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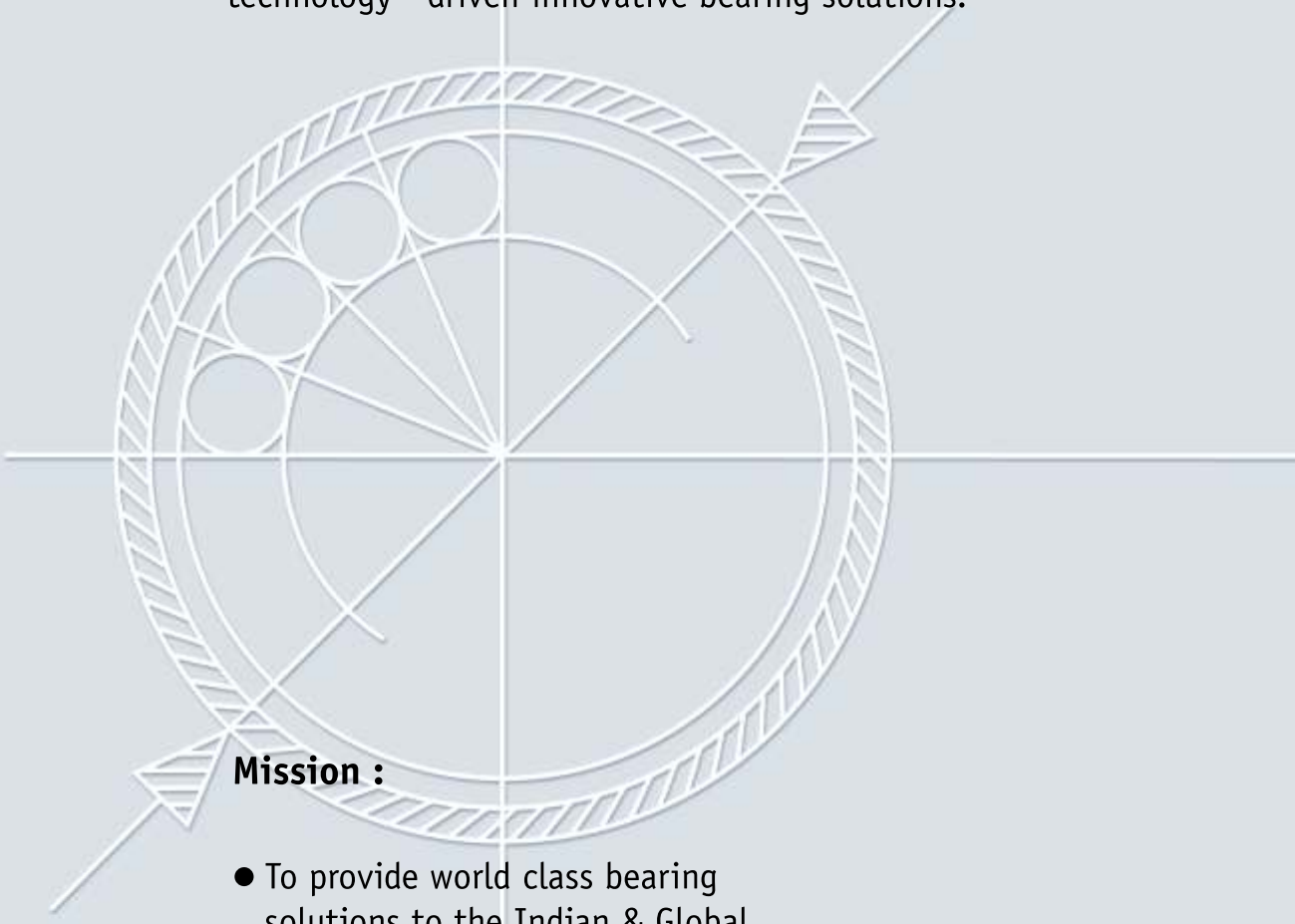
PRODUCT CATALOGUE

NRB BEARINGS

NRB. A MOVEMENT. A REVOLUTION.

Vision: To be the preferred provider of technology - driven innovative bearing solutions.



Mission :

- To provide world class bearing solutions to the Indian & Global markets.
- To attain leadership in roller bearings through continuous improvement, research & development and by ensuring the optimum utilization of resources.
- To draw upon the committed efforts of our people for sustained growth and prosperity to create a win-win position for our customers, our employees, our suppliers and our shareholders.

NRB BEARINGS

A QS 9000 Company

PRODUCT CATALOGUE

NRB Bearings Ltd

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NRB Bearings Limited is committed to provide world class bearing solutions to the Indian and Global markets.

Helping NRB to achieve the goals stated above are our team of highly trained engineers, the latest technology, a deep committment in research and development for new ideas and products, our devotion to provide and deliver quality and reliable bearings for all automotive and industrial applications.

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INTRODUCTION

In the world of bearing technology, where specialisation is the order of the day, NRB Bearings Limited has grown to attain a position of strength and quality leadership.

But amidst the years of rapid advancement and change, the underlying principle has remained constant.

We continue to believe in nothing but the best.

The best technology. The highest standards of precision. And the very latest know-how from world leaders in the field.

Which is, perhaps, the reason why we've steadily moved ahead to become India's most diversified bearing manufacturer. And the most specialised. NRB produces Needle Roller Bearings, Cylindrical Roller Bearings, Spherical Roller Bearings, Tapered roller Bearings, Ball Bearings, Wide Inner Ring Bearings & Housed Units. With such a wide range of products NRB gets the mark of being **"A one-stop shop"** for almost all bearing requirements.

A world of change

NRB was incorporated in 1965 as an Indo-French venture with Nadella, pioneering the production of needle roller bearings in India. NRB acquired SNL Bearings Limited (SNL formerly Shriram Needle Bearing Industries Limited) in June 2000. The TUV Management Services (GmbH), internationally acclaimed registrars awarded the QS 9000 Corporate Certification for NRB at its corporate office and in all its plants in May 2000.

Over the years NRB has expanded to five modern manufacturing facilities producing needle, spherical, cylindrical and taper roller bearings and ball bearings.

With a continual thrust on tailoring bearings to suit specific needs, NRB has successfully developed customisation and application expertise as their forte.

Growing skills and precision over years have won NRB worldwide acceptance, even in markets as demanding as Europe, South East Asia and Australia.

Research and Development

Quality Control is the hallmark of every operation. The success of NRB is aided by its focus on bearing design and development where the latest technology is used to offer need-based customised state of the art software. NRB uses Pro-Engineer and Pro-Mechanica for product design.

NRB has set up an Engineering Centre at its Thane plant to achieve the goal of becoming a bearing solution provider. Our aim is to develop a long lasting partnership with the customers.

Quality & Reliability

At NRB, we believe, if the end result is to be outstanding the highest degree of quality and precision must exist at every level. Whether it is men, machines, materials or methods.

If we have achieved what we have today, it is because of this policy of precision. The special care at every step. And the realization, that nothing matters more than a satisfied customer.

All our plants are equipped with extensive facilities for quality control and material testing. We manufacture our own toolings, special equipment and have a sophisticated R&D center.

We employ the best machinery, superior quality raw materials and the latest technology for every aspect of manufacture.

Sales and Service Support.

NRB has a wide network of preferred distributor and zonal offices throughout the country.

NRB has a highly skilled team of engineers who are available for solving your bearing problems. NRB with its wide range of bearings can offer you quick and economic solutions.

The last page of this catalogue lists the addresses, phone number and fax number of the NRB zonal offices nearest to you.

NRB reserves the right to change the design and/ or specifications and other characteristics of its products without any prior notice.

The Agency Division

NRB's indigenous manufacturing capabilities are complemented by its Agency Division. Initiated in 1980, the activities of the Division encompass Sales and Marketing of bearings, seals for machine tool, automotive, electrical and construction machinery.

The Agency Division plays a key marketing role and has an impressive list of foreign principals viz. Defontaine SA-Rollix, W Schneeberger AG, Gamet Bearings, UKF-Universal-Kugellager Fabrik Gmbh Germany, Tschadin & Heid AG Waldenburg-Switzerland, Roller Bearing Company USA and IBC Walzlager Gmbh.

Usage of this product catalogue

We are committed to providing our customers with world-class bearing solutions. Included in this commitment is a concern for continuous improvement and to develop, produce and deliver products and services that consistently meet or exceed customer's expectations. We help and guide customers in selecting suitable bearings for any application with the assistance of engineers with training and technical competence to interpret and apply the data and principles involved in making the final selection of a bearing.

The Technical information section given in this catalogue along with the other sections contain dimensions, tolerances, load ratings, procedure for mounting and dismounting bearings, bearing fits, radial internal clearances, raw materials and other technical features of the bearing. The catalogue should however not be considered a complete database for reliable bearing selection. Although all data in this product catalogue has been carefully compiled to make it user friendly and complete in all respects, NRB Bearings Limited ASSUMES NO LIABILITY TOWARDS ANY COMPANY OR PERSON FOR ANY DAMAGES, DIRECT OR INDIRECT, DUE TO ANY ACTION BASED ON THE DATA CONTAINED IN THIS CATALOGUE.

Safety recommendations

- Bearings should be stored in a dry and clean area
- Packing should not be opened until ready to use
- Prior to installation, NRB should be consulted for recommendations. Proper installation and maintenance must be adhered to for ultimate performance
- Failure to adhere to recommendations may result in premature product failure, and/or in extreme cases, personal injury.

WARRANTY POLICY

Terms and conditions of sale

Price

This price list is based on ex-works basis, in unit packing with outer packing as per accepted trade practice. Requests for special packaging can be accepted for a mutually settled extra charge.

Freight charges will be extra as applicable based on mode of transport opted for.

Payment

Payment shall be through irrevocable confirmed and without recourse letter of credit payable 100% on demand covering the full value of the contract and valid for the quoted delivery period. The L/C should allow partial shipment, trans shipment and third party bill of lading. The L/C should be unrestricted for negotiation and should preferably be advised through Citibank, Mumbai, Banque Paribas, Mumbai or Canara Bank, Industrial Finance Branch, Fort, Mumbai. All bank charges outside India will be to the account of the opener.

Delivery

Delivery shall be quoted by us separately depending on the quantum of the order and availability of raw material

Insurance

Coverage of insurance shall be mutually agreed upon at the time of confirmation of the contract

Inspection

Testing or Inspection, if any, specified by the buyer shall be carried out only at our company and it shall be considered as final.

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Guarantee

The seller hereby agrees and warrants to repair or replace any of its products or parts thereof, which have become unusable due to defects in material or workmanship, subject to the following conditions:

a) The unusable products or the parts thereof, are returned to the seller for checking and repair or replacement, at no expense to the Seller and at the risk of the Buyer, within one year of the products being put in service, but not later than fifteen months from the date of delivery.

b) The Buyer shall lodge a written complaint concerning the fault to the Seller, without unreasonable delay, after the defect has been detected. The claim shall contain a description of how the fault had been detected.

c) Warranty claims will be analysed jointly by a team from NRB (the Seller) and the customer (the Buyer). This team shall arrive at a mutually acceptable cause for failure.

d) The warranty does not cover damages or defects due to incorrect assembly, unsuitable lubrication, faulty mounting and maintenance, outside action, negligence, overload, incorrect choice of bearings, normal wear and tear or depreciation, improper use of the products or other circumstances beyond the Seller's control.

e) In the case of exports, the warranty shall be subject to the Import and Export Regulations of the Government of India

f) The Seller shall not be responsible for direct or indirect loss suffered by the Buyer by reasons of defective material or workmanship of the products.

g) Even if the Seller has assisted the Buyer in choosing the product or product design, the Seller is not liable for damage or loss arising out of the choice of the product or the product design.

FORCE MAJEURE

All quotations are made in good faith. However, in the event of delay in delivery of goods due to non-availability of raw materials, storms, fire, tempest, earthquake, strikes, lockout accident or any other reason which renders impossible or impracticable or unsafe for the company to fulfil its obligations, the buyer agrees to take the goods with the extension or extensions, without any allowance whatsoever provided that each such extension does not exceed 3 calendar months. A certificate signed by a Director of the company or a responsible officer of the company certifying the cause of delay shall be accepted by and be binding upon the buyer for all purposes of this contract. The company shall not be liable for the damages or delays due to circumstances beyond its control.

ARBITRATION

All disputes, differences and claims arising our of or in connection with this contract shall be referred to the arbitration of two arbitrators, one to be appointed by each party to the dispute and such arbitration shall be held at Mumbai in accordance with the provisions of the Arbitration and Reconciliation Act, 1996, or any statutory modifications or reenactment thereof for the time being in force. The award shall be final and binding on the parties.

JURISDICTION

The Contract and/or other and/or all terms thereof shall be governed by Indian Law and Courts at Mumbai which will be exclusive jurisdiction to entertain and try any action or proceedings in relation to the contract or any matter arising therefrom.

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TECHNICAL INFORMATION

1. GENERAL

The choice of a bearing depends on many factors that need to be examined in order to obtain the most successful results at the lowest cost.

In most cases the selection should be made when the overall design of the machine has been decided. Dimensional limits are then known, as well as the speeds and loads. At this stage the choice can be made from the many types of bearings offered from the NRB standard ranges and the notes given in this section will generally permit selection of the most suitable bearing for each application.

When calculating the cost of the assembly, not only should the price of the bearing be considered, but also costs for heat treatment, machining and handling and fitting of ancillary items (snap rings, locking devices, tools etc) and the eventual quantities required. Large economies can be made on these items if the correct bearing is selected. Sometimes it is more advantageous to choose a bearing of slightly higher cost, which will however, when all criteria are taken into consideration, provide the most economic solution.

In the studies that are undertaken by NRB, the bearings proposed frequently occupy less space and save material, machining and installation costs, which benefit the entire assembly.

The results obtained from bearings depend to a large extent on the design and method of assembly, loading, and alignment between inner and outer rings.

Bearing alignment depends first of all on the geometry of the parts involved and secondly on the deflection of the shaft under load. The shaft diameter should therefore be sufficient to prevent large deflections. This is easier to achieve using needle bearings because they occupy a small radial area.

1.1 BEARING STANDARDS

NRB standard metric bearings conform to International Standards (ISO) for boundary dimensions, tolerances and internal clearances. They also comply with the associated DIN, AFBMA and British Standards. NRB have comprehensive specifications for materials, heat treatment and quality control to ensure high precision products made from clean bearing steels.

1.2 DESIGN PRINCIPLES

NRB have developed their range of bearings to incorporate high load capacity whilst maintaining good cage strength and adequate ring sections. Design optimisation takes account of the need to balance the requirements for increased fatigue performance under ideal conditions against the effects of misalignment and other mounting errors that occur in normal engineering situations. Advantage has been taken of polyamide materials in new standard range cage designs. NRB have the advantage of many years of manufacturing and application experience with such materials on high volume production of both standard and special bearings.

1.3 MATERIALS

Standard bearings are made using high quality carbon-chrome through hardening steel of similar composition of the following specifications:

SAE 52100 (or)
100Cr6

2. CALCULATIONS FOR RADIAL AND THRUST BEARINGS

The calculations for a radial or thrust bearing must take account of the following principal factors:

- Actual supported loads and possible shock loads
- Speed of rotation
- Operating temperature
- Hardness of the bearing raceways

Other features such as lubrication, sealing and alignment do not enter directly into life calculations but they must be considered in order to avoid introducing unfavourable factors.

The life calculation of a radial bearing or a thrust bearing under rotation is established from the dynamic capacity C indicated in the tables of dimensions. The static capacity Co enables one to determine the maximum load under certain conditions (see table on page 9)

2.1 DYNAMIC CAPACTIY C

The dynamic capacity of a bearing is the constant radial load which it can support during 1 000 000 revolutions before the first signs of fatigue appear on a bearing race or rolling element. For a thrust bearing, the capacity of 1 000 000 revolutions assumes a constant axial load centred in line with the axis of rotation.

The dynamic capacity C for caged needle bearings and thrust bearings shown in the tables of dimensions has been established in conformance with the ISO Standard 281 (1990).

2.2 NOMINAL LIFE

The life of a radial bearing or thrust bearing is the number of revolutions (or the number of hours at constant speed) that it will maintain before showing the first signs of material fatigue.

The relationship between the life in millions of revolutions L_{10}, the dynamic capacity C and the supported load P, is given by the formula:

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

In which :

L_{10} - Basic rating life (10^6 Revolutions)

C - Basic dynamic load rating (Newtons)

P - Equivalent dynamic load (Newtons)

p - is equal to 10/3 for needle or roller bearings and 3 for ball bearings.

The formula above is independent of speed of rotation, which must not exceed the recommended limit in respect

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of the radial bearing or the thrust bearing used and the method of lubrication.

If the speed of rotation n (r.p.m.) is constant, the life is given in hours by the function:

$$L_{10\,h} = \frac{L_{10} \times 10^6}{60\ n} \text{ hours}$$

The life in hours is then inversely proportional to the speed.

To make these calculations the table on page 107 gives the values for the factor C/P as a function of the product n x h (speed in r.p.m. and h life in hours). For example for 800 rpm and 6 000 hrs.

(800 x 6 000 = 4 800 000) one finds factor C/P = 5.47.

The above formulae will ensure that 90% of the bearings operating under the same conditions will attain at least the calculated L_{10} life, known as the nominal life (the figure being the percentage of bearings which may not attain this life). The formulae are based on the use of standard quality bearing steel and assume a satisfactory method of lubrication.

2.3 MODIFIED LIFE L_{na}

In various conditions modified life can be determined (in millions of revolutions) following the general formula:

$$L_{na} = a_1\, a_2\, a_3\, L_{10}$$

In which a_1 a_2 and a_3 are correction factors linked to reliability, material and lubrication respectively.

2.3.1 Reliability correction factor a_1

A reliability factor in excess of 90% may be required in certain industries, such as aviation, for reasons of security and to reduce the risk of very costly immobilisation.

The table below indicates the values of the correction factor a_1 as a function of reliability:

Reliability %	Factor a_1	Corrected Life L_{na1}
90	1	L_{10}
95	0.62	L_5
96	0.53	L_4
97	0.44	L_3
98	0.33	L_2
99	0.21	L_1

In order to select as an example a bearing of L_4 life (reliability 96%) it is necessary to consider a theoretical L_{10} life (reliability 90%), equal to $L_4/0.53$ applied in the formula $L_{10} = (C/P)^p$ using the dynamic capacity C given in this catalogue.

2.3.2 Correction factor a_2 for material and a_3 for lubrication

Modern developments in the manufacture of steel enable one to consider the use of special degassed or vacuum remelted types.The practical life achievable with bearings using these special steels is much greater than with conventional bearing steels, on which are based the load capacities in this catalogue.

The factor a_2 for increase of life due to material must be estimated making allowance for the lubricant properties (factor a_3). These properties must take account of the bearing loads. In cases where lubrication is insufficient (e.g. oil viscosity is too low at the operating temperature) one should use a factor a_3 <1.It is therefore recommended that the product of the factors a_2 x a_3 is always considered in its entirety.

The NRB Technical Department should be consulted in these special cases.

2.4 EQUIVALENT LOAD AND SPEEDS

2.4.1 Overload factors

The load on a radial or thrust bearing is established from the characteristics of the machine together with the working loads prevailing. However, account should also be taken as far as possible of the supplementary loads which arise due to imperfections in transmission, etc., or due to overloads, shocks and vibration. For conventional machines and equipment experience is the best guide but in general the coefficients listed below may be applied to determine the equivalent load used in the life calculations:

1.0 - 1. 2 machinery or mechanisms operating smoothly without repeated shocks,

1.1 - 1.3 geared transmissions according to gear quality,

1.4 - 3.0 machinery or equipment operating under repeated shocks or vibration.

As far as belt drive transmissions are considered, the calculated tangential load should be multiplied by the following coefficients:

2.0 - 2.5 for vee belts,

2.5 - 5.0 for flat belts according to drive tension.

2.4.2 Variable loads and speeds

When the loads and speeds are variable, the life calculation can only be made by first establishing an assumed constant load and constant speed equivalent in their effect on the fatigue life of the radial bearing or thrust bearing.

This type of operating condition is frequently met and the possible variations although cyclical are numerous. One encounters this feature in particular, in variable speed drives. The equivalent load P and the equivalent speed n are obtained from the following formulae:

$$P = \sqrt[p]{\frac{m_1 n_1 P_1^{\,p} + m_2 n_2 P_2^{\,p} + \ldots\ldots\ldots + m_n n_n P_n^{\,p}}{m_1 n_1 + m_2 n_2 + \ldots\ldots + m_n n_n}}$$

$$n = m_1 n_1 + m_2 n_2 + \ldots\ldots + m_n n_n$$

In which :

$m_1, m_2, \ldots, m_n$: intervals of operating time under constant load and at constant speed (by definition : $m_1 + m_2 + \ldots\ldots + m_n = 1$)

$n_1, n_2, \ldots, n_n$: Constant speeds corresponding respectively to intervals of time $m_1, m_2, \ldots\ldots, m_n$

$P_1, P_2, \ldots, P_n$: Constant loads corresponding respectively to intervals of time $m_1, m_2, \ldots, m_n$

For radial bearings and needle/roller thrust bearings p is equal to 10/3 ; and for ball bearings p is equal to 3.

2.4.3 Load varying linearly at constant speed

Whilst at constant speed, the load varies linearly during a given time, between a minimum P_{min} and a maximum P_{max}, the equivalent load is given by:

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

2.4.4 Oscillating motion

In order to calculate the life during oscillating motion it is necessary to determine an equivalent speed in revolutions per minute from the formula:

$$n = \frac{n_{osc}\,\alpha}{180}$$

n_{osc} = number of oscillations “Forward and Return” per minute

α = amplitude of oscillation “Forward” in degrees.

However, this formula risks being in error and giving inaccurate lives for oscillations at small amplitudes.It is therefore recommended not to apply it for angles of oscillation below 15°. When the angle of oscillation is very small fretting corrosion is likely to be produced and a suitable lubricant must be chosen in consequence. Experience confirms that full complement needle bearings provide better results under this phenomenon in view of their better load sharing capability.

2.5 APPLICATION CRITERIA

The life calculation may be unreliable when values for speed and load reach the ultimate limits.

A low speed and/or load can yield an extremely long calculated life but this will be limited in practice by other operating factors such as sealing, lubrication and maintenance, all of which have a decisive influence on the life of the product in such cases.

2.6 STATIC CAPACITY Co LIMIT LOAD P_L

The static capacity Co given in the tables of dimensions has been established in conformance with ISO Specification ISO 1987/Amd.1.1999 (E). This takes into consideration the maximum admissible contact stress (Hertzian stress). The value currently being adopted is 4000 M.Pa*.

Since permanent deformation is produced as readily in a bearing rotating as in one that is stationary, the static capacity Co determines the limit load P_L which depends on the type of bearing and the operating conditions (see table below). When the limit load P_L is given within the “min-max” range, the load applied may attain the indicated maximum provided it is applied continuously without sudden repeated variations. Alternatively, in the case of shock loads and vibrations, the load applied should not exceed the minimum value of limit load P_L.

2.7 TEMPERATURE EFFECTS

Having selected a lubricant appropriate to the temperature conditions, it is still necessary to take into account the permanent reduction in the dynamic capacity of bearings operating above 150°C and in capacity above 250°C.

Operating temperature (°C)	150	200	250	300
Capacity reduction coefficient:				
• Dynamic	1.0	0.9	0.75	0.6
• Static	1.0	1.0	1.0	0.8

2.8 BEARING RACEWAYS

2.8.1 Hardness

The load capacities shown in the tables of dimensions apply to raceways with a hardness of between 58 and 64 HRC.

The dynamic and static capacities are reduced when hardness values are lower than 58 and 54 HRC respectively according to the following table:

Operating conditions	Limit Load P_L		
	Needle bushes and radial components of combined bearings RAX or RAXF 700	Axial components of combined bearings type RAX or RAXF 700	Other bearings (1)
Important requirements for smoothness of function, silent operation, or accuracy of rotation.	0.2 Co	0.25 Co	0.25 Co - 0.5 Co
General applications	Please consult NRB		0.5 Co - Co
Slow rotation or oscillatory motion			0.7 Co – 1.2 Co

(1) For studded cam followers the limit load P_L determined as a function of the capacity of the bearing must not be in excess of the authorized maximum strength of the stud given in the tables of dimensions.

* Previous values corresponded approximately to a total permanent deformation of the raceway from a rolling element, bearing the heaviest load to 0.0001 of the diameter of the rolling element.

Hardness	HRC HV	60 697	58 653	56 613	54 577	52 545	50 512	48 485	45 447	40 392	35 346	30 302	25 267
Capacity reduction coefficients	Dyn. Stat.	1 1	1 1	0.93 1	0.84 1	0.73 0.96	0.63 0.86	0.52 0.77	0.43 0.65	0.31 0.50	0.23 0.39	0.15 0.30	0.11 0.25

2.8.2 Heat treatment

The minimum hardness required to apply the calculations without reducing the basic capacities may be obtained with a through-hardened bearing steel or with a case-hardened and tempered steel. In the latter case, the hardened case must be homogeneous and regular over the entire surface of the raceway. The case thickness “e” is the depth between the surface and the core having a hardness value of Vickers HV1 of 550.

The depth is given in table below as a function of the ratio P/Co (P applied load and Co static capacity):

P/Co	≤ 0.2	0.35	0.5	0.75	1	1.2
e min (mm)	0.3	0.5	0.7	0.9	1	1.2

2.8.3 Surface finish

The shafts or housings used directly as raceways for needles must have a surface finish acceptable for the operating conditions and the precision requirements. For general applications under average loads one can accept a surface finish corresponding to the C.L.A. system (centre line average value):

Inner raceway for radial bearings : C.L.A. = 0.35 µm

Outer raceway for radial bearings : C.L.A. = 0.4 µm

Raceway for thrust bearings : C.L.A. = 0.5 µm

2.9 COEFFICIENTS OF FRICTION

The power dissipated with a bearing is generally negligible in comparison to the total power losses of the mechanism. However, the design and sensitivity of certain machines sometimes require the assessment of losses attributable to the bearings.

The resistance torque M of a bearing supporting a load P is given by the following relationships:

- Radial bearing: $M = f \times P \times \frac{Ci}{2}$

  (Ci being the diameter of the inner raceway of the bearing)

- Thrust bearing: $M = f \times P \times \frac{dm}{2}$; with $dm = \frac{(d_1+d_2)}{2}$

  (d_1 and d_2 being the raceway diameters given in table of dimensions)

The coefficient of friction f which appears in these formulae depends on a number of factors, amongst which are:

- Type of bearing
- Applied load
- Speed of rotation
- Lubrication
- Surface finish and alignment

The mean values shown below are for oil lubrication and are applicable under favourable mechanical conditions:

f = 0.002 to 0.003 for caged needle bearings

f = 0.003 to 0.004 for full complement bearings and needle thrust bearings

f = 0.004 to 0.005 for roller thrust bearings.

These coefficients are applicable for values of C/P between 2 and 6 approximately. For values less than or in excess of these limits the coefficient of friction f can be increased by 10 to 50%. Under starting conditions from rest, the values of f may be up to 50% higher than those shown above.

To evaluate the losses of the entire bearing assembly, account must also be taken of the friction due to the seals which can be significant, especially during “running-in”.

2.10 LIMITING SPEEDS

The limiting speed of a bearing depends principally on the type under consideration, the pitch diameter of the rolling elements and the method of lubrication.

Other factors such as the alignment and geometry of the bearing raceways, functional clearances and dispersion of heat are of greater importance when at high speed rotation is considered.

In the case of needle bushes where thin outer ring is deformed to the shape of the housing, the cylinderical tolerance of this later element is of prime importance to good fuction at high speeds.

When satisfactory conditions exists, the speed limits given in the tables of dimensions can be obtained with oil lubrication maintaining a regular flow to the radial or thrust bearing. These speed limits may be exceeded if the flow rate, cooling and recirculation of the oil is specially studied.In such cases it is recommended that the NRB Technical Department is consulted with respect to the special characteristics of the particular bearing envisaged.

The speed limits of caged needle bushes with incorporated seal (DB...E or HK...E) are shown in the appropriate tables.

The speed limits shown in the tables of dimensions are for oil lubrication. For grease lubrication the following coefficients should be applied according to type:

Types	Coefficient
Sealing rings	0.8
Needle bushes with seal incorporated	0.8
Caged needle bearings and bushes	0.66
Full complement needle bearings and bushes	0.5
Needle or roller thrust bearings and combined bearings	0.5

Since cam followers are normally supplied with suitable operating grease, their speed limits are shown accordingly in the tables of dimensions. For cam followers without incorporated seals and having oil lubrication, the speed limits shown may be increased by approximately 30% for continuous rotation (50% for intermittent rotation).

3. LUBRICATION

Lubrication of a bearing provides a viscous film between the rolling elements in order to reduce heat and wear caused by friction.

The lubricant can also assist in preventing corrosion and help to seal the bearing from the introduction of dirt and impurities; it reduces friction between the shafts and seals and lowers the noise level generated within the bearing.

Wherever the operating conditions permit, grease should be chosen in preference to oil, as it is more convenient to use and economical. Furthermore, it acts as an efficient seal against the effects of dust and humidity. On account of its consistency, grease can improve the effectiveness of sealing rings and can be used on its own as a seal, when it is used to fill grooves or labyrinths provided for this purpose.

Grease is indespensible for the lubrication of bearings in certain machines where any oil seepage is totally unacceptable (machines for the manufacture of textiles, paper, etc).

Alternatively, oil is necessary for high rotational speeds in excess of the limits advised for grease lubrication (see “limiting speeds” page 10) and in cases where there is a problem of heat dissipation.

Oil lubrication is also necessary where it is used already in the function of the equipment, such as hydraulic motors and pumps, speed variators and gear boxes, etc .

Oil and grease lubricants must be free of all impurities which could cause premature failure of the bearing and removal from service. Sand and metal particles are particularly injurious to bearings. Every precaution must be taken to assure the cleanliness of gear casings, pipes, grease nipples, couplings, as well as lubricant containers.

The efficiency of a lubricant decreases in service both by age and by continuous mixing to which it is submitted. Therefore replenishment must take place at regular intervals, taking account of operating and environmental conditions (humidity, dirt, and temperature) except for applications where the bearing has been lubricated for life with a suitable grease.

3.1 GREASE LUBRICATION

Bearing greases offer a high strength lubrication, good mechanical stability, resistance to oxidation and satisfactory anti-rust properties, particularly for equipment mounted in humid conditions or undergoing water spray.

Their consistency, generally grades 1, 2 or 3 in the NLGI scale, must remain as stable as possible within the temperature limitations set according to their composition.

3.1.1 Principal types of grease

Lithium soap greases are particularly suitable for the lubrication of needle or roller, radial and thrust bearings. They can be utilised within the temperature range -30º to +120º and even up to 150ºC if they are of very good quality. Generally, they are supplied with anti-rust inhibitors and offer good protection against corrosion.

Sodium soap greases are suitable for lubricating bearings up to 100ºC approx. (minimum temperature -30°C) and they assure good sealing against contamination. They can absorb small amounts of water without losing their effectiveness but large amounts will dissolve them and destroy their efficiency.

Calcium soap greases stabilised with water can only be used upto 50ºC or 60ºC. Their mechanical stability and anti-rust properties are poor. They are therefore not recommended for lubricating bearings but can be utilised in labyrinth seals. However, certain calcium greases having better mechanical stability and improved anti-rust properties can be used up to 100º C for lubricating bearings in humid atmospheres.

3.1.2 Special greases

Greases available with an EP (Extreme Pressure) additive can be used when heavy load conditions mean the bearings endure high stress rates. These greases are generally good lubricants with good anti-rust properties, even in the presence of humidity.

Elaborate greases (with gelified inorganic additives and synthetic oils) may be considered for special high temperature applications, provided there is no possibility of interaction with plastic materials or other incompatible materials.

3.1.3 Compatibility of greases

Certain greases are incompatible with others and, if they are mixed, their function will be impaired. With greases considered as compatible, account should be taken of the reduction in their consistency when mixed and maximum permissible temperature should be reduced accordingly.

3.1.4 Application

Grease can be introduced into the bearing at the time of assembly, care being taken to distribute it around the crown of needles (see below ”Quantity of grease”).

The free space found in the bearing, which is filled with grease, constitutes a reservoir and a reinforced seal. This method is possible if replenishments of grease are necessary at regular maintenance periods, during the course of which one can dismount the bearings, clean and examine them. Otherwise one has to use a hand pump which forces grease into the bearing by means of valves and replenishes the adjacent reservoir and also the channels and labyrinth seals.

The entry passage for the grease must directly abut the bearing or be in close proximity to it, in order that new fresh grease pushes out the used grease through the seals. For this reason the lip of the sealing ring must be oriented towards the outside of the bearing for it to rise under the force of the grease being ejected. This method has the advantage of removing impurities which could be introduced into the seals, particularly in the case of a highly contaminated atmosphere.

Centralised manual or automatic systems provide for the periodic controlled injection of grease at the various lubrication points.

3.1.5 Quantity of grease

The amount of grease that should be contained in a bearing can be established by considering the relationship of the limiting speed permissible for the grease n_G to the speed of rotation n :

$\frac{n_G}{n} < 1.25$	not filled, the bearing being lightly smeared and the adjacent parts packed with grease
$1.25 < \frac{n_G}{n} < 5$	1/3 to 2/3 of the available volume packed with grease of grade 2. These quantities can be increased slightly for grease of grade 1.
$\frac{n_G}{n} > 5$	totally filled with grease.

3.1.6 Re-lubrication

The frequency of grease re-lubrication depends on a number of factors, amongst which are the type of bearing and its dimensions, the speed and load, the temperature and ambient atmospheric conditions (humidity, acidity, pollution), the type of grease and sealing. Only after controlled trials can the re-lubrication period be defined exactly and particular importance should be given to the effects of temperature, speed and humidity.

Under normal conditions of function without unfavourable factors using an appropriate grease with a maximum temperature of 70ºC, the re-lubrication interval T_G in hours can be determined approximately from the formula:

$$T_G = \frac{K \times 10^6}{n \times \sqrt{Ci} \times \sqrt[4]{\frac{n}{n_G}}}$$

n : speed of rotation

n_G : permissible speed limit for grease lubrication (see page 10)

Ci : diameter of inner raceway of bearing in mm

K = coefficient according to the type of bearing

- K = 32 for caged needle bearings
- K = 28 for full complement needle bearings
- K = 15 for needle or roller thrust bearings.

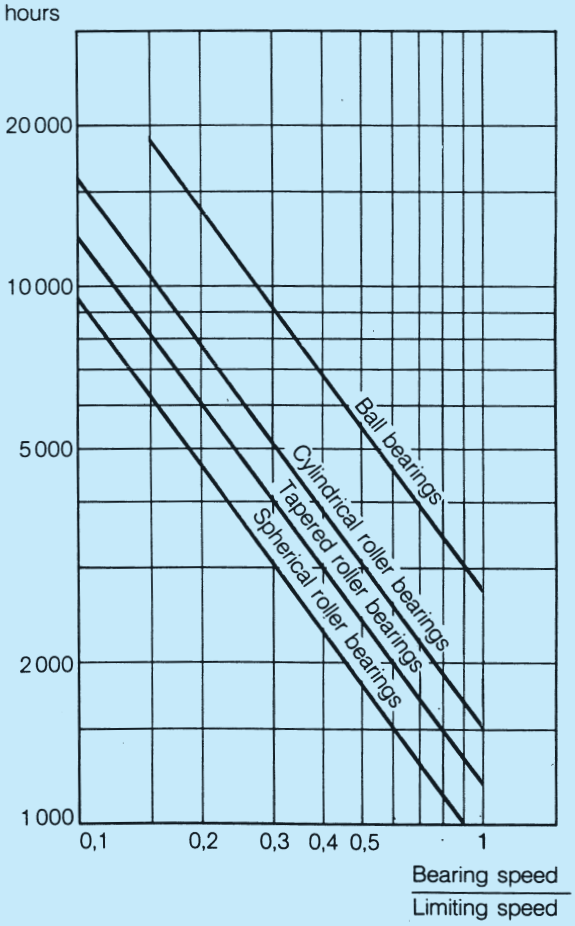
If the operating temperature exceeds 70ºC, the interval T_G determined from the formula above should, for each increase of 15ºC be reduced by 50%. However, this adjustment is not applicable beyond 115ºC for temperatures above this level trials should be made to determine the acceptable re-lubrication interval.

In case of very slow speed rotation, which would give interval T_G in excess of 35 000 hours corresponding to 8 years operation at a rate of 12 hours per day, it is recommended to limit the period to a maximum of 3 years.

For oscillating motion, the speed to be considered is the equivalent speed given by the formula on page 9. For very small amplitudes of oscillation it is recommended to reduce by half the calculated re-lubrication period T_G .

The diagram below gives some indications about the regreasing frequency for Ball bearings, Cylindrical roller bearings, Taper roller bearings and Spherical roller bearings.

Determination of the regreasing frequency for a bearing lubricated with a general purpose grease with a temperature lower than 80 °C

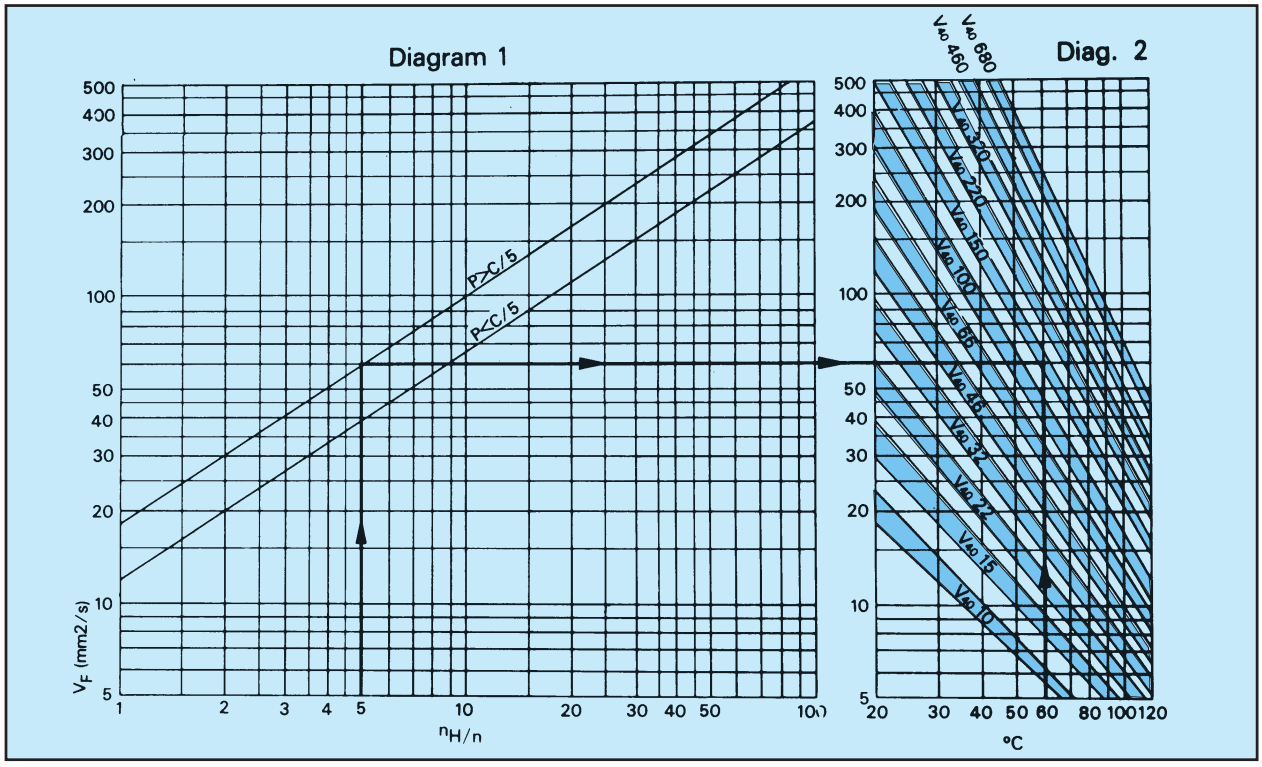


Determination of regreasing frequency is essentially based on the users' experience and on the monitoring system employed.

3.2 OIL LUBRICATION

3.2.1 Viscosity

The essential characteristic of an oil is its basic kinematic viscosity in mm^2 /sec at a reference temperature of 40ºC according to ISO 3448. The old reference temperatures of 20º or 50ºC are no longer used but their corresponding values appear on diagram 2. The base viscosity V_{40} should be increased proportionately as the operating temperature increases but decreased as the speed increases, without however reaching a lower limit below which the film strength of oil is impaired. For applications under moderate load without shocks up to about 1/5 of the dynamic capacity of the bearing, the viscosity V_F at the operating temperature should not be lower than 12 mm^2/sec. For higher loads greater than 1/5 of the dynamic capacity the min. viscosity V_F can be about 18 mm^2 /sec.



