22** 0.8661	**13** 0.512	**0.3** 0.01	JR17x22x13	**0.015** 0.033
	17 0.6693	**22** 0.8661	**16** 0.630	**0.3** 0.01	JR17x22x16	**0.019** 0.042
	17 0.6693	**22** 0.8661	**16** 0.630	**0.3** 0.01	JR17x22x16JS1	**0.019** 0.042
	17 0.6693	**22** 0.8661	**16** 0.630	**0.3** 0.01	JRZ17x22x16JS1	**0.019** 0.042
	17 0.6693	**22** 0.8661	**23** 0.906	**0.3** 0.01	JR17x22x23	**0.028** 0.062
	17 0.6693	**22** 0.8661	**26** 1.024	**0.3** 0.01	JR17x22x26	**0.031** 0.068
	17 0.6693	**22** 0.8661	**32** 1.260	**0.3** 0.01	JR17x22x32	**0.038** 0.084
20 0.7874	**20** 0.7874	**24** 0.9449	**16** 0.630	**0.3** 0.01	JR20x24x16	**0.018** 0.040
	20 0.7874	**24** 0.9449	**20** 0.787	**0.3** 0.01	JR20x24x20	**0.022** 0.049
	20 0.7874	**25** 0.9843	**16** 0.630	**0.3** 0.01	JR20x25x16	**0.022** 0.049
	20 0.7874	**25** 0.9843	**16** 0.630	**0.3** 0.01	JR20x25x16JS1	**0.022** 0.049
	20 0.7874	**25** 0.9843	**17** 0.669	**0.3** 0.01	JR20x25x17	**0.023** 0.051
	20 0.7874	**25** 0.9843	**18** 0.709	**0.3** 0.01	JRZ20x25x18JS1	**0.025** 0.055
	20 0.7874	**25** 0.9843	**20** 0.787	**0.3** 0.01	JR20x25x20	**0.028** 0.062
	20 0.7874	**25** 0.9843	**20.5** 0.807	**0.3** 0.01	JR20x25x20,5	**0.029** 0.064
	20 0.7874	**25** 0.9843	**26** 1.024	**0.3** 0.01	JR20x25x26	**0.036** 0.079

[1] See Table B8-28 on page B-8-19 for outside diameter tolerance.

INNER RINGS
METRIC SERIES



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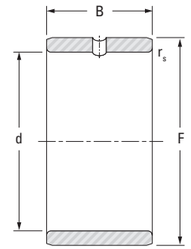
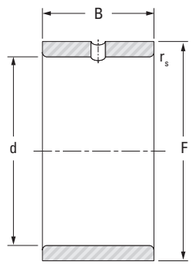


JR.JS1



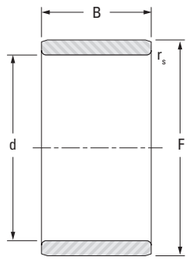
JRZ.JS1

Shaft Dia.	d	F [1]	B	$r_{s\ min.}$	Inner Ring Designation	Approx. Wt.
mm in	**mm** in	**mm** in	**mm** in	**mm** in		**kg** lbs
20 0.7874	**20** 0.7874	**25** 0.9843	**26.5** 1.043	**0.3** 0.01	JR20x25x26,5	**0.037** 0.082
	20 0.7874	**25** 0.9843	**30** 1.181	**0.3** 0.01	JR20x25x30	**0.042** 0.093
	20 0.7874	**25** 0.9843	**32** 1.260	**0.3** 0.01	JR20x25x32	**0.044** 0.097
	20 0.7874	**25** 0.9843	**38.5** 1.516	**0.3** 0.01	JR20x25x38,5	**0.054** 0.119
22 0.8661	**22** 0.8661	**26** 1.0236	**16** 0.630	**0.3** 0.01	JR22x26x16	**0.019** 0.042
	22 0.8661	**26** 1.0236	**20** 0.787	**0.3** 0.01	JR22x26x20	**0.023** 0.051
	22 0.8661	**28** 1.1024	**17** 0.669	**0.3** 0.01	JR22x28x17	**0.030** 0.066
	22 0.8661	**28** 1.1024	**20.5** 0.807	**0.3** 0.01	JR22x28x20,5	**0.038** 0.084
	22 0.8661	**28** 1.1024	**30** 1.181	**0.3** 0.01	JR22x28x30	**0.056** 0.123
25 0.9843	**25** 0.9843	**29** 1.1417	**20** 0.787	**0.3** 0.01	JR25x29x20	**0.027** 0.060
	25 0.9843	**29** 1.1417	**30** 1.181	**0.3** 0.01	JR25x29x30	**0.040** 0.088
	25 0.9843	**30** 1.1811	**16** 0.630	**0.3** 0.01	JR25x30x16	**0.027** 0.060
	25 0.9843	**30** 1.1811	**16** 0.630	**0.3** 0.01	JR25x30x16JS1	**0.027** 0.060
	25 0.9843	**30** 1.1811	**17** 0.669	**0.3** 0.01	JR25x30x17	**0.028** 0.062
	25 0.9843	**30** 1.1811	**18** 0.709	**0.3** 0.01	JRZ25x30x18JS1	**0.031** 0.068
	25 0.9843	**30** 1.1811	**20** 0.787	**0.3** 0.01	JR25x30x20	**0.034** 0.075
	25 0.9843	**30** 1.1811	**20.5** 0.807	**0.3** 0.01	JR25x30x20,5	**0.035** 0.077
	25 0.9843	**30** 1.1811	**26** 1.024	**0.3** 0.01	JR25x30x26	**0.044** 0.097
	25 0.9843	**30** 1.1811	**26.5** 1.043	**0.3** 0.01	JR25x30x26,5	**0.045** 0.099
	25 0.9843	**30** 1.1811	**30** 1.181	**0.3** 0.01	JR25x30x30	**0.051** 0.112
	25 0.9843	**30** 1.1811	**32** 1.260	**0.3** 0.01	JR25x30x32	**0.054** 0.119
	25 0.9843	**30** 1.1811	**38.5** 1.516	**0.3** 0.01	JR25x30x38,5	**0.066** 0.146
28 1.1024	**28** 1.1024	**32** 1.2598	**17** 0.669	**0.3** 0.01	JR28x32x17	**0.028** 0.062
	28 1.1024	**32** 1.2598	**20** 0.787	**0.3** 0.01	JR28x32x20	**0.030** 0.066

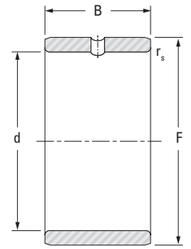
[1] See Table B8-28 on page B-8-19 for outside diameter tolerance.

Continued on next page.

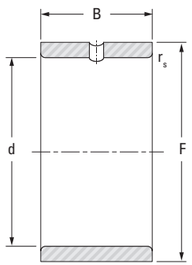
INNER RINGS
METRIC SERIES



JR



JR.JS1

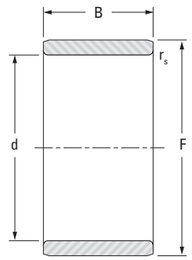


JRZ.JS1

Shaft Dia.	d	F [1]	B	$r_{s\ min.}$	Inner Ring Designation	Approx. Wt.
mm in	mm in	mm in	mm in	mm in		kg lbs
28 1.1024	**28** 1.1024	**32** 1.2598	**30** 1.181	**0.3** 0.01	JR28x32x30	**0.044** 0.097
30 1.1811	**30** 1.1811	**35** 1.3780	**16** 0.630	**0.3** 0.01	JR30x35x16	**0.031** 0.068
	30 1.1811	**35** 1.3780	**17** 0.669	**0.3** 0.01	JR30x35x17	**0.033** 0.073
	30 1.1811	**35** 1.3780	**18** 0.709	**0.3** 0.01	JRZ30x35x18JS1	**0.036** 0.079
	30 1.1811	**35** 1.3780	**20** 0.787	**0.3** 0.01	JR30x35x20	**0.039** 0.086
	30 1.1811	**35** 1.3780	**20** 0.787	**0.3** 0.01	JRZ30x35x20JS1	**0.039** 0.086
	30 1.1811	**35** 1.3780	**20.5** 0.807	**0.3** 0.01	JR30x35x20,5	**0.040** 0.088
	30 1.1811	**35** 1.3780	**26** 1.024	**0.3** 0.01	JR30x35x26	**0.054** 0.119
	30 1.1811	**35** 1.3780	**30** 1.181	**0.3** 0.01	JR30x35x30	**0.057** 0.126
	30 1.1811	**35** 1.3780	**32** 1.260	**0.3** 0.01	JR30x35x32	**0.062** 0.137
	30 1.1811	**38** 1.4961	**20** 0.787	**0.6** 0.02	JR30x38x20JS1	**0.067** 0.148
32 1.2598	**32** 1.2598	**37** 1.4567	**20** 0.787	**0.3** 0.01	JR32x37x20	**0.043** 0.095
	32 1.2598	**37** 1.4567	**30** 1.181	**0.3** 0.01	JR32x37x30	**0.064** 0.141
	32 1.2598	**40** 1.5748	**20** 0.787	**0.6** 0.02	JR32x40x20	**0.069** 0.152
	32 1.2598	**40** 1.5748	**36** 1.417	**0.6** 0.02	JR32x40x36	**0.128** 0.282
35 1.3780	**35** 1.3780	**40** 1.5748	**17** 0.669	**0.3** 0.01	JR35x40x17	**0.040** 0.088
	35 1.3780	**40** 1.5748	**20** 0.787	**0.3** 0.01	JR35x40x20	**0.046** 0.101
	35 1.3780	**40** 1.5748	**20.5** 0.807	**0.3** 0.01	JR35x40x20,5	**0.049** 0.108
	35 1.3780	**40** 1.5748	**22** 0.866	**0.3** 0.01	JR35x40x22	**0.052** 0.115
	35 1.3780	**40** 1.5748	**30** 1.181	**0.3** 0.01	JR35x40x30	**0.071** 0.157
	35 1.3780	**40** 1.5748	**34** 1.339	**0.3** 0.01	JR35x40x34	**0.080** 0.176
	35 1.3780	**40** 1.5748	**40** 1.575	**0.3** 0.01	JR35x40x40	**0.094** 0.207
	35 1.3780	**42** 1.6535	**20** 0.787	**0.6** 0.02	JR35x42x20	**0.065** 0.143
	35 1.3780	**42** 1.6535	**20** 0.787	**0.6** 0.02	JR35x42x20JS1	**0.065** 0.143