The variation in viscosity of an oil as a function of temperature is reduced as the number measuring its index of viscosity is increased. A viscosity index of 85 to 95 is generally satisfactory for the lubrication of bearings.

Diagram 1 above, gives the viscosity V_F required at the operating temperature from the ratio n_H / n (n_H : permitted speed limit for oil lubrication, n: speed rotation).

For the viscosity V_F required in operation, diagram 2 gives the base viscosity V_{40} at the reference temperature of 40ºC for an oil of viscosity index 95.

Example : A bearing supporting a load P > C/5 and having a speed limit for oil lubrication of 10 000 r.p.m., must rotate at 2000 r.p.m. at temperature up to 60ºC.

The ratio n_H / n = 10 000 / 2 000 = 5 indicates a viscosity in operation V_F = 60 mm^2 /sec.(diagram 1). For an operating temperature of 60ºC, the horizontal V_F = 60 cuts the vertical of 60º (diagram 2) in the 150 zone, which is therefore the base viscosity required at 40ºC.

3.2.2 Application

Oil must be supplied to radial or thrust bearings regularly and in sufficient quantity but not abundantly, otherwise an abnormal increase in temperature can occur.

According to the speed of rotation, the following general lubrication methods can be applied.

Lubrication by *oil bath* is suitable for assemblies with the shaft horizontal and average speeds up to about half the values shown in the tables of dimensions. The level of oil in the bath at rest must reach the lowest point of the inner raceway of the bearing, though the movement of oil caused by the immersion of parts in the oil bath may be sufficient to feed bearings situated above this level, providing there are pipes and collectors to ensure sufficient oil reserve when starting.

Lubrication by *drip feed* is applicable to bearings possessing a lubrication hole in their outer ring. This method is suitable even for high speed applications and permits the application of the optimum quality of oil, though it is necessary to maintain observation of the oil level in the reservoir.

Lubrication by *oil circulation* under pressure by pump is suitable for high speed applications.It prevents an increase in the operating temperature if adequate quantity is maintained and the pressure does not impede free expulsion of oil from the bearing.

For thrust bearings, the entry of oil must be ensured if possible at the shaft, in order to utilise the centrifugal force due to rotation.

The method of using an *oil mist* consists of applying to the bearings oil finely atomised in suspension in a current of clean compressed air. The pressure created within the bearing effectively protects it from the introduction of dust, humid vapours and noxious gases. This procedure, which allows a substantial flow from a small quantity of oil, is used particularly for ultra high speed applications in excess of speed limits given in the tables of dimensions.

3.2.3 Centralised lubrication

On individual machines or particular assemblies operating automatically with many positions to be lubricated, it is useful to consider a centralised lubricating system. This may comprise a manual or automatically controlled pump, which via a distribution network supplies oil to the various lubrication points. The necessary equipment is manu-factured by specialised suppliers and offers advantages such as filtration, re-circulation, flow control and metering to each lubrication point.

4. SEALING

Sealing is required to prevent the escape of lubricant from the bearings and also introduction of abrasive or corrosive impurities.

A carefully studied and accurately manufactured seal is of prime importance to the correct operation of a bearing.

4.1. SEALING USING NARROW PASSAGES

This technique avoids the use of rubbing seals, which generate heat and induce wear and require a ground surface, usually heat treated.

A small groove or slot (about 0.1 mm) arranged at the end of the shaft is sufficient to ensure satisfactory sealing when operating in a dry clean atmosphere (Fig 1 and 2). The sealing can be improved if this narrow passage is packed with grease and if further grooves and multiple passages filled with grease can be arranged when operating in abrasive conditions (Fig 3 and 4).

The grease used in sealing is generally the same as that used for the lubrication of radial bearings but in the case where deflectors or baffles are used it is possible to select a different grease specifically chosen for its resistance to water, dust and any other matter harmful to bearings. It is of course necessary to avoid the sealing grease coming into contact with the bearing grease in case of their incompatibility.

Sealing by narrow passages can also be effected by the use of oil in horizontal assemblies. In this method the rotating shaft has flanges or notches which take up the oil and centrifuge it into channels from where it is returned into the sump (Fig 5).

4.2 RUBBING SEALS

Sealing rings of different types provide an effective seal with a light resistance exerted on the surface, though the friction and heat generation which result determine rotational speed and require the rubbing surface to be hardened and of the appropriate finish. The friction is generally highest at the commencement of use but diminishes rapidly during “running-in”. The rubbing area must always be lubricated even before starting in order to avoid premature damage to the seal.

The parts that slide into the seal during assembly must be chamfered (to 30º max.) in front of the rubbing surface in order to avoid damage from a sharp edge.

4.2.1 Various Types of seals

Felt seals can be used successfully with grease lubrication for speeds of 4 or 5 m/sec. and up to a temperature of about 100ºC. Before fitting into place, felt seals should be heated in an oil bath at 80ºC. Their effectiveness is increased if they are themselves protected by a deflector forming a baffle (Fig 6).

Sealing Rings in synthetic nitrile rubber are the most frequently used type, for bearings lubricated with oil or grease.They withstand temperature of - 40 to +120ºC. The heat generation from the rubbing lip depends not only on the rotational speed but also the eccentricity and alignment of the rubbing surface and surface finish.

In cases where the sealing has to be particularly effective, it is recommended that the rubbing surface be plunge ground to avoid imperfections from machine tool.

For speeds above 4 m/sec. a maximum roughness of 0.5µ is recommended and above 8 m/sec. The rubbing surface must be heat treated and hardened up to 60 HRC.

4.2.2 Mounting

When using grease lubrication for bearings, the lip of the seal must be oriented to outside of the bearing to enable the expulsion of old grease during replenishment.

Alternatively, when the sealing ring is needed to enable the retention of oil, its lip should be oriented towards the inside of the bearing (Fig. 8).

If the atmosphere is abrasive or in the case of water spray conditions, one can use two sealing rings spaced a little apart. The seal on the side adjacent to the bearing has its lip facing to the inside for oil lubrication and facing outside for grease lubrication. The other sealing ring is always oriented with its lip facing outwards. The space separating the two seals must be filled with grease, possibly that used to lubricate the bearings. Alternatively, a special passageway can be provided (Fig. 9) and a special fibrous grease more effective against water and impurities can be used.

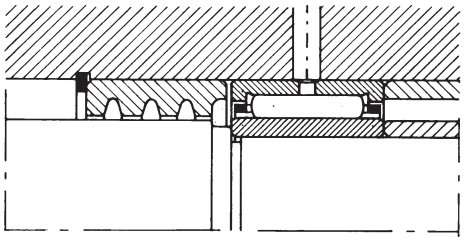


Fig 1

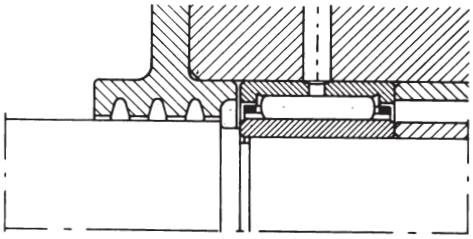


Fig 2

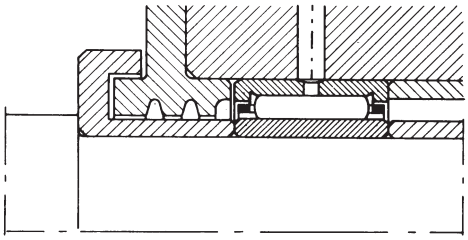


Fig 3

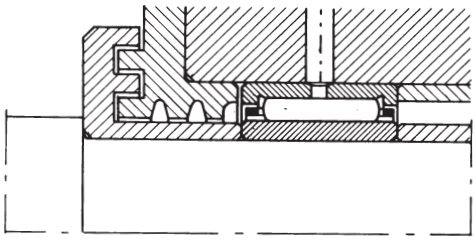


Fig 4

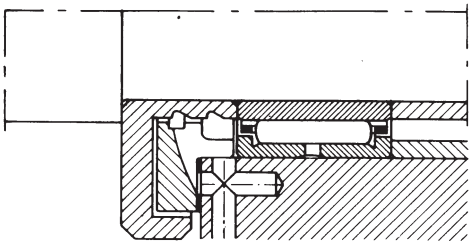


Fig 5

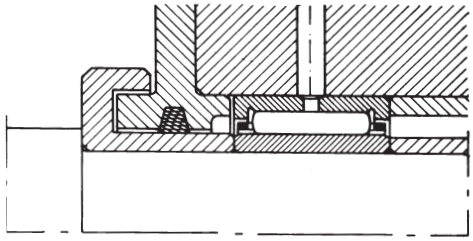


Fig 6

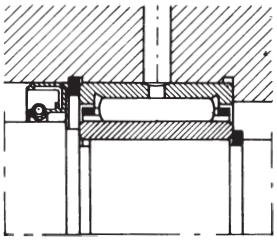


Fig 7

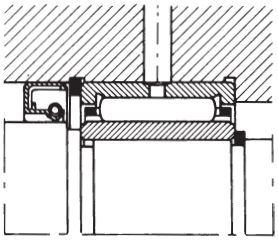


Fig 8

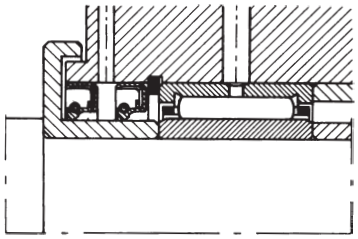


Fig 9

5. BEARING TOLERANCES

5.1 SYMBOLS

NRB tolerances for bearings conform to values for normal class bearings to ISO Standards. Bearings of other tolerance classes (closer tolerances) can be supplied at extra cost provided the quantity is sufficient.

d = bearing bore diameter, nominal

d_1 = basic diameter at the theoretical large end of a basically tapered bore

Δd_s = deviation of a single bore diameter

Δd_{mp} = single plane mean bore diameter deviation (for a basically tapered bore, Δd_{mp} refers to the theoretical small end of the bore).

Δd_{1mp} = mean bore diameter deviations at the theoretical large end of a basically tapered bore

V_{dp} = bore diameter variation in a single radial plane

V_{dmp} = mean bore diameter variation (this applies only to a basically cylindrical bore)

D = bearing outside diameter, nominal

D_1 = outside diameter of outer ring flange

ΔD_s = deviation of a single outside diameter

ΔD_{1s} = deviation of a single outside diameter of outer ring flange

ΔD_{mp} = single plane mean outside diameter deviation

V_{Dp} = outside diameter variation in a single radial plane

V_{Dmp} = mean outside diameter variation

B = inner ring width , nominal

ΔB_s = deviation of a single width of inner ring

V_{BS} = inner ring width variation

C = outer ring width, nominal

C_1 = outer ring flange width

ΔC_s = deviation of a single width of outer ring

ΔC_{1S} = deviation of a single width of outer ring flange

V_{CS} = outer ring width variation

VC_{1S} = variation of outer ring flange width

K_{ia} = radial run out of assembled bearing inner ring

K_{ea} = radial run out of assembled bearing outer ring

S_d = runout of inner ring reference face (back face, where applicable) with respect to the bore

S_D = variation of outer ring outside surface generatrix inclination with respect to the outer ring reference face (back face)

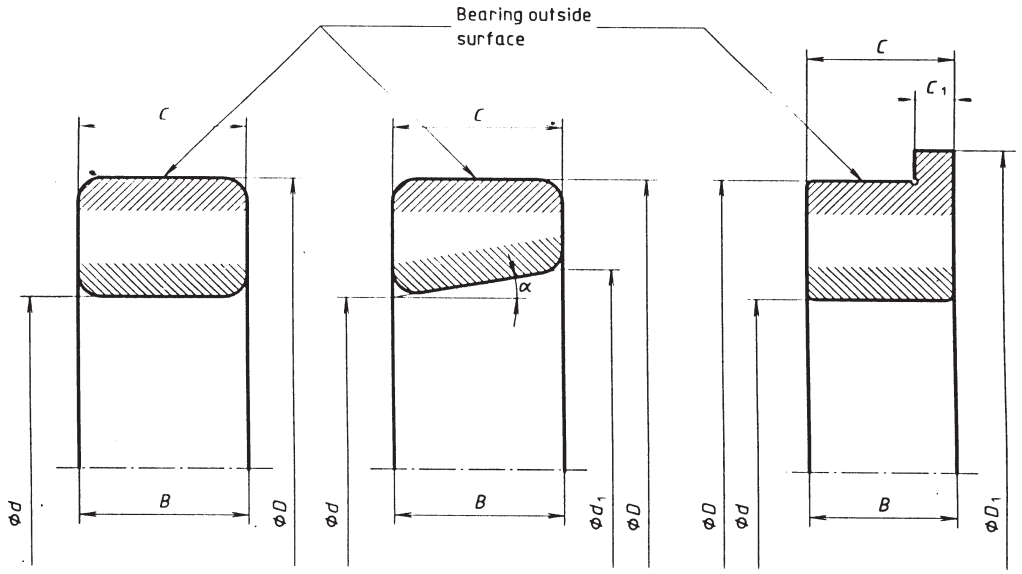
S_{D1} = variation of outer ring outside surface generatrix inclination with respect to the outer ring flange back face

S_{ia} = runout of inner ring face (back face) with respect to the raceway of assembled bearing

S_{ea} = runout of outer ring face (back face) with respect to the raceway of assembled bearing

S_{ea1} = runout of outer ring flange back face with respect to the raceway of assembled bearing

α = taper angle (half the cone angle) of inner ring bore



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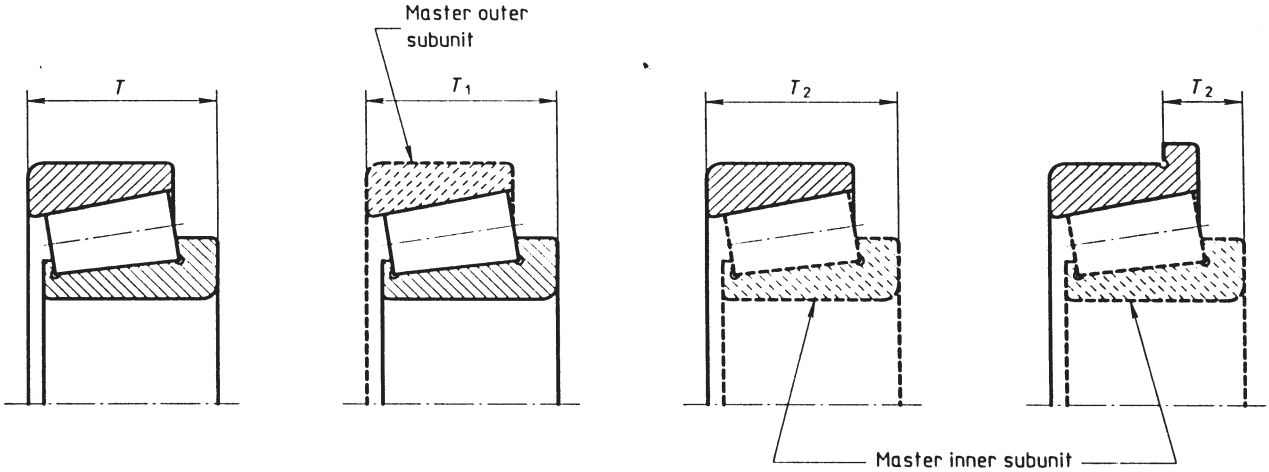
5.1.1 Additional symbols for tapered roller bearings

T	bearing width
ΔT_s	deviation of the actual bearing width
T_1	effective inner subunit width
ΔT_{1S}	deviation of the actual effective inner subunit width
T_2	effective outer subunit width
ΔT_{2S}	deviation of the actual effective outer subunit width



5.2 NORMAL TOLERANCE CLASS

(Radial bearings except tapered roller bearings)

Bore diameter tolerances given in the table apply basically to cylindrical bores. Tolerances for tapered bores are given in table 5.4.

Inner ring

Tolerance values in micrometers

d mm		Δ_{dmp}		V_{dp} Dia series			V_{dmp}	K_{ia}	ΔB_s		V_{BS}
				7,8,9	0,1	2,3,4					
over	incl	high	low	max			max	max	high	low	max
2.5	10	0	-8	10	8	6	6	10	0	-120	15
10	18	0	-8	10	8	6	6	10	0	-120	20
18	30	0	-10	13	10	8	8	13	0	-120	20
30	50	0	-12	15	12	9	9	15	0	-120	20
50	80	0	-15	19	19	11	11	20	0	-150	25
80	120	0	-20	25	25	15	15	25	0	-200	25
120	180	0	-25	31	31	19	19	30	0	-250	30
180	250	0	-30	38	38	23	23	40	0	-300	30
250	315	0	-35	44	44	26	26	50	0	-350	35
315	400	0	-40	50	50	30	30	60	0	-400	40
400	500	0	-45	56	56	34	34	65	0	-450	50

Next

Outer ring

Tolerance values in micrometers

D mm		Δ_{Dmp}		V_{Dp} Dia series			V_{Dmp}	K_{ea}	ΔC_a		V_{CS}
				7,8,9	0,1	2,3,4					
over	incl	high	low	max			max	max	high	low	max
6	18	0	-8	10	8	6	6	15	Identical to ΔB_S and V_{BS} of inner ring of same bearing.		
18	30	0	-9	12	9	7	7	15			
30	50	0	-11	14	11	8	8	20			
50	80	0	-13	16	13	10	10	25			
80	120	0	-15	19	19	11	11	35			
120	150	0	-18	23	23	14	14	40			
150	180	0	-25	31	31	19	19	45			
180	250	0	-30	38	38	23	23	50			
250	315	0	-35	44	44	26	26	60			
315	400	0	-40	50	50	30	30	70			

5.3 NORMAL TOLERANCE CLASS

(Tapered roller bearings)

Bore diameter tolerances given in the table apply to basically cylindrical bores.

Tolerances for tapered bores are given in table 5.4.

Inner ring

Tolerance values in micrometers

d mm		Δ_{dmp}		V_{dp}	V_{dmp}	K_{ia}
over	incl	high	low	max	max	max
10	18	0	-12	12	9	15
18	30	0	-12	12	9	18
30	50	0	-12	12	9	20
50	80	0	-15	15	11	25
80	120	0	-20	20	15	30
120	180	0	-25	25	19	35
180	250	0	-30	30	23	50
250	315	0	-35	35	26	60
315	400	0	-40	40	30	70

Outer ring

Tolerance values in micrometers

d mm		Δ_{dmp}		V_{dp}	V_{dmp}	K_{ia}
over	incl	high	low	max	max	max
18	30	0	-12	12	9	18
30	50	0	-14	14	11	20
50	80	0	-16	16	12	25
80	120	0	-18	18	14	35
120	150	0	-20	20	15	40
150	180	0	-25	25	19	45
180	250	0	-30	30	23	50
250	315	0	-35	35	26	60
315	400	0	-40	40	30	70

Width – Inner and outer rings, single row bearings and single row subunits

Tolerance values in micrometers

d mm		ΔB_s		ΔC_s		ΔT_s		ΔT_{1s}		ΔT_{2s}	
over	incl	high	low	high	low	high	low	high	low	high	low
10	18	0	-120	0	-120	+200	0	+100	0	+100	0
18	30	0	-120	0	-120	+200	0	+100	0	+100	0
30	50	0	-120	0	-120	+200	0	+100	0	+100	0
50	80	0	-150	0	-150	+200	0	+100	0	+100	0
80	120	0	-200	0	-200	+200	-200	+100	-100	+100	-100
120	180	0	-250	0	-250	+350	-250	+150	-150	+200	-100
180	250	0	-300	0	-300	+350	-250	+150	-150	+200	-100
250	315	0	-350	0	-350	+350	-250	+150	-150	+200	-100
315	400	0	-400	0	-400	+400	-400	+200	-200	+200	-200

5.4 TAPERED BORE TOLERANCES – NORMAL TOLERANCE CLASS

Basically tapered bores, tapers 1:12 and 1:130

a) For taper 1:12

The taper angle (half the cone angle) is

α = 2° 23' 9.4" = 2.385 94° = 0.041 643 rad

The diameter at the theoretical large end of the bore is

$d_1 = d + (1/12)\ B$

b) For taper 1:30

The taper angle (half the cone angle) is

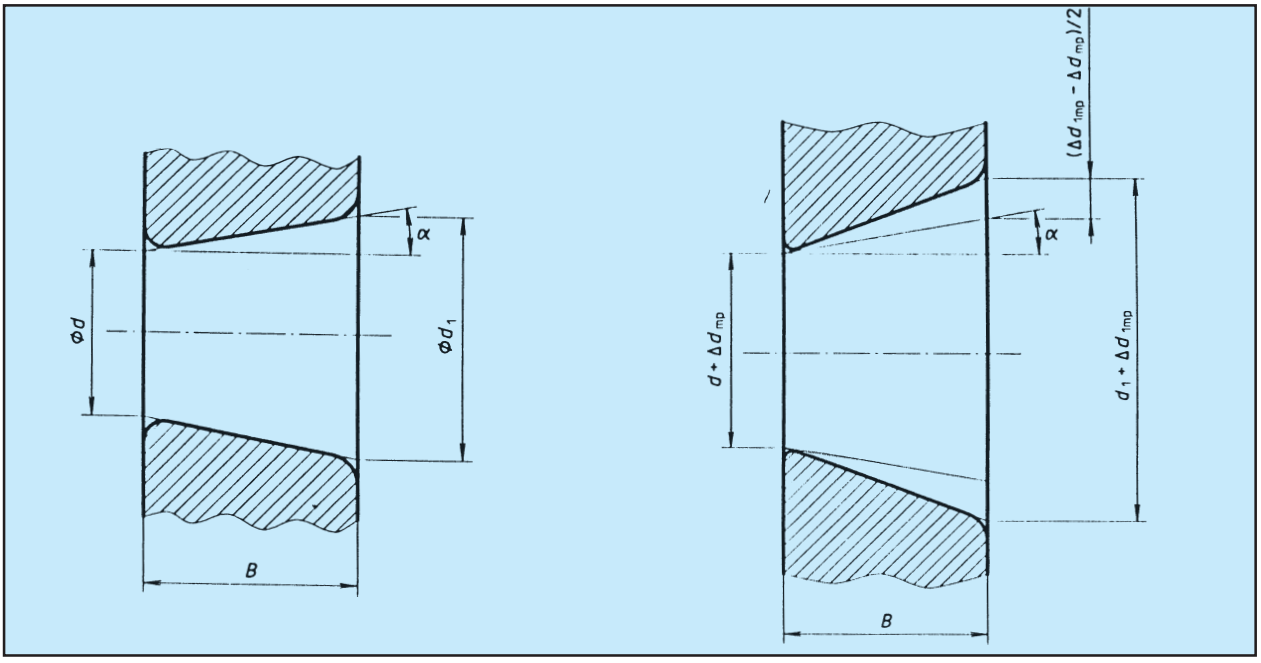
α = 0° 57' 17.4" = 0.954 84° = 0.016 665 rad

The diameter at the theoretical large end of the bore is

$d_1 = d + (1/30)\ B$

The tolerances for a tapered bore comprise:

- A mean diameter tolerance, given by limits for the mean diameter deviation at the theoretical small end of the bore, Δd_{mp} ;
- A taper tolerance, given by limits for the difference between the mean diameter deviations at the two ends of the bore, $\Delta d_{1mp} - \Delta_{dmp}$;
- A tolerance for the diameter variation, V_{dp}, given by a maximum value applying in any radial plane of the bore.



Nominal tapered bore

Tapered bore with diameters and their deviations

Tapered bore, taper 1:12 Tolerance values in micrometers

d mm		Δ_{dmp}		Δ_{dmp}		V_{dp} [1)2)]
over	incl	high	low	high	low	max
d	10	+22	0	+15	0	9
10	18	+27	0	+18	0	11
18	30	+33	0	+21	0	13
30	50	+39	0	+25	0	16
50	80	+46	0	+30	0	19
80	120	+54	0	+35	0	22
120	180	+63	0	+40	0	40
180	250	+72	0	+46	0	46
250	315	+81	0	+52	0	52
315	400	+89	0	+57	0	57

1) Applies in any single radial plane of the bore
2) Does not apply to diameter series 7 and 8

Tapered bore, taper 1:30 Tolerance values in micrometers

d mm		Δ_{dmp}		Δ_{dmp}		V_{dp} [1)2)]
over	incl	high	low	high	low	max
50	80		0	+30	0	19
80	120		0	+35	0	22
120	180		0	+40	0	40
180	250		0	+46	0	46
250	315		0	+52	0	52
315	400		0	+57	0	57

1) Applies in any single radial plane of the bore
2) Does not apply to diameter series 7 and 8

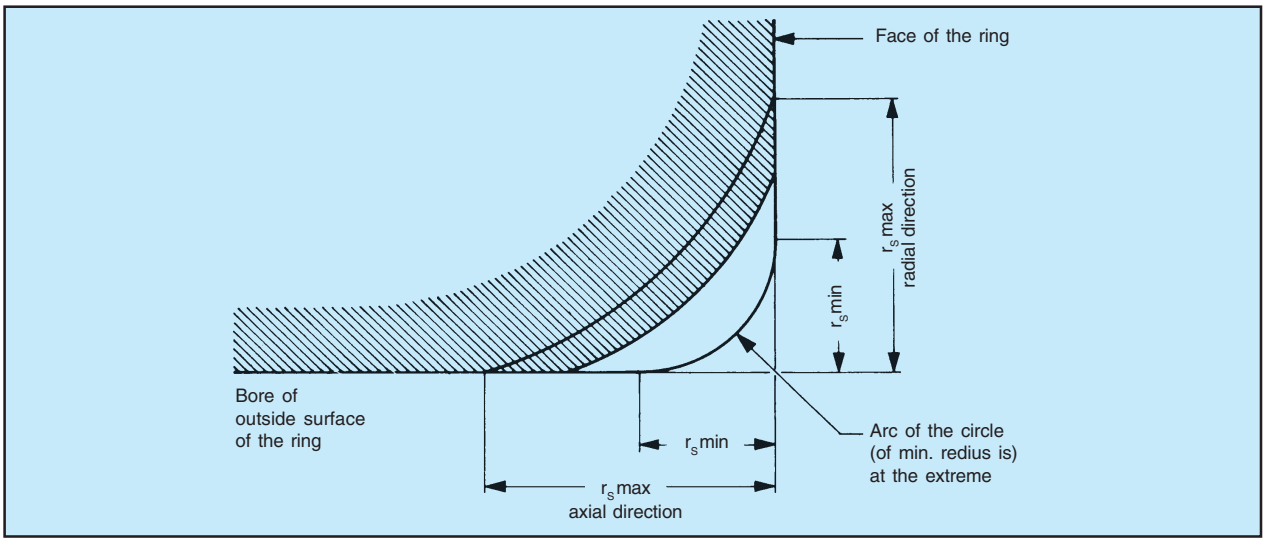
6 CHAMFER DIMENSIONS

In order to ensure that rolling bearing chamfers are compatible with the dimensions of the parts (shaft, housing, retaining ring) which come into contact with the rolling bearings, values of the chamfer dimension limits, of which the minimum limit is of primary interest to the bearing user are given according to ISO 582 – 1979 recommendations wherever adopted.

6.1 SYMBOLS

d	=	nominal bore diameter
D	=	nominal outside diameter of the bearing
r1, r3	=	chamfer in radial direction
r2, r4	=	chamfer in axial direction
rs min	=	general symbol for the minimum chamfer r1s min, r2s min, r3s min, r4s min
r1s max, r3s max	=	maximum chamfer in radial direction
r2s max, r4s max	=	maximum chamfer in axial direction

The exact shape of the surface of the corner radius is not fixed. However, its shape in an axial plane should be within an imaginary arc of a circle with minimum radius rs, tangent to the face of the ring and to the bore, or to the cylindrical outside surface of the ring, as shown in the following figure.



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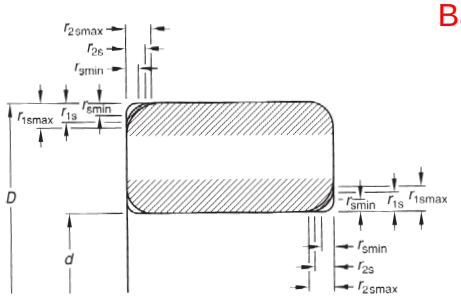

6.2 CHAMFER DIMENSION LIMITS

rs min	d over	d incl	r1s max	r2s max
mm	mm		mm	mm
0.1	—	—	0.2	0.4
0.15	—	—	0.3	0.6
0.2	—	—	0.5	0.8
	—	40	0.6	1
0.3	—	—	—	—
	40	—	0.8	1
	—	40	1	2
0.6	—	—	—	—
	40	—	—	—
		—	1.3	2
	—	50	1.5	3
1	—	—	—	—
	50	—	1.9	3
	—	120	2	3.5
1.1	—	—	—	—
	120	—	2.5	4
	—	120	2.3	4
1.5				
	120	—	3	5

rs min	d over	d incl	r1s max	r2s max
mm	mm		mm	mm
	—	80	3	4.5
2	80	220	3.5	5
	220	—	3.8	8
	—	280	4	6.5
2.1	—	—	—	—
	280	—	4.5	7
		100	3.8	6
2.5	100	280	4.5	6
	280		5.0	7
—	—	280	5	8
3	—	—	—	—
—	280	—	5.5	8
4	—	—	6.5	9
5	—	—	8	10
6	—	—	10	13
7.5	—	—	12.5	17
9.5	—	—	15	19
12	—	—	18	24
15	—	—	21	30
19	—	—	25	38

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7. MOUNTING TOLERANCES

For Radial bearings with cylindrical bore of normal precision class. (Ball, Cylindrical, Tapered and Spherical Roller Bearings)

Several factors like the type and magnitude of bearing load, temperature difference, method of bearing mounting and dismounting should be taken into consideration while selecting the proper fit.

The recommended tolerances for shaft and housing for common applications are given below as general guide lines:

Table - Bearing operating conditions and type of fit

Operating Condition	Type of rotation		Load Conditions	Type of fitting	
	Inner Ring	Outer Ring		Inner Ring	Outer Ring
	Rotation	Stationary	Rotatiing inner ring load Stationary outer ring load	Tight Fit	Loose Fit
	Stationary	Rotation			
	Stationary	Rotation	Rotating inner ring load Stationary outer ring load	Tight Fit	Loose Fit
	Rotation	Stationary			
Direct of load indeterminate due to variation of direction	Rotating or Stationary	Rotating or Stationary	Direction of load indeterminate	Tight Fit	Tight Fit

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TABLE - RECOMMENDED SEATING FITS FOR SHAFTS *

Load Conditions		Examples	Shaft Diameter (mm)			Shaft Tolerances
			Ball Bearings	Cylindrical Roller & Tapered Roller Bearings	Sperical Roller Bearings	
Rotating Outer Ring Load	Easy axial displacement of inner ring on shaft desirable	Wheels on Stationary Axles	All Shaft Diameters			g6
	Easy axial displacement of inner ring on shaft unnecessary	Tension Pulleys and Rope Sheaves				h6
Rotating inner Ring Load or Direction of Load Indeterminate	Light Load (< 0.06 C (1)) Variable Load	Electrical Appliances, Pumps, Blowers, Transport Vehicles, Precision Machinery, Machine Tools	< 18			js5
			18 ~ 100	< 40		js6 (j6)
			100 ~ 200	40 ~ 140		k6
				140 ~ 200		m6
	Normal Loads (0.06 to 0.13 C(1))	General Bearing Applications, Medium & Large Motors, Turbines, Pumps, Engine Main Bearings, Gears, Woodworking Machines	< 18			js5 ~ 6 (j5~6)
			18 ~ 100	< 40	< 40	k5~6
			100 ~ 140	40 ~ 100	40 ~ 65	m5~6
			140 ~ 200	100 ~ 140	65 ~ 100	m6
			200 ~ 280	140 ~ 200	100 ~ 140	n6
				200 ~ 400	140 ~ 280	p6
					280 ~ 500	r6
					over 500	r7
	Heavy Loads (> 0.13 C(1)) Shock Loads	Railway Axle boxes, Industrial Vehicles, Traction Motors, Construction Equipment, Crushers		50 ~ 140	50 ~ 100	n6
				140 ~ 200	100 ~ 140	p6
				over 200	140 ~ 200	r6
					200 ~ 500	r7
Axial Loads Only			All Shaft Diameters			js6(j6)

Note (1) C represents the basic dynamic capacity of the bearing

* Applicable only to solid steel shafts

TABLE - RECOMMENDED SEATING FITS FOR HOUSING *

Load Conditions			Examples	Housing bore Tolerances	Axial Displacement of Outer Ring
Solid Housings	Rotating Outer Ring Load	Heavy Loads on Bearing in Thin-Walled Housing Heavy Shock Loads	Automotive Wheel Hubs (Roller Bearings) Crane Travelling Wheels	P7	Impossible
		Normal and Heavy loads	Automotive Wheel Hubs (Ball Bearings) Vibrating Screens	N7	
		Light and Variable Loads	Conveyor Rollers, Rope Sheaves, Tension Pulleys	M7	
	Direction of Load Indeterminate	Heavy Shock Loads	Traction Motors		
		Normal and Heavy Loads	Pumps, Crankshaft Main Bearings Medium Large Motors	K7	Generally Impossible
Solid or Split Housings		Normal and Light Loads		JS7 (J7)	Possible
	Rotating Inner Ring Load	Loads of All kinds	General Bearing Application, Railway Axle boxes	H7	Easy Displacement
		Normal and Light Loads	Plummer Blocks	H8	
		High Temperature Rise of Inner Ring Through Shaft	Papers Dryers	G7	
Solid Housing		Accurate Running Desirable under Normal and Light Loads	Grinding Spindle Rear Ball Bearings, High Speed Centrifugal Compressor Fixed Bearings	JS6 (J6)	Possible
	Direction of Load indeterminate		Grinding Spindle Front Ball Bearings, High Speed Centrifugal Compressor Fixed Bearings	K6	Generally Impossible
	Rotating Ringing Load	Accurate Running and High Rigidity Desirable under Normal and Light Loads	Cylindrical Roller Bearings for Machine Tool Main Spindle	M6 or N6	Impossible
		Minimum Noise is required	Electrical Home Appliances	H6	Easily Possible

* Applicable for cast iron and steel housings. For housings made of light alloy, the interference should be tighter than those in this table.

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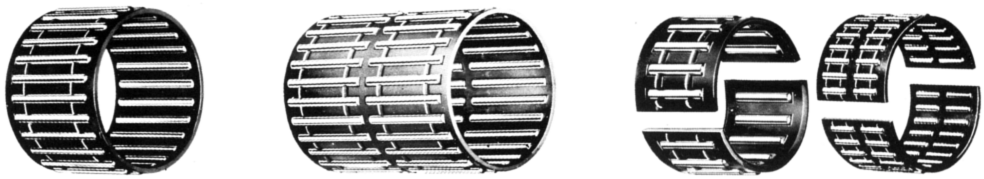
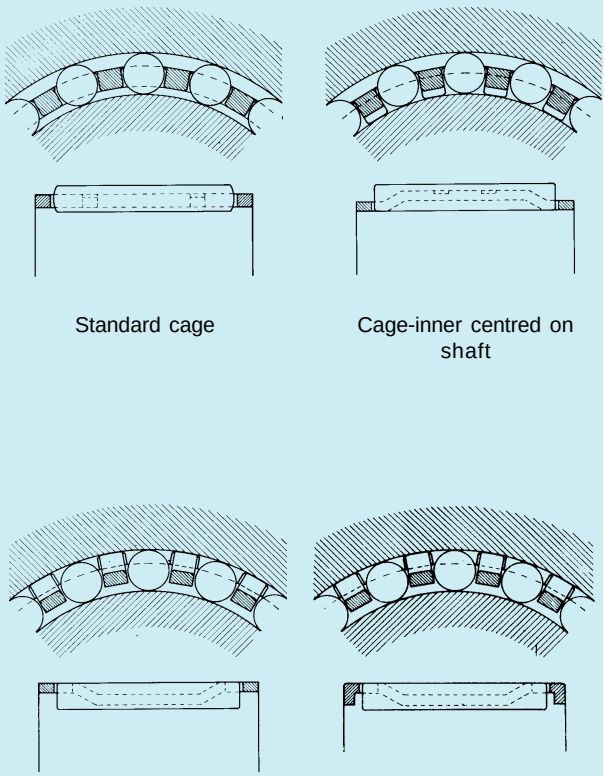
NEEDLE CAGES AND ROLLER CAGES



Needle cages are inexpensive and very easy to install. They can be fitted by hand without the use of tools. They may be manufactured in two parts and can then be mounted on an inner raceway between two shoulders. This arrangement allows the rigidity of the shaft to be increased.

The double cage, that is one having two rows of needles, comprises of two bearings side by side in one continuous unit. It allows parts such as idler pinions to be fitted easily and ensures their stability. The double cage can also be manufactured in two separate parts.

NRB manufacture's cages in steel, polyamide, brass and aluminium bronze materials. Needle rollers used in these assemblies are made of high carbon chrome steel, hardened, ground and lapped to close tolerances for diameter and roundness.



NRB cages, manufactured in steel, present the following advantages:

- Great rigidity preventing deformation during handling
- Good mechanical stability that resists ageing and ensures long operational life without excessive wear whilst maintaining the geometrical shape of the cage at high temperatures
- Excellent resistance to synthetic additives contained in many lubricants
- Minimal thickness allowing maximum oil penetration thus assisting effective lubrication
- Low weight minimising the centrifugal effects of rapid acceleration

CONSTRUCTION

NRB needle cages have 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 needle cages using moulded, one piece or split type glass reinforced engineered polymer cages (suffix TN). These operate well at temperatures up to 120°C. 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. At such high temperatures oil can deteriorate with time and it is recommended that oil change intervals are observed.

In wrap and welded cages the convergent faces of the cage pockets form a V-shaped cradle which ensures correct retention of the needles and prevents them from falling inwards. The cage is centred by the needles and does not come into contact with the raceways, thus considerably reducing operational wear and noise.

Retention of the needles to prevent them moving outwards from the cage is effected by small wedges which remain out of contact with the needles during operation. The sides of two adjacent cage pockets and the needle form a prism ensuring retention of lubricant and silent operation.

PREFIXES

B	: Cage with one row of needle rollers
BB	: Cage with two rows of needle rollers
MB	: Cage in two parts, with one row of needles
MBB	: Cage in two parts, with two row of needles

SUFFIXES

A, a : Modified internal design

No Suffix : Welded cage

FS : Formed Strip welded cage

FT : Cage outside diameter ground (applicable to welded cages only)

FTa : Cage outside diameter ground (applicable to welded cages only), modified internal design

FS : Formed Strip welded cage

D : Drawn cup type cage

DC : Drawn cup type cage, copper plated

DMC : Drawn cup type cage, cage material alloy steel, copper plated

DS : Drawn cup type cage, silver plated

DMS : Drawn cup type cage, cage material alloy steel, silver plated

T : Machined (turned) cage

TC : Machined (turned) cage, copper plated

TM : Machined (turned) cage, cage material alloy steel

TMA : Machined (turned) cage, cage material alloy steel, modified internal design

TMC : Machined (turned) cage, cage material alloy steel, copper plated

TS : Machined (turned) cage, silver plated

TMS : Machined (turned) cage, cage material alloy steel, silver plated

TN : Polyamide cage

MANUFACTURING TOLERANCES

The needles of a particular cage have a diameter restricted to a tolerance of 2 µm according to one of the groups shown in the table below. Unless otherwise specified in advance, NRB may supply a batch of cages within several tolerance groups without distinction by colour coding.

However, if several cages are used on the same shaft, their needles should be of the same tolerance group to ensure the best possible distribution of load.

The tolerance on the width L conforms to ISO standard 3030,or -0.2 / - 0.55

Tolerance Group Microns	Colour Code
0 / - 2	red
-2 / - 4	blue
-4 / - 6	white
-6 / -8	green
-8 / - 10	yellow
-1 / -3	pink
-3 / -5	sky blue
-5 / - 7	grey
-7 / - 9	orange

SHAFT AND HOUSING REQUIREMENTS

For obtaining optimum performance from the needle cages, the shaft and housing should conform to the following parameters for tolerances, hardness, and surface finish when directly used as raceways for needles.

Tolerances

Functional Clearance	Shaft Dimension Ci	Housing Dimension Ce
Closer than standard	j5 h5	G6 H6
Standard	h5 g5	G6 H6
Greater than standard	g6 f6	G6 H6

Cylindrical tolerance, defined as the difference in radii of two coaxial cylinders (ISO Standard 1101) must normally be less than a quarter of the manufacturing tolerance. In the case of precision applications or high speed operation it is recommended to reduce this tolerance to one eighth of the manufacturing tolerance.

The width of the housing formed by the lateral abutments must at least be equal to the nominal dimension L (recommended tolerance: H11).

Hardness

Both shaft and housing should have hardness of 58 to 64 HRC.

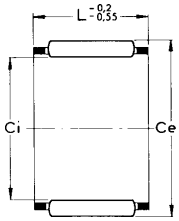
Surface finish

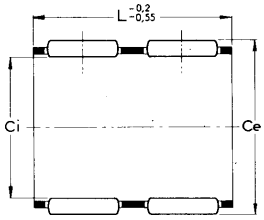
Shaft : 0.35 µm C.L.A.
Housing : 0.40 µm C.L.A.

LATERAL RETENTION

Needles must be laterally retained whether on the shaft or in the housing. Snap rings for shafts or for housings must not be used in direct contact with the faces of the cage, but only with a spacer interposed.

NEEDLE CAGES

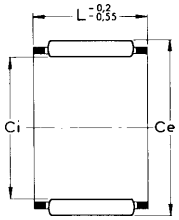


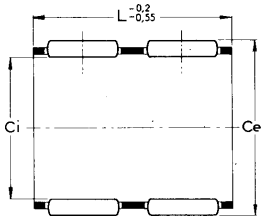


Shaft dia	Designation	Ci	Ce	L	Basic capacities		Limiting speed (oil)	Approx weight
					Dynamic (C)	Static (Co)		
m m		m m	m m	m m	Newtons	Newtons	rpm	gms
6	B 6 9 8	6	9	8	3000	2600	65000	1.10
	B 6 10 13	6	10	13	5400	4700	65000	2.60
8	B 60 204 TM	8	11	9.8	3800	3900	50000	3.75
	B 8 11 10	8	11	10	5400	4600	50000	1.70
	B 8 12 12	8	12	12	5900	5500	50000	3.00
9	B 9 12 10	9	12	10	4900	5500	44000	2.00
	B 9 12 13	9	12	13	6000	6950	44000	3.00
10	B 10 13 9	10	13	9	3700	3900	40000	2.40
	B 10 13 10	10	13	10	4500	5100	40000	2.70
	B 10 13 13	10	13	13	6000	7400	40000	2.80
	B 60 205 TM	10	13	13.5	5500	6500	40000	3.63
	B 60 091 TM	10	13	14.5	5500	6600	40000	3.20
	B 60 194 S	10	14	10	4500	4350	40000	3.90
	B 10 14 13	10	14	13	7000	7100	40000	4.30
12	B 12 15 10	12	15	10	4800	5600	33000	3.20
	B 12 15 13	12	15	13	6300	8300	33000	4.20
14	B 14 17 20	14	17	20	10500	16000	28500	8.80
	B 14 18 10	14	18	10	6200	6900	28500	4.40
	B 14 18 13	14	18	13	8700	10800	28500	5.90
	B 60 015 TM.2	14	18	19.8	11200	14800	28500	12.01
	B 60 015	14	18	20	9800	12400	30800	9.80
14.4	B 50 160	14.4	20.4	19.4	14000	17500	27700	13.00
15	B 15 19 10	15	19	10	6300	8200	26500	4.70
	B 15 19 13	15	19	13	9400	11700	26500	6.30
	BB 15 19 22.2	15	19	22.2	12100	16800	23500	10.00
	B 15 19 24	15	19	24	17000	25000	26500	11.30
15.2	B 600 10 FT	15.2	22.2	12	12300	12100	26300	8.70
16	B 16 20 10	16	20	10	6800	8200	25000	5.00
	B 16 20 13	16	20	13	9400	12400	25000	6.60
	B 60 218 TM	16	20	20	11800	16900	25000	13.48
	B 50 792	16	20	20	12500	17700	25000	11.20
	B 60 025	16	20	21.7	12300	17400	25800	9.50
	B 16 22 12 a	16	22	12	10500	11000	25000	9.80
	B 60 044*	16	22	16	15700	18500	25000	14.00
	B 16 22 17	16	22	17	11700	14200	25000	13.80
17	B 17 21 10	17	21	10	6500	8800	23500	5.20
	B 17 21 13	17	21	13	9300	12500	23500	7.10
	B 60 099 D	17	21	13	10500	14500	23500	5.50
	B 17 21 15	17	21	15	11800	16300	23500	8.30
	B 17 27 17	17	27	17	18900	19800	23500	23.00
17.5	B 60 018*	17.5	22	16	11900	15900	22800	12.00
18	B 18 22 13	18	22	13	10400	14000	22000	7.40
	B 18 22 17 a	18	22	17	12900	19300	22000	9.70
	B 60 002 FT	18	24	12	12400	13900	21600	9.00
18	B 60 050	18	24	20	18700	23800	22000	19.00
	B 18 25 22.2	18	25	22.2	26800	34500	22000	23.90
	B 18 26 16	18	26	16	16700	19400	22000	17.50
	B 18 28 16	18	28	16	22500	21500	22000	22.50
18.25	B 60 182	18.25	24.25	25	21900	29000	21900	21.90
19	B 19 23 13	19	23	13	9500	15000	21000	7.80

* Cages centered on outer raceway

NEEDLE CAGES

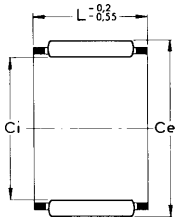


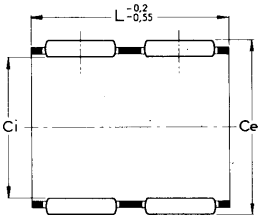


Shaft dia	Designation	Ci	Ce	L	Basic capacities		Limiting speed (oil)	Approx weight
					Dynamic (C)	Static (Co)		
m m		m m	m m	m m	Newtons	Newtons	rpm	gms
20	B 20 24 10	20	24	10	8300	11300	20000	6.10
	B 20 24 10.2	20	24	10.2	8300	11300	20000	6.10
	B 20 24 13	20	24	13	10600	15500	20000	8.20
	SB 20 24 13 TN	20	24	13	9900	14100	33300	5.00
	B 20 24 17	20	24	17	14700	22800	20000	11.00
	BB 20 24 29.7	20	24	29.7	22000	38500	20000	19.50
	B 20 26 13.6	20	26	13.6	12400	13800	20000	11.60
	B 600 14 DA	20	26	16.8	17300	22000	20000	16.70
	B 20 26 17	20	26	17	16000	20000	20000	16.70
	B 20 27 30	20	27	30	30000	40600	20000	31.00
	B 20 27 30 TN	20	27	30	29000	38800	20000	26.00
	B 60 119	20	28	18	21800	24800	18600	18.00
	B 20 28 20 TN	20	28	20	24100	28200	20000	21.00
	B 60 051*	20	28	20.2	21700	24600	20000	20.00
	B 20 30 19 TN	20	30	19	27900	30000	20000	30.00
	B 20 30 30.2 TN	20	30	30.2	36400	41900	20000	42.70
20.218	V 60 136 D	20.218	28.178	18.26	23200	27000	19700	25.00
21	B 60 206 T	21	25	18	13600	21500	19000	25.45
	MB 21 27 15	21	27	15	16000	20300	18200	12.00
	SB 21 27 15 TN	21	27	15	16000	20300	18200	6.00
22	B 22 26 13	22	26	13	10800	16300	18000	9.50
	B 22 26 17	22	26	17	15000	24000	18000	12.80
	SB 22 27 14 TN	22	27	14	12200	19200	17300	9.00
	B 60 198 TM	22	28	23	24200	34900	18100	69.35
	B 60 175 TM	22	29	16.8	19500	23900	18100	22.48
	B 22 30 15 TN	22	30	15	18800	20900	18200	15.00
	B 22 30 20 TN	22	30	20	25500	31000	18200	23.00
	B 22 32 18	22	32	18	28000	29500	18000	30.00
	B 22 33 20	22	33	20	25000	24000	18000	33.50
23	MB 23 27 15	23	27	15	12200	19200	18200	13.00
	SB 23 27 15 TN	23	27	15	12200	19200	17400	7.00
	B 60 122	23	28	24	19600	30300	17400	24.00
	B 61 009 D	23	35	16.2	29300	29500	17300	38.30
23.5	B 23.5 27.5 13	23.5	27.5	13	10700	16400	17400	10.00
24	B 24 28 13	24	28	13	10600	16400	16600	10.00
	SB 24 28 13 TN	24	28	13	11100	17500	16500	7.00
	B 24 36 24 TN	24	36	24	9700	14800	16600	45.00
25	B 25 29 10	25	29	10	8900	13300	16000	8.10
	B 25 29 13	25	29	13	11600	18600	16000	10.80
25	B 25 29 17	25	29	17	16000	27500	16000	14.50
	B 25 30 13	25	30	13	13500	19400	16000	11.00
	B 25 30 17	25	30	17	17300	26700	16000	18.80
	B 60 022*	25	30	20	19200	30400	16000	22.60
	B 60 112	25	30	22	21100	34400	16300	24.00
	B 60 029*	25	30	24	23000	38400	16000	27.20
	SB 60 029 TN	25	30	24	22100	36500	17000	16.00
	B 60 023*	25	30	25.2	24800	42400	16000	28.00
	B 25 30 25.2	25	30	25.2	24800	42400	16000	28.00
	MB 60 200 TN	25	30	26	22800	37800	16000	18.00
	BB 55 597 AJ	25	30	60	33200	61700	16000	47.00
	B 60 093 TM	25	31	17	18300	25300	16000	22.90

* Cages centered on outer raceway

NEEDLE CAGES

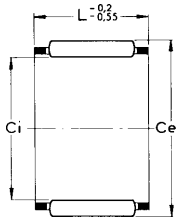


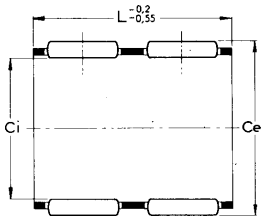


Shaft dia	Designation	Ci	Ce	L	Basic capacities		Limiting speed (oil)	Approx weight
					Dynamic (C)	Static (Co)		
m m		m m	m m	m m	Newtons	Newtons	rpm	gms
25	B 25 31 20	25	31	20	22200	32500	16000	24.00
	MB 60 201 TN	25	31	22	24100	36100	16000	21.00
	B 25 31 24	25	31	24	23500	39500	16000	29.50
	B 25 32 16	25	32	16	18800	23700	16000	25.00
	B 25 33 20	25	33	20	29000	36500	16000	27.50
	B 60 085 D	25	33	23.8	34200	46900	16000	38.70
	B 61 010 D	25	35	36	52600	70600	16000	73.70
	B 60 188 TM	25	37	23.8	39600	44000	16000	68.15
	BIM 25 46 25 T**	25	46	25	42035	57450	11750	170.00
25.4	B 25.4 30.4 11.6	25.4	30.4	11.6	10700	14400	15700	10.00
	V 16 21 16 D	25.4	33.32	25.40	33300	51500	15200	42.00
	V 16 22 14 D	25.4	34.93	22.23	32500	25800	15700	40.00
26	B 7012 TN	26	40	26	50700	56100	15000	75.00
26.568	V 60 133 D	26.568	34.528	18.26	26300	34100	15000	32.00
26.568	V 60 123 D	26.568	34.528	25.40	35900	51000	15000	
26.84	BB SS 26.84 31.85 30 TN	26.84	31.85	30	23600	40500	14900	20.00
27.5	B 60 145	27.5	33.5	22	22900	34600	14300	29.50
	MB 60 145	27.5	33.5	22	22900	34600	14300	29.50
28	B 28 33 13	28	33	13	13700	20400	14200	14.00
	B 28 33 17	28	33	17	18200	29500	14200	18.80
	B 28 33 27	28	33	27	31500	58000	14200	31.00
	B 28 35 18	28	35	18	22400	30600	14200	29.00
	B 60 180 D	28	35	18	23800	33000	14200	26.90
	BB 60 086 D	28	38	33.8	48100	64800	14200	71.00
	B 7050 TN	28	48	23.8	59900	58400	14200	118.00
29	BB 29 33 30	29	33	30	25000	50000	13800	29.00
	B 60 042*	29	34	17	18100	29600	13700	20.00
	B 60 043*	29	34	24	25000	44700	13700	29.70
30	B 30 35 17	30	35	17	19700	33500	13300	20.00
	B 30 37 16	30	35	17	25000	35000	13300	26.40
	B 60 024*	30	35	20	21400	37000	13300	26.00
	B 30 35 20	30	35	20	21900	38300	13300	26.00
	B 60 067*	30	35	25	25600	46800	13300	32.00
	SB 60 027 TN	30	35	25	23200	40900	13300	19.00
	BB 30 35 26.5	30	35	26.5	23200	46500	13300	31.00
	B 30 35 27	30	35	27	31000	59900	13300	33.00
30	B 60 120	30	35	27	29700	56500	13300	33.00
	B 60 053*	30	35	27	29700	56500	13300	35.00
	B 61 005 TM	30	40	20	30300	36400	13300	49.80
	B 30 40 30	30	40	30	50400	70100	13300	78.00
	B 60 146	30	40	30	50400	70100	13300	78.00
31.749	V 60 135 D	31.749	41.275	19.05	33400	43300	12400	45.00
32	B 32 37 17	32	37	17	18900	32400	12500	21.50
	B 32 37 22	32	37	22	24100	44300	12500	29.90
	B 60 116	32	37	25	25200	46800	12700	34.00
	B 32 37 27	32	37	27	33500	65000	12500	35.00
	B 60 121	32	37	27	33500	65000	12500	37.00
	BB 32 37 32	32	37	32	28500	62000	12500	40.00
	BB 32 37 58	32	37	58	45000	112000	12500	80.00
	B 32 52 31 TN	32	52	31	78500	83800	12500	164.00

* Cages centered on outer raceway
** With inner ring. Without inner ring cage size 34 x 46 x 24.5

NEEDLE CAGES

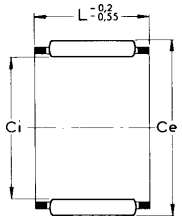


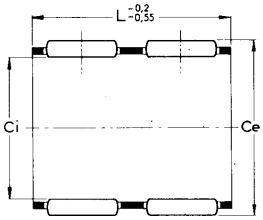


Shaft dia	Designation	Ci	Ce	L	Basic capacities		Limiting speed (oil)	Approx weight
					Dynamic (C)	Static (Co)		
m m		m m	m m	m m	Newtons	Newtons	rpm	gms
32.5	BB 32.5 36.5 29 TN	32.5	36.5	29	22500	47400	12300	18.00
35	B 50 174	35	40	13	14200	23000	11500	17.00
	B 35 40 13	35	40	13	14200	23000	11400	18.30
	B 35 40 17	35	40	17	21400	39100	11500	23.00
	B 35 40 18.5 a	35	40	18.5	20900	37900	11500	24.50
	B 60 117	35	40	22	24900	47400	11400	32.00
	B 35 40 23.5 a	35	40	23.5	28000	55200	11500	31.00
	B 60 054*	35	40	27	31500	64300	11500	40.00
	BB 60 063	35	40	34.9	33900	70500	11400	51.00
	B 60 126 T	35	42	16	23400	34700	11400	35.00
	B 60 228	35	43	26.5	37000	56700	11400	52.30
	B 35 45 30	35	45	30	55000	80000	11400	47.30
35.255	V 60 131 D	35.255	43.218	18.50	31200	46400	11100	52.00
	V 60 114 D	35.255	43.218	31.80	53200	91500	11300	75.00
36	BB 36 40 29.8 TN	36	40	29.8	24800	55800	11100	21.00
	B 36 41 30.5 TN	36	41	30.5	32500	67400	11100	32.00
37	B 37 42 17	37	42	17	22200	41900	10800	24.50
	B 37 42 27	37	42	27	36000	75000	10800	40.00
39	BB 39 44 26 a	39	44	26	27700	56400	10200	37.00
40	B 40 45 17	40	45	17	22600	43700	10000	26.00
	B 40 45 21 a	40	45	21	27100	55300	10000	33.00
	B 40 45 27	40	45	27	37500	80000	10000	43.00
	B 60 118	40	45	27	37500	80000	10000	46.00
	B 40 45 30	40	45	30	36700	81800	10000	51.00
	B 40 45 30 TN	40	45	30	33700	73100	10000	32.00
	B 40 48 20	40	48	20	36000	55000	10000	47.00
	B 60 181	40	53	44	88700	132000	10000	181.50
	B 40 60 26 FS	40	60	26	78200	86900	10000	182.00
40.2	BB 50 458	40.2	44.2	29	24100	56100	10000	38.00
	BB SS 61037 TN A	40.2	44.2	30	28600	69500	9900	24.00
42	BB 50 347	42	46	51.4	36200	95700	9500	70.00
	B 42 47 17	42	47	17	24500	48000	9500	27.50
	B 42 47 27 a	42	47	27	34100	75400	9500	46.00
	B 42 47 27 TN	42	47	27	34100	75400	9400	33.00
	B 42 47 28.4	42	47	28.4	34100	75400	9500	48.50
	BB 42 47 34	42	47	34	33500	72000	9500	59.00
	B 42 47 36 TN	42	47	36	39600	91700	9500	41.20
	B 60 156 D	42	50	30	51500	92300	9500	67.00
	B 42 52 20.2	42	52	20.2	44600	66100	9500	65.00
	B 42 54 30.7	42	54	30.7	62500	87000	9500	110.00
42.395	V 60 113 D	42.395	51.948	21.70	46000	71300	9400	82.00
42.422	V 60 134 D	42.422	51.948	25.40	54800	89200	9400	84.00
42.465	V 60 115 D	42.465	51.991	31.75	65900	113200	9412	110.00
42.467	V 60 125 D	42.467	58.341	31.75	84300	110800	9400	
43	BB 43 48 34	43	48	34	38000	99000	9300	57.00
44	BB 44 51 44.8	44	51	44.8	49500	97800	9000	98.90
	BB 60 102	44	51	44.8	49500	97800	9000	98.90
	BB 44 51 45 FS	44	51	45	50700	100900	9000	108.00
44.45	V 60 124 D	44.45	57.15	27	68400	99000	9000	

* Cages centered on outer raceway

NEEDLE CAGES

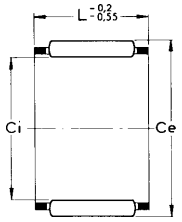


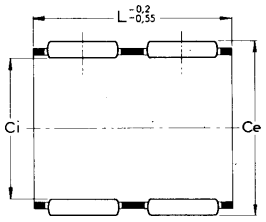


Shaft dia	Designation	Ci	Ce	L	Basic capacities		Limiting speed (oil)	Approx weight
					Dynamic (C)	Static (Co)		
m m		m m	m m	m m	Newtons	Newtons	rpm	gms
45	B 45 49 19.2	45	49	19.2	19200	43100	8800	28.50
	B 45 50 17	45	50	17	25300	51000	8800	29.00
	B 45 50 21	45	50	21	31300	67000	8800	37.00
	B 45 50 27	45	50	27	38100	89500	8800	48.00
	BB 45 50 27	45	50	27	33800	76800	8800	47.00
	B 45 52 21	45	52	21	27400	51500	8800	54.00
	BB 45 52 36 FS	45	52	36	51100	102600	8800	103.00
	BB 45 52 36 TN	45	52	36	53900	110200	8800	42.00
	B 45 53 28	45	53	28	51000	90000	8800	80.00
46	BB SS 46 53 36 TN	46	53	36	45400	88600	8600	58.00
47	B 47 52 17	47	52	17	25200	53500	8500	31.00
	B 60 172	47	52	27	34900	80800	8500	52.00
	B 47 52 27	47	52	27	41000	95000	8500	51.00
48	B 60 173	48	53	17	22200	45500	8300	32.00
	B 48 53 17	48	53	17	23000	53500	8300	31.00
	B 60 047*	48	53	28	34400	79800	8300	56.20
	B 48 54 30.2	48	54	30.2	46500	103500	8300	71.00
49	B 60 148	49	54	25	32400	74500	8100	54.00
49.98	B 80 019 FS	49.98	55	30	39000	97000	8000	
50	B 60 174	50	55	20	27300	60100	8000	40.00
	B 50 55 20	50	55	20	28300	61000	8000	41.00
	B 50 55 30	50	55	30	40600	100300	8000	63.00
50	B 80 019	50	55	30	40000	98300	8300	60.00
	B 50 56 23	50	56	23	35500	71000	8000	53.00
	BB 50 57 36	50	57	36	43000	95000	8000	98.00
52	B 60 183	52	58	19	27600	54300	7690	49.00
53	53 58 25 TN	53	58	25	32200	76000	7500	35.00
55	B 55 59 13 TN	55	59	13	10600	21200	7500	9.00
	B 55 60 20	55	60	20	28300	65100	7300	45.00
	B 60 048*	55	60	24.5	33400	80700	7300	56.20
	B 55 60 30	55	60	30	40500	99000	7300	69.00
	B 60 049*	55	60	37	47300	126000	7300	84.50
	B 60 110	55	61	18.5	25400	49600	7200	50.00
	B 60 077 D	55	63	32	51700	100000	7200	86.00
56	BB 56 61 32	56	61	32	38300	96700	7300	85.00
	BB 56 61 40.2	56	61	40.2	47400	126900	7200	101.00
	BB 56 64 50	56	64	50	75000	185000	7200	175.00
58	BB 58 64 40	58	64	40	57700	145600	6800	108.00
	BB 58 64 51	58	64	51	61000	178000	6800	150.00
58.57	B 80 012	58.57	66.57	30	56500	115700	6800	108.00
	B 50749	58.57	66.57	30	56500	115700	6600	108.00
60	B 60 65 20	60	65	20	31000	72000	6700	50.00
	B 60 235	60	65	25	37300	95500	6600	62.00
	B 60 65 30	60	65	30	43800	117400	6700	75.00
	BB 50 162	60	66	39.9	50100	122600	6600	117.00
	B 60 68 25	60	68	25	51000	102400	6700	93.00
	SB 60 68 25.2 TN	60	68	25.2	39700	73900	6600	63.00
	BB 50 790	60	68	30	52800	106900	6600	105.20
	BB 50 791	60	68	34	60300	126700	6600	125.00
	B 60 68 38.8 FS	60	68	38.8	61600	129600	6600	172.00

* Cages centered on outer raceway

NEEDLE CAGES





Shaft dia	Designation	Ci	Ce	L	Basic capacities		Limiting speed (oil)	Approx weight
					Dynamic (C)	Static (Co)		
m m		m m	m m	m m	Newtons	Newtons	rpm	gms
62	BB 62 70 32.8	62	70	32.8	48700	97400	6400	124.50
	BB 60 101	62	70	32.8	48700	97400	6400	124.50
	BB 62 70 33 FS	62	70	33	53700	110100	6500	147.00
	BB 62 70 39.8	62	70	39.8	68400	150700	6400	152.00
	BB 62 70 40	62	70	40	68400	150700	6400	152.00
	BB 62 70 40 FS	62	70	40	66400	144800	6500	177.80
	BB 62 70 40 TN	62	70	40	70600	156800	6400	110.00
62.1	BB 80 006	62.1	68.1	42.3	59000	153400	6400	131.00
63.66	BB 80 005	63.66	71.66	38.8	74600	170500	6200	150.00
65	B 65 70 20	65	70	20	30800	76800	6200	53.00
	B 65 70 23	65	70	23	43500	116000	6200	56.00
	B 65 70 30	65	70	30	47000	127000	6200	72.00
	B 65 73 23	65	73	23	53000	108000	6200	92.00
	B 65 73 30	65	73	30	60100	129700	6200	122.00
	B 60 026*	65	73	30	60100	129700	6200	124.00
66	BB SS 66 74 36 TN	66	74	36	55700	118300	6100	94.00
68	BB 68 74 34.9	68	74	34.9	55000	138000	5900	118.00
	B 60 106	68	76	26.5	54200	115200	5800	110.00
	B 68 76 34.8	68	76	34.8	61700	136200	5800	141.00
	B 60 104	68	76	34.8	61700	136200	5800	141.00
	B 68 76 35 FS	68	76	35	64600	144100	6400	172.00
	BB 60 107	68	76	36	60200	131600	5800	145.00
	BB 60 108	68	76	38.5	60200	131600	5800	160.00
	BB 60 109	68	76	47.5	70000	159600	5800	200.00
70	B 70 76 20	70	76	20	37500	86000	5700	69.00
	B 70 76 30	70	76	30	56000	145000	5700	105.00
	BB 70 76 40.2	70	76	40.2	63300	174700	5700	144.00
	B 70 78 25	70	78	25	54800	118300	5700	107.00
	B 70 78 30	70	78	30	69000	155000	5700	130.00
	BB 70 78 48.5 FS	70	78	48.5	85900	209900	5700	240.00
72	BB 72 80 40 FS	72	80	40	70900	165500	5500	206.80
	BB 72 80 40 TN	72	80	40	73100	172700	5500	131.00
73	B 73 79 20	73	79	20	36800	88200	5500	72.00
	BB 50 181	73	79	39.9	55400	149000	5400	143.00
	B 60 229	73	79	44	64900	182100	5400	162.00
	B 60 230	73	79	47	64900	182100	5400	169.00
75	BB 75 81 40	75	81	40	65000	180000	5300	137.00
	B 75 83 23	75	83	23	51000	107000	5300	105.00
	SB 75 83 23 TN	75	83	23	43500	89500	5300	72.00
	B 75 83 30	75	83	30	70000	160000	5300	142.00
	BB 75 83 34.8	75	83	34.8	62200	142200	5300	163.00
	BB 75 83 35 FS	75	83	35	62200	142000	5300	182.30
	BB 75 83 39.8 FS	75	83	39.8	73400	175600	5300	212.00
	BB 75 83 46	75	83	46	86000	208000	5300	205.00
80	B 80 86 20	80	86	20	38300	95900	5000	87.00
	B 80 88 30	80	88	30	73000	172000	5000	150.00
	BB 80 88 40 FS	80	88	40	75500	186000	5000	224.70
85	B 85 92 20	85	92	20	39800	91900	4700	95.00
	B 85 93 30	85	93	30	75000	180000	4700	160.00
90	B 90 98 30	90	98	30	76000	190000	4400	170.00
	BB 90 98 45.8 FS	90	98	45.8	91400	247800	4400	295.00

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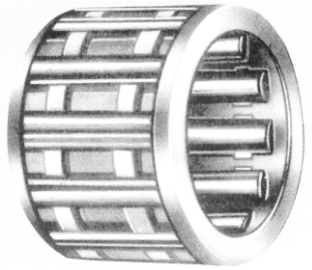
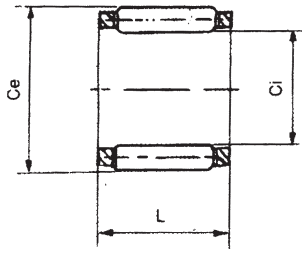
ROLLER CAGES





Shaft dia	Designation	Ci	Ce	L	Basic capacities		Limiting speed (oil)	Approx weight
					Dynamic (C)	Static (Co)		
m m		m m	m m	m m	Newtons	Newtons	rpm	gms
20	NW 20 28 20	20	28	20	24100	28200	20000	30
22	NW 22 30 15	22	30	15	18800	20900	18200	26
	NW 22 30 20	22	30	20	25500	31000	18000	34
24	NW 24 36 24	24	36	24	35600	38000	16000	67
	NS 24 36 24	24	36	24	38200	41800	16700	
25	NW 25 33 24.3	25	33	24.3	29800	39100	16000	
	NS 25 35 24	25	35	24	37100	45300	16000	
	NW 25 35 24	25	35	24	37100	45300	16000	65
	NS 7005	25	35	30	46000	59600	16000	72
	NW 25 35 30	25	35	30	43300	55000	16000	
	NW 225	25	35	30	43300	55000	16000	
25.4	NW 0001	25.4	39.7	39.7	69300	82300	15500	146
26	NS 7012	26	40	26	50700	56100	15300	
	NW 7012	26	40	26	50700	56100	15300	100
	NW 26 40 26	26	40	26	47200	51000	15300	95
28	NS 28 44 24	28	44	24	48200	49300	14000	157
	NW 28 44 24	28	44	24	48200	49300	14000	118
	NS 7050	28	48	23.8	59900	58400	14000	157
	NW 7050	28	48	23.8	59900	58400	14000	155
	NW 28 48 24	28	48	24	59900	58400	14000	156
30	NW 230	30	42	30	51000	63400	13000	104
	NS 30 42 30	30	42	30	51000	63400	15400	98
31	NW 31 46 27	31	46	27	59400	68200	12900	133
	NW 31 46 27.2	31	46	27.2	62100	72500	12500	130
32	NW 32 52 25	32	52	25	60800	60300	11600	175
	NS 32 52 31	32	52	31	78500	83800	12500	207
	NW 32 52 31	32	52	31	78500	83800	12500	214

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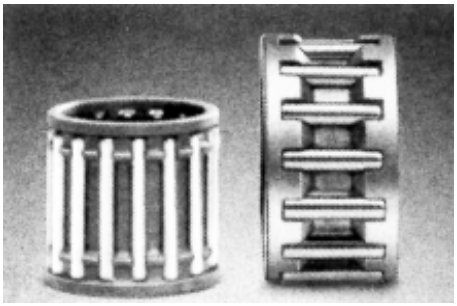
NEEDLE CAGES FOR CONNECTING ROD APPLICATIONS

The severe operating conditions encountered in applications such as connecting rods of internal combustion engines and compressors require the use of special needle cages.



For the crank pin position where considerable centrifugal loads, internal forces, accelerations and high speeds occur, NRB manufactures specially contoured cages which are centred in contact with the outer raceway.

Similarly for the piston pin (gudgeon pin) position where the reciprocating inertia loads and high oscillating speeds occur, NRB manufactures specially contoured cages which are usually centred in contact with the inner raceway.

Cages are duly heat treated and surface treated to keep wear to a minimum and to give high structural strength to the cage. Due to the low weight and good rigidity of heat treated cages, the NRB cages are well suited for high speed engines. Depending on requirement cages are also supplied with copper plating, silver plating, for crank pin position.

MANUFACTURING TOLERANCES

The needles of a particular cage have a diameter restricted to a tolerance of 2 µm according to one of the groups shown in the table below. Unless otherwise specified in advance, NRB may supply a batch of cages within several tolerance groups without distinction by colour coding.

The tolerance on the width L conforms to ISO standard 3030, or - 0.2 / - 0.55; or as per OE specifications.

Tolerance Group Microns	Colour Code
0 / - 2	red
-2 / - 4	blue
-4 / - 6	white
-6 / -8	green
-8 / - 10	yellow
-1 / -3	pink
-3 / -5	sky blue
-5 / - 7	grey
-7 / - 9	orange

SHAFT AND HOUSING REQUIREMENTS

For obtaining optimum performance from the needle cages, the shaft and housing should conform to the following parameters for tolerances, hardness, and surface finish when directly used as raceways for needles.

Hardness and Surface finish of Raceways

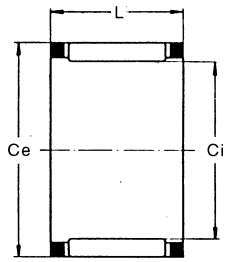
Hardness: the effective case depth of 50 HRC of the raceways should be 0.5 mm minimum, and the surface hardness should be 60 HRC minimum.

After hardening, the connecting rods must be stress relieved.

Surface finish: the connecting rod raceway bores (big end and small end) as well as the crank pins and piston pins (gudgeon pins) should have surface finish 0.2 µm Ra or better.

Next

NEEDLE CAGES FOR CONNECTING ROD (BIG END) CRANK PIN BEARINGS



Shaft dia	Designation	Ci	Ce	L	Basic capacities		Limiting speed (oil)	Approx weight
					Dynamic (C)	Static (Co)		
m m		m m	m m	m m	Newtons	Newtons	rpm	gms
12	B 60 001 FT	12	17	10	7000	6800	27600	4.50
14	B 60 052 DC	14	18	10	7000	8100	28500	4.00
14.11	B 50 845 FTa	14.11	20.11	12	10500	10700	26500	8.00
	B 50 845 D1	14.11	20.11	12	9400	9200	28300	7.00
15.2	B 60 010	15.2	22.2	12	12300	12100	23300	8.70
16	B 60 004	16	21	10	7200	7600	25800	5.40
	B 60 004 DC	16	21	10	8400	9200	25000	6.00
	B 60 017 FT	16	21	12	10100	11700	24200	7.30
	B 60 017 D	16	21	12	9500	10800	25000	7.00
	B 60 017 TMC	16	21	12	8900	10000	25000	8.00
	B 60 003 FT	16	22	12	11800	12700	25000	9.60
	B 60 003 D	16	22	12	11000	11600	25000	9.00
	B 60 003 TMC	16	22	12	11000	11600	25000	9.50
	B 60 003 DC2	16	22	12	11000	11600	25000	9.00
18	B 60 002	18	24	12	10900	11900	22200	9.00
	B 60 002 DC	18	24	12	12200	13800	22200	10.00
	B 60 033 DC	18	24	13.5	12400	14000	22200	11.50
	B 60 033 DMC	18	24	13.5	12600	14300	22200	10.00
20	B 60 014 DC	20	26	16.9	16400	20500	20000	14.60
	B 60 014 TMC	20	26	16.9	14000	16700	20000	16.00
	B 60 177 TMS	20	26	17	17000	20900	21500	17.54
	B 61 004 TMC	20	28	16	18100	19500	20000	16.50
22	B 60 031 DC	22	28	14	14100	17400	18100	13.00
	B 60 088 TMC	22	28	14	13800	16900	18000	14.00
	B 60 012 DC	22	28	16	27400	40700	18100	15.10
	B 60 012 TMC	22	28	16	15000	18700	18100	16.00
	B 60 012 DMC	22	28	16	16400	21000	18100	15.00
	B 60 068 TMC	22	29	14	15700	18000	18100	17.50
	B 50 743	22	29	15.7	17400	20700	17000	15.00
	B 50 743 D	22	29	15.7	19600	24100	18100	18.70
	B 50 743 DC2	22	29	15.7	19600	24100	18100	19.00
22.9	B 50 793	22.9	28.9	13.9	15200	19400	16700	14.00
	B 50 793 D	22.9	28.9	13.9	16300	21200	17400	14.00
23.1	B 60 143 TMC	23.1	28.1	14	11500	15200	17300	
24	B 50 794	24	28	10	9100	13500	17400	6.00
25	B 60 161 TMC	25	32	16	18500	23100	16000	23.00
25.1	B 60 035 DS	25.1	30.1	14	14800	21800	15900	13.10
	B 60 035 DMS	25.1	30.1	14	15000	22200	15900	
	B 60 035 TMS	25.1	30.1	14	14600	21400	15900	14.00
26	B 61 014 TMC	26	31	13.8	14200	20900	15350	13.30
	B 60 092 TMS	26	33	14	19200	24700	15400	20.90
	B 60 137 TMS	26	33	14	19200	24700	15400	20.90
28	B 60 130 TMS	28	33	14	14800	22700	14200	
	B 60 184 TMC	28	34	16.8	21400	32000	14200	22.50
	B 60 074 TMC	28	36	14	17500	20300	14200	24.50
	B 60 154 TMC	28	36	15.8	23700	30000	14200	30.00
	B 61 013 TMC	28	36	16	21500	26600	14200	28.00
	B 60 141 TMC	28	36	16	24500	31400	14200	28.00
	B 60 100 TMC	28	36	16.8	26200	34300	14285	35.50
	B 60 142 TMC	28	38	16	26100	29700	14200	
29	B 61 001 TMC	29	37	16	21500	26700	13700	30.00
30	B 60 179 TMS	30	37.9	16.8	25900	34300	13300	36.50
	B 61 003 TMC	30	38	16	23200	29800	13300	31.00
	B 60 090 TMS	30	38	18	27300	36900	13300	40.50

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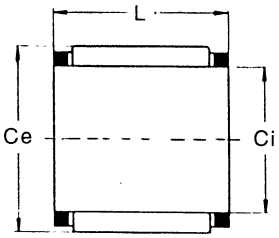
NEEDLE CAGES FOR CONNECTING ROD (SMALL END) PISTON PIN BEARINGS



Shaft dia	Designation	Ci	Ce	L	Basic capacities		Limiting speed (oil)	Approx weight
					Dynamic (C)	Static (Co)		
mm		mm	mm	mm	Newtons	Newtons	rpm	gms
12	B 50 386	12	15	13	5850	8500	34800	3.90
	B 60 013	12	15	15	6800	9000	34800	4.00
	B 60 007	12	15	16	6700	9000	36400	5.80
	B 55 017a	12	15	17.7	6800	9000	38100	6.00
	B 50 713	12	16	13	8000	9300	38100	5.10
	B 50 713 T	12	16	13	7000	7800	34800	4.93
	B 60 016	12	16	16	8000	9300	34800	6.00
	B 50 137	12	17	10.2	5650	5800	34800	5.50
13	B 50 114	13	16	14	6300	8400	36400	4.50
14	B 60 034	14	18	16.5	9100	11300	29600	8.10
	B 60 034 TM	14	18	16.5	8800	10900	28500	7.50
	B 50 773	14	18	17	10300	15000	28500	9.00
	B 60 030	14	18	17.5	9400	11800	29600	9.00
	B 60 015	14	18	20	9400	11900	28500	9.80
	B 60 015 T	14	18	20	8800	10900	28500	10.00
	B 60 032	14	19	17.3	12400	14800	27600	11.00
	B 60 032 T	14	19	17.3	10600	12000	28500	10.00
	B 60 089 TM	15	19	19	10300	13500	26000	12.00
15	B 50 190	15	19	20.2	11700	16100	28600	10.00
15.2	B 50 113	15.2	22.2	12	11400	11000	21400	8.70
16	B 60 078 TMA	16	20	19.7	9800	13000	25000	12.50
	B 50 972	16	20	20	12700	18100	28600	11.00
	B 60 011	16	20	22.7	12300	17400	27600	11.70
	B 50 139	16	21	10	8300	9100	23500	5.40
18	B 50 787	18	32	21.8	14600	22500	25000	11.50

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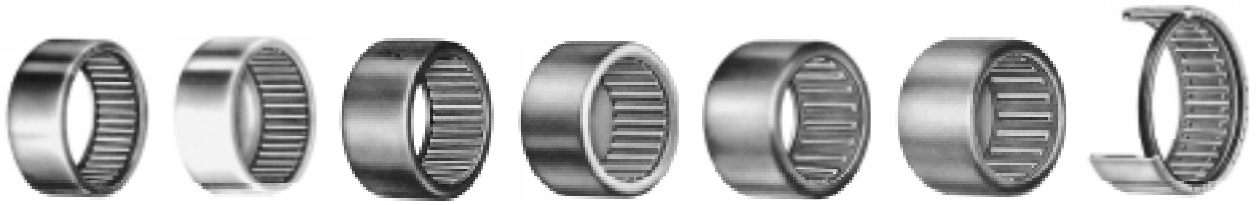
NEEDLE BUSHES



1 2 3 4 5 6 7

Needle bushes consist of a thin, heat treated outer ring formed from accurately controlled sheet steel encasing a set of needles. Bushes may have a full complement of needles retained in outer ring by their ends or by grease, others have needles retained in a cage which is prevented from moving laterally in the outer ring.

These bearings which occupy very little radial space are particularly economical to use and possess a high load capacity, relative to their size. They should be selected in preference to other bearings when conditions of mounting and operation permit.

When needle bushes are used without an inner ring and needles rotate on a shaft of suitable hardness they occupy minimum space and therefore provide a very satisfactory solution. Maximum load capacity is obtained with a shaft hardness under needles of atleast 650 HV. A lower hardness is acceptable if loads and required life permit, please consult NRB.

whilst also providing a high load capacity. This is obtained by the use of flat ended needles having a greater effective length.

Such bearings are useful for applications involving large quantities at very low cost and where the lack of retention of needles cannot constitute a risk, e.g. needles dislodging when shaft is fitted.

Caged needle bushes (figs. 5 and 6) are less susceptible to misalignment between the shaft and housing and are generally preferred in applications involving a vertical shaft under light to medium loads.

The relatively large volume of grease available in these bearings reduces the frequency of relubrication and may even permit lubrication for life in certain applications.

Caged needle bushes type DB...E (fig. 7) have a seal incorporated, thus dispensing with the need for separate sealing rings. The seal lip design achieves a light and constant contact with inner raceway throughout the range of the mounted 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 entering the raceway area.