[1] See Table B8-28 on page B-8-19 for outside diameter tolerance.

INNER RINGS
METRIC SERIES



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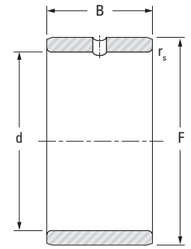
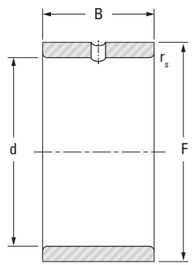


JR.JS1



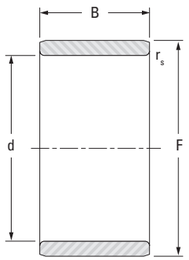
JRZ.JS1

Shaft Dia.	d	F [1]	B	$r_{s\ min.}$	Inner Ring Designation	Approx. Wt.
mm in	mm in	mm in	mm in	mm in		kg lbs
35 1.3780	**35** 1.3780	**42** 1.6535	**23** 0.906	**0.6** 0.02	JRZ35x42x23JS1	**0.074** 0.163
	35 1.3780	**42** 1.6535	**36** 1.417	**0.6** 0.02	JR35x42x36	**0.122** 0.269
	35 1.3780	**44** 1.7323	**22** 0.866	**0.6** 0.02	JR35x44x22	**0.097** 0.214
38 1.4961	**38** 1.4961	**43** 1.6929	**20** 0.787	**0.3** 0.01	JR38x43x20	**0.050** 0.110
	38 1.4961	**43** 1.6929	**30** 1.181	**0.3** 0.01	JR38x43x30	**0.075** 0.165
40 1.5748	**40** 1.5748	**45** 1.7717	**17** 0.669	**0.3** 0.01	JR40x45x17	**0.044** 0.097
	40 1.5748	**45** 1.7717	**20** 0.787	**0.3** 0.01	JR40x45x20	**0.052** 0.115
	40 1.5748	**45** 1.7717	**20.5** 0.807	**0.3** 0.01	JR40x45x20,5	**0.054** 0.119
	40 1.5748	**45** 1.7717	**30** 1.181	**0.3** 0.01	JR40x45x30	**0.078** 0.172
	40 1.5748	**45** 1.7717	**34** 1.339	**0.3** 0.01	JR40x45x34	**0.089** 0.196
	40 1.5748	**45** 1.7717	**40** 1.575	**0.3** 0.01	JR40x45x40	**0.115** 0.254
	40 1.5748	**48** 1.8898	**22** 0.866	**0.6** 0.02	JR40x48x22	**0.094** 0.207
	40 1.5748	**48** 1.8898	**23** 0.906	**0.6** 0.02	JRZ40x48x23JS1	**0.100** 0.220
	40 1.5748	**48** 1.8898	**40** 1.575	**0.6** 0.02	JR40x48x40	**0.173** 0.381
	40 1.5748	**50** 1.9685	**20** 0.787	**1** 0.04	JR40x50x20	**0.110** 0.243
42 1.6535	**42** 1.6535	**47** 1.8504	**20** 0.787	**0.3** 0.01	JR42x47x20	**0.055** 0.121
	42 1.6535	**47** 1.8504	**30** 1.181	**0.3** 0.01	JR42x47x30	**0.083** 0.183
45 1.7717	**45** 1.7717	**50** 1.9685	**20** 0.787	**0.3** 0.01	JR45x50x20	**0.058** 0.128
	45 1.7717	**50** 1.9685	**25** 0.984	**0.6** 0.02	JR45x50x25	**0.073** 0.161
	45 1.7717	**50** 1.9685	**25.5** 1.004	**0.3** 0.01	JR45x50x25,5	**0.075** 0.165
	45 1.7717	**50** 1.9685	**35** 1.378	**0.6** 0.02	JR45x50x35	**0.103** 0.227
	45 1.7717	**50** 1.9685	**40** 1.575	**0.3** 0.01	JR45x50x40	**0.117** 0.258
	45 1.7717	**52** 2.0472	**22** 0.866	**0.6** 0.02	JR45x52x22	**0.090** 0.198
	45 1.7717	**52** 2.0472	**23** 0.906	**0.6** 0.02	JR45x52x23	**0.096** 0.212

[1] See Table B8-28 on page B-8-19 for outside diameter tolerance.

Continued on next page.

INNER RINGS
METRIC SERIES



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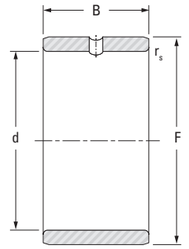
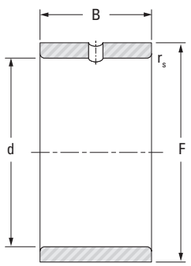


JR.JS1

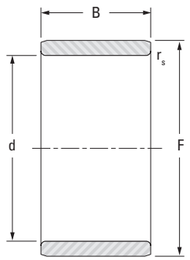


JRZ.JS1

Shaft Dia.	d	F [1]	B	$r_{s\ min.}$	Inner Ring Designation	Approx. Wt.
mm in	**mm** in	**mm** in	**mm** in	**mm** in		**kg** lbs
45 1.7717	**45** 1.7717	**52** 2.0472	**23** 0.906	**0.6** 0.02	JRZ45x52x23JS1	**0.096** 0.212
	45 1.7717	**52** 2.0472	**40** 1.575	**0.6** 0.02	JR45x52x40	**0.167** 0.368
	45 1.7717	**55** 2.1654	**20** 0.787	**1** 0.04	JR45x55x20	**0.133** 0.293
	45 1.7717	**55** 2.1654	**20** 0.787	**1** 0.04	JR45x55x20JS1	**0.133** 0.293
	45 1.7717	**55** 2.1654	**22** 0.866	**1** 0.04	JR45x55x22	**0.135** 0.298
	45 1.7717	**55** 2.1654	**40** 1.575	**1** 0.04	JR45x55x40	**0.247** 0.545
50 1.9685	**50** 1.9685	**55** 2.1654	**20** 0.787	**0.3** 0.01	JR50x55x20	**0.065** 0.143
	50 1.9685	**55** 2.1654	**25** 0.984	**0.6** 0.02	JR50x55x25	**0.081** 0.179
	50 1.9685	**55** 2.1654	**35** 1.378	**0.6** 0.02	JR50x55x35	**0.113** 0.249
	50 1.9685	**55** 2.1654	**40** 1.575	**0.3** 0.01	JR50x55x40	**0.130** 0.287
	50 1.9685	**58** 2.2835	**22** 0.866	**0.6** 0.02	JR50x58x22	**0.117** 0.258
	50 1.9685	**58** 2.2835	**23** 0.906	**0.6** 0.02	JRZ50x58x23JS1	**0.122** 0.269
	50 1.9685	**58** 2.2835	**40** 1.575	**0.6** 0.02	JR50x58x40	**0.213** 0.470
	50 1.9685	**60** 2.3622	**20** 0.787	**1** 0.04	JR50x60x20	**0.155** 0.342
	50 1.9685	**60** 2.3622	**20** 0.787	**1** 0.04	JR50x60x20JS1	**0.155** 0.342
	50 1.9685	**60** 2.3622	**25** 0.984	**1** 0.04	JR50x60x25	**0.170** 0.375
	50 1.9685	**60** 2.3622	**40** 1.575	**1** 0.04	JR50x60x40	**0.310** 0.683
55 2.1654	**55** 2.1654	**60** 2.3622	**25** 0.984	**0.6** 0.02	JR55x60x25	**0.088** 0.194
	55 2.1654	**60** 2.3622	**35** 1.378	**0.6** 0.02	JR55x60x35	**0.124** 0.273
	55 2.1654	**63** 2.4803	**25** 0.984	**1** 0.04	JR55x63x25	**0.141** 0.311
	55 2.1654	**63** 2.4803	**45** 1.772	**1** 0.04	JR55x63x45	**0.286** 0.631
	55 2.1654	**65** 2.5591	**30** 1.181	**1** 0.04	JR55x65x30	**0.222** 0.489
	55 2.1654	**65** 2.5591	**60** 2.362	**1** 0.04	JR55x65x60	**0.444** 0.979
60 2.3622	**60** 2.3622	**68** 2.6772	**25** 0.984	**0.6** 0.02	JR60x68x25	**0.153** 0.337

[1] See Table B8-28 on page B-8-19 for outside diameter tolerance.

INNER RINGS
METRIC SERIES



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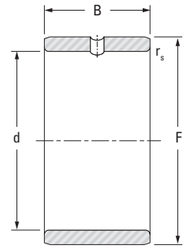
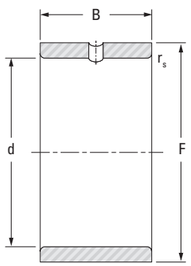


JR.JS1



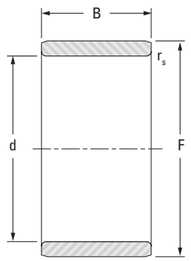
JRZ.JS1

Shaft Dia.	d	F [1]	B	$r_{s\ min.}$	Inner Ring Designation	Approx. Wt.
mm in	**mm** in	**mm** in	**mm** in	**mm** in		**kg** lbs
60 2.3622	**60** 2.3622	**68** 2.6772	**35** 1.378	**0.6** 0.02	JR60x68x35	**0.220** 0.485
	60 2.3622	**68** 2.6772	**45** 1.772	**1** 0.04	JR60x68x45	**0.284** 0.626
	60 2.3622	**70** 2.7559	**25** 0.984	**1** 0.04	JR60x70x25	**0.200** 0.441
	60 2.3622	**70** 2.7559	**30** 1.181	**1** 0.04	JR60x70x30	**0.240** 0.529
	60 2.3622	**70** 2.7559	**60** 2.362	**1** 0.04	JR60x70x60	**0.480** 1.058
65 2.5591	**65** 2.5591	**72** 2.8346	**25** 0.984	**1** 0.04	JR65x72x25	**0.143** 0.315
	65 2.5591	**72** 2.8346	**45** 1.772	**1** 0.04	JR65x72x45	**0.266** 0.586
	65 2.5591	**73** 2.8740	**25** 0.984	**0.6** 0.02	JR65x73x25	**0.170** 0.375
	65 2.5591	**73** 2.8740	**35** 1.378	**0.6** 0.02	JR65x73x35	**0.240** 0.529
	65 2.5591	**75** 2.9528	**28** 1.102	**1** 0.04	JR65x75x28	**0.240** 0.529
	65 2.5591	**75** 2.9528	**30** 1.181	**1** 0.04	JR65x75x30	**0.260** 0.573
	65 2.5591	**75** 2.9528	**60** 2.362	**1** 0.04	JR65x75x60	**0.520** 1.146
70 2.7559	**70** 2.7559	**80** 3.1496	**25** 0.984	**1** 0.04	JR70x80x25	**0.230** 0.507
	70 2.7559	**80** 3.1496	**30** 1.181	**1** 0.04	JR70x80x30	**0.270** 0.595
	70 2.7559	**80** 3.1496	**35** 1.378	**1** 0.04	JR70x80x35	**0.320** 0.705
	70 2.7559	**80** 3.1496	**54** 2.126	**1** 0.04	JR70x80x54	**0.500** 1.102
	70 2.7559	**80** 3.1496	**60** 2.362	**1** 0.04	JR70x80x60	**0.556** 1.226
75 2.9528	**75** 2.9528	**85** 3.3465	**25** 0.984	**1** 0.04	JR75x85x25	**0.240** 0.529
	75 2.9528	**85** 3.3465	**30** 1.181	**1** 0.04	JR75x85x30	**0.289** 0.637
	75 2.9528	**85** 3.3465	**35** 1.378	**1** 0.04	JR75x85x35	**0.338** 0.745
	75 2.9528	**85** 3.3465	**54** 2.126	**1** 0.04	JR75x85x54	**0.530** 1.168
80 3.1496	**80** 3.1496	**90** 3.5433	**25** 0.984	**1** 0.04	JR80x90x25	**0.260** 0.573
	80 3.1496	**90** 3.5433	**30** 1.181	**1** 0.04	JR80x90x30	**0.306** 0.675
	80 3.1496	**90** 3.5433	**35** 1.378	**1** 0.04	JR80x90x35	**0.355** 0.783

[1] See Table B8-28 on page B-8-19 for outside diameter tolerance.

Continued on next page.

INNER RINGS
METRIC SERIES



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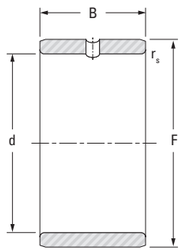
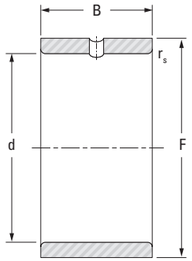


JR.JS1

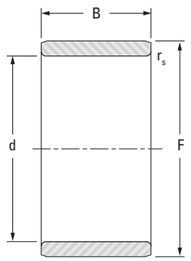


JRZ.JS1

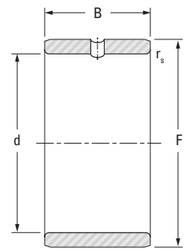
Shaft Dia.	d	F (1)	B	$r_{s\ min.}$	Inner Ring Designation	Approx. Wt.
mm in	mm in	mm in	mm in	mm in		kg lbs
80 3.1496	**80** 3.1496	**90** 3.5433	**54** 2.126	**1** 0.04	JR80x90x54	**0.565** 1.246
85 3.3465	**85** 3.3465	**95** 3.7402	**26** 1.024	**1** 0.04	JR85x95x26	**0.290** 0.639
	85 3.3465	**95** 3.7402	**30** 1.181	**1** 0.04	JR85x95x30	**0.334** 0.736
	85 3.3465	**95** 3.7402	**36** 1.417	**1** 0.04	JR85x95x36	**0.397** 0.875
	85 3.3465	**100** 3.9370	**35** 1.378	**1.1** 0.04	JR85x100x35	**0.595** 1.312
	85 3.3465	**100** 3.9370	**63** 2.480	**1.1** 0.04	JR85x100x63	**1.080** 2.381
90 3.5433	**90** 3.5433	**100** 3.9370	**26** 1.024	**1** 0.04	JR90x100x26	**0.300** 0.661
	90 3.5433	**100** 3.9370	**30** 1.181	**1** 0.04	JR90x100x30	**0.350** 0.772
	90 3.5433	**100** 3.9370	**36** 1.417	**1** 0.04	JR90x100x36	**0.422** 0.930
	90 3.5433	**105** 4.1339	**32** 1.260	**1.1** 0.04	JR90x105x32	**0.580** 1.279
	90 3.5433	**105** 4.1339	**35** 1.378	**1.1** 0.04	JR90x105x35	**0.624** 1.376
	90 3.5433	**105** 4.1339	**63** 2.480	**1.1** 0.04	JR90x105x63	**1.140** 2.513
95 3.7402	**95** 3.7402	**105** 4.1339	**26** 1.024	**1** 0.04	JR95x105x26	**0.310** 0.683
	95 3.7402	**105** 4.1339	**36** 1.417	**1** 0.04	JR95x105x36	**0.430** 0.948
	95 3.7402	**110** 4.3307	**35** 1.378	**1.1** 0.04	JR95x110x35	**0.653** 1.440
	95 3.7402	**110** 4.3307	**63** 2.480	**1.1** 0.04	JR95x110x63	**1.200** 2.646
100 3.9370	**100** 3.9370	**110** 4.3307	**30** 1.181	**1.1** 0.04	JR100x110x30	**0.384** 0.847
	100 3.9370	**110** 4.3307	**40** 1.575	**1.1** 0.04	JR100x110x40	**0.510** 1.124
	100 3.9370	**115** 4.5276	**40** 1.575	**1.1** 0.04	JR100x115x40	**0.790** 1.742
110 4.3307	**110** 4.3307	**120** 4.7244	**30** 1.181	**1** 0.04	JR110x120x30	**0.425** 0.937
	110 4.3307	**125** 4.9213	**40** 1.575	**1.1** 0.04	JR110x125x40	**0.870** 1.918
120 4.7244	**120** 4.7244	**130** 5.1181	**30** 1.181	**1** 0.04	JR120x130x30	**0.460** 1.014
	120 4.7244	**135** 5.3150	**45** 1.772	**1.1** 0.04	JR120x135x45	**1.060** 2.337
130 5.1181	**130** 5.1181	**145** 5.7087	**35** 1.378	**1.1** 0.04	JR130x145x35	**0.890** 1.962

(1) See Table B8-28 on page B-8-19 for outside diameter tolerance.