Closed end needle bushes (figs. 2,4,6) ensure perfect sealing at the end of a shaft and do not necessitate the use of blind housings or end caps. They are also able to support a small axial force transmitted by shaft. Where a large axial load requires the additional use of a thrust bearing, please consult NRB. The low price and minimal space occupied and the ease of installation of this bearing provide a very acceptable solution in many cases.

TYPES OF NEEDLE BUSHES – In metric dimensions – Without oil hole.

Full complement needle bushes				Caged needle bushes		
Retained needles		Grease-retained needles				
Open (fig. 1)	Closed end (fig. 2)	Open (fig. 3)	Closed end (fig. 4)	Open (fig. 5)	Closed end (fig. 6)	Open with seal (fig. 7)
DL DL...P	DLF DLF…P	SL SL…P	CN , CNS	DB DB…P	DBF DBF...P	DB...E DB...PE

Full complement needle bushes in inch dimensions open or with closed end (types JL or JLF) are also available. Please refer tables of dimensions.

Needle bushes with oil hole can be supplied where the quantities involved are large. Nevertheless, it may be necessary to supply bushes with oil hole if the standard type is not available.

Needle bushes with suffix P are manufactured to tolerances confirming to ISO standard 3245.

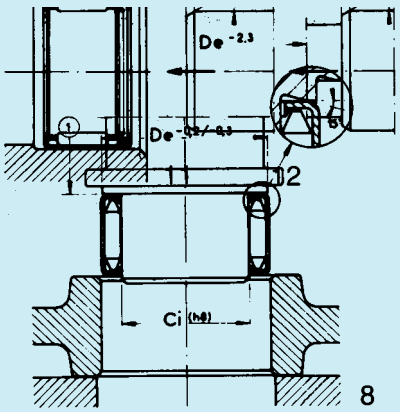
Hardened inner rings can be supplied for most NRB needle bushes. They remove the necessity to harden the shaft and enable the bearings to accept a full load capacity.

Needle bushes are normally supplied with rust preventive oil expect where a special grease has been requested. Needle bushes SL, CN and CNS types where needles are retained by grease are supplied with grease.

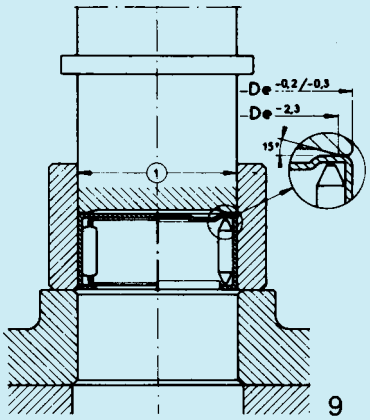
The full complement needle bush with needles retained in the outer ring (figs. 1 and 2) incorporate the advantages of low price high load capacity and ease of handling and fitting.

Full complement needle bushes with grease retained needles in the outer ring (figs. 3 and 4) combine economy

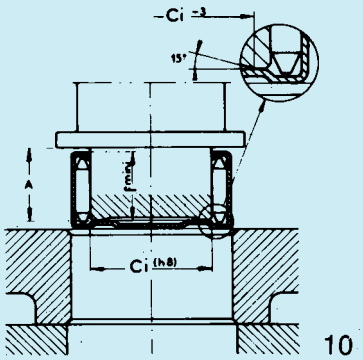
Next



1) Marked face



1) Bore of Ring: De + 0.3 mm



A min=f min+1mm

* For more details on inspection and installation please refer NRB brochure on Mounting & Dismounting and Inspection Procedure for NRB Needle Bushes

INSPECTION*

Needle bushes are not truly cylindrical in free state and therefore they can be inspected only after they have been fitted in a ring-gauge having sufficient thickness to withstand deformation and with a bore ground truly cylindrical. The sizes of these gauges, together with the tables of dimensions of " GO" and "NO-GO" plug gauges are given in the tables of dimensions. For needle bushes with suffix P inspection dimensions are in conformance with ISO standard 3245 which applies to a ring-gauge of tolerance N6. For needle bushes without suffix P inspection dimensions relate to ring-gauge of tolerance H6.

Because considerable tightening of the needle bush takes place in the ring gauge due to the interference fit, insertion and removal of the bush is likely to make it unsuitable for subsequent use. This method, which is the only valid way of correct inspection, can only be applied therefore to parts set aside for inspection.

INSTALLATION *

For needle bushes one must accept that the thin outer ring is interference fitted to the housing bore and will correspond closely to the shape of the housing. A housing with localised imperfections and thickness variations may cause deformation of the bush, which is detrimental to smooth operation. Best results are obtained with a geometrically uniform shape and even load distribution. The force required to insert needle bush must be applied without shock to the side marked with the bearing part number. Thus it is advisable to use a small press fitted with a suitable mandrel to apply uniform force to the bush centred in the housing (fig. 8).The axial movement of the mandrel should be limited by a shoulder coming against the face of the housing.

Bushes having one closed end should preferably have the open end presented to the housing bore (fig. 9) .If this is not possible, the force may be applied to the inside face of the closed end in the case of bushes type DLF (fig. 10). (This must not be done in the case of bushes type DBF).

CAGED NEEDLE BUSHES INCORPORATING SEALS

Caged needle bushes type DB…E (DB…PE) have a seal incorporated on the inside of the face marked with the bearing part number. To this face should be applied the force necessary for installation. Thus, after fitting, the seal will normally be situated towards the outside of the bearing to prevent loss of lubricant and the entry of dirt, etc (fig. 11). The bearing seal which is made of synthetic rubber permits operation upto 120 º C. (Minimum running temperature –20º C)

The shaft to be introduced into the needle bush on assembly must be chamfered at its end or at its shoulder (fig. 12). When carrying out this operation the surface passing through the seal must be greased, in order to provide satisfactory sealing at commencement of operation.

INNER RINGS

Inner rings for needle bushes are normally supplied without oil hole and have a cylindrical needle track (series IM or IM…P). In those infrequent cases where lubrication is provided through the shaft inner rings can be supplied on request with oil hole (series IMC). Please consult NRB for details.

The inner rings with a slightly convex needle track series IM...R6 without oil hole are primarily intended for full complement needle bushes type DL as a means of extending the permissible misalignment tolerance upto 1 in 1 000 for continuous operation (instantaneous maximum: 2 in 1 000). Inner rings type IM…R6 must be correctly centred in relation to the bush (maximum permissible displacement: 5% of width L). For this reason these inner rings cannot be used with closed end bushes type DLF.

HOUSING TOLERANCES

Types of bush	Housing Dimension De	
	Steel or cast iron	Non-ferrous metal [1] or thin casings in steel
JL , JLF	J6 (J7)	N6 (N7)
DL, DLF, DB, DBF, DB...E	H6 (H7)	M6 (M7)
DL...P, DLF...P DB...P, DBF…P, DB….PE	N6 (N7)	R6 (R7)

[1] If a housing of non-ferrous metal reaches temperatures considerably higher (or lower) than 20° C, account should be taken of the difference in expansion (or contraction) of the bush and suitable adjustments to the fits should be made.

The cylindrical tolerance defined as the difference in radii of two coaxial cylinders (Recommendation R 1101) must normally be less than a quarter of the machining tolerance on the defined diameter. However, for precision applications or high speeds, it is recommended that the cylindrical tolerance is reduced to one eighth of the machining tolerance.

RADIAL PLAY

The fit of a bush in its housing determines to a large extent the dimension under the needles after fitting and consequently the radial play during operation.

The recommended shaft and housing tolerances give a radial play the limits of which are suitable for most normal applications. To obtain a closer clearance, it is possible to match the shaft diameters with the diameters under the needles of the bushes after the latter have been fitted into their housings.

The possible differences in the rigidity of housings and variations of clamping force resulting from the tolerance build up do not permit one to establish a range of dimensions under the needles for every application. However, for housings of very thick steel, taking into account the probable restraining force, the variations of the dimension under the needles after installation will be within the tolerances given below :

Type of bush	Tolerance of dimension under the needles after fitting	
DL...P, DLF...P DB...P, DBF...P, DB...PE	F8	
	Dimension Ci	
DL , DLF DB, DBF, DB...E	≤ 22 mm	+15/+50 µm
	25 – 40 mm	+20/+60 µm
	45 – 55 mm	+20/+65 µm

The radial play limits should also take into account the tolerance of the shaft used directly as a raceway or the outer diameter of the inner ring after it has been fitted on to the shaft.

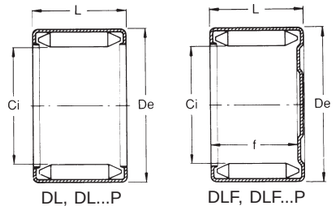
Where an inner ring is used on a shaft of recommended tolerance k5 (k6) or m5 (m6), the minimum play may be slightly lower and the maximum play slightly higher than for the case of an assembly without inner ring on a shaft of h5 (h6) tolerance.

SHAFT TOLERANCES

Operating conditions	Needle bushes without inner ring	Dim. Ci	Needle bushes with inner ring	Dim. Ci
Rotating	All types expect CN and CNS	h5 (h6)	All types expect CN and CNS	k5 (k6)
Oscillating motion	All types expect CN and CNS	j5 (j6)	All types expect CN and CNS	m5 (m6)

Needle Bushes with Full Complement, Retained Needle Rollers (Metric Sizes)

Type DL, DL...P
DLF, DLF...P



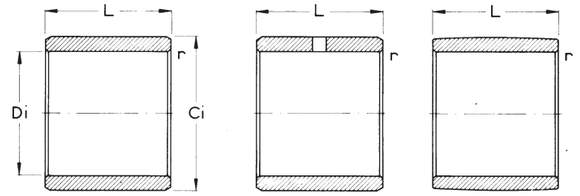
DL, DL...P DLF, DLF...P

Shaft dia mm	Designation	Ci mm	De mm	L mm	f min mm	Basic capacities Dynamic C Newtons	Static Co Newtons	Limiting speed (oil) rpm	Approx. weight DL gms	DLF gms
6	DL,DLF 6 10	6.00	12.00	10.00	7.70	3900	3500	50000	4.20	4.40
8	DL,DLF 8 10	8.00	14.00	10.00	7.70	5600	5700	37500	5.30	5.60
9	DL,DLF 9 14 12	9.00	14.00	12.00	9.70	7200	9000	33000	6.10	6.50
10	DL 10 14 10 PA	10.00	14.00	10.00	-	5600	8000	32700	4.00	-
	DL,DLF 10 12	10.00	16.00	12.00	9.70	7900	9400	30000	8.00	8.50
12	DL,DLF 12 10	12.00	18.00	10.00	7.70	6800	8100	25000	7.60	8.40
	DL,DLF 12 12	12.00	18.00	12.00	9.70	8900	11400	25000	9.40	10.20
13	DL,DLF 13 12	13.0a0	19.00	12.00	9.70	9300	12200	23000	9.90	10.90
14	DL,DLF 14 12	14.00	20.00	12.00	9.70	9700	13400	21500	10.50	11.60
15	DL,DLF 15 12 P	15.00	20.00	12.00	9.70	9700	15100	20500	10.00	-
	DL,DLF 15 12	15.00	21.00	12.00	9.70	10100	14200	20000	11.00	12.20
16	DL,DLF 16 12	16.00	22.00	12.00	9.70	10500	15400	18500	12.00	13.40
17	DL,DLF 17 12	17.00	23.00	12.00	9.70	10800	16200	17500	13.00	14.40
	DL,DLF 17 23 12 P	17.00	23.00	12.00	9.70	10800	16200	17500	13.00	14.40
18	DL,DLF 18 12	18.00	24.00	12.00	9.70	11200	17400	16500	14.00	16.00
	DL,DLF 18 16	18.00	24.00	16.00	13.70	15900	27300	16500	19.00	21.00
	DL,DLF 18 24 16 P	18.00	24.00	16.00	13.70	15900	27300	16500	19.00	21.00
20	DL,DLF 20 12	20.00	26.00	12.00	9.70	11800	19400	15000	15.00	17.00
	DL,DLF 20 14 P	20.00	26.00	14.00	11.70	14400	24900	15000	17.60	-
	DL,DLF 20 16	20.00	26.00	16.00	13.70	16800	30400	15000	20.00	22.00
	DL,DLF 20 20 P	20.00	26.00	20.00	17.70	21400	41500	15000	27.00	-
	DL,DLF 20 25 P	20.00	26.00	25.00	22.70	26700	55200	15000	33.80	-
22	DL,DLF 22 16	22.00	28.00	16.00	13.70	17700	33500	13500	22.00	25.00
25	DL,DLF 25 32 25 P	25.00	32.00	25.00	22.70	32100	64200	12000	46.80	49.80
	DL,DLF 25 16	25.00	33.00	16.00	13.70	22100	36000	12000	35.00	39.00
	DL,DLF 25 20	25.00	33.00	20.00	17.70	26200	44400	12000	43.00	47.00
28	DL,DLF 28 20	28.00	36.00	20.00	17.70	30300	55800	11000	47.00	51.00
30	DL,DLF 30 16	30.00	38.00	16.00	13.70	24400	43200	10000	40.00	45.00
	DL,DLF 30 20	30.00	38.00	20.00	17.70	31400	59800	10000	50.00	55.00
	DL,DLF 30 25	30.00	38.00	25.00	22.70	39600	80500	10000	63.00	68.00
35	DL,DLF 35 42 16 P	35.00	42.00	16.00	13.70	21500	48000	8500	40.00	46.00
	DL,DLF 35 16	35.00	43.00	16.00	13.70	26600	50500	8500	46.00	53.00
	DL,DLF 35 20	35.00	43.00	20.00	17.70	34200	69800	8500	57.00	64.00
	DL 35 20 M	35.00	43.00	20.00	-	29700	61700	8600	112.00	-
40	DL,DLF 40 16	40.00	48.00	16.00	13.70	24700	48000	7500	51.00	61.00
	DL,DLF 40 20	40.00	48.00	20.00	17.70	33100	70100	7500	64.00	74.00
44	DL,DLF 44 16	44.00	52.00	16.00	13.70	29900	63500	6800	56.00	66.00
45	DL,DLF 45 52 16 P	45.00	52.00	16.00	13.70	25800	63000	6500	48.00	58.00
47	DL,DLF 47 16	47.00	55.00	16.00	13.70	31000	67800	6400	60.00	71.00
50	DL,DLF 50 12	50.00	58.00	12.00	9.70	19300	37600	6000	47.00	61.00
	DL,DLF 50 18	50.00	58.00	18.00	15.70	29600	65200	6000	71.00	85.00
	DL,DLF 50 20	50.00	58.00	20.00	17.70	37300	87700	6000	77.00	91.00
	DL,DLF 50 30	50.00	58.00	30.00	27.70	61600	167500	6000	-	135.00
55	DL,DLF 55 20	55.00	63.00	20.00	17.70	39100	96500	5500	86.00	102.00

Inner Rings

(1) Inner rings with lubrication hole, type IMC, available on request

(2) Inner ring with convex raceways cannot be used with needle bushes with closed end (Series DLF or DLF...P)



IM IMC (1) IM...R6 (2)

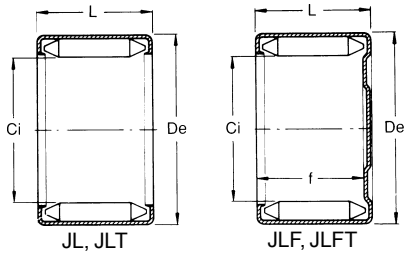
Ring bore mm	Inspection Gauges* GO Plug mm	NO GO Plug mm	Shaft dia mm	Designation	Di mm	Ci mm	L mm	r mm	Approx weight gms	Reference Needle Bush
12.000	6.009	6.036								
14.000	8.009	8.036								
14.000	9.009	9.036								
13.995	10.031	10.056								
16.000	10.009	10.036								
18.000	12.009	12.035								
18.000	12.009	12.035	8.00	IM 8 12 12.4	8.00	12	12.40	0.30	5.80	DL,DLF 12 12
19.000	13.009	13.035	9.00	IM 9 13 12.4	9.00	13	12.40	0.30	6.40	DL,DLF 13 12
20.000	14.009	14.035	10.00	IM 10 14 12.4	10.00	14	12.40	0.30	7.00	DL,DLF 14 12
19.972	15.009	15.035								
21.000	15.009	15.035	12.00	IM 12 15 12.4	12.00	15	12.40	0.20	5.80	DL,DLF 15 12
22.000	16.009	16.035		IM 12 16 12.4	12.00	16	12.40	0.30	8.10	DL,DLF 16 12
23.000	17.009	17.035	13.00	IM 13 17 12.4	13.00	17	12.40	0.30	8.70	DL,DLF 17 12
22.976	17.016	17.034		IM 13 17 12.4	13.00	17	12.40	0.30	8.70	DL,DLF 17 23 12 P
24.000	18.009	18.035		IM 13 18 12.4	13.00	18	12.40	0.35	11.20	DL,DLF 18 12
24.000	18.009	18.035		IM 13 18 16.4	13.00	18	16.40	0.35	15.00	DL,DLF 18 16
23.976	18.016	18.034		IM 13 18 16.4	13.00	18	16.40	0.35	15.00	DL,DLF 18 24 16 P
26.000	20.009	20.035	15.00	IM 15 20 12.4	15.00	20	12.40	0.35	12.70	DL,DLF 20 12
25.972	20.009	20.035								
26.000	20.009	20.035		IM 15 20 16.4	15.00	20	16.40	0.35	17.00	DL,DLF 20 16
25.972	20.009	20.035								
25.972	20.009	20.035								
28.000	22.009	22.035	17.00	IM 17 22 16.4	17.00	22	16.40	0.35	18.80	DL,DLF 22 16
31.967	25.015	25.041								
33.000	25.015	25.041	20.00	IM 20 25 16.4	20.00	25	16.40	0.35	21.50	DL,DLF 25 16
33.000	25.015	25.041		IM 20 25 20.4	20.00	25	20.40	0.35	27.00	DL,DLF 25 20
36.000	28.015	28.041	23.00	IM 23 28 20.4	23.00	28	20.40	0.35	30.50	DL,DLF 28 20
38.000	30.015	30.041	25.00	IM 25 30 16.4	25.00	30	16.40	0.35	26.50	DL,DLF 30 16
38.000	30.015	30.041		IM 25 30 20.4	25.00	30	20.40	0.35	33.00	DL,DLF 30 20
38.000	30.015	30.041		IM 25 30 25	25.00	30	25.00	0.35	40.00	DL,DLF 30 25
41.972	35.025	35.050	30.00	IM 30 35 16.4	30.00	35	16.40	0.35	31.00	DL,DLF 35 42 16 P
43.000	35.015	35.041		IM 30 35 16.4	30.00	35	16.40	0.35	31.00	DL,DLF 35 16
43.000	35.015	35.041		IM 30 35 20.4	30.00	35	20.40	0.35	39.00	DL,DLF 35 20
43.000	35.015	35.041								
48.000	40.015	40.041	35.00	IM 35 40 16.4	35.00	40	16.40	0.35	36.00	DL,DLF 40 16
48.000	40.015	40.041		IM 35 40 20.4	35.00	40	20.40	0.35	45.00	DL,DLF 40 20
52.000	44.015	44.041	40.00	IM 40 44 16.4	40.00	44	16.40	0.30	32.00	DL,DLF 44 16
51.967	45.025	45.050		IM 40 45 16.4 P	40.00	45	16.40	0.30	32.00	DL,DLF 45 52 16 P
55.000	47.015	47.041								
58.000	50.015	50.041								
58.000	50.015	50.041								
58.000	50.015	50.041	45.00	IM 45 50 20.4	45.00	50	20.40	0.60	56.00	DL,DLF 50 20
57.967	50.013	50.043								
63.000	55.015	55.041	50.00	IM 50 55 20.4	50.00	55	20.40	0.60	62.00	DL,DLF 55 20

* This inspection renders a bush unfit for further use

Next

Needle bushes with Full Complement, Retained Needle Rollers (JL Sizes)

Type JL, JLT
JLF, JLFT

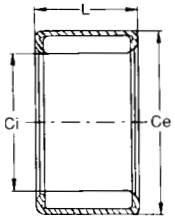


JL, JLT JLF, JLFT

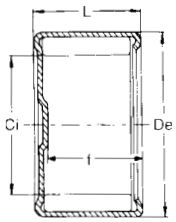
Shaft dia	Designation	Ci	De	L	f	Basic capacities Dynamic C	Static Co	Limiting speed (oil)	Approx. wt JL JLT	JLF JLFT	Inspection Gauges* Ring bore	GO Plug	NO GO Plug
mm		mm	mm	mm	mm	Newtons	Newtons	rpm	gms	gms	mm	mm	mm
7.94	JL 59	7.94	12.7	14.3	–	8700	10600	37700	6.50	-	12.71	7.975	8.001
9.525	JL,JLF 6 6	9.525	14.288	9.525	7.366	5400	6800	31500	5.00	5.50	14.2748	9.5402	9.5631
	JL,JLF 6 8	9.525	14.288	12.70	10.414	7800	10900	31500	6.00	7.00	14.2748	9.5402	9.5631
	JL 6 10	9.525	14.288	15.875	-	9800	14800	31500	7.30	-	14.2748	9.5631	9.5885
11.112	JL,JLF 78	11.112	15.875	12.70	10.414	8400	12500	27000	7.30	8.50	15.8623	11.1277	11.1506
12.70	JL,JLF 8 5	12.70	17.462	7.938	5.7912	4500	5800	23500	5.00	6.20	17.4498	12.7152	12.7381
	JL 8 6	12.70	17.462	9.525	-	10500	17500	23600	5.80	-	17.4498	12.7127	12.7381
	JL,JLF 8 8	12.70	17.462	12.70	10.414	9000	14300	23600	8.20	9.10	17.4498	12.7152	12.7381
	JL,JLF 8 10	12.70	17.462	15.875	13.716	11800	20200	23600	10.90	11.80	17.4498	12.7152	12.7381
	JLT,JLFT 8 10	12.70	19.05	15.875	13.208	13700	19500	23600	14.50	15.80	19.0373	12.7152	12.7381
	JL,JLF 8 12	12.70	17.462	19.05	16.764	14100	25400	23600	13.20	14.10	17.4498	12.7152	12.7381
	JLT,JLFT 8 12	12.70	19.05	19.05	16.51	16900	24600	23600	17.60	19.00	19.0373	12.7152	12.7381
14.288	JL.JLF 9 5	14.288	19.05	7.938	5.842	5200	7000	21000	5.00	6.00	19.0373	14.3027	14.3256
	JL.JLF 9 12	14.288	19.05	19.05	16.764	15200	28900	21000	15.00	16.00	19.0373	14.3027	14.3256
	JLT,JLFT 9 12 †	14.288	20.638	19.05	16.51	16600	25600	21000	19.50	20.80	20.6248	14.3027	14.3256
15.875	JL,JLF 10 5	15.875	20.638	7.938	5.842	5400	7900	18900	5.90	7.70	20.6248	15.8902	15.9131
	JL,JLF 10 8	15.875	20.638	12.70	10.414	10200	17900	18900	10.00	11.80	20.6248	15.8902	15.9131
	JL,JLF 10 12	15.875	20.638	19.05	16.764	15900	31800	18900	16.00	18.00	20.6248	15.8902	15.9131
	JLT.JLFT 10 12	15.875	22.225	19.05	16.51	17800	27900	18900	21.40	23.20	22.2123	15.8902	15.9131
	JLT,JLFT 10 16	15.875	22.225	25.40	22.86	25300	45300	18900	29.50	31.40	22.2123	15.8902	15.9131
17.462	JL,JLF 11 8	17.462	22.225	12.70	10.414	10900	20100	17100	11.00	14.00	22.2123	17.4777	17.5006
	JL,JLF 11 10	17.462	22.225	15.875	13.208	14000	27800	17100	15.00	16.00	22.2123	17.4777	17.5006
19.05	JL 12 6	19.05	25.4	9.525	-	7700	10100	15700	10.20	-	25.3873	19.0627	19.0881
	JL 12 8	19.05	25.4	12.70	-	12400	18300	15700	13.90	-	25.3873	19.0627	19.0856
	JL,JLF 12 10	19.05	25.4	15.875	13.208	16500	26700	15700	20.00	23.00	25.3873	19.0627	19.0881
	JL,JLF 12 12	19.05	25.4	19.05	16.51	20400	35000	15700	25.00	27.70	25.3873	19.0627	19.0881
20.638	JL,JLF 13 16	20.638	28.575	25.40	22.86	29700	58100	14500	37.00	40.00	26.9748	20.6502	20.6756
22.225	JL,JLF 14 8	22.225	28.575	12.70	10.16	13400	22300	13500	18.20	23.30	28.5623	22.2377	22.2631
	JL,JLF 14 12	22.225	28.575	19.05	16.51	21800	41800	13500	28.60	32.70	28.5623	22.2377	22.2631
	JL,JLF 14 16	22.225	28.575	25.40	22.86	29300	61300	13500	40.90	43.20	28.5623	22.2377	22.2631
	JLT,JLFT 14 10	22.225	20.638	15.875	12.70	18400	28800	13500	30.40	35.40	30.1498	22.2377	22.2631
25.40	JL,JLF 16 8	25.40	31.75	12.70	10.414	14400	25400	11800	20.00	25.00	31.7373	25.4127	25.4381
	JL,JLF 16 12	25.40	31.75	19.05	16.891	23400	47600	11800	32.00	37.00	31.7373	25.4127	25.4381
	JL,JLF 16 16	25.40	31.75	25.40	23.1902	31600	69900	11800	44.00	49.00	31.7373	25.4127	25.4381
	JLT,JLFT 16 12 †	25.40	33.338	19.05	16.002	25900	44900	11800	39.90	45.30	33.3248	25.4127	25.4381
	JLT,JLFT 16 16	25.40	33.338	25.40	22.352	35400	44900	11800	54.90	59.80	33.3248	25.4127	25.4381
	JLT,JLFT 16 24	25.40	33.338	38.10	35.052	52600	111600	11800	85.30	90.70	33.3248	25.4127	25.4381
28.575	JL,JLF 18 8	28.575	34.925	12.70	10.414	15300	28500	10500	23.00	28.00	34.9123	28.5877	28.6131
	JL,JLF 18 12	28.575	34.925	19.05	16.891	25000	53500	10500	36.00	41.00	34.9123	28.5877	28.6131
	JL,JLF 18 16	28.575	34.925	25.40	23.1902	41400	102200	10500	49.00	54.00	34.9123	28.5877	28.6131
	JLT,JLFT 18 12 †	28.575	38.10	19.05	15.494	31300	51900	10500	55.30	62.10	38.0873	28.5877	28.6131
	JLT,JLFT 18 16 †	28.575	38.10	25.40	21.844	41400	74300	10500	74.80	81.60	38.0873	28.5877	28.6131
31.75	JL,JLF 20 8	31.75	38.10	12.70	10.16	16200	32000	9400	25.00	31.00	38.0873	31.7627	31.7881
	JL,JLF 20 12	31.75	38.10	19.05	16.891	26300	59900	9400	39.00	45.00	38.0873	31.7627	31.7881
	JL,JLF 20 16	31.75	38.10	25.40	22.86	35400	87700	9400	53.60	60.00	38.0873	31.7627	31.7881
	JL,JLF 20 20	31.75	38.10	31.75	29.21	46200	117400	9400	68.20	74.50	38.0873	31.7627	31.7881
34.925	JL,JLF 22 8	34.925	41.275	12.70	10.16	17100	33700	8500	26.80	33.60	41.2623	34.9377	34.9656
	JL,JLF 22 16	34.925	41.275	25.40	22.86	38200	94900	8500	53.60	61.00	41.2623	34.9377	34.9656
	JL,JLF 22 20	34.925	41.275	31.75	29.21	48200	124900	8500	74.50	82.70	41.2623	34.9377	34.9656
38.10	JL,JLF 24 14	38.10	47.625	22.225	18.796	41900	82500	7800	80.90	90.50	47.6123	38.1127	38.1432
	JL,JLF 24 16	38.10	47.625	25.40	21.844	49800	103100	7800	92.50	102.00	47.6123	38.1127	38.1432
	JL,JLF 24 20	38.10	47.625	31.75	28.194	62000	136500	7800	121.00	130.50	47.6123	38.1127	38.1432
44.45	JL,JLF 28 16	44.45	53.975	25.40	21.844	53300	119600	6700	109.00	122.50	53.9623	44.4627	44.4957
	JL,JLF 28 24	44.45	53.975	38.10	34.544	78800	197700	6700	172.00	188.50	53.9623	44.4627	44.4957

* This inspection renders a bush unfit for further use
† JLT,JLFT are equivalent to RL, RLF respectively.

Needle Bushes with Full Complement Grease-retained Needle Rollers (Metric sizes)



SL



CN

Open end type : SL

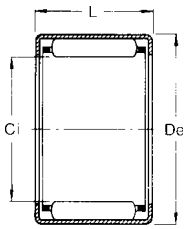
Shaft dia mm	Designation	Ci mm	De mm	L mm	f min mm	Basic capacities Dynamic C Newtons	Basic capacities Static Co Newtons	Limiting speed (oil) rpm	Approx. weight gms	Inspection Gauges* Ring bore mm	Inspection Gauges* GO Plug mm	Inspection Gauges* NO GO Plug mm
8	SL 8 12 8 P	8.00	12	8.00	-	4900	6300	18750	3.20	11.980	8.013	8.031
9	SL 9 14 12	9.00	14	12.00	-	9000	11600	44000	6.40	13.980	9.013	9.028
12	SL 12 20 12	12.00	20.00	12.00	-	12900	15000	25500	15.00	20.000	12.015	12.041
12	SL 12 20 14	12.00	20.00	14.00	27.80	15000	18300	25000	16.50	20.000	12.015	12.041
16	SL 16 22 8.5 P	16.00	22.00	8.50	-	8300	11500	18500	8.00	21.976	16.020	16.038
18	SL 18 16 P	18.00	24.00	16.00	-	18100	32300	16500	19.80	23.972	18.009	18.035
32	SL 32 20	32.00	40.00	20.00	-	36100	72800	12000	57.10	39.987	32.010	32.025
35	SL 35 20	35.00	43.00	20.00	-	41100	88400	8500	53.09	43.000	35.015	35.041
45	SL 45 52 22 P	45.00	52.00	22.00	-	41800	115600	6500	75.00	51.967	45.025	45.038
50	SL 50 58 25 P	50.00	58.00	25.00	-	56600	154500	6000	105.00	57.967	50.020	50.030

Closed end type : CN

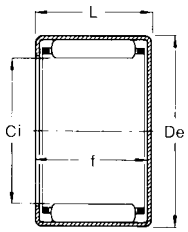
Shaft dia mm	Designation	Ci mm	De mm	L mm	f min mm	Basic capacities Dynamic C Newtons	Basic capacities Static Co Newtons	Limiting speed (oil) rpm	Approx. weight gms	Inspection Gauges* Ring bore mm	Inspection Gauges* GO Plug mm	Inspection Gauges* NO GO Plug mm
7	CN 7 14 12 P	7.00	14.00	12.00	10.80	8200	8000	42800	7.028	13.980	7.013	7.028
10	CN 47 363	10.00	15.00	9.35	7.60	5900	8400	30000	6.50	15.016	10.011	10.260
12	CN 12 10	12.00	18.00	9.95	8.40	8600	11000	25000	9.00	18.016	12.009	12.035
13	CN 90001	13.00	19.00	11.85	9.60	10000	14300	23000	12.70	19.020	13.013	13.031
18	CN 18 13	18.00	24.00	12.80	-	14200	23600	16500	22.00	24.021	18.007	18.033
18	CN 90 040	18.00	24.00	13.50	11.25	13400	23000	16500	11.25	24.020	18.013	18.031

Note:Closed end shape may differ from size to size,therefore ,please consult NRB

Needle Bushes with Cage-Guided Needle Rollers (Inch Sizes)



JV



JVF

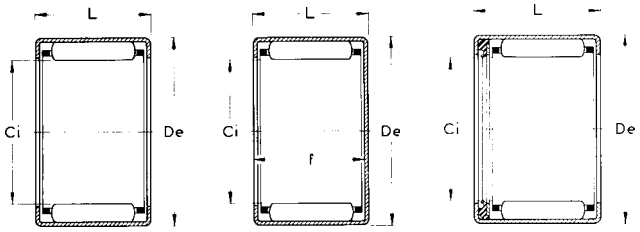
Type : JV, JVF

Shaft dia mm	Designation	Ci mm	De mm	L mm	f mm	Basic capacities Dynamic C Newtons	Basic capacities Static Co Newtons	Limiting speed (oil) rpm	Approx. weight JV gms	Approx. weight JVF gms	Inspection Gauges* Ring bore mm	Inspection Gauges* GO Plug mm	Inspection Gauges* NO GO Plug mm
22.225	JV 14 6.1	22.225	28.575	9.51	-	6800	9000	18000	11.70	-	28.5623	22.2377	22.2631
23.355	JV 90 033	23.355	29.745	9.00	-	8500	13000	17100	12.58	-	29.7450	23.4000	23.4210
25.400	JV 16 6	25.400	31.750	9.525	-	7100	10100	15500	13.20	-	31.7373	25.4127	25.4381
28.575	JV, JVF 18 8	28.575	34.925	12.70	10.414	10700	17700	14000	20.90	25.50	34.9123	28.5877	28.6131
41.160	JV 90 019	41.160	49.319	16.08	-	24500	42500	9000	46.80	-	49.2940	41.1750	41.2010

* This inspection renders a bush unfit for further use

Needle Bushes with Caged-Guided Needle Rollers (Metric Sizes)

Type DB, DB…P
DBF, DBF…P
DB….E, DB…PE



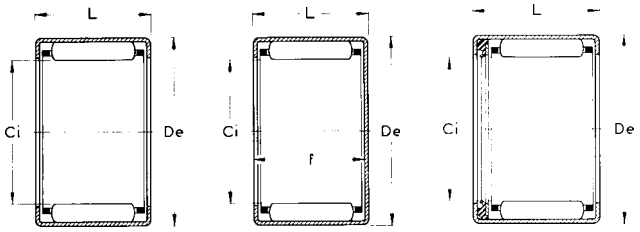
DB, DB...P | DBF, DBF...P | DB...E, DB...PE

Shaft dia	Designation	Ci	De	L	f min	Basic capacities Dynamic C	Static Co	Limiting speed (oil)	Approx. weight DB	DBF	Inspection Gauges* Ring bore	GO Plug	NO GO Plug
mm		mm	mm	mm	mm	Newtons	Newtons	rpm	gms	gms	mm	mm	mm
5	DB 5 8.5 7 P	5.00	8.50	7.00	-	1300	1500	80000	1.30	-	8.4840	5.01	5.028
6	DB 6 10 8 P	6.00	10.00	8.00	-	1650	2030	66000	2.08	-	9.9840	6.01	6.028
7	DB,DBF 7 11 9 P	7.00	11.00	9.00	7.90	2900	3000	57000	2.70	2.90	10.9800	7.0130	7.0310
8	DB,DBF 8 12 8 P	8.00	12.00	8.00	6.90	2700	2800	50000	2.60	2.80	11.9800	8.0130	8.0310
	DB,DBF 8 12 10 P	8.00	12.00	10.00	8.90	3600	4100	50000	3.20	3.40	11.9800	8.0130	8.0310
	DB,DBF 8 10 P	8.00	12.00	10.00	8.90	3600	4100	50000	3.20	3.40	11.9770	8.0090	8.0350
9	DB,DBF 9 13 10 P	9.00	13.00	10.00	8.90	4000	4800	44000	3.50	3.80	12.9800	9.0130	9.0310
	DB,DBF 9 10 P	9.00	13.00	10.00	8.90	4000	4800	44000	3.50	3.80	12.9770	9.0009	9.0360
	DB,DBF 9 13 12 P	9.00	13.00	12.00	10.90	4900	6300	44000	4.10	4.40	12.9800	9.0130	9.0310
	DB 9 16 12 PE	9.00	16.00	12.00	-	4600	3900	50000	8.00	-	15.9800	9.0130	9.0310
	DBF 90 050 P	9.00	16.00	13.90	9.085	3800	4600	44000	-	-	15.9800	9.0130	9.0310
9.551	DBF 90 042 PE	9.551	14.808	10.16	8.735	2500	2500	33000	-	3.45	14.8080	9.5630	9.5860
10	DB,DBF 10 14 10 P	10.00	14.00	10.00	8.90	4200	5200	40000	3.90	4.20	13.9800	10.0130	10.0310
	DB,DBF 10 10 P	10.00	14.00	10.00	8.90	4200	5200	40000	3.90	4.20	13.9770	10.0090	10.0360
	DB 10 14 12 P	10.00	14.00	12.00	-	5100	6800	40000	4.70	-	13.9800	10.0130	10.0310
	DBF 90 051 PE	10.00	14.00	13.30	11.40	4300	5400	32000	-	5.95	13.9800	10.0130	10.0310
	DB 90 020	10.00	14.00	15.00	-	6900	8800	40000	6.00	-	13.9770	10.0050	10.0200
	DB 10 14 15 P	10.00	14.00	15.00	-	6000	8400	40000	5.70	-	13.9800	10.0130	10.0310
	DB 10 14.5 12 P	10.00	14.50	12.00	-	3900	4800	40000	5.54	-	14.4800	10.0130	10.0310
	DB 90 005	10.00	15.00	15.00	-	7100	8600	40000	7.50	-	15.0000	9.97200	9.9900
	DBF 10 15 15 PE	10.00	15.00	15.00	14.25	5000	6600	32000	-	7.50	14.9660	9.96300	9.9810
	DB 90 045 P	10.00	15.00	15.00	-	6900	8400	40000	6.00	-	15.0000	10.0100	10.0310
	DB,DBF 10 12	10.00	16.00	12.00	10.50	5700	6000	40000	7.50	8.20	16.0000	10.0090	10.0360
	DB 90 021	10.00	17.00	15.00	-	7300	6800	40000	9.00	-	16.9920	10.0050	10.0200
12	DB,DBF 12 16 10 P	12.00	16.00	10.00	8.90	4700	6400	33000	4.50	5.00	15.9800	12.0160	12.0340
	DB,DBF 12 10 P	12.00	16.00	10.00	8.90	5200	5400	33000	4.50	5.00	15.9770	12.0090	12.0350
	DBF 90 032	12.00	16.00	14.00	10.90	5800	8400	33000	6.12	-	15.98	12.0160	12.0340
	DB,DBF 12 10	12.00	18.00	10.00	8.50	3900	5000	33000	7.00	7.80	18.0000	12.0090	12.0350
	DB,DBF 12 18 12 P	12.00	18.00	12.00	10.50	6500	7600	33000	8.70	9.50	17.9800	12.0160	12.0340
	DB,DBF 12 12 P	12.00	18.00	12.00	10.50	6500	7600	33000	8.70	9.50	17.9770	12.0090	12.0350
	DB,DBF 12 12	12.00	18.00	12.00	10.50	6300	7300	33000	8.70	9.50	18.0000	12.0090	12.0350
	DB 12 18 16 PEE	12.00	18.00	16.00	-	6000	7300	33300	11.70	-	17.9800	12.0160	12.0340
13	DB,DBF 13 19 12 P	13.00	19.00	12.00	10.50	6800	8200	31000	9.20	10.00	18.9760	13.0160	13.0340
	DB,DBF 13 12	13.00	19.00	12.00	10.50	6800	8100	31000	9.20	10.00	19.0000	13.0090	13.0350
	DBF 90 002	13.00	19.00	12.00	9.60	6800	8200	31000	9.20	10.40	18.9760	13.0160	13.0340
	DB 13 19 14 PE	13.00	19.00	14.00	-	6300	7900	30500	10.80	-	18.9760	13.0160	13.0340
	DB 13 20 12 P	13.00	20.00	12.00	-	7400	8400	30800	10.00	-	19.9760	13.0160	13.0340
13.5	DB 13.5 19 12 P	13.50	19.00	12.00	-	6600	8500	29000	8.66	-	19.0210	13.4850	13.5100
14	DB,DBF 14 20 12 P	14.00	20.00	12.00	10.50	7500	9500	29000	9.80	10.70	19.9760	14.0160	14.0340
	DB,DBF 14 12 P	14.00	20.00	12.00	10.50	11800	18200	29000	9.80	10.70	19.9720	14.0090	14.0350
	DB,DBF 14 12	14.00	20.00	12.00	10.50	6900	8500	29000	9.80	10.70	20.0000	14.0090	14.0350
	DB,DBF 14 20 16 P	14.00	20.00	16.00	14.50	10300	14300	29000	13.00	13.90	19.9760	14.0160	14.0340
	DB 14 20 31 PE	14.00	20.00	31.00	-	12200	17800	28600	26.00	-	19.9760	14.0160	14.0340
15	DB,DBF 15 21 12 P	15.00	21.00	12.00	10.50	7500	9600	27000	10.50	11.50	20.9760	15.0160	15.0340
	DB,DBF 15 12 P	15.00	21.00	12.00	10.50	7400	9400	27000	10.50	11.50	20.9720	15.0090	15.0350
	DB,DBF15 12	15.00	21.00	12.00	10.50	7400	9400	27000	10.50	11.50	21.0000	15.0090	15.0350
	DB 15 21 14 PE**	15.00	21.00	14.00	-	7500	9600	13000	11.30	-	20.9760	15.0160	15.0340
	DB,DBF15 21 16 P	15.00	21.00	16.00	14.50	10500	15000	27000	14.40	15.70	20.9760	15.0160	15.0340
	DB 15 21 18 PE**	15.00	21.00	18.00	-	10500	15000	13000	15.20	-	20.9760	15.0160	15.0340
	DB 15 21 24 PE**	15.00	21.00	24.00	-	12400	18400	13000	20.20	-	20.9760	15.0160	15.0340