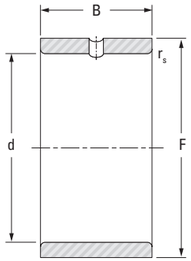
INNER RINGS
METRIC SERIES



JR



JR.JS1

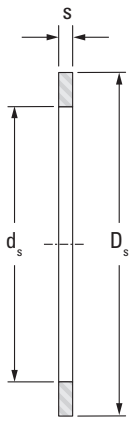


JRZ.JS1

Shaft Dia.	d	F (1)	B	$r_{s\ min.}$	Inner Ring Designation	Approx. Wt.
mm in	mm in	mm in	mm in	mm in		kg lbs
130 5.1181	**130** 5.1181	**150** 5.9055	**50** 1.969	**1.5** 0.06	JR130x150x50	**1.730** 3.814
140 5.5118	**140** 5.5118	**155** 6.1024	**35** 1.378	**1.1** 0.04	JR140x155x35	**0.955** 2.105
	140 5.5118	**160** 6.2992	**50** 1.969	**1.5** 0.06	JR140x160x50	**1.860** 4.101
150 5.9055	**150** 5.9055	**165** 6.4961	**40** 1.575	**1.1** 0.04	JR150x165x40	**1.170** 2.579
160 6.2992	**160** 6.2992	**175** 6.8898	**40** 1.575	**1.1** 0.04	JR160x175x40	**1.240** 2.734
170 6.6929	**170** 6.6929	**185** 7.2835	**45** 1.772	**1.1** 0.04	JR170x185x45	**1.480** 3.263
180 7.0866	**180** 7.0866	**195** 7.6772	**45** 1.772	**1.1** 0.04	JR180x195x45	**1.560** 3.439

(1) See Table B8-28 on page B-8-19 for outside diameter tolerance.

END WASHERS
METRIC SERIES



SNSH

d_s	D_s	S	End Washer Designation	Approx. Wt.
mm in	**mm** in	**mm** in		**kg** lbs
8.0 0.315	**18** 0.709	**2.0** 0.079	SNSH8X18X2	**0.003** 0.007
8.5 0.335	**15** 0.591	**0.5** 0.020	SNSH8,5X15X0,5	**0.0005** 0.001
10.5 0.413	**17** 0.669	**0.5** 0.020	SNSH10,5X17X0,5	**0.0006** 0.001
10.5 0.413	**20** 0.787	**0.5** 0.020	SNSH10,5X20X0,5	**0.0009** 0.002
12.5 0.492	**19** 0.748	**0.5** 0.020	SNSH12,5X19X0,5	**0.0006** 0.001
12.5 0.492	**22** 0.866	**0.5** 0.020	SNSH12,5X22X0,5	**0.0010** 0.002
14.5 0.571	**22** 0.866	**0.5** 0.020	SNSH14,5X22X0,5	**0.0008** 0.002
14.5 0.571	**26** 1.024	**0.5** 0.020	SNSH14,5X26X0,5	**0.0014** 0.003
15.5 0.610	**23** 0.906	**0.5** 0.020	SNSH15,5X23X0,5	**0.0009** 0.002
16.5 0.650	**24** 0.945	**0.5** 0.020	SNSH16,5X24X0,5	**0.0009** 0.002
16.5 0.650	**28** 1.102	**0.5** 0.020	SNSH16,5X28X0,5	**0.0016** 0.004
17.5 0.689	**25** 0.984	**0.5** 0.020	SNSH17,5X25X0,5	**0.001** 0.002
18.5 0.728	**26** 1.024	**0.5** 0.020	SNSH18,5X26X0,5	**0.001** 0.002
18.5 0.728	**30** 1.181	**0.5** 0.020	SNSH18,5X30X0,5	**0.002** 0.004
20.5 0.807	**28** 1.102	**0.5** 0.020	SNSH20,5X28X0,5	**0.001** 0.002
20.5 0.807	**32** 1.260	**0.5** 0.020	SNSH20,5X32X0,5	**0.002** 0.004

d_s	D_s	S	End Washer Designation	Approx. Wt.
mm in	**mm** in	**mm** in		**kg** lbs
22.5 0.886	**30** 1.181	**0.5** 0.020	SNSH22,5X30X0,5	**0.001** 0.003
22.5 0.886	**35** 1.378	**0.5** 0.020	SNSH22,5X35X0,5	**0.002** 0.005
25.5 1.004	**35** 1.378	**0.5** 0.020	SNSH25,5X35X0,5	**0.002** 0.004
25.5 1.004	**37** 1.457	**0.5** 0.020	SNSH25,5X37X0,5	**0.002** 0.005
28.5 1.122	**40** 1.575	**0.5** 0.020	SNSH28,5X40X0,5	**0.002** 0.005
30.5 1.201	**40** 1.575	**0.5** 0.020	SNSH30,5X40X0,5	**0.002** 0.005
35.5 1.398	**47** 1.850	**0.5** 0.020	SNSH35,5X47X0,5	**0.003** 0.006
40.5 1.594	**50** 1.969	**0.5** 0.020	SNSH40,5X50X0,5	**0.003** 0.006
41.0 1.614	**55** 2.165	**1.0** 0.039	SNSH41X55X1	**0.008** 0.018
45.5 1.791	**55** 2.165	**0.5** 0.020	SNSH45,5X55X0,5	**0.003** 0.007
46.0 1.811	**62** 2.441	**1.0** 0.039	SNSH46X62X1	**0.011** 0.024
51.0 2.008	**65** 2.559	**1.0** 0.039	SNSH51X65X1	**0.010** 0.022
56.0 2.205	**72** 2.835	**1.0** 0.039	SNSH56X72X1	**0.013** 0.029
61.0 2.402	**78** 3.071	**1.0** 0.039	SNSH61X78X1	**0.015** 0.033
66.0 2.598	**85** 3.346	**1.0** 0.039	SNSH66X85X1	**0.018** 0.040

SUPPLEMENTARY TABLES

C

C SUPPLEMENTARY TABLES, INDEX

C

Supplementary table 1 (1) SI units and conversion factors

Mass	SI units	Other Units[1)]	Conversion into SI units	Conversion from SI units
Angle	rad [radian(s)]	° [degree(s)] * ′ [minute(s)] * ″ [second(s)] *	1° = π / 180 rad 1′ = π / 10 800 rad 1″ = π / 648 000 rad	1 rad = 57.295 78°
Length	m [meter(s)]	Å [Angstrom unit] μ [micron(s)] in [inch(es)] ft [foot(feet)] yd [yard(s)] mile [mile(s)]	1 Å = 10^{-10} m = 0.1 nm = 100 pm 1 μ = 1 μm 1 in = 25.4 mm 1 ft = 12 in = 0.304 8 m 1 yd = 3 ft = 0.914 4 m 1 mile = 5 280 ft = 1 609.344 m	1 m = 10^{10} Å 1 m = 39.37 in 1 m = 3.280 8 ft 1 m = 1.093 6 yd 1 km = 0.621 4 mile
Area	m^2	a [are(s)] ha [hectare(s)] acre [acre(s)]	1 a = 100 m^2 1 ha = 10^4 m^2 1 acre = 4 840 yd^2 = 4 046.86 m^2	 1 km^2 = 247.1 acre
Volume	m^3	ℓ, L [liter(s)] * cc [cubic centimeters] gal (US) [gallon(s)] fl oz (US) [fluid ounce(s)] barrel (US) [barrels (US)]	1ℓ = 1 dm^3 = 10^{-3} m^3 1 cc = 1 cm^3 = 10^{-6} m^3 1 gal (US) = 231 in^3 = 3.785 41 dm^3 1 fl oz (US) = 29.573 5 cm^3 1 barrel (US) = 158.987 dm^3	1 m^3 = 10^3ℓ 1 m^3 = 10^6 cc 1 m^3 = 264.17 gal 1 m^3 = 33 814 fl oz 1 m^3 = 6.289 8 barrel
Time	s [second(s)]	min [minute(s)] * h [hour(s)] * d [day(s)] *		
Angular velocity	rad / s			
Velocity	m / s	kn [knot(s)] m / h *	1 kn = 1 852 m / h	1 km / h = 0.539 96 kn
Acceleration	m / s^2	G	1 G = 9.806 65 m / s^2	1 m / s^2 = 0.101 97 G
Frequency	Hz [hertz]	c / s [cycle(s) / second]	1 c / s = 1 s^{-1} = 1 Hz	
Rotational frequency	s^{-1}	rpm [revolutions per minute] min^{-1} * r / min	1 rpm = 1 / 60 s^{-1}	1 s^{-1} = 60 rpm
Mass	kg [kilogram(s)]	t [ton(s)] * lb [pound(s)] gr [grain(s)] oz [ounce(s)] ton (UK) [ton(s) (UK)] ton (US) [ton(s) (US)] car [carat(s)]	1 t = 10^3 kg 1 lb = 0.453 592 37 kg 1 gr = 64.798 91 mg 1 oz = 1 / 16 lb = 28.349 5 g 1 ton (UK) = 1 016.05 kg 1 ton (US) = 907.185 kg 1 car = 200 mg	 1 kg = 2.204 6 lb 1 g = 15.432 4 gr 1 kg = 35.274 0 oz 1 t = 0.984 2 ton (UK) 1 t = 1.102 3 ton (US) 1 g = 5 car

[Note] 1) * : Unit can be used as an SI unit.
No asterisk : Unit cannot be used.

Supplementary table 1 (2) SI units and conversion factors

Mass	SI units	Other Units[1)]	Conversion into SI units	Conversion from SI units
Density	kg / m^3			
Linear density	kg / m			
Momentum	kg·m / s			
Moment of momentum, Angular momentum	$kg·m^2 / s$			
Moment of inertia	$kg·m^2$			
Force	N [newton(s)]	dyn [dyne(s)] kgf [kilogram-force] gf [gram-force] tf [ton-force] lbf [pound-force]	$1\ dyn = 10^{-5}\ N$ 1 kgf = 9.806 65 N $1\ gf = 9.806\ 65 \times 10^{-3}\ N$ $1\ tf = 9.806\ 65 \times 10^{3}\ N$ 1 lbf = 4.448 22 N	$1\ N = 10^{5}\ dyn$ 1 N = 0.101 97 kgf 1 N = 0.224 809 lbf
Moment of force	N·m [newton meter(s)]	gf·cm kgf·cm kgf·m tf·m lbf·ft	$1\ gf·cm = 9.806\ 65 \times 10^{-5}\ N·m$ $1\ kgf·cm = 9.806\ 65 \times 10^{-2}\ N·m$ 1 kgf·m = 9.806 65 N·m $1\ tf·m = 9.806\ 65 \times 10^{3}\ N·m$ 1 lbf·ft = 1.355 82 N·m	 1 N·m = 0.101 97 kgf·m 1 N·m = 0.737 56 lbf·ft
Pressure, Normal stress	Pa [pascal(s)] or N / m^2 {1 Pa = 1 N / m^2}	gf / cm^2 kgf / mm^2 kgf / m^2 lbf / in^2 bar [bar(s)] at [engineering air pressure] mH_2O, mAq [meter water column] atm [atmosphere] mHg [meter mercury column] Torr [torr]	$1\ gf / cm^2 = 9.806\ 65 \times 10\ Pa$ $1\ kgf / mm^2 = 9.806\ 65 \times 10^{6}\ Pa$ $1\ kgf / m^2 = 9.806\ 65\ Pa$ $1\ lbf / in^2 = 6\ 894.76\ Pa$ $1\ bar = 10^{5}\ Pa$ $1\ at = 1\ kgf / cm^2 = 9.806\ 65 \times 10^{4}\ Pa$ $1\ mH_2O = 9.806\ 65 \times 10^{3}\ Pa$ 1 atm = 101 325 Pa $1\ mHg = \frac{101\ 325}{0.76}\ Pa$ 1 Torr = 1 mmHg = 133.322 Pa	 $1\ MPa = 0.101\ 97\ kgf / mm^2$ $1\ Pa = 0.101\ 97\ kgf / m^2$ $1\ Pa = 0.145 \times 10^{-3}\ lbf / in^2$ $1\ Pa = 10^{-2}\ mbar$ $1\ Pa = 7.500\ 6 \times 10^{-3}\ Torr$
Viscosity	Pa·s [pascal second]	P [poise] $kgf·s / m^2$	$10^{-2}\ P = 1\ cP = 1\ mPa·s$ $1\ kgf·s / m^2 = 9.806\ 65\ Pa·s$	 $1\ Pa·s = 0.101\ 97\ kgf·s / m^2$
Kinematic viscosity	m^2 / s	St [stokes]	$10^{-2}\ St = 1\ cSt = 1\ mm^2 / s$	
Surface tension	N / m			

Supplementary table 1 (3) SI units and conversion factors

Mass	SI units	Other Units[1)]	Conversion into SI units	Conversion from SI units
Work, energy	J [joule(s)] {1 J = 1 N·m}	eV [electron volt(s)] * erg [erg(s)] kgf·m lbf·ft	1 eV = (1.602 189 2 ± 0.000 004 6) × 10^{-19} J 1 erg = 10^{-7} J 1 kgf·m = 9.806 65 J 1 lbf·ft = 1.355 82 J	1 J = 10^{7} erg 1 J = 0.101 97 kgf·m 1 J = 0.737 56 lbf·ft
Power	W [watt(s)]	erg / s [ergs per second] kgf·m / s PS [French horse-power] HP [horse-power (British)] lbf·ft / s	1 erg / s = 10^{-7} W 1 kgf·m / s = 9.806 65 W 1 PS = 75 kgf·m / s = 735.5 W 1 HP = 550 lbf·ft / s = 745.7 W 1 lbf·ft / s = 1.355 82 W	1 W = 0.101 97 kgf·m / s 1 W = 0.001 36 PS 1 W = 0.001 34 HP
Thermo-dynamic temperature	K [kelvin(s)]			
Celsius temperature	°C [celsius(s)] {t °C = (t + 273.15) K}	°F [degree(s) Fahrenheit]	$t\,°F = \frac{5}{9}(t - 32)\,°C$	$t\,°C = (\frac{9}{5}t + 32)\,°F$
Linear expansion coefficient	K^{-1}	$°C^{-1}$ [per degree]		
Heat	J [joule(s)] {1 J = 1 N·m}	erg [erg(s)] kgf·m cal_{IT} [I. T. calories]	1 erg = 10^{-7} J 1 cal_{IT} = 4.186 8 J 1 $Mcal_{IT}$ = 1.163 kW·h	1 J = 10^{7} erg 1 J = 0.238 85 cal_{IT} 1 kW·h = 0.86 × 10^{6} cal_{IT}
Thermal conductivity	W / (m·K)	W / (m·°C) cal / (s·m·°C)	1 W / (m·°C) = 1 W / (m·K) 1 cal / (s·m·°C) = 4.186 05 W / (m·K)	
Coefficient of heat transfer	W / (m^2·K)	W / (m^2·°C) cal / (s·m^2·°C)	1 W / (m^2·°C) = 1 W / (m^2·K) 1 cal / (s·m^2·°C) = 4.186 05 W / (m^2·K)	
Heat capacity	J / K	J / °C	1 J / °C = 1 J / K	
Massic heat capacity	J / (kg·K)	J / (kg·°C)		

[Note] 1) * : Unit can be used as an SI unit.
No asterisk : Unit cannot be used.

Supplementary table 1 (4) SI units and conversion factors

Mass	SI units	Other Units[1)]	Conversion into SI units	Conversion from SI units
Electric current	A [ampere(s)]			
Electric charge, quantity of electricity	C [coulomb(s)] {1 C = 1 A·s}	A·h *	1 A·h = 3.6 kC	
Tension, electric potential	V [volt(s)] {1 V = 1 W / A}			
Capacitance	F [farad(s)] {1 F = 1 C / V}			
Magnetic field strength	A / m	Oe [oersted(s)]	1 Oe = $\frac{10^3}{4\pi}$ A / m	1 A / m = $4\pi \times 10^{-3}$ Oe
Magnetic flux density	T [tesla(s)] {1 T = 1 N / (A·m) = 1 Wb / m² = 1 V·s / m²}	Gs [gauss(es)] γ [gamma(s)]	1 Gs = 10^{-4} T 1 γ = 10^{-9} T	1 T = 10^4 Gs 1 T = 10^9 γ
Magnetic flux	Wb [weber(s)] {1 Wb = 1 V·s}	Mx [maxwell(s)]	1 Mx = 10^{-8} Wb	1 Wb = 10^8 Mx
Self inductance	H [henry(-ries)] {1 H = 1 Wb / A}			
Resistance (to direct current)	Ω [ohm(s)] {1 Ω = 1 V / A}			
Conductance (to direct current)	S [siemens] {1 S = 1 A / V}			
Active power	{W 1 W = 1 J / s = 1 A·V}			

C

C

Supplementary table 2 Steel hardness numbers (1)