* This inspection renders a bush unfit for further use
** Needle Bush with seal on one end

Needle Bushes with Caged-Guided Needle Rollers (Metric Sizes)

Type DB, DB…P
DBF, DBF…P
DB….E, DB…PE



DB, DB...P DBF, DBF...P DB...E, DB...PE

Shaft dia	Designation	Ci	De	L	f min	Basic capacities Dynamic C	Static Co	Limiting speed (oil)	Approx. weight DB	DBF	Inspection Gauges* Ring bore	GO Plug	NO GO Plug
mm		mm	mm	mm	mm	Newtons	Newtons	rpm	gms	gms	mm	mm	mm
16	DB,DBF16 22 12 P	16.00	22.00	12.00	10.50	7800	10300	25000	11.00	12.30	21.9760	16.0160	16.0340
	DB,DBF 16 12 P	16.00	22.00	12.00	10.50	7800	10300	25000	11.00	12.30	21.9720	16.0090	16.0350
	DB 16 22 14 PE	16.00	22.00	14.00	-	7800	10300	25000	12.00	-	21.9760	16.0160	16.0340
	DBF 47 730	16.00	22.00	14.30	12.80	7800	10300	25000	-	14.20	22.0210	16.0050	16.0310
	DB 16 22 16 P	16.00	22.00	16.00	-	11000	16100	25000	14.70	-	21.9760	16.0160	16.0340
	DBF 90 027	16.00	22.00	16.00	14.50	8800	12800	25000	-	16.00	21.9760	16.0160	16.0340
	DBJ 90 036	16.00	22.00	27.00	-	16700	25900	25000	28.00	-	21.9760	16.0160	16.0340
	DBJ 16 22 27 P	16.00	22.00	27.00	-	24800	14600	25000	28.00	-	21.9760	16.0160	16.0340
17	DB,DBF 17 23 12 P	17.00	23.00	12.00	10.50	8000	11000	24000	11.60	13.00	22.9760	17.0160	17.0340
	DB,DBF 17 12 P	17.00	23.00	12.00	10.50	7600	10000	24000	11.60	13.00	22.9720	17.0090	17.0350
	MNJ 671 †	17.00	23.825	17.53	16.00	7400	8600	24000	20.00	-	23.8250	17.0380	17.0640
	DB 17 25 18 PE	17.00	25.00	18.00	-	11900	14800	23500	24.00	-	24.9760	16.9920	17.0100
18	DB,DBF 18 24 12	18.00	24.00	12.00	10.50	8300	11600	22000	12.70	14.30	23.9760	18.0160	18.0340
	DB,DBF 18 12 P	18.00	24.00	12.00	10.50	10500	7800	22000	12.70	14.30	23.9720	18.0090	18.0350
	DB,DBF 18 24 16 P	18.00	24.00	16.00	14.50	11800	18200	22000	17.00	18.60	23.9760	18.0160	18.0340
	DB,DBF 18 16 P	18.00	24.00	16.00	14.50	11800	18200	22000	17.00	18.60	23.9720	18.0090	18.0350
	DB,DBF 18 16	18.00	24.00	16.00	14.50	11400	17600	22000	17.00	18.60	24.0000	18.0090	18.0350
20	DB,DBF20 26 10 P	20.00	26.00	10.00	8.50	6300	8500	20000	11.50	13.50	25.9760	20.0200	20.0410
	DB,DBF 20 26 12 P	20.00	26.00	12.00	10.50	8800	13000	20000	13.80	15.80	25.9760	20.0200	20.0410
	DB,DBF 20 12 P	20.00	26.00	12.00	10.50	8800	13000	20000	13.80	15.80	25.9720	20.0090	20.0350
	DB,DBF 20 12	20.00	26.00	12.00	10.50	8400	12300	20000	13.80	15.80	26.0000	20.0090	20.0350
	DB 20 26 14 PE	20.00	26.00	14.00	-	8600	12100	16000	5.10	-	25.9760	20.0200	20.0410
	DB,DBF 20 26 16 P	20.00	26.00	16.00	14.50	12500	20300	20000	18.40	20.40	25.9760	20.0200	20.0410
	DB,DBF 20 16 P	20.00	26.00	16.00	14.50	12500	20300	20000	18.40	20.40	25.9720	20.0090	20.0350
	DB,DBF 20 16	20.00	26.00	16.00	14.50	12500	20300	20000	18.40	20.40	26.0000	20.0090	20.0350
	DBF 20 26 18 PE	20.00	26.00	18.00	15.30	11300	19000	10000	-	20.50	25.9760	20.0200	20.0410
	DB 20 27 20 P	20.00	27.00	20.00	-	16900	27500	20000	28.00	-	26.9760	20.0200	20.0410
	DBF 90007	20.00	28.00	20.00	18.70	14600	20100	20000	-	33.00	27.9760	20.0200	20.0410
21	DB 21 28 10 P	21.00	28.00	10.00	-	7100	9000	19000	13.00	-	27.9760	21.0200	21.0410
22	DB,DBF 22 28 12 P	22.00	28.00	12.00	10.50	9300	14400	18000	15.00	18.00	27.9760	22.0200	22.0410
	DB 22 28 12 PE **	22.00	28.00	12.00	-	6000	8700	18200	15.00	19.00	27.9760	22.0200	22.0410
	DB,DBF22 12 P	22.00	28.00	12.00	10.50	9300	14400	18000	15.00	18.00	27.9720	22.0090	22.0350
	DB 22 28 14 PE	22.00	28.00	14.00	-	8400	13400	18200	16.00	-	27.9760	22.0200	22.0410
	DB 22 28 16 PEE ††	22.00	28.00	16.00	-	8400	13400	18200	20.00	-	27.9760	22.0200	22.0410
	DB,DBF 22 28 16 P	22.00	28.00	16.00	14.50	13200	22500	18000	20.00	23.00	27.9760	22.0200	22.0410
	DB,DBF 22 16 P	22.00	28.00	16.00	14.50	13200	22500	18000	20.00	23.00	27.9720	22.0090	22.0350
	DB,DBF 22 16	22.00	28.00	16.00	14.50	13200	22500	18000	20.00	23.00	28.0000	22.0090	22.0350
	DB 22 29 30	22.00	29.00	30.00	-	23500	43000	18200	40.00	-	28.9910	22.0070	22.0280
25	DB 25 32 12 P	25.00	32.00	12.00	-	9900	14700	16000	19.70	-	31.9720	25.0200	25.0410
	DB,DBF 25 16 P	25.00	32.00	16.00	14.50	14900	18900	16000	26.00	29.00	31.9670	25.0150	25.0410
	DB 25 32 18 P	25.00	32.00	18.00	-	14300	23800	16000	30.00	-	31.9720	25.0200	25.0410
	DB 25 32 18 PE	25.00	32.00	18.00	-	13700	22400	16000	28.30	-	31.9720	25.0200	25.0410
	DB,DBF 25 32 20 P	25.00	32.00	20.00	18.50	18900	32500	16000	32.00	35.00	31.9720	25.0200	25.0410
	DB,DBF 25 20 P	25.00	32.00	20.00	18.50	18700	32000	16000	32.00	35.00	31.9670	25.0150	25.0410
	DB,DBF 25 16	25.00	33.00	16.00	14.50	15400	22200	16000	30.00	34.00	33.0000	25.0150	25.0410
	DB,DBF 25 20	25.00	33.00	20.00	18.50	20400	32000	16000	37.00	41.00	33.0000	25.0150	25.0410
30	DB 30 37 16 PEE	30.00	37.00	16.00	-	10800	17400	6500	28.20	-	36.9720	30.0200	30.0410
	DB,DBF 30 37 20 P	30.00	37.00	20.00	18.50	20900	39000	13000	38.00	42.00	36.9720	30.0200	30.0410
	DB,DBF 30 20	30.00	38.00	20.00	18.50	22300	37800	13000	45.00	50.00	38.0000	30.0150	30.0410

* This inspection renders a bush unfit for further use
** Needle Bush with seal on one end
† Closed end type Needle Bush with seal
†† Needle Bush with seal on both ends

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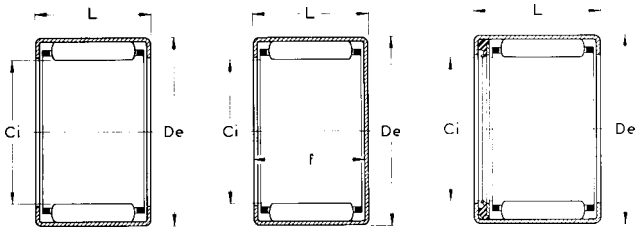
Needle Bushes with Caged-Guided Needle Rollers (Metric Sizes)

Type DB, DB…P
DBF, DBF…P
DB….E, DB…PE



DB, DB...P DBF, DBF...P DB...E, DB...PE

Shaft dia	Designation	Ci	De	L	f min	Basic capacities Dynamic C	Static Co	Limiting speed (oil)	Approx. weight DB	DBF	Inspection Gauges* Ring bore	GO Plug	NO GO Plug
mm		mm	mm	mm	mm	Newtons	Newtons	rpm	gms	gms	mm	mm	mm
35	DB 35 42 12 P	35.00	42.00	12.00	-	11600	19300	11400	34.00	-	41.9720	35.0250	35.0500
	DB 35 42 16 P	35.00	42.00	16.00	-	17400	32400	11400	35.00	-	41.9720	35.0250	35.0500
	DB 35 42 20 P	35.00	42.00	20.00	-	22600	45500	11400	41.47	-	41.9720	35.0250	35.0500
	DB 35 20	35.00	43.00	20.00	-	23900	43500	11400	48.00	-	43.0000	35.0150	35.0410
	DB 35 43 24 PEE	35.00	43.00	24.00	-	24100	43800	5700	55.50	-	42.9580	35.0250	35.0500
40	DB,DBF 40 47 20 P	40.00	47.00	20.00	18.50	23200	49000	10000	49.00	56.00	46.9720	40.0250	40.0500
	DB,DBF 40 20	40.00	48.00	20.00	18.50	26200	51000	10000	55.00	63.00	48.0000	40.0150	40.0410
45	DB,DBF 45 52 16 P	45.00	52.00	16.00	14.50	19000	39600	9000	43.00	53.00	51.9670	45.0250	45.0500
	DB,DBF 45 52 20 P	45.00	52.00	20.00	18.50	25800	58600	9000	54.00	64.00	51.9670	45.0250	45.0500
	DB,DBF 45 20	45.00	52.00	20.00	18.50	25800	58600	9000	54.00	64.00	52.0000	45.0150	45.0410
47	DB,DBF 47 16	47.00	55.00	16.00	14.50	21600	41900	8500	50.00	61.00	55.0000	47.0150	47.0400
50	DB,DBF 50 58 20 P	50.00	58.00	20.00	18.50	29600	64300	8000	70.00	83.00	57.9670	50.0250	50.0500

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BEARINGS WITH CAGE-GUIDED NEEDLES

Caged needle bearings possess an outer ring made from through hardened bearing steel. The cage, guides the needles and retains them in the outer ring.

The bearings may be used without an inner ring if the shaft journal serving as a raceway is of sufficient hardness and has the correct surface finish. To ensure that the full load capacity of these bearings is achieved, a hardness of 58-64 HRC is required. A lower hardness will entail a reduction in the load capacities (both dynamic and static) as shown in table of dimensions (see Technical Section)

TOLERANCES OF THE INNER AND OUTER RINGS

The inner and outer rings of caged bearings are manufactured in conformance with the tolerance class of ISO 1206.

SHAFT AND HOUSING TOLERANCES

TYPES OF BEARINGS

Without inner ring	With inner ring
NB	NBI
RNA	NA
Dimensions of series 49 in accordance with ISO Standard 1206	

For high precision applications, bearing rings can be made to closer tolerances corresponding to classes 6, 5 and 4 of ISO 492 (DIN 620) denoted by symbols P6, P5, P4.

Type of operation	Load direction	Shaft			Housing De [2]
		Without inner ring Ci	With inner ring Di [1]		
			£ 80	85 – 130	
Shaft revolving Housing stationary	Fixed Revolving at shaft speed Indeterminate	h5 g5 g5	k5 h5 k5*	m5 h5 m5*	J6 (J7) M6 (M7) M6 (M7)
Shaft revolving Housing stationary	Fixed Revolving at shaft speed Indeterminate	h5 g5 g5	k5 h5 k5*	m5 h5 m5*	J6 (J7) M6 (M7) M6 (M7)
Shaft & housing revolving	Variable	g5	k6*	m5*	M6 (M7)
Oscillatory	Variable	h5	k5	k5	M6 (M7)

* Class C3 bearing required in these cases.

The cylindrical tolerance defined as the difference in radii of two coaxial cylinders (ISO R 1101) should normally be less than a quarter of the manufacturing tolerance. For high precision or high speed operation it is recommended to reduce this tolerance to one eight of manufacturing tolerance.

[1] Tolerances shown are valid for solid shafts of steel or cast iron. Tighter fits are required for inner rings mounted on hollow or non-ferrous metal shafts.

[2] Tolerances shown are valid for housings of steel or cast iron having rigid walls. Tighter fits are required for outer rings in thin-walled or non-ferrous metal housings.

If shafts or housings are of light alloy and can reach temperatures considerably higher (or lower) than 20°C, allowance should be made for differential expansion (or contraction).

RADIAL PLAY (i.e. RADIAL INTERNAL CLEARANCE)

Bearings without inner ring

Radial play results from the difference between the diameter beneath the needles, which is held within tolerance F6 in accordance with ISO 1206 and the recommended shaft tolerance (g5 or h5). After installation this clearance may be slightly reduced where the outer ring is a tight fit in the housing of tolerance M6 (or M7). Bearings can be supplied with a dimension beneath the needles selected from the lower half of the tolerance F6 (suffix TB) or from the the upper half of the tolerance (suffix TC). See table below:

Nominal dimension Ci mm		Tolerance of diameter under needles		
		Normal F6 µm	Selected TB µm	Selected TC µm
above	to			
3	6	+10 +18	+10 +14	+14 +18
6	10	+13 +22	+13 +18	+17 +22
10	18	+16 +27	+16 +22	+21 +27
18	30	+20 +33	+20 +27	+26 +33
30	50	+25 +41	+25 +33	+33 +41
50	80	+30 +49	+30 +40	+39 +49
80	120	+36 +58	+36 +47	+47 +58
120	180	+43 +68	+43 +56	+55 +68
180	250	+50 +79	+50 +65	+64 +79
Examples of bearings		NB 25 33 20 RNA 4904	NB 25 33 30 TB RNA 4904 TB	NB 25 33 20 TC RNA 4904 TC

Designations for bearings with outer ring that have been manufactured to closer tolerances of classes 6,5 or 4 include the suffix P6,P5 or P4.

Examples: NB 25 33 20 P6, NB 25 33 20 P6 TB, NB 25 33 20 P6 TC.
RNA 4904 P6, RNA 4904 P6 TB, RNA 4904 P6 TC.

BEARINGS WITH INNER RING

Caged bearings with inner rings of standard manufacture have a radial play in the group according to ISO 5753.

By prior agreement bearings can be supplied as follows:

- having a radial play in group 2, smaller than standard (Suffix C2)
- having a radial play in groups 3, 4 or 5, larger than standard to allow for expansion of the inner ring (Suffix C3, C4 or C5)

Within each class, bearings can be supplied with a radial play for reduced overall tolerances (suffix "ZS"). The inner and outer rings of a bearing with reduced radial play "ZS" are matched and if these rings are interchanged with other inner or outer rings, the reduced radial play "ZS" will not be retained. They will, however, remain within limits of standard play for their class.

Complete bearings of which the inner and outer rings are manufactured to tolerance class P6, P5 or P4, and with radial play in class C2, C3, C4 or C5 have designations with the suffix P. Example…P62 refers to a bearing the inner ring and outer rings of which are manufactured to class P6 and with play in class C2.

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Examples of bearing designations

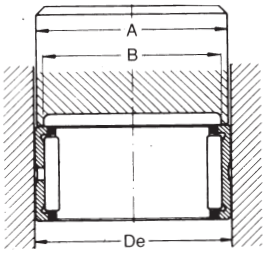
Tolerance of inner and outer rings	Normal Radial play		C2 Radial play	
	Standard tolerance	Reduced tolerance ZS	Standard tolerance	Reduced tolerance ZS
Normal	NBI 20 33 20 NA 4904	NBI 20 33 20 ZS NA 4904 ZS	NBI 20 33 20 C2 NA 4904 C2	NBI 20 33 20 C2 Z NA 4904 C2 ZS
Class P6	NBI 20 33 20 P6 NA 4904 P6	NBI 20 33 20 P6 ZS NA 4904 P6 ZS	NBI 20 33 20 P62 NA 4904 P62	NBI 20 33 20 P62 ZS NA 4904 P62 ZS

Radial play for bearings with inner rings

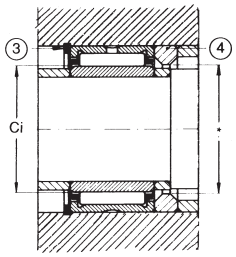
Inner ring		C2 play				normal play				C3 play				C4 play				C5 play			
bore		Interval				Interval				Interval				Interval				Interval			
Di		ZS		standard		ZS		standard		ZS		standard		ZS		standard		ZS		standard	
mm		µm	µm	µm	µm	µm	µm	µm	µm	µm	µm	µm	µm	µm	µm	µm	µm	µm	µm	µm	µm
Above	To	min	max	min	max	min	max	min	max	min	max	min	max	min	max	min	max	min	max	min	max
–	24	10	20	0	30	20	30	10	40	35	45	25	55	45	55	35	65	65	75	55	85
24	30	10	25	0	30	25	35	10	45	40	50	30	65	50	60	40	70	70	80	60	90
30	40	12	25	0	35	25	40	15	50	45	55	35	70	55	70	45	80	80	95	70	105
40	50	15	30	5	40	30	45	20	55	50	65	40	75	65	80	55	90	95	110	85	120
50	65	15	35	5	45	35	50	20	65	55	75	45	90	75	90	65	105	110	130	100	140
65	80	20	40	5	55	40	60	25	75	70	90	50	105	90	110	75	125	130	150	115	165
80	100	25	45	10	60	45	70	30	80	80	105	65	115	105	125	90	140	155	180	145	195
100	120	25	50	10	65	50	80	35	90	95	120	80	135	120	145	105	160	180	205	165	220
120	140	30	60	10	75	60	90	40	105	105	135	90	155	135	160	115	180	200	230	185	250
140	160	35	65	15	80	65	100	50	115	115	150	100	165	150	180	130	195	225	260	210	275
160	180	35	75	20	85	75	110	60	125	125	165	110	175	165	200	150	215	250	285	235	300
180	200	40	80	25	95	80	120	65	135	140	180	125	195	180	220	165	235	275	315	260	330

In cases where an order separately specifies inner rings for a cage-guided needle bearing it is recommended to make reference to the corresponding bearing complete, eg. Inner ring for NBI 20 33 20.

Next

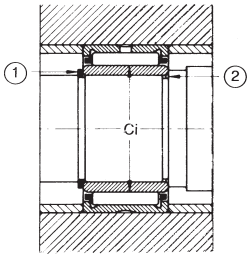


A=De-0.2 to 0.4



*Ci + 0.2 max

1. Snap Ring
2. Groove for extraction tool
3. Snap Ring
4. Guidance ring for inserting shaft



INSTALLATION

Outer rings

The force applied to the face of the outer ring must be exerted only on the area bounded by the outer diameter De and inner diameter B. Under no circumstances must force be applied to the flanges which retain the needle cage.

Where inner or outer rings of small diameter not requiring a tight fit are used, they should be fitted by tightly tapping on a mandrel (see figure). In other cases a press should be used, the force being applied direct on the bearing center line.

Inner rings

The smaller sizes of inner rings are installed in similar manner to that outlined above. Large inner rings having a tight fit should be immersed in an oil bath at 70-80 °C to expand them sufficiently to slide easily into position on the shaft.

AXIAL RETENTION

The outer rings of caged bearings must be retained laterally. This also applies to inner rings if the shaft is of tolerance h5. When the shaft is of tolerance k5, inner rings generally have a sufficiently close fit not to need retention. Any retaining rings used laterally to position the outer ring must have an inside diameter greater than dimension Ci. Similarly, any parts used laterally to position the inner ring must have an outside diameter smaller than dimension Ci.

Such an arrangement prevents any fretting at the faces of the bearings and allows the introduction of the shaft (fitted with inner rings if necessary) through the outer ring installed in its housing.

Retention of outer rings

Whenever possible, the outer rings should be installed in “through bored” housings as these are easier to manufacture accurately than housings with shoulders. Lateral retention of rings can then be ensured by snap - rings, or end caps,etc.

If the housing is not through bored, the bottom of the bore should either include a recess groove or possess a radius less than that of the outer ring.

When installing large parts, particularly when the bearings are not readily accessible or difficult to observe, it is advisable to protect the outer ring by means of a collar having an inner diameter slightly greater than dimension Ci with a large chamfer, through which to guide the shaft during mounting.

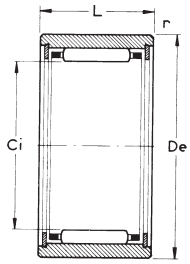
Retention of inner rings

Inner rings may be laterally retained by snap rings. They can also seat against a shoulder on the shaft, provided that the radius between the shoulder and the shaft is smaller than the chamfer on the rings as shown in the table of dimensions. Whenever possible, an extraction groove should also be provided on the shaft. If, however, to maintain the strength of the shaft a large radius is to be machined between the inner ring and the shoulder, thus ensuring accurate face abutment with the inner ring.

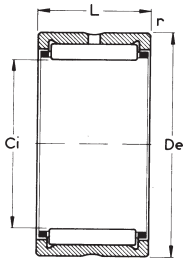
De mm	B mm	De mm	B mm	De mm	B mm	De mm	B mm	De mm	B mm	De mm	B mm
14	12	26	23	37	34	50	46	80	73	110	102
15	13	27	24	38	35	52	48	82	75	115	107
16	14	28	25	39	36	55	51	85	78	120	110
17	15	29	26	40	36	57	53	90	83	125	115
19	17	30	27	42	38	62	56	92	83	130	122
22	19	32	29	45	41	68	61	95	90	140	132
23	20	33	30	47	43	72	66	100	92	150	142
24	21	34	31	48	44	78	71	105	97	-	-

Bearings with Cage-guided needles without inner ring

Type NB, RNA 49 series



Up to Ci = 12 mm



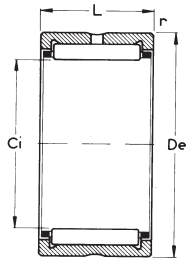
From Ci = 14 mm

Shaft dia	Designation Series NB	Series RNA 49	Ci	De	L	r	Basic capacities Dyn.C	Stat.Co	Limiting speed (oil)	Approx. weight
mm			mm	mm	mm	min mm	Newtons	Newtons	rpm	gms
9	NB 9 16 12		9	16	12	0.35	5000	5500	44000	10.30
	NB 9 16 16		9	16	16	0.35	6300	7300	44000	13.80
10	NB 10 17 12		10	17	12	0.35	4600	5200	40000	11.70
	NB 10 17 16		10	17	16	0.35	6000	7400	40000	15.20
	NB 10 17 16 TB		10	17	16	0.35	6000	7400	40000	15.20
12	NB 12 19 12		12	19	12	0.35	5050	6000	33000	13.30
	NB 12 19 16		12	19	16	0.35	6500	8600	33000	17.50
		RNA 4900	12	22	13	0.35	9700	10800	28500	17.00
14	NB 14 22 16		14	22	16	0.30	12200	14400	28500	21.00
	RNAB 95 027		14	30	16	0.50	18200	28300	28500	65.00
15	NB 15 23 12		15	23	12	0.35	8300	8900	26000	15.00
	NB 15 23 16		15	23	16	0.35	12800	15700	27000	22.30
	NB 15 23 20		15	23	20	0.35	12800	15700	23700	26.60
	NB 15 25 12		15	25	12	0.35	8400	9100	26000	23.80
16	NB 16 23 16		16	23	16	0.35	13700	17400	23700	22.00
		RNA 4901	16	24	13	0.30	10700	12700	25000	19.00
	NB 16 24 16		16	24	16	0.35	13500	17000	25000	23.50
	NB 16 24 22		16	24	22	0.35	13500	17000	25000	31.00
18	NB 18 26 16		18	26	16	0.35	19700	14700	22000	26.00
19	NB 19 27 16		19	27	16	0.35	15200	20800	21000	27.00
	NB 19 27 20		19	27	20	0.35	19400	27500	21000	34.00
20		RNA 4902	20	28	13	0.30	12000	15700	20000	22.50
	NB 20 28 16		20	28	16	0.35	15100	20900	20000	28.00
	NB 20 28 20		20	28	20	0.35	18900	28000	20000	35.50
	NB 20 28 23		20	28	23	0.35	18900	28000	20000	39.70
		RNA 6902	20	28	23	0.35	18700	27600	20000	39.70
	NB 20 30 15		20	30	15	0.35	13500	20100	20000	40.00
	NB 20 33 15		20	33	15	0.35	13500	20100	20000	55.00
21	NB 21 29 16		21	29	16	0.35	15600	22200	19000	29.00
	NB 21 29 20		21	29	20	0.35	20800	31000	19000	37.00
22		RNA 4903	22	30	13	0.30	12900	17600	18000	24.50
	NB 22 30 16		22	30	16	0.35	16100	23500	18000	30.50
	NB 22 30 20		22	30	20	0.35	20200	31400	18000	38.00
	NB 22 30 23		22	30	23	0.35	21100	33200	18000	42.40
24	NB 24 32 16		24	32	16	0.35	17100	26100	16700	33.00
	NB 24 32 20		24	32	20	0.35	21400	34800	16700	41.00
25	NB 25 33 16		25	33	16	0.35	17600	27400	16000	34.00
	NB 25 33 20		25	33	20	0.35	22000	36600	16000	43.00
		RNA 4904	25	37	17	0.30	21700	26200	16000	56.00
26	NB 26 34 20		26	34	20	0.35	22600	38300	15400	44.00
28	NB 28 37 20		28	37	20	0.30	25500	40300	14000	53.00
		RNA 49/22 17	28	39	17	0.35	27000	34500	14000	54.00

* With double row of needle rollers

Bearings with Cage-guided needles without inner ring

Type NB, RNA 49 series

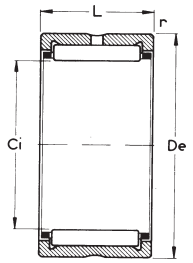


Shaft dia	Designation Series NB	Series RNA 49	Ci	De	L	r min	Basic capacities Dyn.C	Stat.Co	Limiting speed (oil)	Approx. weight
mm			mm	mm	mm	mm	Newtons	Newtons	rpm	gms
29	NB 29 38 15		29	38	15	0.35	14500	25000	13800	40.00
	NB 29 38 20		29	38	20	0.35	25300	40400	13800	54.00
	NB 29 38 30		29	38	30	0.35	41500	73000	13800	82.00
30	NB 30 40 20		30	40	20	0.35	26000	42300	13000	65.00
	NB 30 40 20 P6		30	40	20	0.35	26000	42300	13000	65.00
	NB 30 40 30		30	40	30	0.35	39000	71100	13000	98.00
		RNA 4905	30	42	17	0.30	24300	31900	13000	65.00
	NB 30 42 30*		30	42	30	0.35	53000	122000	13000	130.00
	NB 30 47 30		30	47	30	0.35	47200	64500	13000	185.00
32	NB 32 42 20		32	42	20	0.35	26600	44400	12500	68.00
	NB 32 42 30		32	42	30	0.35	39900	74800	12500	103.00
35	NB 35 45 20		35	45	20	0.35	27800	48300	11000	74.00
	NB 35 45 30		35	45	30	0.35	41700	81400	11000	112.00
		RNA 4906	35	47	17	0.30	26600	37500	11000	75.00
37	NB 37 47 20		37	47	20	0.35	29000	52100	10800	78.00
38	NB 38 48 20		38	48	20	0.35	29600	54000	10500	80.00
40	NB 40 50 20		40	50	20	0.35	30100	56000	10000	83.00
	NB 40 50 30		40	50	30	0.35	45100	94000	10000	125.00
	NB 95 029		40	50	38	0.50	37300	83500	10000	170.00
	NB 40 52 20		40	52	20	0.35	30100	56000	10000	90.00
42	NB 42 52 20		42	52	20	0.35	31300	59800	9500	87.00
		RNA 4907	42	55	20	0.60	35600	57700	9500	115.00
45	NB 45 55 20		45	55	20	0.35	32300	63700	9000	92.00
	NB 45 55 30		45	55	30	0.35	48500	107400	9000	140.00
47	NB 47 57 20		47	57	20	0.35	32900	66100	8500	95.00
48		RNA 4908	48	62	22	0.60	39900	69700	8500	158.00
50	NB 50 62 25		50	62	25	0.65	41400	90800	8000	162.00
	NB 50 62 35		50	62	35	0.65	57800	139400	8000	230.00
	NB 50 65 25		50	65	25	0.65	41400	90800	8000	220.00
	NB 50 68 25		50	68	25	0.65	41400	90800	8000	280.00
50.83	NB 95076		50.83	65.087	22.225	1.50	39235	68492	8000	171.81
52		RNA 4909	52	68	22	0.60	42400	77400	7700	205.00
55	NB 55 68 25		55	68	25	0.65	41400	93600	7000	197.00
	NB 55 68 35		55	68	35	0.65	61000	154500	7000	278.00
58	NB 95 002		58	68	25.5	0.80	41300	9310	6900	205.00
		RNA 4910	58	72	22	0.60	49500	95000	6900	185.00
60	NB 60 72 25		60	72	25	0.65	42500	108100	6700	190.00
	NB 60 72 35		60	72	35	0.65	63100	166000	6700	270.00
63		RNA 4911	63	80	25	1.00	64000	115000	6400	283.00
65	NB 65 78 25		65	78	25	0.85	50600	114800	6000	228.00
	NB 65 78 35		65	78	35	0.85	66100	181100	6000	320.00

* With double row of needle rollers

Bearings with Cage-guided needles without inner ring

Type NB, RNA 49 series

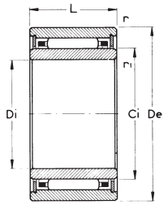


Shaft dia	Designation Series NB	Series RNA 49	Ci	De	L	r	Basic capacities Dyn.C	Stat.Co	Limiting speed (oil)	Approx. weight
mm			mm	mm	mm	mm	Newtons	Newtons	rpm	gms
68	NB 68 82 25		68	82	25	0.85	54000	123000	5900	253.00
	NB 68 82 35		68	82	35	0.85	75000	185000	5900	355.00
		RNA 4912	68	85	25	1.00	66000	124000	5900	300.00
70	NB 70 85 25		70	85	25	0.85	55100	131600	5700	285.00
	NB 70 85 35		70	85	35	0.85	76900	202000	5700	405.00
72		RNA 4913	72	90	25	1.00	63800	124400	5500	345.00
73	NB 73 90 35		73	90	35	0.85	98000	210000	5500	460.00
75	NB 75 92 25		75	92	25	0.85	56000	129000	5300	350.00
	NB 75 92 35		75	92	35	0.85	82200	204400	5300	490.00
80	NB 80 95 25		80	95	25	1.35	73000	148000	5000	294.00
	NB 80 95 35		80	95	35	1.35	103000	220000	5000	410.00
		RNA 4914	80	100	30	1.00	100000	195000	5000	500.00
	NB 80 100 35		80	100	35	1.35	97800	222900	5000	610.00
85		RNA 4915	85	105	30	1.00	103000	205000	4700	530.00
	NB 85 105 35		85	105	35	1.35	100300	235100	4700	650.00
90	NB 90 110 25		90	110	25	1.35	75300	136800	4400	480.00
		RNA 4916	90	110	30	1.00	106000	219000	4400	560.00
	NB 90 110 35		90	110	35	1.35	102800	247400	4400	680.00
95	NB 95 115 26		95	115	26	1.00	77900	145600	4200	470.00

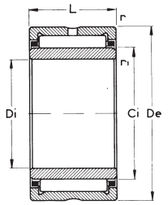
Next

Bearings with Cage-guided needles with inner ring

Type NBI, NA 49 series



Up to Ci = 12 mm



From Ci = 14 mm

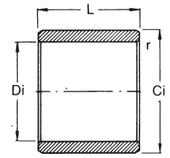
Shaft dia	Designation Series NBI	Designation Series NA 49	Di	De	L	Ci	r min	r1 min	Basic capacities Dyn.C	Basic capacities Stat.Co	Limiting speed (oil)	Approx weight
mm			mm	mm	mm	mm	mm	mm	Newtons	Newtons	rpm	gms
6	NBI 6 16 12		6	16	12	9	0.35	0.20	4900	5500	44000	13.4
	NBI 6 16 16		6	16	16	9	0.35	0.20	6300	7300	44000	18
7	NBI 7 17 12		7	17	12	9	0.35	0.20	4600	5200	40000	15.3
	NBI 7 17 16		7	17	16	10	0.35	0.20	6000	7400	40000	20
9	NBI 9 19 12		9	19	12	12	0.35	0.20	5050	6000	33000	17.7
	NBI 9 19 16		9	19	16	12	0.35	0.20	6500	8600	33000	23.3
10		NA 4900	10	22	13	14	0.30	0.30	9700	10800	28500	24.3
	NBI 95 003 †		10	22	13	14	0.35	0.20	8100	11100	28500	25.8
	NBI 10 22 16		10	22	16	14	0.35	0.30	12200	14400	28500	30
12	NBI 12 23 16		12	23	16	15	0.35	0.20	12800	15700	27000	30
		NA 4901	12	24	13	16	0.30	0.30	10700	12700	25000	27.5
	NBI 12 24 16		12	24	16	16	0.35	0.30	13500	17000	25000	34
13	NBI 13 26 16		13	26	16	18	0.35	0.35	15700	20500	22000	40.5
15	NBI 15 27 16		15	27	16	19	0.35	0.30	15200	20800	21000	40
	NBI 15 27 20		15	27	20	19	0.35	0.30	19400	27500	21000	50
		NA 4902	15	28	13	20	0.30	0.30	12000	15700	20000	36
	NBI 15 28 16		15	28	16	20	0.35	0.35	15100	20900	20000	44.5
	NBI 15 28 20		15	28	20	20	0.35	0.35	18900	28000	20000	56
17	NBI 17 29 16		17	29	16	21	0.35	0.30	15600	22200	19000	43.5
	NBI 17 29 20		17	29	20	21	0.35	0.30	20800	31000	19000	55
		NA 4903	17	30	13	22	0.30	0.30	12900	17600	18000	39
	NBI 17 30 16		17	30	16	22	0.35	0.35	16100	23500	18000	49
	NBI 17 30 20		17	30	20	22	0.35	0.35	17100	26100	18000	61
20	NBI 20 32 16		20	32	16	24	0.35	0.30	21400	34800	16700	49
	NBI 20 32 20		20	32	20	24	0.35	0.30	17600	27400	16700	62
	NBI 20 33 16		20	33	16	25	0.35	0.35	22000	36600	16000	55
	NBI 20 33 20		20	33	20	25	0.35	0.35	21700	26200	16000	69
		NA 4904	20	37	17	25	0.30	0.30	22600	38300	16000	79
22	NBI 22 34 20		22	34	20	26	0.35	0.30	22300	38000	15400	67
		NA 49/22 17	22	39	17	28	0.30	0.30	27000	34500	14000	84
23	NBI 23 37 20		23	37	20	28	0.35	0.35	25500	40300	14000	83
25	NBI 25 38 15		25	38	15	29	0.35	0.35	15500	13200	13800	60
	NBI 25 38 20		25	38	20	29	0.35	0.30	25300	40400	13800	80
	NBI 25 38 30		25	38	30	29	0.35	0.30	41500	73000	13800	120
	NBI 25 40 20		25	40	20	30	0.35	0.35	26000	42300	13000	97
	NBI 25 40 30		25	40	30	30	0.35	0.35	39000	71100	13000	147
		NA 4905	25	42	17	30	0.30	0.30	24300	31900	13000	93
	NBI 25 42 30*		25	42	30	30	0.35	0.35	53000	122000	13000	179
28	NBI 28 42 20		28	42	20	32	0.35	0.30	26600	44400	12500	96
	NBI 28 42 30		28	42	30	32	0.35	0.30	39900	74800	12500	145
30	NBI 30 45 20		30	45	20	35	0.35	0.35	27800	48300	11000	112
	NBI 30 45 30		30	45	30	35	0.35	0.35	41700	81400	11000	170
		NA 4906	30	47	17	35	0.30	0.30	26600	37500	11000	107
32	NBI 32 47 20		32	47	20	37	0.35	0.35	29000	52100	10800	118
33	NBI 33 48 20		33	48	20	38	0.35	0.35	29600	54000	10500	120
35	NBI 35 50 20		35	50	20	40	0.35	0.35	30100	56000	10000	127
	NBI 35 50 30		35	50	30	40	0.35	0.35	45100	94000	10000	192
		NA 4907	35	55	20	42	0.60	0.60	35600	57700	9500	178
37	NBI 37 52 20		37	52	20	42	0.35	0.35	31300	59800	9000	133
40	NBI 40 55 20		40	55	20	45	0.35	0.35	32300	63700	9000	142
	NBI 40 55 30		40	55	30	45	0.35	0.35	48500	107400	8500	215
		NA 4908	40	62	22	48	0.60	0.60	39900	69700	8500	250

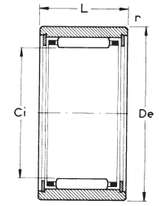
* With double row of needle rollers

† Outer and inner rings separatable type

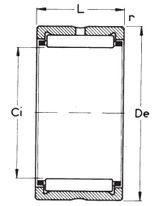
Inner Rings

Type NB, RNA 49 Series





Up to Ci = 12 mm



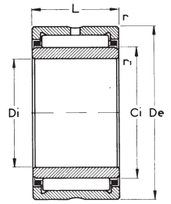
From Ci = 14 mm

Shaft dia Di	Designation	Ci	L	r min	Approx weight	Bearing Reference Series NB	Bearing Reference Series RNA 49
mm		mm	mm	mm	gms		
6	IM 6 9 12 P	9	12	0.20	3.1	NB 9 16 12	
	IM 6 9 16 P	9	16	0.20	4.2	NB 9 16 12	
7	IM 7 10 12 P	10	12	0.20	3.6	NB 10 17 12	
	IM 7 10 16 P	10	16	0.20	4.8	NB 10 17 16	
9	IM 9 12 12 P	12	12	0.20	4.4	NB 12 19 12	
	IM 9 12 16 P	12	16	0.20	5.9	NB 12 19 16	
10	IM 4900	14	13	0.35	7.3		RNA 4900
	IM 10 14 16 P	14	16	0.30	9.0	NB 14 22 16	
	IM 4900	14	13	0.35	7.3	NB 95003	
12	IM 12 15 16 P	15	16	0.20	7.6	NB 15 23 16	
	IM 4901	16	13	0.35	8.5		RNA 4901
	IM 12 16 16 P	16	16	0.30	10.5	NB 16 24 16	
13	IM 13 18 16 P	18	16	0.35	14.5	NB 18 26 16	
15	IM 15 19 16 P	19	16	0.30	12.8	NB 19 27 16	
	IM 15 19 20 P	19	20	0.30	16.0	NB 19 27 20	
	IM 4902	20	13	0.35	13.3		RNA 4902
	IM 15 20 16 P	20	16	0.35	16.5	NB 20 28 16	
	IM 15 20 20 P	20	20	0.35	20.5	NB 20 28 20	
17	IM 17 21 16 P	21	16	0.30	14.3	NB 21 29 16	
	IM 17 21 20 P	21	20	0.30	18.0	NB 21 29 20	
	IM 4903	22	13	0.35	14.9		RNA 4903
	IM 17 22 16 P	22	16	0.35	18.5	NB 22 30 16	
	IM 17 22 20 P	22	20	0.35	23.0	NB 22 30 20	
20	IM 20 24 16 P	24	16	0.30	16.5	NB 24 32 16	
	IM 20 24 20 P	24	20	0.30	20.5	NB 24 32 20	
	IM 20 25 16 P	25	16	0.35	21.0	NB 25 33 16	
	IM 20 25 20 P	24	20	0.35	26.5	NB 25 33 20	
	IM 4904	25	17	0.35	22.5		RNA 4904
22	IM 22 26 20 P	26	20	0.30	22.5	NB 26 34 20	
	IM 49/22 17	28	17	0.35	30.0		RNA 49/22 17
23	IM 23 28 20 P	28	20	0.35	30.0	NB 28 37 20	
25	IM 25 29 25 P	29	20	0.30	20.0	NB 29 38 15	
	IM 25 29 20 P	29	20	0.30	25.0	NB 29 38 20	
	IM 25 29 30 P	29	30	0.30	38.0	NB 29 38 30	
	IM 25 30 20 P	30	20	0.35	32.0	NB 30 40 20	
	IM 25 30 30 P	30	30	0.35	49.0	NB 30 40 30	
	IM 4905	30	17	0.35	27.5		RNA 4905
	IM 25 30 30 P	30	30	0.35	49.0	NB 30 42 30	
28	IM 28 32 20 P	32	20	0.30	28.0	NB 32 42 20	
	IM 28 32 30 P	32	30	0.30	42.0	NB 32 42 30	
30	IM 30 35 20 P	35	20	0.35	38.0	NB 35 45 20	
	IM 30 35 30 P	35	30	0.35	57.0	NB 35 45 30	
	IM 4906	35	17	0.35	32.5		RNA 4906
32	IM 32 37 20 P	37	20	0.35	40.0	NB 37 47 20	
33	IM 33 38 20 P	38	20	0.35	42.0	NB 38 48 20	
35	IM 35 40 20 P	40	20	0.35	44.0	NB 40 50 20	
	IM 35 40 30 P	40	30	0.35	66.0	NB 40 50 30	
	IM 4907	42	20	0.35	63.0		RNA 4907
37	IM 37 42 20 P	42	20	0.35	46.0	NB 42 52 20	
40	IM 40 45 20 P	45	20	0.35	50.0	NB 45 55 20	
	IM 40 45 30 P	45	30	0.35	75.0	NB 45 55 30	
	IM 4908	48	22	0.85	91.0		RNA 4908

Next

Bearings with Cage-guided needles with inner ring

Type NBI, NA 49 series



Shaft dia	Designation Series NBI	Series NA 49	Di	De	L	Ci	r min	r1 min	Basic capacities Dyn.C	Stat.Co	Limiting speed (oil)	Approx weight
mm			mm	mm	mm	mm	mm	mm	Newtons	Newtons	rpm	gms
42	NBI 42 57 20		42	57	20	47	0.35	0.35	32900	66100	8000	148
45	NBI 45 62 25		45	62	25	50	0.65	0.35	41400	90800	8000	230
	NBI 45 62 35		45	62	35	50	0.65	0.65	57800	139400	7700	325
	NBI 45 65 25		45	65	25	50	0.65	0.65	41400	90800	8000	28
		NA 4909	45	68	22	52	0.60	0.60	42400	77400	7000	290
	NBI 45 68 25		45	68	25	50	0.65	0.35	41400	90800	6900	348
50	NBI 50 68 25		50	68	25	55	0.65	0.65	41400	93600	7000	275
	NBI 95 002		50	68	25.5	55	0.65	0.35	37500	93000	6900	290
	NBI 50 68 35		50	68	35	55	0.65	0.65	61000	154500	6700	385
		NA 4910	50	72	22	58	0.60	0.60	49500	95000	6700	295
55	NBI 55 72 25		55	72	25	60	0.65	0.65	42500	108100	6400	275
	NBI 55 72 35		55	72	35	60	0.65	0.65	63100	166000	6000	385
		NA 4911	55	80	25	63	1.00	1.00	64000	115000	6000	420
58	NBI 58 78 35		58	78	25	65	0.85	0.85	50600	114800	5900	355
	NIB 58 78 35		58	78	35	65	0.85	0.85	66100	181100	5900	500
60	NBI 60 82 25		60	82	25	68	0.85	0.85	54000	123000	5900	400
	NBI 60 82 35		60	85	35	68	0.85	0.85	75000	185000	5700	570
		NA 4912	60	85	25	68	1.00	1.00	66000	124000	5700	450
62	NBI 62 85 25		62	85	25	70	0.85	0.85	55100	131600	5500	440
	NBI 62 85 35		62	85	35	70	0.85	0.85	76900	202000	5500	620
65		NA 4913	65	90	25	72	1.00	1.00	63800	124400	5300	480
	NBI 65 90 35		65	90	35	73	0.85	0.85	98000	210000	5300	690
67	NBI 67 92 25		67	92	25	75	0.85	0.85	64000	143000	5000	520
	NBI 67 92 35		67	92	35	75	0.85	0.85	88000	215000	5000	730
70	NBI 70 95 25		70	95	25	80	1.35	1.35	73000	148000	5000	520
	NBI 70 95 35		70	95	35	80	1.35	1.35	103000	230000	5000	720
		NA 4914	70	100	30	80	1.00	1.00	100000	195000	4700	760
	NBI 70 100 35		70	100	35	80	1.35	1.35	88000	220000	4700	920
75		NA 4915	75	105	30	85	1.00	1.00	103000	205000	4400	810
	NBI 75 105 35		75	105	35	85	1.35	1.35	105000	240000	4400	970
80	NBI 80 110 25		80	110	25	90	1.35	1.35	77000	165000	4400	730
		NA 4916	80	110	30	90	1.00	1.00	106000	219000	4400	850
	NBI 80 110 35		80	110	35	90	1.35	1.35	108000	255000	4400	1035

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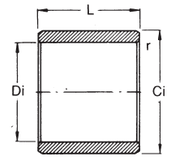
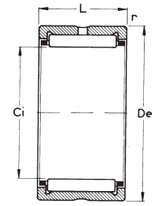
Inner Rings

Type NB, RNA 49 series





Shaft dia Di	Designation	Ci	L	r min	Approx weight	Bearing Reference Series NB	Series RNA 49
mm		mm	mm	mm	gms		
42	IM 42 47 20 P	47	20	0.35	52.0	NB 47 57 20	
45	IM 45 50 25 P	50	25	0.65	69.0	NB 50 62 25	
	IM 45 50 35 P	50	35	0.65	97.0	NB 50 62 35	
	IM 45 50 25 P	50	25	0.65	69.0	NB 50 65 25	
	IM 4909	52	22	0.85	87.0		RNA 4909
	IM 45 50 25 P	50	25	0.65	69.0	NB 55 68 25	
50	IM 50 55 25 P	55	25	0.65	76.0	NB 55 68 25	
	IM 95002 P	55	25.5	0.35	82.0	NB 95002	
	IM 50 55 35 P	55	35	0.65	107.0	NB 55 68 35	
	IM 4910	58	22	0.85	111.0		RNA 4910
55	IM 55 60 25 P	60	25	0.65	84.0	NB 60 72 25	
	IM 55 60 35 P	60	35	0.35	118.0	NB 60 72 35	
	IM 4911	63	25	1.35	135.0		RNA 4911
58	IM 58 65 25 P	65	25	0.85	125.0	NB 65 78 25	
	IM 58 65 35 P	65	35	0.85	177.0	NB 65 78 35	
60	IM 60 68 25 P	68	25	0.85	150.0	NB 68 82 25	
	IM 60 68 35 P	68	35	0.85	210.0	NB 68 82 35	
	IM 4912	68	25	1.35	148.0		RNA 4912
62	IM 62 70 25 P	70	25	0.85	155.0	NB 70 85 25	
	IM 62 70 35 P	70	35	0.85	215.0	NB 70 85 35	
65	IM 4913	72	25	1.35	138.0		RNA 4913
	IM 65 70 35 P	73	35	0.85	225.0	NB 73 90 35	
67	IM 67 75 25 P	75	25	0.85	167.0	NB 75 92 25	
	IM 67 75 35 P	75	35	0.85	235.0	NB 75 92 35	
70	IM 70 80 20 P	80	25	1.35	222.0	NB 80 95 25	
	IM 70 80 35 P	80	35	1.35	310.0	NB 80 95 35	
	IM 4914	80	30	1.35	265.0		RNA 4914
	IM 70 80 35 P	80	35	1.35	310.0	NB 80 100 35	
75	IM 4915	85	30	1.35	280.0		RNA 4915
	IM 75 85 35 P	85	35	1.35	330.0	NB 90 110 25	
80	IM 80 90 25 P	90	25	1.35	245.0		RNA 4916
	IM 4916	90	30	1.35	295.0	NB 90 110 35	
	IM 80 90 35 P	90	35	1.35	350.0		

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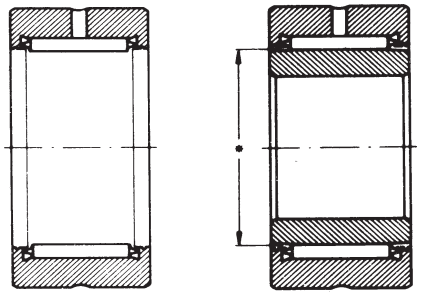
FULL COMPLEMENT NEEDLE BEARINGS

Full complement needle bearings have a through hardened outer ring which results in high static and dynamic load capacities and an ability to withstand overloading, shocks and vibration.

They are particularly suitable for operations involving oscillating motion but may not accept high speed conditions where good alignment is necessary. This can more easily be achieved using a convex inner ring raceway.

The retention of needles in outer ring enables the bearings to be installed easily during assembly.



RNA NA

* Standard convex inner ring R6

These bearings are available with or without an inner ring from 12 mm bore size. Standard complete bearings type NA have an inner ring with convex raceway form. If extra wide inner rings or rings with lubrication hole are required, they should be ordered separately for use with the corresponding RNA series.

FULL COMPLEMENT BEARINGS WITHOUT INNER RING

Standard type RNA (old designation Na…sa/Bi)
Series 1 000, 2 000, 22 000, 3 000

The shaft journal which is used directly as the inner ring raceway of the bearing should have adequate hardness and satisfactory surface finish. A hardness of 58-64 HRC will ensure full load capacity for the bearing. Lower hardness will entail a reduction in both static and dynamic capacities as shown in the table of dimensions (see Technical Section).

In cases of misalignment a convex inner ring raceway can be machined directly at the shaft journal position by grinding, using a concave profile and inclining the diamond impregnated grinding wheel. A convex inner ring raceway calculated to permit misalignment of 1 in 1 000 does not affect bearing load capacity. A larger convex radius is necessary for greater degree of misalignment but this will reduce the effective bearing load capacity. Further information is available on request.

STANDARD TYPES

<table>
<tr><td rowspan="2">Bearings without inner ring</td><td colspan="3">Inner rings with cylindrical raceway</td></tr>
<tr><td rowspan="2">Same width as bearings (with lubrication hole)</td><td colspan="2">Extra wide inner rings [2]</td></tr>
<tr><td rowspan="2">RNA [1] series 1 000, 2 000, 22 000, 3 000</td><td>with lubrication hole</td><td>without lubrication hole</td></tr>
<tr><td>BIC series 1 000, 2 000, 22 000 , 3 000</td><td>BICG</td><td>BIP, BIG, BIK</td></tr>
<tr><td colspan="4">Complete bearings with convex inner raceway</td></tr>
<tr><td colspan="4">NA series 1 000, 2 000 , 3 000</td></tr>
</table>

[1] Old designation Na…sa/Bi

[2] Widths quoted on request

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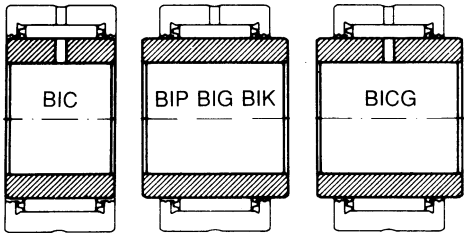
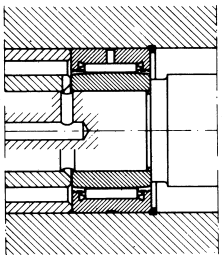




INNER RINGS

Inner rings made from high quality bearing steel heat treated and through hardened avoid any necessity for heat treatment of the shaft and enable the bearings to operate within their full load capacity (with the exception of special convex inner ring).

Inner Rings with convex raceway R6

These inner rings without lubrication hole are of the same width as the outer ring and are supplied with series NA complete, types 1 000, 2 000, 22 000, and 3 000.They can accept a misalignment of 1 in 1 000 in continuous operation and upto 2 in 1 000 temporarily, as in the case of sudden deflection due to overload conditions. The inner and outer rings may be displaced axially from one to the other by up to 5 % of the ring width.

Inner Rings with cylindrical raceway

Cylindrical inner rings of the same bore as those with convex raceway may be supplied on request:

- with oil hole permitting lubrication through the shaft
- wider than corresponding outer ring to enable a displacement in position of one ring relative to the other (e.g. expansion of the shaft) or lateral shaft movement.(Please consult NRB Technical Department).

The use of cylindrical inner rings with standard bearings type RNA series 1 000, 2 000, 22 000 and 3 000 requires that the housing and shaft be correctly aligned at assembly with due regard to the application under load.If it is not essential to use these inner rings, it is always preferable to use complete bearings type NA with convex inner rings type R6, without oil hole, of the same width as the outer ring. In particular cases where lubrication is provided through the shaft, the inner ring with oil hole may be replaced by a lubrication hole at the face of the inner ring (see figure).

RING TOLERANCES

Inner and outer rings for full complement standard needle bearings are manufactured in accordance with the normal tolerance class of ISO 492 (class zero according to DIN 620). Closer tolerances corresponding to classes 6,5 and 4 may be necessary for special high precision applications (symbols P6, P5, P4).

SHAFT AND HOUSING TOLERANCES

Type of Operation	Direction of load	Shaft					Housing [2] Dim De
		Bearings without inner ring Dim Ci	Bearings with inner ring [1] Dim Di				
			< 80	85 - 130	140 - 220	≥ 230	
Shaft rotating	Fixed	h5	k5	m5	n6	p6	J6 (J7)
	Rotating with shaft	g5	h5	h5	h6	h6	M6 (M7)
housing fixed	Unknown	g5	k5*	m5*	n6	p6	M6 (M7)
Shaft fixed	Fixed	g5	h5	h5	h6	h6	M6 (M7)
	Rotating with shaft	h5	k5	m5	n6	p6	J6 (J7)
housing rotating	Unknown	g5	k5*	m5*	n6	p6	M6 (M7)
Shaft and housing rotating	Any direction	g5	k5*	m5*	n6	p6	M6 (M7)
Oscillating motion	Any direction	h5	k5*	m5*	m6	m6	M6 (M7)

*To be used with bearings with selected TC clearance

Cylindrical tolerance ,defined as the difference in radii of two coaxial cylinders (ISO Standard 1101) must normally be less than a quarter of the manufacturing tolerance. In case of precision applications or high speed operation it is recommended to reduce this tolerance to one eight of the manufacturing tolerance.

[1] tolerances applicable for solid shafts in steel or cast iron. The fit of the inner ring should be controlled to closer limits for hallow shafts or shafts of non-ferrous metals.

[2] tolerances applicable for solid shafts in steel or cast iron of rigid wall sections. Housing fit at outer ring should be controlled to closer limits for thin wall sections in non-ferrous metals.

If the housing or shaft are manufactured from light alloys and can reach temperatures greatly in excess or below 20 °C, if necessary to allow for differential expansion or contraction with respect to the accompanying bearing and make the necessary adjustments.

RADIAL PLAY

Bearings without inner ring

The radial play of a bearing without inner ring results from the difference in diameter beneath the needles and the size of the shaft. The standard diameter beneath the needles for RNA bearings with the recommended shaft tolerances should provide suitable radial play for most normal applications.

For special applications (high precision, close fits, etc.), NRB can offer the diameter beneath the needles selected as follows:

- in the bottom half of the normal tolerance (RNA…TB)
- in the upper half of the normal tolerance (RNA…TC)

Bearings without inner ring tolerance Class TB mounted on a shaft with k5 tolerance will have a reduced radial play suitable for certain applications.

A nominal diameter under the needles further reduced and having a tolerance of 10,15, or 20 microns according to size may be required for certain precision applications (Type RNA…TA).

Should a larger clearance than normal be necessary the shaft diameter must be controlled nearer to the nominal size than the tolerance h5 or g5 would normally provide.

Standard complete bearings with inner ring

Complete bearings type NA are offered with radial play that is suitable for a majority of applications. They can be supplied if necessary:

- with the radial play selected from the bottom half of the normal tolerance (NA…TB).
- with the radial play selected from the upper half of the normal tolerance (NA…TC).

For bore dimensions Di >130 mm bearings NA….TB or NA…TC are supplied only on special request.

A reduced radial play in the 10,15 or 20 micron groups, can be supplied for special precision applications (NA…TA..).

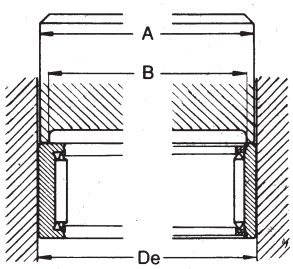
A radial play larger than normal may be necessary for certain applications, for example an inner ring subject to expansion mounted on a shaft running at high temperature (NA…TS…).

INSTALLATION OF RINGS

Outer Rings

The force applied to the face of the ring must be exerted only on the area bounded by the outer diameter De and the inner diameter B. The area of a ring with shoulders must not be subjected to loads or shocks.

It is recommended to use a mandrel with which to tap small outer rings lightly into position. Alternatively, a press may be used, provided the load exerted is on the center line of the ring.



A = De - 0.5 mm

De mm	B mm	De mm	B mm	De mm	B mm	De mm	B mm	De mm	B mm	De mm	B mm
16	13.5	52	46.5	100	90	145	135	205	190	300	280
19	16.0	58	52	105	95	150	138	215	200	315	295
22	18.5	62	55	110	100	155	143	220	205	325	305
24	21.0	65	58	115	105	160	148	230	215	340	315
28	24.0	72	64	120	110	165	153	245	225	350	325
32	27.5	80	71	125	115	170	158	255	235	365	340
35	30.5	85	76	130	120	180	168	265	245	375	350
42	37.0	90	81	135	125	190	175	280	260	385	360
47	41.5	95	85	140	130	195	180	290	270	395	370

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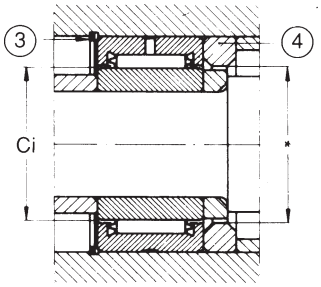
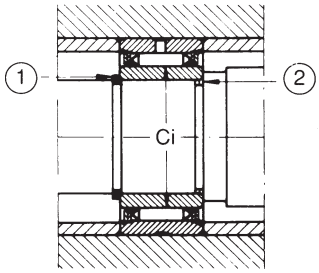


1. Snap ring
2. Groove for extraction tool
3. Snap ring
4. Guidance ring

* Dimention Ci + 0.2 max



Inner Rings

For inner rings of small dimensions one can proceed in the manner described above. For larger sizes where tight fits are required, the rings should first be immersed in an oil bath at a temperature of 70° C to 80° C to enable them to expand and slide more easily upto their correct position on the shaft.

LATERAL RETENTION OF RINGS

Inner and outer rings for NA bearings must be positioned laterally :

- each lateral abutment for the outer rings must have an inner diameter greater than dimension Ci
- each lateral abutment for the inner rings must have an outer diameter smaller than dimension Ci

In this way correct fitting is ensured and fretting at the face of the bearing is avoided.

Fitting of outer rings

Whenever possible outer rings should be installed in through bored housings, which are easier to manufacture in cylindrical form without taper than housings with shoulders. Lateral retention of rings can then be assured by snap rings, etc .

If the housing cannot be through bored, its base must possess grooves for engaging a bearing extraction tool.

For those installations using large components and where bearings are inaccessible or difficult to observe, it is advisable to protect the face of the outer ring on the mounting side by a ring having an internal diameter slightly larger than the dimension Ci and possessing a chamfer to help guide the shaft into position during installation.

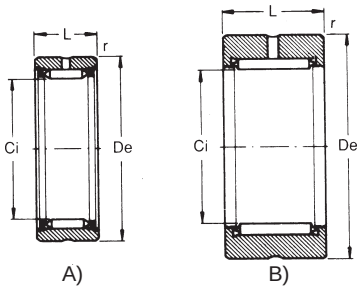
Fitting of inner rings

Inner rings may be positioned laterally by snap rings. They may also be supported by a shoulder on the shaft provided that the shoulder radius is smaller than the chamfer on the ring – shown in table of dimensions. Whenever possible, it is preferable to provide a groove for a bearing extration tool on the shaft. If it is necessary to provide a ring of larger shoulder radius in order to retain the shaft strength, then a ring incorporating a larger chamfer may be placed between the shoulder and the inner ring.

Next

Full complement needle bearings without inner ring

Series RNA 1 000, 2 000
22 000, 3 000



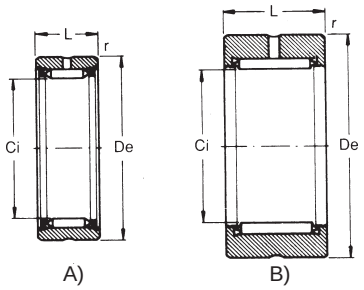
RNA 1 005 to RNA 1 017 are not manufactured with lubrication hole.

1) Old designation Na ...s/Bi

Shaft dia	Designations Series 1000, 2000 22000 fig.A)	Designations Series 3000 fig.B)	Ci	De	L	r min	Basic capacities Dyn.C	Basic capacities Stat.Co	Limiting speed (oil)	Approx. weight
mm			mm	mm	mm	mm	Newtons	Newtons	rpm	gms
7.3	RNA 1 005		7.3	16	12	0.35	3950	4450	52000	10
9.7	RNA 1 007		9.7	19	12	0.35	7260	6070	39000	13
12.1	RNA 1 009		12.1	22	12	0.35	7500	7600	31000	18
14.4	RNA 1 010		14.4	24	12	0.35	8400	9100	26000	20
15.2	RNA 9 5008		15.2	26	26	0.35	29100	45900	25000	65
17.6	RNA 1 012		17.6	28	15	0.35	12900	16700	21600	34
20.8	RNA 1 015		20.8	32	15	0.65	14100	19800	18300	44
22	RNA 22 35 25		22	35	25	0.65	27800	48000	18100	95
22	RNA 95 026		22	35	26.5	0.65	28500	43800	17200	95
22.1	RNA 2 015		22.1	35	22	0.65	25800	38500	17200	82
23.9	RNA 1 017		23.9	35	15	0.65	15200	22800	15900	47
24	RNA 24 37 20		24	37	20	0.65	21000	38500	15800	85
28.7	RNA 1 020		28.7	42	18	0.65	22200	34500	13200	84
	RNA 2 020		28.7	42	22	0.65	29800	50300	13200	104
33.5	RNA 1 025		33.5	47	18	0.65	24100	40300	11100	97
	RNA 2 025		33.5	47	22	0.65	32400	58700	11100	122
	RNA 22 025		33.5	47	30	0.65	47300	95800	11100	170
38.2	RNA 1 030		38.2	52	18	0.65	25900	46000	10000	107
	RNA 2 030		38.2	52	22	0.65	34700	67100	10000	139
	RNA 22 030		38.2	52	30	0.65	50800	109500	10000	193
41.275	RNA 95 074		41.275	56	26	1.50	48400	90800	9200	200
44	RNA 1 035		44	58	18	0.65	54500	28500	8600	127
	RNA 2 035		44	58	22	0.65	37300	77200	8600	160
	RNA 22 035		44	58	30	0.65	54600	125900	8600	225
		RNA 3 030	44	62	30	0.65	58700	123200	8600	309
48	RNA 95 073		48	62	36	1.50	86000	171500	7900	280
49.7	RNA 1 040		49.7	65	18	0.85	29700	59900	7600	160
	RNA 2 040		49.7	65	22	0.85	39800	87300	7600	200
	RNA 22 040		49.7	65	30	0.85	58300	142400	7600	278
		RNA 3 035	49.7	72	36	0.65	76600	180300	7600	545
50	RNA 50 65 25		50	65	25	0.85	42000	110000	7600	235
	RNA 50 68 25		50	68	25	0.85	42000	110000	7600	290
55.4	RNA 1 045		55.4	72	18	0.85	31400	66800	6900	193
	RNA 2 045		55.4	72	22	0.85	42100	97400	6900	242
		RNA 3 040	55.4	80	36	0.85	81100	200800	6900	672
62.1	RNA 1 050		62.1	80	20	0.85	33300	74900	6100	255
	RNA 2 050		62.1	80	28	0.85	55200	143400	6100	375
		RNA 3 045	62.1	85	38	0.85	86000	225500	6100	710
68.8	RNA 1 055		68.8	85	20	0.85	35200	83000	5500	248
	RNA 2 055		68.8	85	28	0.85	58200	158900	5500	361
		RNA 3 050	68.8	90	38	0.85	90800	250100	5500	705

Full complement needle bearings with inner ring

Series NA 1 000, 2 000 3 000



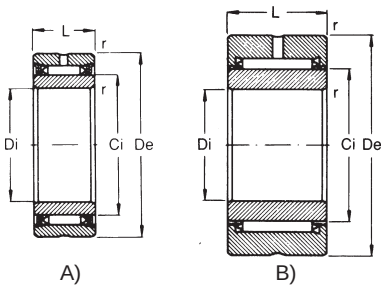
RNA 1 005 to RNA 1 017 are not manufactured with lubrication hole.

1) Old designation Na ...s/Bi

Shaft dia	Designations Series 1000, 2000 fig.A)	Designations Series 3000 fig.B)	Ci	De	L	r min	Basic capacities Dyn.C	Basic capacities Stat.Co	Limiting speed (oil)	Approx. weight
mm			mm	mm	mm	mm	Newtons	Newtons	rpm	gms
72.6	RNA 1 060		72.6	90	20	0.85	36200	87600	5200	283
	RNA 2 060		72.6	90	28	0.85	59900	167700	5200	413
		RNA 3 055	72.6	95	38	0.85	92900	26200	5200	782
78.3	RNA 1 065		78.3	95	20	0.85	37200	93500	4900	306
	RNA 2 065		78.3	95	28	0.85	62000	179900	4900	433
		RNA 3 060	78.3	100	38	0.85	96600	284600	4900	810
83.1	RNA 1 070		83.1	100	20	0.85	39600	103200	4500	322
	RNA 2 070		83.1	100	28	0.85	63900	190900	4500	470
		RNA 3 065	83.1	105	38	0.85	100500	303400	4500	865
88	RNA 1 075		88	110	24	0.85	57300	151200	4300	577
	RNA 2 075		88	110	32	0.85	84200	248400	4300	767
		RNA 3 070	88	110	38	0.85	102900	321200	4300	906
96	RNA 1 080		96	115	24	0.85	59800	164600	4000	510
	RNA 2 080		96	115	32	0.85	87900	270400	4000	694
		RNA 3 075	96	120	38	0.85	107900	351800	4000	1098
99.5	RNA 2 085		99.5	120	32	1.35	89500	279900	3800	787
		RNA 3 080	99.5	125	38	0.85	109400	361900	3800	1220
104.7	RNA 2 090		104.7	125	32	1.35	92100	295600	3600	837
		RNA 3 085	104.7	130	38	1.35	112600	382300	3600	1252
100.5	RNA 95 020		100.5	125	45	1.5	115900	391700	3600	2415
109.1	RNA 2 095		109.1	130	32	1.35	94200	308200	3500	882
		RNA 3 090	109.1	135	43	1.35	131700	474000	3500	1522
114.7	RNA 2 100		114.7	135	32	1.35	96700	323900	3300	677
		RNA 3 095	114.7	140	43	1.35	135200	498200	3300	1551
119.2	RNA 2 105		119.2	140	32	1.35	98500	336500	3200	941
	RNA 3 100		119.2	145	43	1.35	137700	517600	3200	1645
124.7	RNA 2 110		124.7	145	34	1.5	102100	358300	3000	1015
		RNA 3 105	124.7	150	45	1.35	140900	541800	3000	1762
132.5	RNA 2 115		132.5	155	34	1.35	103900	374300	2900	1205
		RNA 3 110	132.5	160	45	1.35	145200	575700	2900	2037
137	RNA 2 120		137	160	34	1.35	105700	386900	2800	1265
		RNA 3 115	137	165	45	1.35	147700	595100	2800	2140
143.5	RNA 2 125		143.5	165	34	1.35	108500	405000	2700	1218
		RNA 3 120	143.5	170	45	1.35	224000	630000	2700	2107
148	RNA 2 130		148	170	34	1.35	110300	417700	2600	1292
152.8		RNA 3 125	152.8	185	52	1.35	187100	760500	2500	3180
158	RNA 2 140		158	180	36	1.35	157000	455000	2400	1478
		RNA 3 130	158	190	52	1.35	275000	790000	2400	3285
170.5	RNA 2 150		170.5	195	36	1.35	118700	481400	2200	1790
		RNA 3 140	170.5	205	52	1.35	198200	849300	2200	3840
179.3	RNA 2 160		179.3	205	36	1.35	170000	515000	2100	1970
		RNA 3 150	179.3	215	52	1.35	203900	891800	2100	4185

Full complement needle bearings with inner ring

Series NA 1 000, 2 000
22 000, 3 000

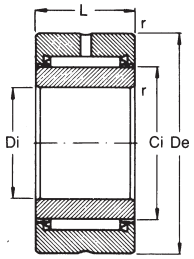


NA 1 012,NA 1 015,NA 1 017 are not manufactured with lubrication hole

Shaft dia	Designations Series 1000, 2000, 22000 fig.A) upto Di=60 fig.B) above Di=60	Series 3000 fig.B)	De	Di	L	Ci	r	Basic capacities		Limiting speed (oil)	Approx. weight
							min	Dyn.C	Stat.Co		
mm			mm	mm	mm	mm	mm	Newtons	Newtons	rpm	gms
12	NA 1 012		12	28	15	17.60	0.35	12900	16700	21600	50
15	NA 1 015		15	32	15	20.80	0.65	14100	19800	18300	62
	NA 2 015		15	35	22	22.10	0.65	25800	38500	17200	117
17	NA 1 017		17	35	15	23.90	0.65	15200	22800	15900	73
	NA 17 37 20		17	37	20	24.00	0.65	21000	38500	15800	120
20	NA 1 020		20	42	18	28.70	0.65	22200	34500	13200	130
	NA 2 020		20	42	22	28.70	0.65	29800	50300	13200	160
25	NA 1 025		25	47	18	33.50	0.65	24100	40300	11100	151
	NA 2 025		25	47	22	33.50	0.65	32400	58700	11100	187
	NA 22 025		25	47	30	33.50	0.65	47300	95800	11100	259
30	NA 1 030		30	52	18	38.20	0.65	25900	46000	10000	167
	NA 2 030		30	52	22	38.20	0.65	34700	67100	10000	213
	NA 22 030		30	52	30	38.20	0.65	50800	109500	10000	293
		NA 3 030	30	62	30	44.00	0.65	58700	123200	8600	497
35	NA 1 035		35	58	18	44.00	0.65	54500	28500	8600	204
	NA 2 035		35	58	22	44.00	0.65	37300	77200	8600	253
	NA 22 035		35	58	30	44.00	0.65	54600	125900	8600	352
		NA 3 035	35	72	36	49.70	0.65	76600	180300	7600	815
40	NA 1 040		40	65	18	49.70	0.85	29700	59900	7600	254
	NA 2 040		40	65	22	49.70	0.85	39800	87300	7600	315
	NA 22 040		40	65	30	49.70	0.85	58300	142400	7600	434
		NA 3 040	40	80	36	55.40	0.85	81100	200800	6900	993
45	NA 1 045		45	72	18	55.40	0.85	31400	66800	6900	306
	NA 2 045		45	72	22	55.40	0.85	42100	97400	6900	381
		NA 3 045	45	85	38	62.10	0.85	86000	225500	6100	1132
50	NA 1 050		50	80	20	62.10	0.85	33300	74900	6100	418
	NA 2 050		50	80	28	62.10	0.85	55200	143400	6100	603
		NA 3 050	50	90	38	68.80	0.85	90800	250100	5500	1220
55	NA 1 055		55	85	20	68.80	0.85	35200	83000	5500	453
	NA 2 055		55	85	28	68.80	0.85	58200	158900	5500	649
		NA 3 055	55	95	38	72.60	0.85	92900	264200	5200	1307
60	NA 1 060		60	90	20	72.60	0.85	36200	87600	5200	485
	NA 2 060		60	90	28	72.60	0.85	59900	167700	5200	695
		NA 3 060	60	100	38	78.30	0.85	96600	284600	4900	1393
65	NA 1 065		65	95	20	78.30	0.85	37200	93500	4900	536
	NA 2 065		65	95	28	78.30	0.85	62000	179900	4900	757
		NA 3 065	65	105	38	83.10	0.85	100500	303400	4500	1488

Full complement needle bearings with inner ring

Series NA 1 000, 2 000 3 000



B)

NA 1 012,NA 1 015,NA 1 017 are not manufactured with lubrication hole

Shaft dia	Designations Series 1000, 2000 fig.B) above Di=60	Series 3000 fig.B)	De	Di	L	Ci	r	Basic capacities		Limiting speed (oil)	Approx. weight
							min	Dyn.C	Stat.Co		
mm			mm	mm	mm	mm	mm	Newtons	Newtons	rpm	gms
70	NA 1 070		70	100	20	83.10	0.85	39600	103200	4500	567
	NA 2 070		70	100	28	83.10	0.85	63900	190900	4500	805
		NA 3 070	70	110	38	88.00	0.85	102900	321200	4300	1568
75	NA 1 075		75	110	24	88.00	0.85	57300	151200	4300	882
	NA 2 075		75	110	32	88.00	0.85	84200	248400	4300	1177
		NA 3 075	75	120	38	96.00	0.85	107900	351800	4000	1923
80	NA 1 080		80	115	24	96.00	0.85	59800	164600	4000	920
	NA 2 080		80	115	32	96.00	0.85	87900	270400	3800	1239
		NA 3 080	80	125	38	99.50	0.85	109400	361900	3700	2025
		*NA 95 020	80	125	45	100.50	1.35	106000	395000	3800	2410
85	NA 2 085		85	120	32	99.50	1.35	89500	279900	3600	1302
		NA 3 085	85	130	38	104.70	1.35	112600	382300	3600	2117
90	NA 2 090		90	125	32	104.70	1.35	92100	295600	3500	1368
		NA 3 090	90	135	43	109.70	1.35	131700	474000	3500	2512
95	NA 2 095		95	130	32	109.10	1.35	94200	308200	3300	1430
		NA 3 095	95	140	43	114.70	1.35	135200	498200	3300	2626
100	NA 2 100		100	135	32	114.70	1.35	96700	323900	3200	1497
		NA 3 100	100	145	43	119.20	1.35	137700	517600	3200	2735
105	NA 2 105		105	140	32	119.20	1.35	98500	336500	3200	1556
		NA 3 105	105	150	45	124.70	1.35	140900	541800	3000	2987
110	NA 2 110		110	145	34	124.70	1.35	102100	358300	3000	1720
		NA 3 100	110	160	45	132.50	1.35	145200	575700	2900	3532
115	NA 2 115		115	155	34	132.50	1.35	103900	374300	2900	2100
		NA 3 115	115	165	45	137.00	1.35	147700	545100	2800	3660
120	NA 2 120		120	160	34	137.00	1.35	105700	386900	2800	2167
		NA 3 120	120	170	45	143.50	1.35	224000	630000	2700	3792
125	NA 2 125		125	165	34	143.50	1.35	108500	405000	2700	2240
130	NA 2 130		130	170	34	148.00	1.35	110300	417700	2600	2325
		NA 3 130	130	190	52	158.00	1.35	275000	790000	2400	5815
140	NA 2 140		140	180	36	158.00	1.35	157000	455000	2400	2643
		NA 3 140	140	205	52	170.50	1.35	198200	849300	2200	6840
150	NA 2 150		150	195	36	170.50	1.35	118700	481400	2200	3230
		NA 3 150	150	215	52	179.30	1.35	203900	891800	2100	7230

* Grease retained needles

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CAM FOLLOWERS

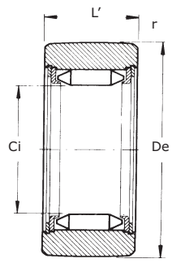
NRB cam followers are designed to run directly on various type of surface such as cams, ramps and slideways.

In order to satisfy the operating conditions imposed on this type of bearing heavy radial loads usually accompanied by substantial and repeated shocks, the various NRB cam followers have these common advantages :

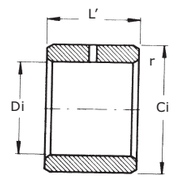
- heavy section outer ring of high strength steel hardened to 58-61.5 HRC
- outer ring possessing no oil hole or lubrication groove, thus preventing the introduction of impurities into the bearing track
- convex outer ring tolerating out-of-parallelism of contact surfaces
- oil holes situated under the needles enabling lubricant replenishment through the shaft
- full complement of needles providing maximum dynamic and static load capacities.

Although the use of a convex outer ring is advisable in many cases, cam followers are also available with cylindrical outer ring for special applications or for use as radial bearings.

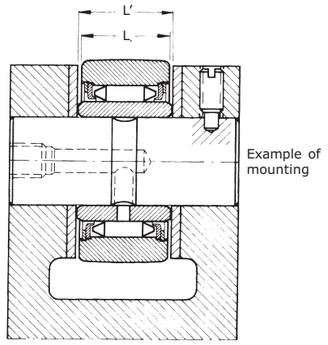
For the use of cam followers with convex outer ring as bearings, please consult NRB Technical Department.



RNA...B6



BIC



Cam Followers Without Inner Ring

Outer Dia. mm	RNA...B6 Series RNA 11 005 B6	RNAB Series	Ci mm	De mm	L Nom. mm	L Tol. mm	r min mm	Basic Capacities when used as a bearing Dyn. C N	Basic Capacities when used as a bearing Stat. Co N	Basic Capacities when used as a follower (1) Dyn. C N	Basic Capacities when used as a follower (1) Stat. Co N	Speed limit for grease(2) r.p.m.	Weight approx g
16	-	RNAB 95 083*	7.02	16	7.7	0 -0.10	0.20	6 400	6 300	5 120	5 040	28 000	13.2
17	-	RNAB 95 082*	8.307	17	6.5	0 -0.10	0.30	6 100	6 100	4 880	4 780	24 000	11.4
19	RNA 11 005 B6	RNAB 11 005	7.3	19	12	0 -0.10	0.35	3 950	2 930	3 700	2 700	31 000	19
20	-	RNAB 95 090*	8.414	20	7	0 -0.10	0.20	6 500	7 400	5 200	6 000	23 000	30.76
22	RNA 11 007 B6	RNAB 11 007	9.7	22	12	0 -0.10	0.35	4 820	3 660	4 380	3 240	23 500	25
24	RNA 11 601 B6	RNAB 14 601	12.1	24	12	0 -0.10	0.35	5 650	4 400	4 550	3 300	19 000	27
28	RNA 11 009 B6	RNAB 11 009	12.1	28	12	0 -0.10	0.35	5 650	4 400	5 450	4 180	19 000	42
32	RNA 11 012 B6	RNAB 11 012	17.6	32	15	-0.20 -0.30	0.35	11 000	9 200	9 000	7 080	14 000	57
35	RNA 11 015 B6	RNAB 11 015	20.8	35	15	-0.20 -0.30	0.65	12 400	10 700	9 250	7 300	12 000	62
42	RNA 11 017 B6	RNAB 11 017	23.9	42	15	-0.20 -0.30	0.65	13 700	12 100	11 800	9 900	10 500	98
47	RNA 11 020 B6	RNAB 11 020	28.7	47	18	-0.20 -0.30	0.65	19 300	18 100	14 400	12 300	8 700	133

Inner Rings

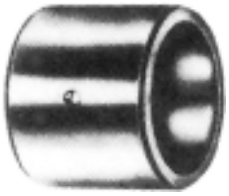
Shaft. Dia. mm	Designation BIC	Ci mm	De mm	L Nom. mm	L Tol. mm	r min mm	Weight approx. g	For follower
12	BIC 1 012	12	17.6	15	-0 -0.10	0.35	16	11012
15	BIC 1 015	15	20.8	15	-0 -0.10	0.65	18	11015
17	BIC 1 017	17	23.9	15	-0 -0.10	0.65	26	11017
20	BIC 1 020	20	28.7	18	-0 -0.10	0.65	46	11020

(1) These capacities are to be use for followers running on cams and having cylindrical or convex outer rings. They allow for the distribution of interal forces due to elastic deformation of the outer rings.