Rockwell C-Scale Hardness Number	Diamond Pyramid Hardness Number Vickers	Brinell Hardness Number 10 mm Ball 3000 kg Load			Rockwell Hardness Number			Rockwell Superficial Hardness Number Superficial Brale Penetrator			Shore Scleroscope Hardness Number	Tensil Strength (approx.) MPa	Tensil Strength (approx.) 1000 psi	Rockwell C-Scale Hardness Number
		Standard Ball	Hultgren Ball	Tungsten Carbide Ball	A-Scale 60 kg Load Brale Penetrator	B-Scale 15 kg Load 1/16 in (1.59 mm) Dia.	D-Scale 100 kg Brale Penetrator	15-N Scale 15 kg Load	30-N Scale 30 kg Load	45-N Scale 45 kg Load				
68	940	—	—	—	85.6	—	76.9	93.2	84.4	75.4	97	—	—	68
67	900	—	—	—	85	—	76.1	92.9	83.6	74.2	95	—	—	67
66	865	—	—	—	84.5	—	75.4	92.5	82.8	73.3	92	—	—	66
65	832	—	—	739	83.9	—	74.5	92.2	81.9	72	91	—	—	65
64	800	—	—	722	83.4	—	73.8	91.8	81.1	71	88	—	—	64
63	772	—	—	705	82.8	—	73	91.4	80.1	69.9	87	—	—	63
62	746	—	—	688	82.3	—	72.2	91.1	79.3	68.8	85	—	—	62
61	720	—	—	670	81.8	—	71.5	90.7	78.4	67.7	83	—	—	61
60	697	—	613	654	81.2	—	70.7	90.2	77.5	66.6	81	—	—	60
59	674	—	599	634	80.7	—	69.9	89.8	76.6	65.5	80	2250	326	59
58	653	—	587	615	80.1	—	69.2	89.3	75.7	64.3	78	2170	315	58
57	633	—	575	595	79.6	—	68.5	88.9	74.8	63.2	76	2100	305	57
56	613	—	561	577	79	—	67.7	88.3	73.9	62	75	2030	295	56
55	595	—	546	560	78.5	—	66.9	87.9	73	60.9	74	1980	287	55
54	577	—	534	543	78	—	66.1	87.4	72	59.8	72	1920	278	54
53	560	—	519	525	77.4	—	65.4	86.9	71.2	58.6	71	1850	269	53
52	544	500	508	512	76.8	—	64.6	86.4	70.2	57.4	69	1810	262	52
51	528	487	494	496	76.3	—	63.8	85.9	69.4	56.1	68	1740	253	51
50	513	475	481	481	75.9	—	63.1	85.5	68.5	55	67	1690	245	50
49	498	464	469	469	75.2	—	62.1	85	67.6	53.8	66	1650	239	49
48	484	451	455	455	74.7	—	61.4	84.5	66.7	52.5	64	1600	232	48
47	471	442	443	443	74.1	—	60.8	83.9	65.8	51.4	63	1550	225	47
45	446	421	421	421	73.1	—	59.2	83	64	49	60	1460	212	45
44	434	409	409	409	72.5	—	58.5	82.5	63.1	47.8	58	1420	206	44
43	423	400	400	400	72	—	57.7	82	62.2	46.7	57	1390	201	43
42	412	390	390	390	71.5	—	56.9	81.5	61.3	45.5	56	1350	196	42
41	402	381	381	381	70.9	—	56.2	80.9	60.4	44.3	55	1320	191	41
40	392	371	371	371	70.4	—	55.4	80.4	59.5	43.1	54	1280	186	40
39	382	362	362	362	69.9	—	54.6	79.9	58.6	41.9	52	1250	181	39
38	372	353	353	353	69.4	—	53.8	79.4	57.7	40.8	51	1210	176	38
37	363	344	344	344	68.9	—	53.1	78.8	56.8	39.6	50	1190	172	37
36	354	336	336	336	68.4	(109)	52.3	78.3	55.9	38.4	49	1160	168	36
35	345	327	327	327	67.9	(108.5)	51.5	77.7	55	37.2	48	1120	163	35
34	336	319	319	319	67.4	(108)	50.8	77.2	54.2	36.1	47	1100	159	34
33	327	311	311	311	66.8	(107.5)	50	76.6	53.3	34.9	46	1060	154	33
32	318	301	301	301	66.3	(107)	49.2	76.1	52.1	33.7	44	1030	150	32
31	310	294	294	294	65.8	(106)	48.4	75.6	51.3	32.5	43	1010	146	31
30	302	286	286	286	65.3	(105.5)	47.7	75	50.4	31.3	42	980	142	30
29	294	279	279	279	64.7	(104.5)	47	74.5	49.5	30.1	41	950	138	29
28	286	271	271	271	64.3	(104)	46.1	73.9	48.6	28.9	41	920	134	28
27	279	264	264	264	63.8	(103)	45.2	73.3	47.7	27.8	40	900	131	27
26	272	258	258	258	63.3	(102.5)	44.6	72.8	46.8	26.7	38	880	127	26
25	266	253	253	253	62.8	(101.5)	43.8	72.2	45.9	25.5	38	850	124	25
24	260	247	247	247	62.4	(101)	43.1	71.6	45	24.3	37	830	121	24
23	254	243	243	243	62	100	42.1	71	44	23.1	36	810	118	23
22	248	237	237	237	61.5	99	41.6	70.5	43.2	22	35	790	115	22
21	243	231	231	231	61	98.5	40.9	69.9	42.3	20.7	35	780	113	21
20	238	226	226	226	60.5	97.8	40.1	69.4	41.5	19.6	34	760	110	20