(2) When using oil lubrication this spees can be increase by up to 30% for continuous rotation and up to 50% momentarily.

* Special size for Rocker Arm application. For corresponding shaft & other details, please consult NRB technical department.

INNER RINGS



For a bearing with a given internal diameter there is a choice of inner rings with the same diameter Ci but of different widths. Normally, the width of the inner ring should never be less than that of the bearing. Alternatively cylindrical inner rings wider than the bearing may be used to permit the fitting of a sealing ring, which should be locate on the extended portion at one end of the bearing. In this case, if the inner ring has an oil hole, care should be taken to ensure that the hole does not coincide with the ends of the needles.

Inner rings having the suffix…P, inner rings series 49 and inner rings series 19 000 and 20 600 are not to be used (without first consulting NRB Technical Department) with needles bushes not having the suffix…P, nor with the combined bearings RAX (or RAXF) 700.

The inner rings indicated by an asterisk (*) may be produced with a convex outer diameter under the designation IM…R6. Inner rings IM…R6 are intended principally for use with DL series full complement type needle bushes, to increase the allowable misalignment tolerance and must always be positioned immediately below the needle bush, the maximum axial displacement being 5% of the bearing width.

Inner rings may also be supplied with oil hole (designation IMC).Please consult NRB Technical Department with regard to specific requirements.

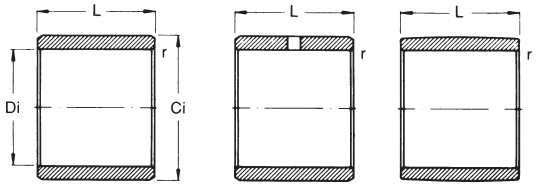
MANUFACTURING TOLERANCES

Inner ring types		Nom dia Di µm	Tolerances			
			Bore Di µm	Width L µm	Out of Round µm	Outer dia Ci
Inner rings listed under their three dimensions	With suffix ...P	to ISO 1206 or ISO 492 normal class (DIN 620 class 0)				h5
	without suffix ...P	8 to 25 30 to 45 50	0/-12 0/-15 0/-15	0/-120 0/-120 0/-120	10 15 18	g5
Inner Rings Series 49		to ISO 1206 or ISO 492 normal class (DIN 620 class 0)				1)
Inner Rings Series IM 19 000 and IM 20 600		17 to 40 45 to 60	0/-10 0/-10	0/-130 0/-160	5 5	µm 0/-5 0/-5

1) Please consult NRB

The following summary tables list the recommended inner rings for bushes, caged needle bearings and combined bearings.

Next



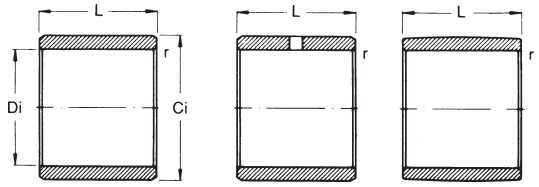
IM, IM...P IMC [1] IM...R6

[1] for inner rings with lubrication hole, IMC series, please consult NRB

Inner Rings - table of dimensions

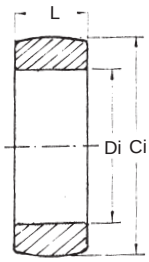
Shaft dia Di	Designation	Ci	L	r min	Approx. weight
mm		mm	mm	mm	gms
6	IM 6 9 12 P	9	12.00	0.20	3.1
	IM 6 9 16 P	9	16.00	0.20	4.2
7	IM 7 10 12 P	10	12.00	0.20	3.6
	IM 7 10 16 P	10	16.00	0.20	4.8
	IM 7 11 9	11	9.00	0.35	4.0
8	IM 8 12 10 P	12	10.00	0.30	4.6
	IM 8 12 12.4*	12	12.40	0.30	5.8
	IM 8 12 16	12	16.00	0.30	7.4
9	IM 9 12 12P	12	12.00	0.20	4.4
	IM 9 12 12.4*	12	12.40	0.20	4.5
	IM 9 12 16 P	12	16.00	0.20	5.9
	IM 9 13 12.4*	13	12.40	0.30	6.4
10	IM 10 14 12.4*	14	12.40	0.30	7.0
	IM 4 900	14	13.00	0.35	7.3
	IM 10 14 16 P	14	16.00	0.30	9.0
	IM 10 14 16.4	14	16.40	0.30	9.2
11	IM 11 15 12.4	15	12.40	0.20	8.0
	IM 11 17 9	17	9.00	0.35	9.3
12	IM 12 15 12.4*	15	12.40	0.20	5.8
	IM 12 15 16 P	15	16.00	0.20	7.6
	IM 12 15 22.4 P	15	22.40	0.20	10.7
	IM 12 16 12.4*	16	12.40	0.30	8.1
	IM 4 901	16	13.00	0.35	8.5
	IM 12 16 16 P	16	16.00	0.30	10.5
	IM 12 16 20 P	16	20.00	0.30	13.2
13	IM 13 17 12.4*	17	12.40	0.30	8.7
	IM 13 17 16.4	17	16.40	0.30	11.5
	IM 13 18 12.4*	18	12.40	0.35	11.2
	IM 13 18 16 P	18	16.00	0.35	14.5
	IM 13 18 16.4*	18	16.40	0.35	15.0
14	IM 14 17 17 P	17	17.00	0.20	9.3
	IM 14 18 20.4	18	20.40	0.30	15.5
15	IM 15 19 16 P	19	16.00	0.30	12.8
	IM 15 19 20 P	19	20.00	0.30	16.0
	IM 15 20 12.4*	20	12.40	0.35	12.7
	IM 4 902	20	13.00	0.35	13.3
	IM 15 20 16 P	20	16.00	0.35	16.5
	IM 15 20 16.4*	20	16.40	0.35	17.0
	IM 15 20 20 P	20	20.00	0.35	20.5
	IM 15 20 20	20	20.00	0.35	20.5
16	IM 16 20 12.4	20	12.40	0.20	11.0
17	IM 17 20 16.4 *	20	16.40	0.20	11.2
	IM 17 20 20.4	20	20.40	0.20	14.0
	IM 19 017	20	27.50	0.20	19.0
	IM 20 617	20	31.50	0.20	21.0

* These inner rings are also available with convex raceway on Ci diameter - designation IM...R6



IM, IM...P IMC [1] IM...R6

[1] for inner rings with lubrication hole, IMC series, please consult NRB



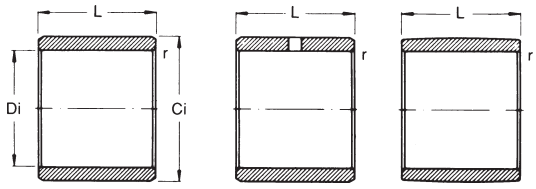
† Special Rings

Inner Rings - table of dimensions

Shaft dia Di	Designation	Ci	L	r min	Approx. weight
mm		mm	mm	mm	gms
17	IM 17 21 16 P	21	16.00	0.30	14.3
	IM 17 21 20 P	21	20.00	0.30	18.0
	IM 4 903	22	13.00	0.35	14.9
	IM 17 22 13 P	22	13.00	0.35	14.9
	IM 17 22 16 P	22	16.00	0.35	18.5
	IM 17 22 16.4*	22	16.40	0.35	18.8
	IM 17 22 20 P	22	20.00	0.35	23.0
	IM 17 22 20.4	22	20.40	0.35	23.5
	IM 17 24 20 P	22	20.00	0.35	35.3
19.05	IM 19.05 26.6 27.5	26.6	27.50	1.00	59.0
19.05	IM 19.05 32 27.5	32	27.50	1.00	112.0
19.349	JR 2014†	27.79	9.30	-	20.0
20	IM 20 24 16 P	24	16.00	0.30	16.5
	IM 20 24 20 P	24	20.00	0.30	20.5
	IM 20 25 16 P	25	16.00	0.35	21.0
	IM 20 25 16.4*	25	16.40	0.35	21.5
	IM 4 904	25	17.00	0.35	22.5
	IM 20 25 20 P	25	20.00	0.35	26.5
	IM 20 25 20.4*	25	20.40	0.35	27.0
	IM 20 25 25	25	25.00	0.35	33.0
	IM 19 020	25	27.50	0.35	38.0
	IM 20 620	25	31.50	0.35	44.0
21.3	JR 2006	29.2	9.60		21.0
21.8	JR 2021	26.986	25.80	-	35.0
21.9	JR 2015†	31.95	10.60	-	33.0
	JR 2017	26.84	33.30	-	40.0
22	IM 22 26 20 P	26	20.00	0.30	22.5
	IM 49/22 17	28	17.00	0.35	30.0
	IM 22 28 20 P	28	20.00	0.35	37.0
23	IM 23 28 20 P	28	20.00	0.35	30.0
	IM 23 28 20.4*	28	20.40	0.35	30.5
25	IM 25 29 15 P	29	15.00	0.35	20.0
	IM 25 29 20 P	29	20.00	0.30	25.0
	IM 25 29 30 P	29	30.00	0.30	38.0
	IM 25 30 12.4 P	30	12.40	0.35	19.7
	IM 25 30 16.4*	30	16.40	0.35	26.5
	IM 4 905	30	17.00	0.35	27.5
	IM 25 30 20 P	30	20.00	0.35	32.0
	IM 25 30 20.4*	30	20.40	0.35	33.0
	IM 25 30 25*	30	25.00	0.35	40.0
	IM 19 025	30	27.50	0.35	42.0
	IM 25 30 30 P	30	30.00	0.35	49.0
	IM 20 625	30	31.50	0.35	52.0
25.544	JR 2016	36.85	15.25	-	64.0
28	IM 28 32 20 P	32	20.00	0.30	28.0
	IM 28 32 30 P	32	30.00	0.30	42.0
30	IM 30 35 16.4*	35	16.40	0.35	31.0
	IM 4 906	35	17.00	0.35	32.5

* These inner rings are also available with convex raceway on Ci diameter - designation IM...R6

† Special rings, please consult NRB



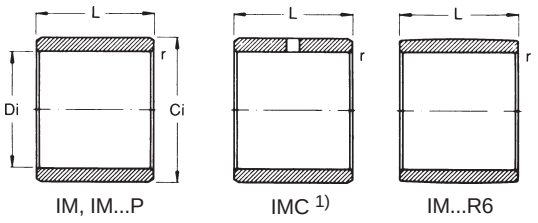
IM, IM...P IMC [1] IM...R6

[1] for inner rings with lubrication hole, IMC series, please consult NRB

Inner Rings - table of dimensions

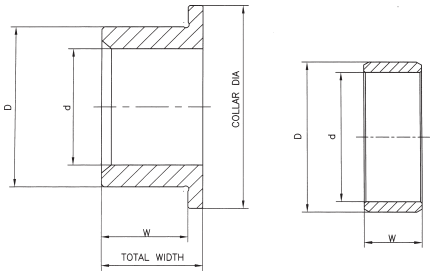
Shaft dia Di	Designation	Ci	L	r min	Approx. weight
mm		mm	mm	mm	gms
30	IM 30 35 20 P	35	20.00	0.35	38.0
	IM 30 35 20.4*	35	20.40	0.35	39.0
	IM 30 35 25	35	25.00	0.35	48.0
	IM 19 030	35	27.50	0.35	53
	IM 30 35 30 P	35	30.00	0.35	57
	IM 20 630	35	31.50	0.35	61
	JR 2026	37	40.50	1.10	115.0
32	IM 32 37 20 P	37	20.00	0.35	40
33	IM 33 38 20 P	38	20.00	0.35	42
35	IM 35 40 16.4*	40	16.40	0.35	36
	IM 35 40 20 P	40	20.00	0.35	44
	IM 35 40 20.4*	40	20.40	0.35	45
	IM 35 40 25	40	25.00	0.35	55
	IM 19 035	40	27.50	0.35	63
	IM 35 40 30 P	40	30.00	0.35	66
	IM 20 635	40	31.50	0.35	72
	IM 4 907	40	20.00	0.85	63
37	IM 37 42 20 P	42	20.00	0.35	46
	JR 2001	55.55	8.80	-	40
38	JR 2013	44.95	27.00	-	90
40	IM 40 44 16.4 *	44	16.40	0.30	32
	IM 40 45 16.4 *	45	16.40	0.35	41
	IM 40 45 20 P	45	20.00	0.35	50
	IM 40 45 20.4 *	45	20.40	0.35	51
	IM 40 45 25 P	45	27.50	0.35	62
	IM 19 040	45	30.00	0.35	69
	IM 40 45 30 P	45	31.50	0.35	75
	IM 40 45 34	45	34	0.30	89
	IM 20 640	45	22.00	0.35	80
	IM 4 908	48	22.00	0.85	91
	JR 2018	49.7	46.00	-	24
42	IM 42 47 20 P	47	20.40	0.35	52
45	IM 45 50 20.4*	50	25.00	0.65	56
	IM 45 50 25 P	50	30.50	0.65	69
	IM 45 50 25	50	34.50	0.65	69
	IM 19 045	50	35.00	0.65	85
	IM 20 645	50	22.00	0.65	96
	IM 45 50 35 P	50	20.40	0.65	97
	IM 4 909	52	22.00	0.85	87
	IM 45 55 40.5	55	40.50	0.50	250
50	IM 50 55 20.4*	55	35.00	0.65	62
	IM 50 55 25 P	55	22.00	0.65	76
	IM 50 55 35 P	55	32.50	0.65	107
	IM 4 910	58	22.00	0.65	111
	IM 19 050	60	25.00	0.65	208
	IM 20 650	60	35.00	0.65	250

* These inner rings are also available with convex raceway on Ci diameter - designation IM...R6



IM, IM...P IMC [1] IM...R6

[1] for inner rings with lubrication hole, IMC series, please consult NRB



** Applicable for Bi type sleeves

Inner Rings - table of dimensions

Shaft dia Di	Designation	Ci	L	r min	Approx. weight
mm		mm	mm	mm	gms
55	IM 55 60 25 P	60	25.00	0.65	84
	IM 55 60 35 P	60	35.00	0.65	118
	IM 4 911	63	25.00	1.35	135
	IM 55 65 40.5	65	40.50	0.50	215
58	IM 58 65 25 P	65	25.00	0.85	125
	IM 58 65 30.2	65	30.20	0.50	160
	IM 58 65 35 P	65	25.00	0.85	177
60	IM 4 912	68	25.00	1.35	148
	IM 60 68 25 P	68	25.00	0.85	150
	IM 60 68 35 P	68	35.00	0.85	210
	IM 60 70 25 P	70	25.00	0.85	190
	IM 19 060	70	32.50	0.85	247
	IM 20 066	70	39.50	0.85	300
62	IM 62 70 25 P	70	25.00	0.85	155
	IM 62 70 35 P	70	35.00	0.85	215
65	IM 4 913	72	25.00	1.35	138
	IM 65 73 35 P	73	35.00	0.85	225
67	IM 67 75 25 P	75	25.00	0.85	167
	IM 67 75 35 P	75	35.00	0.85	235
70	IM 4 914	80	30.00	1.35	265
	IM 70 80 25 P	80	25.00	1.35	222
	IM 70 80 35 P	80	35.00	1.35	310
75	IM 4 915	85	30.00	1.35	280
	IM 75 85 35 P	85	35.00	1.35	330
80	JR 2025	89.96	46.20	1.00	475
	IM 80 90 25 P	90	25.00	1.35	245
	IM 4 916	90	30.00	1.35	295
	IM 80 90 35 P	90	35.00	1.35	350
85	IM 85 95 26 P	95	26.00	1.35	270
	IM 85 95 36 P	95	36.00	1.35	380
	IM 4 917	100	35.00	1.85	570
90	IM 90 100 26 P	100	26.00	1.35	290
	IM 90 100 36 P	100	36.00	1.35	400
95	IM 95 105 26 P	105	26.00	1.35	300
	IM 95 107 32 P	107	32.00	1.35	450
100	IM 100 110 30 P	110	30.00	1.85	360

* These inner rings are also available with convex raceway on Ci diameter - designation IM...R6

Sleeves: Bi type **

Shaft dia d	Designation	D	W	Collar dia	Total width
mm		mm	mm	mm	mm
15	Bi 95 001	21	5.4	-	-
24.7	Bi 95 007	31.25	26.3	-	-
35.1	Bi 95 032	40.2	29.25	-	-
40	Bi 95 070	80	31.4	62.8	34.75
44.1	Bi 95 005	62	33	78.5	38.65
47	Bi 95 063	66	36	85	42
55	Bi 95 006	68	35.4	82.5	39.5

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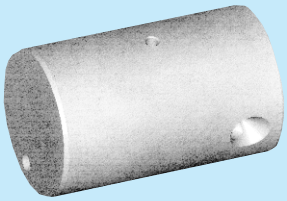
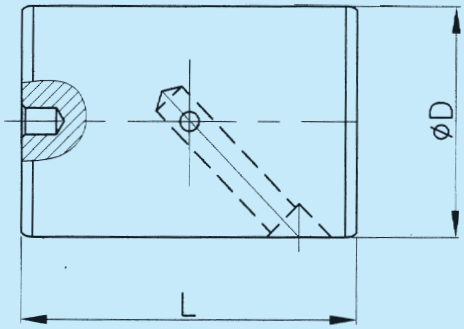
CRANK PINS

NRB crank pins are high precision components which are used in the connnecting rod bearing arrangement at the big end position of 2-stroke and 4-stroke engines.

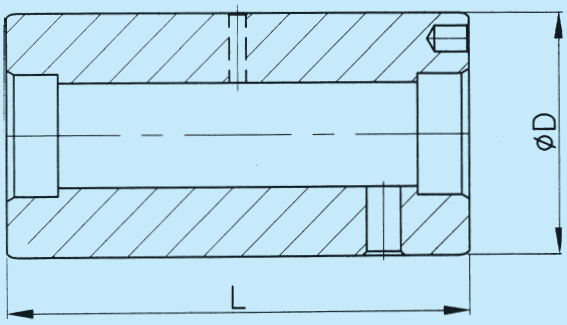
Crank pins undergo the severe operating conditions of particular load, high temperatures and adverse lubrication. The application demands the use of very high quality crank pins.

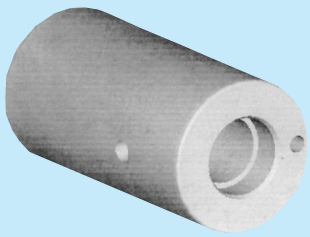
Design, raw material, heat treatment parameters, surface finish values and form tolerances of NRB crank pins confirm to OE specifications.





Cross hole type crank pin





Straight hole type crank pin

Next

CRANK PINS

Designation	Size [1] (Dia x Length)	Customer	Vehicle
SH 1103	22 x 38.95	Bajaj Auto Ltd	Chetak/Cub / Super/Stride/150cc
SH 1104	18 x 35.90	"	M80
SH 1114	22.004 x 38.50	"	4S - Motorcycle
SH 1115	22 x 46.30	"	KB 100
SH 1116	22 x 33.95	"	3 Wheeler
SH 1121	16 x 36	"	Sunny
SH 1127	20 x 42	"	M80 - 4S, Saffire
SH 1128	30 x 45.50	"	3 Wheeler - 4S
SH 1129	28 x 42.50	"	Legend
SH 5102	26 x 38.5	"	Caliber, Boxer, Aspire, Champion
SH 5113	28 x 54	"	Eliminator
SH 5114	28 x 46.3	"	Wind
SH 5115	25 x 42	"	CS Project
SH 5125	25 x 46	"	CS Project, Wave
SH 5117	30 x 54	"	Omega Project
SH5126	30 x 54	"	Pulsar
SH 5127	30 x 52.1	"	CN Project
SH 5148	26 x 49.7	"	GF Project
SH 1101	22 x 45	Yahama Motorcycle	Rajdoot-175/ Rajdoot GTS
SH 1101 A	22 x 51	"	350 cc
SH 1101 B	22 x 54.70	"	RX - 100
SH 1101 C	22 x 54.70	"	RXG-135/ RXZ-135
SH 1102	29 x 46	"	YBX 100 / Enticer
SH 5101	26 x 46	"	Crux
SH 1112	25.1 x 39	Hero Honda	CD 100 / Sleek/ Street / Dawn / Passion
SH 1113	16 x 35	Hero Motors	Puch 65 cc
SH 5103	25.1 x 39.2	Honda Motorcycle & Scooter	Activa (100 cc Scooter)
SH 5124	28 x 46.5	"	Eterno, (SC 150)
SH 5130	28 x 47	"	Unicorn
SH 1108	16 x 33	Kinetic Engineering	Luna
SH 1112 A	25.1 x 39	"	K4 / 100 Motorcycle
SH 1119	16 x 30	"	Spark
SH 1124	16 x 34.8	"	Safari
SH 5131	30 x 53	"	GF 170
SH 5132	20 x 39	"	Velocity 115
SH 5133	25.1 x 39	"	Boss
SH 5144	30 x 53	"	150cc millennium scooter
SH 1109	18 x 47.30	Kinetic Motor Co.	Kinetic Honda 100 cc
SH 1103 A	22 x 38.90	LML	Vespa/ PX150
SH 1103	22 x 38.95	Maharashtra Scooters	Priya 150
SH 1118	14.11 x 36	Majestic Auto	Ankur /Pacer / Panther
SH 1105	22 x 50	"	Shogun
SH 1106 (old)	16 x 32.70	TVS	XL50 / XL60 / Scooty
SH 1107 (old)	20 x 50	"	MAX 100 / MAX 100R / Samurai
SH 5104 (new)	16 x 32.70	"	Scooty
SH 5105 (new)	22 x 50	"	AX-100
SH 5112	23.1 x 40	"	Scooty
SH 5106	28 x 53	"	Fiero
SH 5118	28 x 53	"	Fiero ES
SH 5108	26 x 42	"	Victor
SH 5116	23.1 x 40	"	N8/N9
SH 5128	25.1 x 42	"	Star / Centra / N14
SH 5129	28 x 47	"	3-Wheeler
SH 5134	28 x 42	"	Victor Edge / GLX
SH 5140	25 x 47.5	"	N36 (3-Wheeler)
SH 5149	28 x 42	"	110cc Step Through Bike
SH 5139	10 x 27.8	Electrolux outdoor products Italy	

[1] Dia over size crank pins are also available

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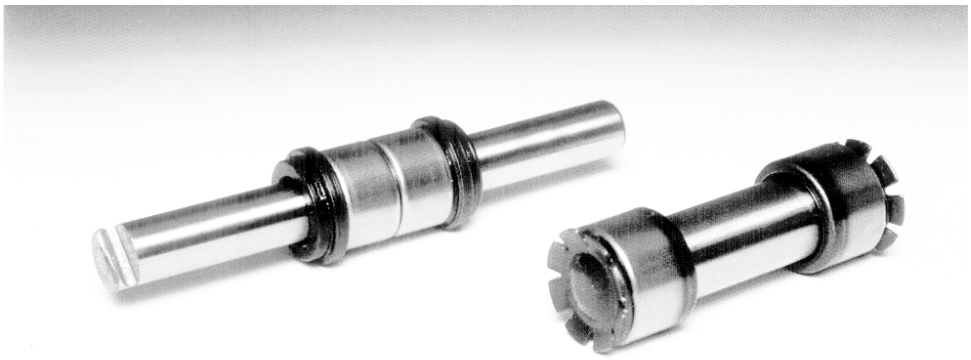
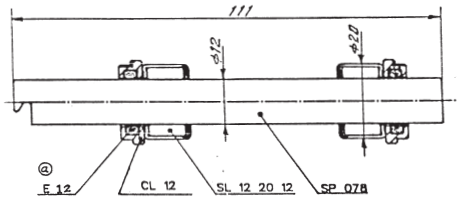
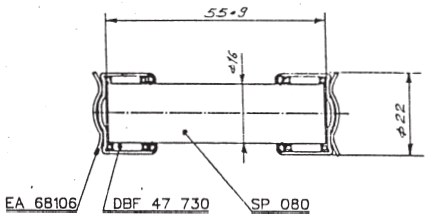
HUB PIN KITS



Hub Pin Kits consist of a precision ground shaft having one needle bush fitted at each end. Hub Pin Kits are available with seals depending on the application. It is used in Scooters and Three wheelers.



SP90014/12, for Bajaj Scooter



SP90014/16, for LML Scooter

Hub Pin Reference	Customer	Vehicle
SP90014/12	Bajaj	Scooter and Three wheeler
SP90014/20	Bajaj	Classic
SP90014/18	Greaves	Garuda
SP90014/16	LML	Scooter
SP90014/16/S*	LML	Scooter
SP90014/22	Bajaj	Bravo
SP90014/24	Bajaj 3 W	4S- Eng.

* Hub Pin Kit with seals

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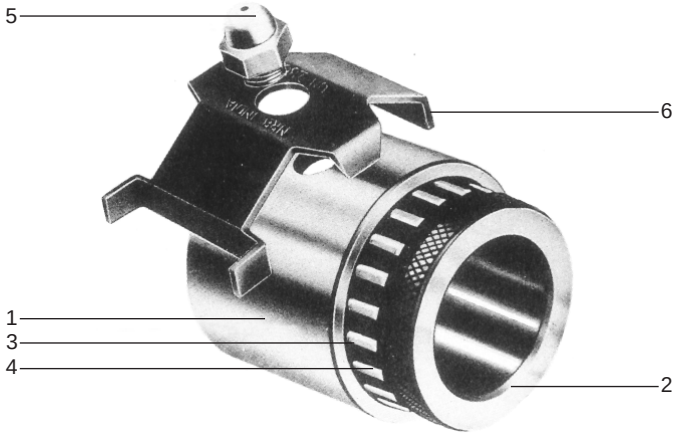
BOTTOM ROLLER BEARINGS



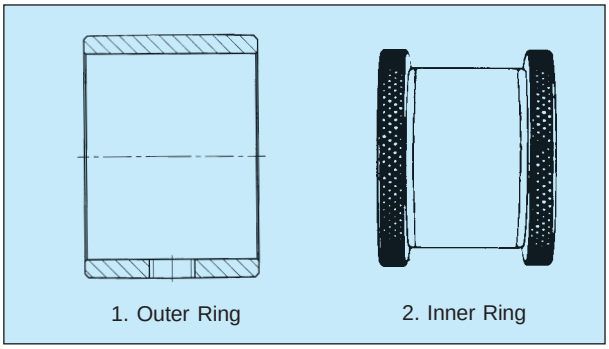
NRB manufactures a wide range of Bottom Roller Bearings for supporting bottom rollers in Ring spinning frames and Speed frames of textile industry.

NRB Bottom Roller Bearings conform to International Standards. Holders (locating caps) for these bearings are made suitable for various sizes of roller stands. Special sizes of Bottom Roller Bearings are also manufactured as per customer's requirements.

FEATURES

NRB Bottom Roller Bearings – UN Series are specially constructed Needle Roller Bearings for long and trouble free service. Every component of the bearing is manufactured to strict quality norms. The stringent limits of manufacture ensure the running accuracy of the bearing.

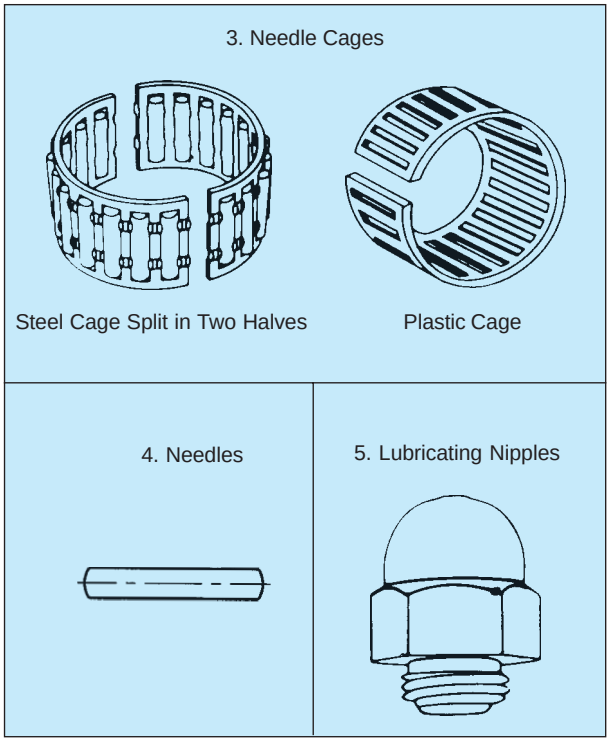
The outer ring (1) of the bearing is crowned to accommodate some misalignment in the Roller Stands. Crowning also helps in preventing early failure of the bearing by distributing the load uniformly.



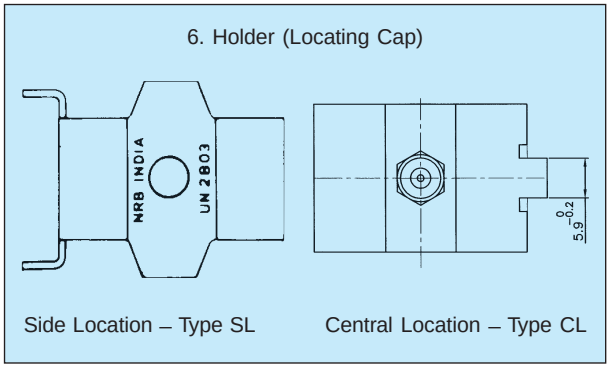
The inner ring (2) has knurling on its flanges, which provides an effective seal to prevent entry of fibres in the bearing and protect it from damage.

NRB Bottom Roller Bearing – UN Series incorporates a steel cage split in two halves or plastic cage (3). The design of cage pockets ensures that the needles (4) do not fall and also give them positive and accurate guidance.

Lubrication to the bearing is effected through the grease nipple (5).



The bearing is secured on the roller stand very easily by a holder (locating cap) (6). Holder (locating cap) in different designs as per customer's requirement can be supplied.



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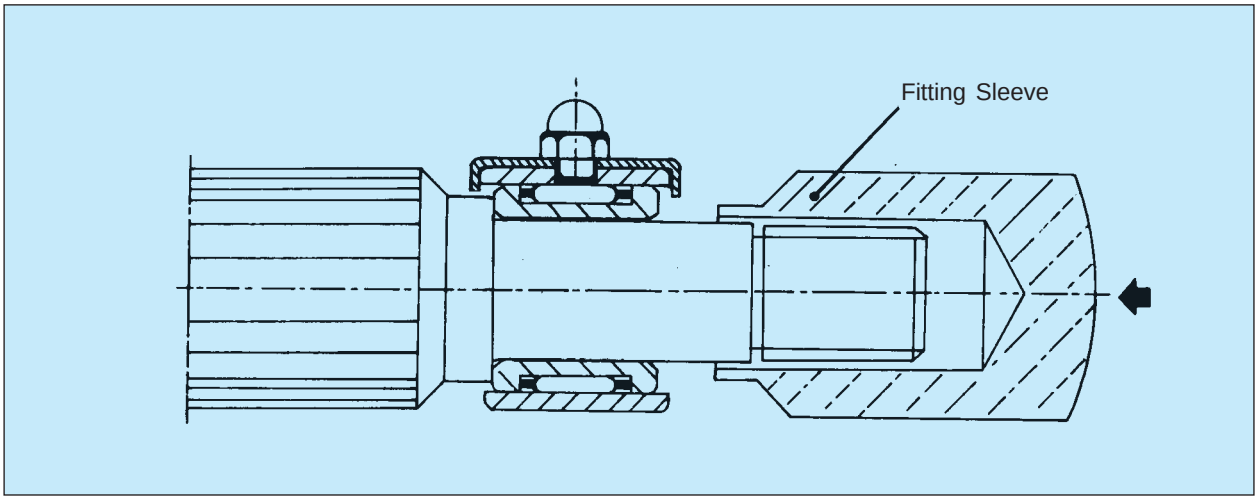


MOUNTING

To mount the bearings on the Bottom Rollers, we recommend the following:

1. Light mineral oil should be applied on the journal seating. Care should be taken to ensure that the faces and journals of the Bottom Rollers are neither damaged nor dirty.
2. The inner ring is a press fit on the journal. A special tubular dummy should be placed against the inner ring face and the force for mounting should be applied uniformly (use of a pneumatic cylinder is advisable) until the bearing ring abuts the face of the Bottom Roller. No sharp tool or pointed edge should be used against the Bearing ring face.
3. After the Rollers are placed on the stands and the holders are in position, the alignment in the longitudinal direction should be checked to ensure true running. Excessive misalignment can reduce the service life of the bearings.

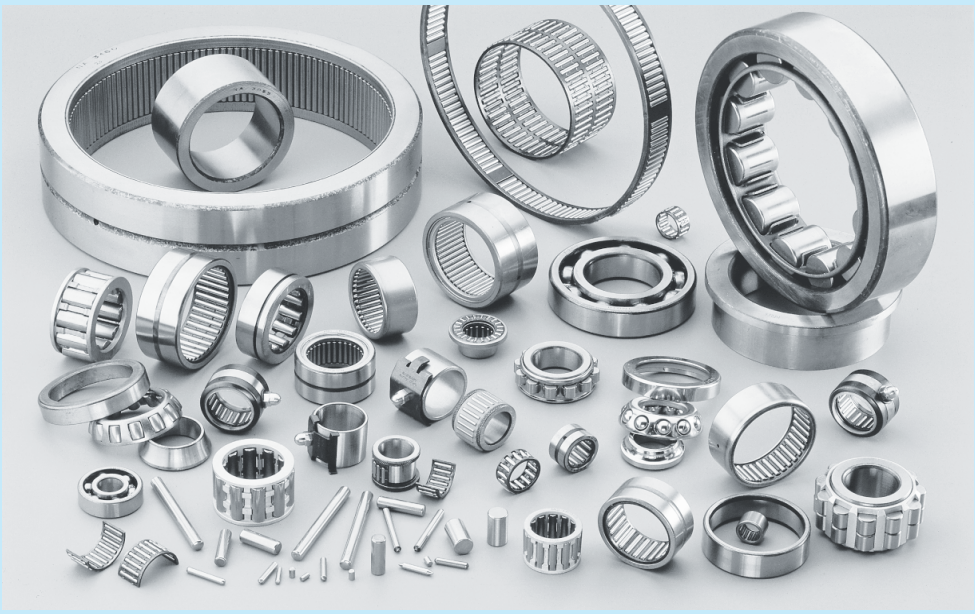
LUBRICATION

On delivery, NRB Bottom Roller Bearings are supplied with a rust preventive oil and are not greased. Therefore, all bearings should be greased before use.

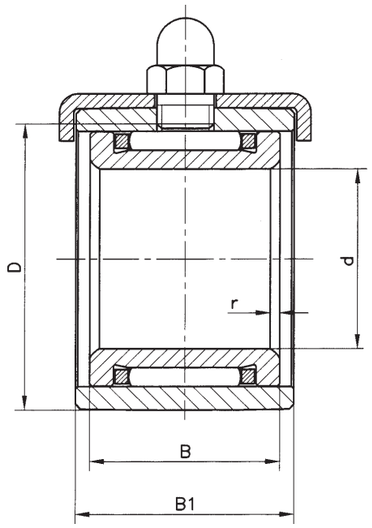
We recommend the use of good quality lithium base grease of consistency to NLGI 2.

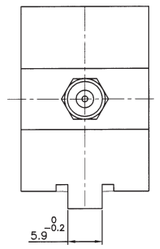
Relubrication frequency depends on the operating conditions and can vary from mill to mill. However, relubrication interval between 1500 to 3000 operating hours can be taken as a guide line.

It is recommended to relubricate the bearing while the bottom rollers are revolving and it is very important to ensure that the same grease is used, which was used at the time of initial greasing.

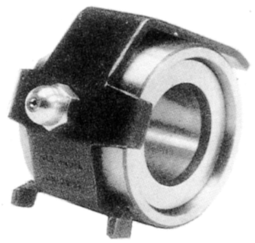


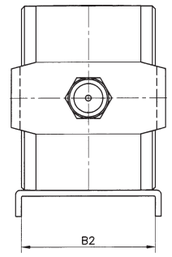
Other Bearings used in the Textile Industry





Holder Central Location – Type CL





Holder Side Location – Type SL

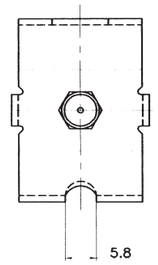


Fig 1

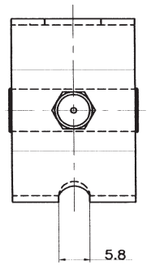
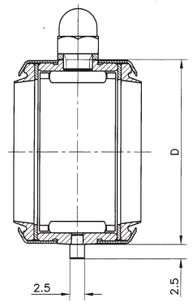


Fig 2



Holder Pin – Type Pin

Journal Dia (mm)	NRB No.	Equivalant		d	D	B	B1	r*	Holder**	B2	C	Co
		SKF No.	INA No.	(mm)	(mm)	(mm)	(mm)	(mm)	Type	(mm)	Newtons	Newtons
14.2	UN 2813	UL 112 - 28	–	14.2	28	16.6	23	0.5	SL	22.2	9900	14100
16.5	UN 2803	–	UW 2128.20	16.5	28	19	22	0.6	SL	20.0	9900	14100
16.5	UN 2804	–	UWL 2800	16.5	28	19	22	0.6	CL	–	9900	14100
16.5	UN 2809	–	UW 2128.22	16.5	28	19	22	0.6	SL	22.0	9900	14100
16.5	UN 2821	–	UW 2128.22	16.5	28	19	22	0.6	SL	22.0	9900	14100
16.5 [1)]	UN 2810	–	UW 2128.22	16.5	28	19	22	0.6	SL	22.0	9900	14100
16.5	UN 2814	UL 2528 - 0 000417	–	16.5	28	19	23	0.6	SL	22.2	9900	14100
16.5	UN 2822	UL 2800 - 00417	–	16.5	28	19	23	0.6	SL	22.3	9900	14100
16.5	UN 3229	–	–	16.5	32	19	23	0.6	SL	22.2	9700	14200
16.5	UN 2815	UL 2800 - 100 80	–	16.5	28	23	23	0.5	SL	24.0	9900	14100
16.5	UN 3001	–	–	16.5	30	19	23	0.6	SL	22.0	9900	14100
17.0	UN 3203	–	–	17.0	32	22	25	0.4	SL	20.4	15800	20000
17.0	UN 3204	–	–	17.0	32	22	25	0.4	SL	20.4	15800	20000
18.5	UN 3003	UL 30 - 0 007 871	UWL 3000	18.5	30	19	22	0.6	CL	–	9000	12700
18.5	UN 3003 D3	–	–	18.5	30	19	22	0.6	SL	22.2	9000	12700
19.0 [2)]	UN 3209	–	UW 2132.22	19.0	32	20	23	0.25	SL	22.2	12200	19200
19.0 [2)]	UN 3230	–	UW 2132.22	19.0	32	20	23	0.25	SL	22.2	12200	19200
19.0 [2)]	UN 3210	–	UWL 3200	19.0	32	20	23	0.25	CL	–	12200	19200
19.0 [2)]	UN 3211	–	UW 2132.20	19.0	32	20	23	0.25	SL	20.0	12200	19200
19.0 [2)]	UN 3213b	–	UWL 3200	19.0	32	20	23	0.25	CL	–	12200	19200
19.0 [3)]	UN 3224	–	–	19.0	32	20	23	0.6	SPECIAL [(fig. 1)]	–	12200	19200
19.0 [3)]	UN 3225	–	–	19.0	32	20	23	0.6	SPECIAL [(fig. 2)]	–	12200	19200
19.0	UN 3233	UL 3200 - 0 0421	–	19.0	32	20	24	0.6	SL	22.3	12200	19200
19.0	UN 3233B	–	–	19.0	32	20	24	0.6	CL	-	12600	17000
24.0	UN 3216	–	F - 18636	24.0	32	–	22	–	PIN	–	10600	16400
24.0	UN 3235	–	–	24.0	32	–	22	–	CL	–	11000	17500

Note :* r : max. shaft fillet radius
** Holder type : design features of holders can vary from bearing to bearing. Pictures shown above indicate the basic type of holders.
Equivalent SUESSEN bearing no. [1)] UZ 2808, [2)] UZ 328, [3)] UZ 3202

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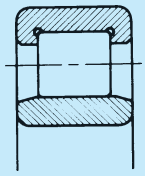
CYLINDRICAL ROLLER BEARINGS

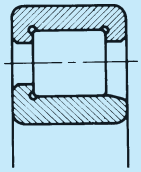
NRB cylinderical roller bearings are most suitable for high radial loads and capable of operating at high speeds. Thermal expansion of the shaft in axial direction is best taken care of by using a cylindrical roller bearing with plain inner ring (type NU) or plain outer ring (type N). The cage and roller assembly with two ribbed rings (either the inner or outer) is separable from the other ring, and thus can be mounted independently. This feature simplifies the mounting of a cylindrical roller bearing when interference fit is to be considered for both the inner and outer rings.