(1) Source ASTM

Supplementary table 3 Inch/millimeter conversion

Inch		Inches										
		0	1	2	3	4	5	6	7	8	9	10
		mm										
0	0	**0**	**25.4000**	**50.8000**	**76.2000**	**101.6000**	**127.0000**	**152.4000**	**177.8000**	**203.2000**	**228.6000**	**254.0000**
1/64	0.015625	0.3969	25.7969	51.1969	76.5969	101.9969	127.3969	152.7969	178.1969	203.5969	228.9969	254.3969
1/32	0.03125	0.7938	26.1938	51.5938	76.9938	102.3938	127.7938	153.1938	178.5938	203.9938	229.3938	254.7938
3/64	0.046875	1.1906	26.5906	51.9906	77.3906	102.7906	128.1906	153.5906	178.9906	204.3906	229.7906	255.1906
1/16	0.0625	1.5875	26.9875	52.3875	77.7875	103.1875	128.5875	153.9875	179.3875	204.7875	230.1875	255.5875
5/64	0.078125	1.9844	27.3844	52.7844	78.1844	103.5844	128.9844	154.3844	179.7844	205.1844	230.5844	255.9844
3/32	0.09375	2.3812	27.7812	53.1812	78.5812	103.9812	129.3812	154.7812	180.1812	205.5812	230.9812	256.3812
7/64	0.109375	2.7781	28.1781	53.5781	78.9781	104.3781	129.7781	155.1781	180.5781	205.9781	231.3781	256.7781
1/8	0.125	**3.1750**	**28.5750**	**53.9750**	**79.3750**	**104.7750**	**130.1750**	**155.5750**	**180.9750**	**206.3750**	**231.7750**	**257.1750**
9/64	0.140625	3.5719	28.9719	54.3719	79.7719	105.1719	130.5719	155.9719	181.3719	206.7719	232.1719	257.5719
5/32	0.15625	3.9688	29.3688	54.7688	80.1688	105.5688	130.9688	156.3688	181.7688	207.1688	232.5688	257.9688
11/64	0.171875	4.3656	29.7656	55.1656	80.5656	105.9656	131.3656	156.7656	182.1656	207.5656	232.9656	258.3656
3/16	0.1875	4.7625	30.1625	55.5625	80.9625	106.3625	131.7625	157.1625	182.5625	207.9625	233.3625	258.7625
13/64	0.203125	5.1594	30.5594	55.9594	81.3594	106.7594	132.1594	157.5594	182.9594	208.3594	233.7594	259.1594
7/32	0.21875	5.5562	30.9562	56.3562	81.7562	107.1562	132.5562	157.9562	183.3562	208.7562	234.1562	259.5562
15/64	0.234375	5.9531	31.3531	56.7531	82.1531	107.5531	132.9531	158.3531	183.7531	209.1531	234.5531	259.9531
1/4	0.25	**6.3500**	**31.7500**	**57.1500**	**82.5500**	**107.9500**	**133.3500**	**158.7500**	**184.1500**	**209.5500**	**234.9500**	**260.3500**
17/64	0.265625	6.7469	32.1469	57.5469	82.9469	108.3469	133.7469	159.1469	184.5469	209.9469	235.3469	260.7469
9/32	0.28125	7.1438	32.5438	57.9438	83.3438	108.7438	134.1438	159.5438	184.9438	210.3438	235.7438	261.1438
19/64	0.296875	7.5406	32.9406	58.3406	83.7406	109.1406	134.5406	159.9406	185.3406	210.7406	236.1406	261.5406
5/16	0.3125	7.9375	33.3375	58.7375	84.1375	109.5375	134.9375	160.3375	185.7375	211.1375	236.5375	261.9375
21/64	0.328125	8.3344	33.7344	59.1344	84.5344	109.9344	135.3344	160.7344	186.1344	211.5344	236.9344	262.3344
11/32	0.34375	8.7312	34.1312	59.5312	84.9312	110.3312	135.7312	161.1312	186.5312	211.9312	237.3312	262.7312
23/64	0.359375	9.1281	34.5281	59.9281	85.3281	110.7281	136.1281	161.5281	186.9281	212.3281	237.7281	263.1281
3/8	0.375	**9.5250**	**34.9250**	**60.3250**	**85.7250**	**111.1250**	**136.5250**	**161.9250**	**187.3250**	**212.7250**	**238.1250**	**263.5250**
25/64	0.390625	9.9219	35.3219	60.7219	86.1219	111.5219	136.9219	162.3219	187.7219	213.1219	238.5219	263.9219
13/32	0.40625	10.3188	35.7188	61.1188	86.5188	111.9188	137.3188	162.7188	188.1188	213.5188	238.9188	264.3188
27/64	0.421875	10.7156	36.1156	61.5156	86.9156	112.3156	137.7156	163.1156	188.5156	213.9156	239.3156	264.7156
7/16	0.4375	11.1125	36.5125	61.9125	87.3125	112.7125	138.1125	163.5125	188.9125	214.3125	239.7125	265.1125
29/64	0.453125	11.5094	36.9094	62.3094	87.7094	113.1094	138.5094	163.9094	189.3094	214.7094	240.1094	265.5094
15/32	0.46875	11.9062	37.3062	62.7062	88.1062	113.5062	138.9062	164.3062	189.7062	215.1062	240.5062	265.9062
31/64	0.484375	12.3031	37.7031	63.1031	88.5031	113.9031	139.3031	164.7031	190.1031	215.5031	240.9031	266.3031
1/2	0.5	**12.7000**	**38.1000**	**63.5000**	**88.9000**	**114.3000**	**139.7000**	**165.1000**	**190.5000**	**215.9000**	**241.3000**	**266.7000**
33/64	0.515625	13.0969	38.4969	63.8969	89.2969	114.6969	140.0969	165.4969	190.8969	216.2969	241.6969	267.0969
17/32	0.53125	13.4938	38.8938	64.2938	89.6938	115.0938	140.4938	165.8938	191.2938	216.6938	242.0938	267.4938
35/64	0.546875	13.8906	39.2906	64.6906	90.0906	115.4906	140.8906	166.2906	191.6906	217.0906	242.4906	267.8906
9/16	0.5625	14.2875	39.6875	65.0875	90.4875	115.8875	141.2875	166.6875	192.0875	217.4875	242.8875	268.2875
37/64	0.578125	14.6844	40.0844	65.4844	90.8844	116.2844	141.6844	167.0844	192.4844	217.8844	243.2844	268.6844
19/32	0.59375	15.0812	40.4812	65.8812	91.2812	116.6812	142.0812	167.4812	192.8812	218.2812	243.6812	269.0812
39/64	0.609375	15.4781	40.8781	66.2781	91.6781	117.0781	142.4781	167.8781	193.2781	218.6781	244.0781	269.4781
5/8	0.625	**15.8750**	**41.2750**	**66.6750**	**92.0750**	**117.4750**	**142.8750**	**168.2750**	**193.6750**	**219.0750**	**244.4750**	**269.8750**
41/64	0.640625	16.2719	41.6719	67.0719	92.4719	117.8719	143.2719	168.6719	194.0719	219.4719	244.8719	270.2719
21/32	0.65625	16.6688	42.0688	67.4688	92.8688	118.2688	143.6688	169.0688	194.4688	219.8688	245.2688	270.6688
43/64	0.671875	17.0656	42.4656	67.8656	93.2656	118.6656	144.0656	169.4656	194.8656	220.2656	245.6656	271.0656
11/16	0.6875	17.4625	42.8625	68.2625	93.6625	119.0625	144.4625	169.8625	195.2625	220.6625	246.0625	271.4625
45/64	0.703125	17.8594	43.2594	68.6594	94.0594	119.4594	144.8594	170.2594	195.6594	221.0594	246.4594	271.8594
23/32	0.71875	18.2562	43.6562	69.0562	94.4562	119.8562	145.2562	170.6562	196.0562	221.4562	246.8562	272.2562
47/64	0.734375	18.6531	44.0531	69.4531	94.8531	120.2531	145.6531	171.0531	196.4531	221.8531	247.2531	272.6531
3/4	0.75	**19.0500**	**44.4500**	**69.8500**	**95.2500**	**120.6500**	**146.0500**	**171.4500**	**196.8500**	**222.2500**	**247.6500**	**273.0500**
49/64	0.765625	19.4469	44.8469	70.2469	95.6469	121.0469	146.4469	171.8469	197.2469	222.6469	248.0469	273.4469
25/32	0.78125	19.8438	45.2438	70.6438	96.0438	121.4438	146.8438	172.2438	197.6438	223.0438	248.4438	273.8438
51/64	0.796875	20.2406	45.6406	71.0406	96.4406	121.8406	147.2406	172.6406	198.0406	223.4406	248.8406	274.2406
13/16	0.8125	20.6375	46.0375	71.4375	96.8375	122.2375	147.6375	173.0375	198.4375	223.8375	249.2375	274.6375
53/64	0.828125	21.0344	46.4344	71.8344	97.2344	122.6344	148.0344	173.4344	198.8344	224.2344	249.6344	275.0344
27/32	0.84375	21.4312	46.8312	72.2312	97.6312	123.0312	148.4312	173.8312	199.2312	224.6312	250.0312	275.4312
55/64	0.859375	21.8281	47.2281	72.6281	98.0281	123.4281	148.8281	174.2281	199.6281	225.0281	250.4281	275.8281
7/8	0.875	**22.2250**	**47.6250**	**73.0250**	**98.4250**	**123.8250**	**149.2250**	**174.6250**	**200.0250**	**225.4250**	**250.8250**	**276.2250**
57/64	0.890625	22.6219	48.0219	73.4219	98.8219	124.2219	149.6219	175.0219	200.4219	225.8219	251.2219	276.6219
29/32	0.90625	23.0188	48.4188	73.8188	99.2188	124.6188	150.0188	175.4188	200.8188	226.2188	251.6188	277.0188
59/64	0.921875	23.4156	48.8156	74.2156	99.6156	125.0156	150.4156	175.8156	201.2156	226.6156	252.0156	277.4156
15/16	0.9375	23.8125	49.2125	74.6125	100.0125	125.4125	150.8125	176.2125	201.6125	227.0125	252.4125	277.8125
61/64	0.953125	24.2094	49.6094	75.0094	100.4094	125.8094	151.2094	176.6094	202.0094	227.4094	252.8094	278.2094
31/32	0.96875	24.6062	50.0062	75.4062	100.8062	126.2062	151.6062	177.0062	202.4062	227.8062	253.2062	278.6062
63/64	0.984375	25.0031	50.4031	75.8031	101.2031	126.6031	152.0031	177.4031	202.8031	228.2031	253.6031	279.0031

Supplementary table 4 °C / °F conversion

°C		°F	°C		°F	°C		°F	°C		°F
−73	**−100**	−148	− 1.6	**29**	84.2	17.7	**64**	147.2	37.1	**99**	210.2
−62	**− 80**	−112	− 1.1	**30**	86.0	18.2	**65**	149.0	37.7	**100**	212
−51	**− 60**	− 76	− 0.6	**31**	87.8	18.8	**66**	150.8	40.6	**105**	221
−40	**− 40**	− 40	0	**32**	89.6	19.3	**67**	152.6	43	**110**	230
−29	**− 20**	− 4	0.5	**33**	91.4	19.9	**68**	154.4	49	**120**	248
−23.3	**− 10**	14	1.1	**34**	93.2	20.4	**69**	156.2	54	**130**	266
−17.7	**0**	32	1.6	**35**	95.0	21.0	**70**	158.0	60	**140**	284
−17.2	**1**	33.8	2.2	**36**	96.8	21.5	**71**	159.8	65	**150**	302
−16.6	**2**	35.6	2.7	**37**	98.6	22.2	**72**	161.6	71	**160**	320
−16.1	**3**	37.4	3.3	**38**	100.4	22.7	**73**	163.4	76	**170**	338
−15.5	**4**	39.2	3.8	**39**	102.2	23.3	**74**	165.2	83	**180**	356
−15.0	**5**	41.0	4.4	**40**	104.0	23.8	**75**	167.0	88	**190**	374
−14.4	**6**	42.8	4.9	**41**	105.8	24.4	**76**	168.8	93	**200**	392
−13.9	**7**	44.6	5.4	**42**	107.6	25.0	**77**	170.6	121	**250**	482
−13.3	**8**	46.4	6.0	**43**	109.4	25.5	**78**	172.4	149	**300**	572
−12.7	**9**	48.2	6.6	**44**	111.2	26.2	**79**	174.2	177	**350**	662
−12.2	**10**	50.0	7.1	**45**	113.0	26.8	**80**	176.0	204	**400**	752
−11.6	**11**	51.8	7.7	**46**	114.8	27.3	**81**	177.8	232	**450**	842
−11.1	**12**	53.6	8.2	**47**	116.6	27.7	**82**	179.6	260	**500**	932
−10.5	**13**	55.4	8.8	**48**	118.4	28.2	**83**	181.4	288	**550**	1 022
−10.0	**14**	57.2	9.3	**49**	120.2	28.8	**84**	183.2	315	**600**	1 112
− 9.4	**15**	59.0	9.9	**50**	122.0	29.3	**85**	185.0	343	**650**	1 202
− 8.8	**16**	61.8	10.4	**51**	123.8	29.9	**86**	186.8	371	**700**	1 292
− 8.3	**17**	63.6	11.1	**52**	125.6	30.4	**87**	188.6	399	**750**	1 382
− 7.7	**18**	65.4	11.5	**53**	127.4	31.0	**88**	190.4	426	**800**	1 472
− 7.2	**19**	67.2	12.1	**54**	129.2	31.5	**89**	192.2	454	**850**	1 562
− 6.6	**20**	68.0	12.6	**55**	131.0	32.1	**90**	194.0	482	**900**	1 652
− 6.1	**21**	69.8	13.2	**56**	132.8	32.6	**91**	195.8	510	**950**	1 742
− 5.5	**22**	71.6	13.7	**57**	134.6	33.3	**92**	197.6	538	**1 000**	1 832
− 5.0	**23**	73.4	14.3	**58**	136.4	33.8	**93**	199.4	593	**1 100**	2 012
− 4.4	**24**	75.2	14.8	**59**	138.2	34.4	**94**	201.2	648	**1 200**	2 192
− 3.9	**25**	77.0	15.6	**60**	140.0	34.9	**95**	203.0	704	**1 300**	2 372
− 3.3	**26**	78.8	16.1	**61**	141.8	35.5	**96**	204.8	760	**1 400**	2 552
− 2.8	**27**	80.6	16.6	**62**	143.6	36.1	**97**	206.6	815	**1 500**	2 732
− 2.2	**28**	82.4	17.1	**63**	145.4	36.6	**98**	208.4	871	**1 600**	2 937

[Example] The center columns of numbers is the temperature in either degrees Centigrade (°C) or Fahrenheit (°F) whichever is desired to convert into the other. If degrees Fahrenheit is given, read degrees Centigrade to the left. If degrees Centigrade is given, read degrees Fahrenheit to the right.

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

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

Supplementary table 5 Viscosity conversion

Kinematic viscosity mm²/s	Saybolt SUS (second)		Redwood R (second)		Engler E (degree)
	100 °F	210 °F	50 °C	100 °C	
2	32.6	32.8	30.8	31.2	1.14
3	36.0	36.3	33.3	33.7	1.22
4	39.1	39.4	35.9	36.5	1.31
5	42.3	42.6	38.5	39.1	1.40
6	45.5	45.8	41.1	41.7	1.48
7	48.7	49.0	43.7	44.3	1.56
8	52.0	52.4	46.3	47.0	1.65
9	55.4	55.8	49.1	50.0	1.75
10	58.8	59.2	52.1	52.9	1.84
11	62.3	62.7	55.1	56.0	1.93
12	65.9	66.4	58.2	59.1	2.02
13	69.6	70.1	61.4	62.3	2.12
14	73.4	73.9	64.7	65.6	2.22
15	77.2	77.7	68.0	69.1	2.32
16	81.1	81.7	71.5	72.6	2.43
17	85.1	85.7	75.0	76.1	2.54
18	89.2	89.8	78.6	79.7	2.64
19	93.3	94.0	82.1	83.6	2.76
20	97.5	98.2	85.8	87.4	2.87
21	102	102	89.5	91.3	2.98
22	106	107	93.3	95.1	3.10
23	110	111	97.1	98.9	3.22
24	115	115	101	103	3.34
25	119	120	105	107	3.46
26	123	124	109	111	3.58
27	128	129	112	115	3.70
28	132	133	116	119	3.82
29	137	138	120	123	3.95
30	141	142	124	127	4.07
31	145	146	128	131	4.20
32	150	150	132	135	4.32
33	154	155	136	139	4.45
34	159	160	140	143	4.57

Kinematic viscosity mm²/s	Saybolt SUS (second)		Redwood R (second)		Engler E (degree)
	100 °F	210 °F	50 °C	100 °C	
35	163	164	144	147	4.70
36	168	170	148	151	4.83
37	172	173	153	155	4.96
38	177	178	156	159	5.08
39	181	183	160	164	5.21
40	186	187	164	168	5.34
41	190	192	168	172	5.47
42	195	196	172	176	5.59
43	199	201	176	180	5.72
44	204	205	180	185	5.85
45	208	210	184	189	5.98
46	213	215	188	193	6.11
47	218	219	193	197	6.24
48	222	224	197	202	6.37
49	227	228	201	206	6.50
50	231	233	205	210	6.63
55	254	256	225	231	7.24
60	277	279	245	252	7.90
65	300	302	266	273	8.55
70	323	326	286	294	9.21
75	346	349	306	315	9.89
80	371	373	326	336	10.5
85	394	397	347	357	11.2
90	417	420	367	378	11.8
95	440	443	387	399	12.5
100	464	467	408	420	13.2
120	556	560	490	504	15.8
140	649	653	571	588	18.4
160	742	747	653	672	21.1
180	834	840	734	757	23.7
200	927	933	816	841	26.3
250	1 159	1 167	1 020	1 051	32.9
300	1 391	1 400	1 224	1 241	39.5

[Remark] 1 mm²/s = 1 cSt (centi stokes)

INDEX

C

C

CODE	DESCRIPTION	PAGE
RNA69	Heavy-duty needle roller bearing, caged, with flanges (inserted or integral), lubricating groove and one lubricating hole in the outer ring, without inner ring (sizes with 40 mm and larger bores have two needle roller and cage assemblies), metric series	B-4-21~B-4-26, B-4-28
RNAO	Heavy-duty needle roller bearing without flanges, without inner ring, metric series	B-4-35~B-4-37
RP	Radial needle roller and cage assembly, steel cage, metric series	B-1-31~B-1-40
RPU	Radial needle roller and cage assembly, half-caged, steel cage, metric series	B-1-33~B-1-40
RS	Radial needle roller and cage assembly, steel cage, metric series	B-1-30~B-1-39
RSTO	Needle roller bearing, track roller, yoke type, caged, crowned outer ring outer diameter, separable design, without inner ring, without end washers, metric series	B-5-22
RSTO. DZ	Needle roller bearing, track roller, yoke type, caged, cylindrical outer ring outer diameter, separable design, without inner ring, without end washers, metric series	B-5-22
RSU	Radial needle roller and cage assembly, half-caged, steel cage, metric series	B-1-37
RV	Radial needle roller and cage assembly, steel cage, metric series	B-1-30~B-1-41
RVU	Radial needle roller and cage assembly, half-caged, steel cage, metric series	B-1-35
SNSH	End washers, for use with NAO and RNAO needle roller bearings, metric series	B-4-32~B-4-37 & B-8-30
STO	Needle roller bearing, track roller, yoke type, caged, crowned outer ring outer diameter, separable design, with inner ring, metric series	B-5-23
STO. DZ	Needle roller bearing, track roller, yoke type, caged, cylindrical outer ring outer diameter, separable design, with inner ring, metric series	B-5-23
STO. ZZ	Needle roller bearing, track roller, yoke type, caged, crowned outer ring outer diameter, with end washers, separable design, with inner ring, metric series	B-5-26
STO. ZZ.DZ	Needle roller bearing, track roller, yoke type, caged, cylindrical outer ring outer diameter, with end washers, separable design, with inner ring, metric series	B-5-26

CODE	DESCRIPTION	PAGE
TP	Thrust needle roller and cage assembly (without washers), two-piece cage, metric series	B-6-18
TPK J	Unitized needle roller thrust bearing, non-separable design, with one O.D. lipped thrust washer, metric series	B-6-23
TPK JL	Unitized needle roller thrust bearing, with non-separable washers, one I.D. lipped washer and one O.D. lipped washer, metric series	B-6-21
TPK L	Unitized needle roller thrust bearing, non-separable design, with one I.D. lipped thrust washer, metric series	B-6-25
TR	Thrust washer A, B, C, etc. indicates (A,B,C, etc) washer thickness, inch series	B-6-39~B-6-47
TRI	Thrust washer, shaft piloted, inch series	B-6-51
TRID	Thrust washer, housing piloted, inch series	B-6-51
TRJ	Thrust washer, shaft piloted, inch series	B-6-51
TRJD	Thrust washer, housing piloted, inch series	B-6-51
TVK J	Unitized needle roller thrust bearing, non-separable design, with one O.D. lipped thrust washer, metric series	B-6-23
TVK JL	Unitized needle roller thrust bearing, with non-separable washers, one I.D. lipped washer and one O.D. lipped washer, metric series	B-6-21
TVK L	Unitized needle roller thrust bearing, non-separable design, with one I.D. lipped thrust washer, metric series	B-6-25
UR P	Radial needle roller and cage assembly for wrist pin applications, half-caged, metric series	B-1-53
V	Radial needle roller and cage assembly, steel cage, metric series	B-1-31~B-1-41
VE	Radial needle roller and cage assembly for crank pin applications, metric series	B-1-49~B-1-50
VENN	Grease fitting for stud-type track rollers, metric series	B-5-14
VEU	Radial needle roller and cage assembly for crank pin applications, half-caged, metric series	B-1-50
VS	Radial needle roller and cage assembly, steel cage, metric series	B-1-31~B-1-36
VS P	Radial needle roller and cage assembly for crank pin applications, metric series	B-1-49~B-1-50

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