Type NU



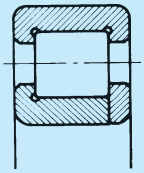
Does not provide axial location to the shaft.

Type NJ



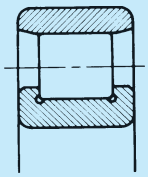
Shaft axial location in one direction

Type NUP



Shaft axial location in both directions

Type N



Does not provide axial location to the shaft

BEARING TYPES

The various types of cylindrical roller bearings differ by the rib arrangement.

Selection of a particular type of bearing depends on the assembly requirements and the bearing mounting procedures. Type NJ can support light thrust load in one direction while type NUP can support light thrust load in both directions - please consult NRB for details.

NRB also manufactures special types of cylindrical roller bearings as per the specific requirements of the customers. Refer to the table of dimensions - **Special sizes**. *Please consult NRB before selecting a bearing from the list of special sizes for new applications.* NRB would be pleased to develop new sizes as per the specific requirements provided the quantities are large.

SUFFIXES

C2	Radial internal clearance less than Normal marked C2
CN	Normal grade of radial internal clearance – not marked
C3	Radial internal clearance greater than Normal marked C3
C4	Radial internal clearance greater than C3 marked C4
C5	Radial internal clearance greater than C4 marked C5
E	Metric bearings – extra load capacity
N	Snap ring groove on the outer ring outside diameter
NR	Snap ring groove with snap ring
CJ	Pressed steel cage
M	Machined brass cage, located on the rolling elements
MB	Machined brass cage, located on the inner ring outside diameter
TN	Polyamide cage (G15 in case of EG15 series)

CAGES

The standard cage for bearings listed in the table of dimensions is of steel (no suffix). Bearings with brass and polyamide cages are also available.

BEARING TOLERANCES

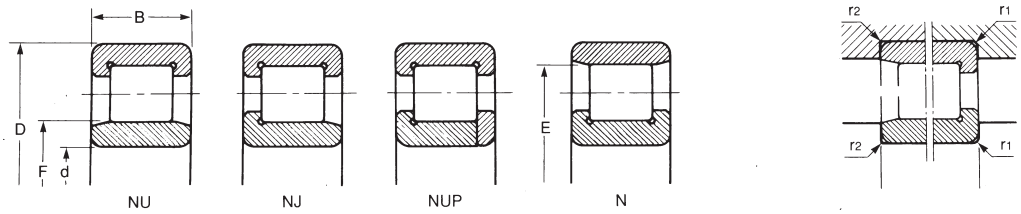
NRB standard cylindrical roller bearings are manufactured according to the normal tolerance class of ISO 492 (DIN 620 class 0).

RADIAL INTERNAL CLEARANCE (RIC)

Bearing internal clearance is the total clearance between the raceway and the rolling elements measured normal to the bearing axis.

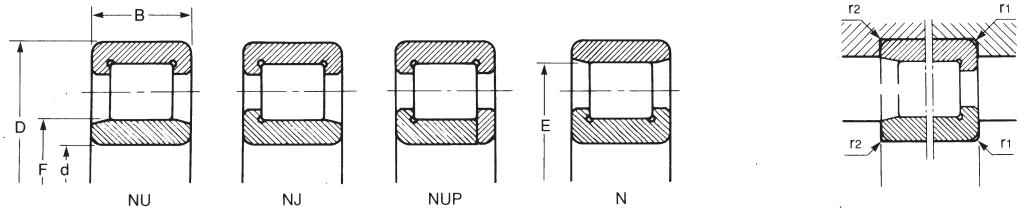
The standard clearance is CN.Bearings in any other clearance group can be supplied on order. Table below lists the RIC values for standard bearings. Bearings having these clearances are interchangeable and are being introduced by NRB in accordance with ISO 5753: 1991 (E). NRB can also supply bearings with matched rings (i.e. rings of one bearing cannot be interchanged with the rings of other bearings).

Bore diameter d mm		Radial internal clearance groups									
		C2		CN		C3		C4		C5	
over	incl	min	max	min	max	min	max	min	max	min	max
–	10	0	25	20	45	35	60	50	75	–	–
10	24	0	25	20	45	35	60	50	75	65	90
24	30	0	25	20	45	35	60	50	75	70	95
30	40	5	30	25	50	45	70	60	85	80	105
40	50	5	35	30	60	50	80	70	100	95	125
50	65	10	40	40	70	60	90	80	110	110	140
65	80	10	45	40	75	65	100	90	125	130	165
80	100	15	50	50	85	75	110	105	140	155	190
100	120	15	55	50	90	85	125	125	165	180	220
120	140	15	60	60	105	100	145	145	190	200	245
140	160	20	70	70	120	115	165	165	215	225	275
160	180	25	75	75	125	120	170	170	220	250	300
180	200	35	90	90	145	140	195	195	250	275	330
200	225	45	105	105	165	160	220	220	280	305	365
225	250	45	110	110	175	170	235	235	300	330	395
250	280	55	125	125	195	190	260	260	330	370	440
280	315	55	130	130	205	200	275	275	350	410	485
315	355	65	145	145	225	225	305	305	385	455	535
355	400	100	190	190	280	280	370	370	460	510	600
400	450	110	210	210	310	310	410	410	510	565	665
450	500	110	220	220	330	330	440	440	550	625	735



Cylindrical roller bearings - single row

Shaft dia	Designation	Dimensions d	D	B	F	E	Basic capacities Dynamic C	Static Co	Limiting speeds (oil)	Approx weight	Fillet radii r1 max	r2 max
mm		mm	mm	mm	mm	mm	Newtons	Newtons	rpm	kg	mm	mm
20	NU 204	20	47	14	27	40	15430	12670	18000	0.109	1.0	0.6
	NJ 204	20	47	14	27	40	15430	12670	18000	0.109	1.0	0.6
	NUP 204	20	47	14	27	40	15430	12670	18000	0.109	1.0	0.6
	N 204	20	47	14	27	40	15430	12670	18000	0.109	1.0	0.6
	NU 304	20	52	15	28.5	44.5	22340	17315	16000	0.15	1.0	0.6
	NJ 304	20	52	15	28.5	44.5	22340	17315	16000	0.15	1.0	0.6
	NUP 304	20	52	15	28.5	44.5	22340	17315	16000	0.15	1.0	0.6
	NJ 12078 SO2	20	52	15	27.5	45.5	31540	26850	14500	0.15	1.6	0.5
	NU 304 EG 15	20	52	15	27.5	45.5	36770	32810	14500	0.143	1.0	0.6
	NJ 304 EG 15	20	52	15	27.5	45.5	38000	37500	14000	0.163	1.0	0.6
	NUP 304 EG 15	20	52	15	27.5	45.5	53000	54000	12000	0.26	1.0	0.6
25	NU 205	25	52	15	32	45	18480	15680	15000	0.131	1.0	0.6
	NU 205 EG15	25	52	15	31.5	46.5	31600	30500	14000	0.13	1.0	0.6
	NJ 205 EG15	25	52	15	31.5	46.5	31600	30500	14000	0.13	1.0	0.6
	NUP 205 EG15	25	52	15	31.5	46.5	31600	30500	14000	0.13	1.0	0.6
	NJ 205	25	52	15	32	45	18480	15680	15000	0.131	1.0	0.6
	NUP 205	25	52	15	32	45	18480	15680	15000	0.131	1.0	0.6
	N 205	25	52	15	32	45	18480	15680	15000	0.131	1.0	0.6
	NU 2205 EG15	25	52	18	31.5	46.5	38000	37500	14000	0.163	1.0	0.6
	NJ 2205 EG15	25	52	18	31.5	46.5	38000	37500	14000	0.163	1.0	0.6
	NUP 2205 EG15	25	52	18	31.5	46.5	38000	37500	14000	0.163	1.0	0.6
	NU 305	25	62	17	35	53	34790	31500	16500	0.25	1.0	1.0
	NJ 305	25	62	17	35	53	34790	31500	16500	0.25	1.0	1.0
	NUP 305	25	62	17	35	53	34790	31500	16500	0.25	1.0	1.0
	N 305	25	62	17	35	53	34790	31500	12000	0.25	1.0	1.0
	NJ 305 EM	25	62	17	34	54	41560	37400	11000	0.26	1.0	1.0
	NJ 305 ETN	25	62	17	34	54	44000	400000	12000	0.24	1.0	1.0
	NU 2305 EM	25	62	24	34	54	56960	56100	11000	0.35	1.5	1.5
	NJ 2305 EM	25	62	24	34	54	56960	56100	11000	0.36	1.5	1.5
	NJ 2305 ETN	25	62	24	34	54	59800	60800	11000	0.35	1.5	1.5
	NUP 2305 EM	25	62	24	34	54	56960	56100	11000	0.37	1.5	1.5
25.585	RNU 2204 P		47	18	25.585	41.585	40110	39620	18000	0.123	-	-
27	RNU 2204		47	18	40	27	20660	18440	18000	0.105	-	-
30	NU 2206 EG15	30	62	20	37.5	55.5	53000	54000	12000	0.26	1.0	0.6
	NJ 2206 EG15	30	62	20	37.5	55.5	53000	54000	12000	0.26	1.0	0.6
	NUP 2206 EG15	30	62	20	37.5	55.5	53000	54000	12000	0.26	1.0	0.6
	NU 306 EG15	30	72.2	19	40.5	62.5	56460	54420	9500	0.353	1.0	1.0
	NJ 306 EG15	30	72.2	19	40.5	62.5	56460	54420	9500	0.353	1.0	1.0
	NUP 306 EG15	30	72.2	19	40.5	62.5	56460	54420	9500	0.353	1.0	1.0
	NUP 306 ETN	30	72	19	40.5	62.5	56460	54420	9500	0.353	0.5	0.5
35	NU 207	35	72	17	43.8	61.8	33570	31530	11000	0.29	1.0	0.6
	NJ 207	35	72	17	43.8	61.8	33570	31530	11000	0.29	1.0	0.6
	NUP 207	35	72	17	43.8	61.8	33570	31530	11000	0.29	1.0	0.6
	NU 2207 EG15	35	72	23	44	64	67000	700000	10500	0.408	1.0	0.6
	NJ 2207 EG15	35	72	23	44	64	67000	700000	10500	0.408	1.0	0.6
	NUP 2207 EG15	35	72	23	44	64	67000	700000	10500	0.408	1.0	0.6
	N 2207 W	35	72	23	44	64	67000	73350	10500	0.408	1.0	0.6
	NU 307 EMN	35	80	23	49.5	71.5	72330	77610	8500	0.55	0.5	0.2
	NU 307 ENTN	35	80	23	49.5	71.5	72338	77616	9500	0.48	0.5	2.0
	N 2307 E	35	80	31	45.5	71.5	117600	130400	3000	0.76	1.5	1.5
35.026	RNU 305		62	17	35.026	53.026	34800	31504	14000	0.18	1.5	2.0



Cylindrical roller bearings - single row

Shaft dia	Designation	Dimensions d	D	B	F	E	Basic capacities Dynamic C	Static Co	Limiting speeds (oil)	Approx weight	Fillet radii r1 max	r2 max
mm		mm	mm	mm	mm	mm	Newtons	Newtons	rpm	kg	mm	mm
40	N 1008	40	68	15	48	62	36930	40980	12000	0.195	0.6	1.0
	NU 208 EG15	40	80	18	49.5	71.5	58600	59400	9000	0.38	1.1	1.1
	NJ 208 EG15	40	80	18	49.5	71.5	58600	59400	9000	0.38	1.1	1.1
	NUP 208 EG15	40	80	18	49.5	71.5	58600	59400	9000	0.38	1.1	1.1
	NU 2208 EG15	40	80	23	49.5	71.5	76170	83160	9000	0.493	1.0	1.0
	NJ 2208 EG15	40	80	23	49.5	71.5	76170	83160	9000	0.493	1.0	1.0
	NUP 2208 EG15	40	80	23	49.5	71.5	76170	83160	9000	0.493	1.0	1.0
45	N 209	45	85	19	55	75	46050	46910	9000	0.431	1.5	1.5
	NU 209	45	85	19	55	75	46050	46910	9000	0.431	1.5	1.5
	NU 209 N	45	85	19	55	75	46050	46910	9000	0.431	1.5	1.5
	NJ 209	45	85	19	55	75	46050	46910	9000	0.431	1.5	1.5
	NUP 209	45	85	19	55	75	46050	46910	9000	0.431	1.5	1.5
	NU 209 EMN	45	85	19	54.5	76.5	66170	70870	8000	0.44	1.5	1.5
	NU 209 MN	45	85	19	54.5	76.5	66170	70870	8000	0.44	1.5	1.5
	NU 2209 EMN	45	85	23	54.5	76.5	79830	90200	8000	0.545	1.5	1.5
	NU 2209 EG15	45	85	23	54.5	76.5	79830	90200	8500	0.536	1.0	1.0
	NJ 2209 EG15	45	85	23	54.5	76.5	79830	90200	8500	0.536	1.0	1.0
	NUP 2209 EG15	45	85	23	54.5	76.5	79830	90200	8500	0.536	1.0	1.0
	NU 309	45	100	25	58.5	86.5	73810	71070	7100	0.863	1.5	1.5
	NU 309 N	45	100	25	58.5	86.5	73810	71070	7100	0.863	1.5	1.5
	NJ 309	45	100	25	58.5	86.5	73810	71070	6700	0.863	1.5	1.5
	NUP 309 N	45	100	25	58.5	86.5	73810	71070	6700	0.863	1.5	1.5
	N 309	45	100	25	58.5	86.5	73810	71070	7100	0.863	1.5	1.5
	N 309 W	45	100	25	56.5	88.5	107424	107532	7100	0.863	1.5	1.5
	NUP 309	45	100	25	58.5	86.5	73810	71070	-	0.900	1.5	1.5
	NUP 309 EM	45	100	25	58.5	88.5	100530	102430	6700	0.881	0.8	1.5
	NJG 2309 VH	45	100	36	56.1	88.1	168568	191720	-	1.390	0.8	1.0
50	NUP 210 ENTNR	50	90	20	59.5	81.5	72900	81900	7500	0.48	0.5	1.0
	NU 310	50	110	27	65	97	100070	99420	9200	1.21	2.0	2.0
	NJ 310	50	110	27	65	97	100070	99420	9200	1.21	2.0	2.0
	NUP 310	50	110	27	65	97	100070	99420	9200	1.21	2.0	2.0
	NUP 310 N	50	110	27	65	97	100070	99420	9200	1.21	2.0	2.0
55	NJG 1011	55	90	18	62.8	80.8	62400	77900	3400	0.437	1.1	1.1
	NJ 1011 EP	55	90	18	62.8	80.0	52800	62300	7000	0.419	1.1	1.1
	NU 211	55	100	21	66.5	88.5	57970	62290	7500	0.636	1.5	1.0
	NJ 211	55	100	21	66.5	88.5	57970	62290	7500	0.636	1.5	1.0
	NU 311 ECJ	55	120	29	70.5	106.5	140936	147634	5600	1.45	2.0	2.0
	NUP 311 ECJ NR	55	120	29	70.5	106.5	148990	158990	5600	1.41	2.0	2.0
60	NUP 12097*	60	110	22	72	100	97520	107270	6700	0.84	1.5 Hsg 1 Shaft	0.4
	NUP 312 ECJNR	60	130	31	77	115	152000	160000	5000	1.95	2.1	2.1
65	NUP 313 ECJ	65	140	33	82.5	124.5	187500	201000	4800	2.35	2.1	2.1
	NU 313 ECJ	65	140	33	82.5	124.5	187500	201000	4800	2.3	2.1	2.1
66.5	RNU 211	66.5	100	21	66.5	88.5	57970	62290	7500	0.472	1.5	
70	N 314	70	150	35	89.376	130.65	174990	188310	4900	2.692	2.5	2.5
	N 314 MB	70	150	35	89.376	130.65	174990	188310	4900	2.82	2.5	2.5
75	NU 315	75	160	37	95.5	141.5	216310	234880	6300	3.52	2.5	2.5
	NJ 315	75	160	37	95.5	141.5	216310	234880	6300	3.74	2.5	2.5
	NUP 315	75	160	37	95.5	141.5	216310	234880	6300	3.85	2.5	2.5
80	NU 316 ECJ	80	170	39	101	151	267225	298030	3800	3.95	2.1	2.1

*Standard designation NUP 212

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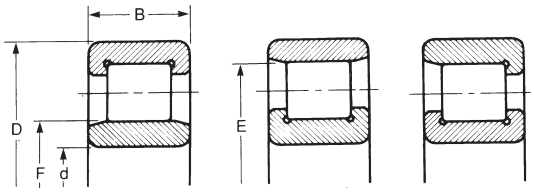

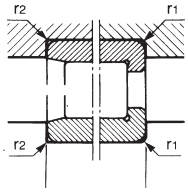

Cylindrical roller bearings - Other sizes

Shaft dia	Designation	Dimensions d	D	B	F	E	Basic capacities Dynamic C	Static Co	Limiting speeds (oil)	Approx weight	Fillet radii r1 max	r2 max
mm		mm	mm	mm	mm	mm	Newtons	Newtons	rpm	kg	mm	mm
19.05	CRL 6	19.05	47.625	14.288	27	40	15430	12670	18000	0.118	1.5	1.5
25.40	CRL 8	25.40	57.15	15.875	32.52	50.52	31310	27290	13000	0.172	1.5	1.5
-	LO 64*	25.40	53.975	28.575	34.90	54.00	59990	61750	-	0.262	0.26	1.8
31.75	CFM 10	31.75	79.375	22.225	46.20	70.20	58100	54480	12700	0.517	1.8	1.8

* Double row rollers, without outer ring

Cylindrical roller bearings - Special sizes †

Shaft dia	Designation	Dimensions d	D	B	F	E	Basic capacities Dynamic C	Static Co	Limiting speeds (oil)	Approx weight	Fillet radii r1 max	r2 max
mm		mm	mm	mm	mm	mm	Newtons	Newtons	rpm	kg	mm	mm
19.99	JC 8027	19.99	47	14	26.50	41.50	31600	28800	9500	0.12	1	0.6
22	JC 8037	22	58	17	39.00	51.00	33500	39000	9800	0.24	1.4	1.5
24	JC 8008	24	50	19	30.50	42.50	33550	37720	-	0.169	2.5	2.5
	JC 8033	24	50	19	30.50	42.50	39000	46000	6000	0.181	3	2
25	JC 8004	25	62	17	34.50	52.60	39850	37850	12000	0.24	1.5	1.5
	JC 8011	25	62	17	34.50	52.50	47140	47110		0.279	1.5	0.3
	JC 8005	25	62	29.50	34.00	54.00	56960	56100	11000	0.39	0.3	2.3
27.762	JC 8019	27.762	62	18	33.96	53.38	47070	44960	5000	0.25	1.1	3.2
30	JC 8009	30	50	17	30.00	42.00	29750	31680	13300	0.12	0.12	0.5
	JC 8038	30	58	17	39.00	51	33500	39000	10500	0.195	1.1	1.5
	JC 8002	30	62	19.05	38.23	54.23	51380	57630	12000	0.275	0.7	3.2
	JC 8002 A	30	62	19.05	38.23	54.23	51380	57630	12000	0.275	0.7	0.25
	JC 8022	30		21.00	39.50	57.50	52000	54500	6000	0.200	0.7	-
32	JC 8016	32	62	18	38.50	54.50	51380	57700	12000	0.246	0.4	1.1
34.991	JC 8018	34.991	71.999	20.65	44.00	63.7	66950	73600	4800	0.35	1.1	4.0
35	JC 8015	35	57	15	35.00	51	33500	32089	13000	0.124	1.5	1.5
36.99	JC 8028	36.99	73	17	46.00	64	53000	57000	3000	0.324	0.3	0.6
37	JC 8024***	37	64.5	27	-	64.5	95700	116000	-	-	-	-
	JC 8021***	37	64.5	31	44.5	64.5	103540	128258	3400	0.35	2.0	3.5
40	JC 8017	40	90	23	52.5	77.822	90250	96750	3000	0.73	1.5	2.5
45	JC 8025	45	95	32	57.18	81.18	136100	172800	4300	1.1	2.5	0.5
46	JC 8030 NUPEP	46	80	23	54.3	72.3	67300	82000	7500	0.47	1.1	1.1
	JC 8001	46	80	23.50	57.00	72.00	73790	104980	9000	0.495	0.7	0.7
46.80	JC 8010**	46.8	72	17	46.80	64.80	49460	53140	-	0.237	1.5	1.0
50	JC 8003	50	80	15	56.80	72.80	45170	53990	-	0.262	0.6	0.6
	JC 8007**	50	80	18.50	50.00	72.00	83670	94410	-	0.337	1.0	1.0
60	JC 8029	60	110	22	72	100	97500	107200	6700	0.86	1	1.5
60	JC 8020	60	110	26	72	100	117000	136898	6300	1.18	0.5	1

† Please consult NRB before selecting a bearing from the list of special sizes

** Bearing without inner ring *** Bearing without outer ring

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TAPERED ROLLER BEARINGS

INTRODUCTION

Tapered Roller Bearings main characteristics are the ability to handle high combined axial and radial loads. It consists of two components: an outer ring or cup, and an assembly incorporating a tapered inner ring with cage and tapered rollers, known as the cone assembly. The tapered rollers are held in the cone by a pressed steel cage, which comes in contact with the cone flange.

Tapered Roller Bearing Component Parts

SALIENT FEATURES

Excellence in *quality* of the Tapered Roller Bearings is achieved by focusing on critical aspects like:

- The internal design of the bearing
- The quality of the material used and its heat treatment techniques
- Precision of the machining process
- Stringent inspection procedures

BEARING DIMENSIONS

d = bore diameter of cone

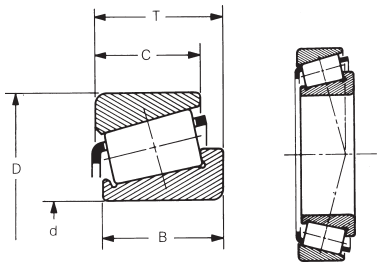
D = outside diameter of the cup

T = total width

B = cone width

C = cup width

TAPERED ROLLER BEARINGS



Shaft dia mm	Designation	Dimensions Bore dia d mm	Outside dia D mm	Total width T mm	Cone width B mm	Cup width C mm	Basic capacities Dynamic C Newtons	Static Co Newtons	Limiting speed oil rpm	grease rpm	Approx. weight kgs
15	30302 V	15	42	14.25	13	11	24300	21990	13000	9500	0.094
15.875	K-11590/K-11520	15.875	42.863	14.288	14.288	9.525	19000	20000	12000	8500	0.099
17	30203 A M39	17	40	13.25	12	11	20950	19860	13300	9800	0.076
20	32004 V	20	42	15	15	12	27300	31400	12000	9000	0.098
	10R 32004 V C12 D82	20	42	15	15	12	26500	27500	12300	9000	0.100
	30204 BA	20	47	15.25	14	12	24150	24370	11000	8000	0.120
	30204 A M39	20	47	15.25	14	12	30900	32430	11300	8400	0.125
21.5	EC 12250	21.5	47	16.5	16.5	13	35500	390000	11000	7800	0.135
25	EC 12589 S01	25	47	15	15	11.5	28500	32780	11000	7700	0.105
	33005 10 RV	25	47	17	17	14	32640	40880	11000	8000	0.126
	30305 BV	25	62	18.25	17	14	42190	44680	8500	6300	0.263
30	31306 BV	30	72	20.75	19	14	57100	55870	7000	5300	0.390
31.75	K-2580/K-2520	31.75	66.421	25.4	25.357	20.638	77500	94400	4500	3400	0.400
34.925	LM 48548/ LM 48510	34.925	65.088	18.034	18.288	13.97	50500	63100	-	-	0.260
35	30307 BV	35	80	22.75	21	16	49110	60360	6300	4800	0.500
	EC 12245 S04	35	84.985	18.25	18.25	17	67600	45600	7000	5700	0.550
	32207 BV	35	72	24.25	23	18	65600	84900	9500	8000	0.400
40	32008 V	40	68	19	19	14.5	50790	66230	7100	5300	0.269
	30308 BV	40	90	25.25	23	17	77540	86430	4300	5600	0.769
40.987	LM 300849 A/ LM 300811 A	40.987	67.975	17.5	18	13.5	43700	58540	7100	5300	0.245
45.23	LM 603049 V/ LM 603014 V	45.23	79.985	19.842	20.638	15.08	65700	75500	6300	4500	0.400
60	33012 V	60	95	27	27	21	100890	160050	4900	3600	0.710
	33112-V	60	100	30	30	23	117000	170000	5000	3800	0.910
60.325	K-1272/K-28920	60.235	101.6	28.4	28.4	19.845	88600	130500	4500	3400	0.800
65	32213	65	120	32.75	31	27	169000	215000	4000	3000	1.455
70	32214	70	125	33.25	31	27	162100	206300	3800	2800	1.617
80	32216	80	140	35.25	33	28	177000	220000	3400	2500	2.020
95	33019 VC 12	95	145	39	39	32.5	222800	372500	3200	2300	2.2868

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SPHERICAL ROLLER BEARINGS

INTRODUCTION

The **NRB** self-aligning spherical roller bearing is a combination radial and axial bearing,designed to operate even if the shaft and housing are, or become, misaligned under load. This type of heavy duty bearing is of a favoured choice when conditions include heavy loads, plus difficulties in establishing or maintaining housing alignment, or when the shaft deflection can be expected.

Shaft deflections and housing distortions caused by shock or heavy loads,which lead to misalignment,are compensated for by the internal self-alignment of the bearing elements during operation.Corner loading of rollers, a condition that limits service life on other types of bearings,cannot develop in spherical roller bearings.Optimum bearing capacity can often be realized with up to ± 1 ½ degrees of misalignment, depending on the size and series of bearing selected.

The inherent compensation for misalignment provided by spherical roller bearings offers the designer the opportunity to use weldments for housing frames instead of complex castings, eliminating high cost machining operations. Even when castings may be preferred, the bore alignment is less critical if spherical roller bearings are specified. Unit design and construction also make the spherical roller bearing convenient to handle during installation or maintenance.

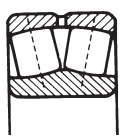
Most types have a circular groove and lubricating holes in the outer rings. This feature facilitates more effective lubrication. **NRB** manufactures spherical roller bearings with a cylindrical or tapered bore. Tapered bore series may be used either in Plummer blocks or conventional housings.

DESIGN FEATURES

The proven design of **NRB** 'E' type of bearing has shown that a design without a central guide rib is both reliable and efficient. In this design of bearing the roller guidance is provided by the track and cage.

Now, also the other type of bearing, type 'EA' from **NRB** is comprised of minimum number of components. A number of years of experience and precise control of the manufacturing process has made this possible. In this design stamped steel cages are used which are mass produced to tolerances similar to those normally achieved with moulded cages.

BEARING SERIES AND BASIC VARIATIONS



Bearing with cylindrical bore

Bearing with cylindrical taper bore

SUFFIXES

C2 Radial internal clearance less than normal. Marked C2.

CN Normal grade of radial internal clearance. Not marked.

C3 Radial internal clearance greater than normal. Marked C3.

C4 Radial internal clearance greater than C3.Marked C4.

C5 Radial internal clearance greater than C4.Marked C5

E Extra high capacity bearing

K Tapered bore (1:12 on diameter)

B33 Lubrication groove and holes in the outer ring

A Steel cage

BEARING LIFE

Decisions on bearing selection depend upon the conditions of load, required life and available space .The relationship between load capacity and bearing life must be thoroughly understood to select the most appropriate bearing. This is particularly important in new applications, which should be reviewed by NRB sales engineer. The NRB Technical Department is also available for consultation on bearing selection problems. These services are rendered confidentially to assist the designer in developing an installation which will optimise space and economy.

Bearing selection starts with tentative identification of a bearing which meets bore size, load and space requirements. Dynamic Radial Equivalent Load (P), which is a combination of applied radial load (Fr) and applied axial load (Fa) must then be calculated for that bearing.

$P = XFr + YFa$

X = Radial load factor Y = Axial load factor

For static load conditions, permanent deformation at the contact areas replaces fatigue as the major consideration. To calculate Static Radial Equivalent load (Po),use the formula:

$Po = XoFr + Yo\ Fa$

Xo = Static radial load factor Yo = Static axial load factor

Po should not exceed 0.5 times the Basic static capacity. If conditions in excess of this are contemplated, consult NRB.

Values of X, Y, Xo and Yo will be found in the table of dimensions.

RADIAL INTERNAL CLEARANCE (RIC)

The internal clearance of a bearing is the value of the maximum displacement being measured without load.

NRB Spherical Roller Bearings are manufactured with Normal RIC as Standard. Bearings with C3 clearance are also normally available whereas other clearances are made to order.

Table below lists the RIC values for bearings with cylindrical bores. Bearings with tapered bores have increased clearance to accommodate the extra losses caused by axial drive up of the bearing on its seating. RIC values for bearings with tapered bore are also given in a separate Table below.

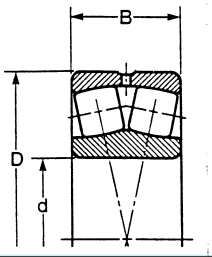
Radial Internal Clearance of Spherical Roller Bearings with Cylindrical Bore

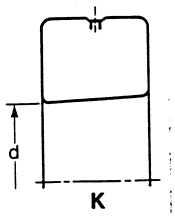
Bore diameter d		Radial Internal Clearance									
		C2		Normal		C3		C4		C5	
over	incl	min	max	min	max	min	max	min	max	min	max
mm		μm									
18	24	10	20	20	35	35	45	45	60	60	75
24	30	15	25	25	40	40	55	55	75	75	95
30	40	15	30	30	45	45	60	60	80	80	100
40	50	20	35	35	55	55	75	75	100	100	125
50	65	20	40	40	65	65	90	90	120	120	150
65	80	30	50	50	80	80	110	110	145	145	180
80	100	35	60	60	100	100	135	135	180	180	225
100	120	40	75	75	120	120	160	160	210	210	260
120	140	50	95	95	145	145	190	190	240	240	300
140	160	60	110	110	170	170	220	220	280	280	350
160	180	65	120	120	180	180	240	240	310	310	390
180	200	70	130	130	200	200	260	260	340	340	430
200	225	80	140	140	220	220	290	290	380	380	470
225	250	90	150	150	240	240	320	320	420	420	520
250	280	100	170	170	260	260	350	350	460	460	570
280	315	110	190	190	280	280	370	370	500	500	630

Radial Internal Clearance of Spherical Roller Bearings with Tapered Bore

Bore diameter d		Radial Internal Clearance									
		C2		Normal		C3		C4		C5	
over	incl	min	max	min	max	min	max	min	max	min	max
mm		μm									
24	30	20	30	30	40	40	55	55	75	75	95
30	40	25	35	35	50	50	65	65	85	85	105
40	50	30	45	45	60	60	80	80	100	100	130
50	65	40	55	55	75	75	95	95	120	120	160
65	80	50	70	70	95	95	120	120	150	150	200
80	100	55	80	80	110	110	140	140	180	180	230
100	120	65	100	100	135	135	170	170	220	220	280
120	140	80	120	120	160	160	200	200	260	260	330
140	160	90	130	130	180	180	230	230	300	300	380
160	180	100	140	140	200	200	260	260	340	340	430
180	200	110	160	160	220	220	290	290	370	370	470
200	225	120	180	180	250	250	320	320	410	410	520
225	250	140	200	200	270	270	350	350	450	450	570
250	280	150	220	220	300	300	390	390	490	490	620
280	315	170	240	240	330	330	430	430	540	540	680

SPHERICAL ROLLER BEARINGS





Tapered bore 1/12

Bearing Reference		Dimensions mm			Basic capacities Newtons		Speed limit r.p.m		Equivalent load factors						
										dynamic				static	
										Fa/Fr ≤ e		Fa/Fr > e			
		d	D	B	C	Co	grease	oil	e	X	Y	X	Y	X_o	Y_o
22200E B33															
22205E B33	22205EK B33	25	52	18	43490	45360	9100	11700	0.34	1	2.00	0.67	2.98	1	1.96
22206E B33	22206EK B33	30	62	20	57580	63580	7600	9800	0.31	1	2.15	0.67	3.20	1	2.10
22207E B33	22207EK B33	35	72	23	76000	90900	6500	8400	0.31	1	2.21	0.67	3.29	1	2.16
22208E B33	22208EK B33	40	80	23	88000	100000	5800	7500	0.27	1	2.47	0.67	3.67	1	2.41
22208EA B33	22208EAK B33	40	80	23	88000	100000	5800	7500	0.27	1	2.47	0.67	3.67	1	2.41
22209E B33	22209EK B33	45	85	23	92000	111570	5400	6900	0.26	1	2.64	0.67	3.93	1	2.58
22209EA B33	22209EAK B33	45	85	23	92000	111570	5400	6900	0.26	1	2.64	0.67	3.93	1	2.58
22210E B33	22210EK B33	50	90	23	99080	122560	5000	6400	0.24	1	2.84	0.67	4.23	1	2.78
22210EA B33	22210EAK B33	50	90	23	99080	122560	5000	6400	0.24	1	2.84	0.67	4.23	1	2.78
22211E B33	22211EK B33	55	100	25	118000	146760	4500	5800	0.23	1	2.95	0.67	4.40	1	2.89
22211EA B33	22211EAK B33	55	100	25	118000	146760	4500	5800	0.23	1	2.95	0.67	4.40	1	2.89
22212E B33	22212EK B33	60	110	28	147170	186310	4100	5300	0.24	1	2.84	0.67	4.23	1	2.78
22212EA B33	22212EAK B33	60	110	28	147170	186310	4100	5300	0.24	1	2.84	0.67	4.23	1	2.78
22213E B33	22213EK B33	65	120	31	177770	230120	3800	4900	0.24	1	2.79	0.67	4.15	1	2.73
22213EA B33	22213EAK B33	65	120	31	177770	230120	3800	4900	0.24	1	2.79	0.67	4.15	1	2.73
22214E B33	22214EK B33	70	125	31	184720	245870	3600	4600	0.23	1	2.95	0.67	4.40	1	2.89
22214EA B33	22214EAK B33	70	125	31	184720	245870	3600	4600	0.23	1	2.95	0.67	4.40	1	2.89
22215E B33	22215EK B33	75	130	31	191150	255630	3400	4400	0.22	1	3.07	0.67	4.57	1	3.00
22215EA B33	22215EAK B33	75	130	31	191150	255630	3400	4400	0.22	1	3.07	0.67	4.57	1	3.00
22216E B33	22216EK B33	80	140	33	216870	291860	3200	4100	0.22	1	3.14	0.67	4.67	1	3.07
22216EA B33	22216EAK B33	80	140	33	216870	291860	3200	4100	0.22	1	3.14	0.67	4.67	1	3.07
22217E B33	22217EK B33	85	150	36	252230	334480	3000	3800	0.22	1	3.07	0.67	4.57	1	3.00
22217EA B33	22217EAK B33	85	150	36	252230	334480	3000	3800	0.22	1	3.07	0.67	4.57	1	3.00
22218E B33	22218EK B33	90	160	40	300330	406170	2800	3600	0.23	1	2.90	0.67	4.31	1	2.83
22218EA B33	22218EAK B33	90	160	40	300330	406170	2800	3600	0.23	1	2.90	0.67	4.31	1	2.83
22219E B33	22219EK B33	95	170	43	335000	445000	2600	3400	0.24	1	2.84	0.67	4.23	1	2.78
22219EA B33	22219EAK B33	95	170	43	335000	445000	2600	3400	0.24	1	2.84	0.67	4.23	1	2.78
22220E B33	22220EK B33	100	180	46	370000	504330	2500	3200	0.24	1	2.79	0.67	4.15	1	2.73
22220AE B33	22220EAK B33	100	180	46	370000	504330	2500	3200	0.24	1	2.79	0.67	4.15	1	2.73
22222E B33	22222EK B33	110	200	53	479800	673160	2300	2900	0.25	1	2.74	0.67	4.08	1	2.68
22222EA B33	22222EAK B33	110	200	53	479800	673160	2300	2900	0.25	1	2.74	0.67	4.08	1	2.68
22224E B33	22224EK B33	120	215	58	550000	760000	2100	2700	0.25	1	2.69	0.67	4.00	1	2.63
22226E B33	22226EK B33	130	230	64	640000	930000	1900	2500	0.26	1	2.60	0.67	3.84	1	2.54
22300E B33															
22308E B33	22308EK B33	40	90	33	132600	156300	4300	5700	0.36	1	1.87	0.67	2.79	1	1.83
22308EA B33	22308EAK B33	40	90	33	136000	152000	4100	5300	0.36	1	1.87	0.67	2.79	1	1.83
22309E B33	22309EK B33	45	100	36	162000	191700	3900	5200	0.36	1	1.90	0.67	2.83	1	1.86
22309EA B33	22309EAK B33	45	100	36	166000	187000	3700	4800	0.36	1	1.90	0.67	2.83	1	1.86
22310E B33	22310EK B33	50	110	40	195000	237000	3500	4700	0.36	1	1.87	0.67	2.79	1	1.83
22310EA B33	22310EAK B33	50	110	40	201000	232000	3400	4400	0.36	1	1.87	0.67	2.79	1	1.83

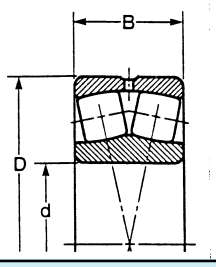
NRB is progressively introducing the range of type E B33 spherical roller bearings.
Please enquire for availability.
Loose internal clearance available upon request.

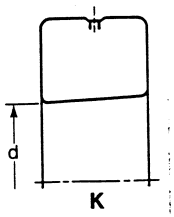
Dynamic equivalent load:

$\frac{Fa}{Fr} \leq e$ P = Fr + Y Fa $\frac{Fa}{Fr} > e$ P = 0.67 Fr + Y Fa

Static equivalent load: Po = Fr + Y_o FA

SPHERICAL ROLLER BEARINGS





Tapered bore 1/12

Bearing Reference		Dimensions m m			Basic capacities Newtons		Speed limit r.p.m		Equivalent load factors dynamic					static	
										Fa/Fr ≤ e		Fa/Fr > e			
		d	D	B	C	Co	grease	oil	e	X	Y	X	Y	X_o	Y_o
22311E B33	22311EK B33	55	120	43	231200	279380	3200	4300	0.36	1	1.87	0.67	2.79	1	1.83
22311EA B33	22311EAK B33	55	120	43	238000	274000	3100	4000	0.36	1	1.87	0.67	2.79	1	1.83
22312E B33	22312EK B33	60	130	46	265000	310000	3000	4000	0.35	1	1.95	0.67	2.90	1	1.91
22312EA B33	22312EAK B33	60	130	46	274000	319000	2900	3700	0.35	1	1.95	0.67	2.9	1	1.91
22313E B33	22313EK B33	65	140	48	295600	361900	2800	3700	0.33	1	2.06	0.67	3.06	1	2.01
22313EA B33	22313EAK B33	65	140	48	297000	343000	2700	3400	0.33	1	2.06	0.67	3.06	1	2.01
22314E B33	22314EK B33	70	150	51	325000	385000	2600	3500	0.34	1	2.00	0.67	2.98	1	1.96
22314EA B33	22314EAK B33	70	150	51	338000	396000	2500	3200	0.34	1	2.00	0.67	2.98	1	1.96
22315E B33	22315EK B33	75	160	55	380000	455000	2500	3300	0.34	1	2.00	0.67	2.98	1	1.96
22315EA B33	22315EAK B33	75	160	55	395000	467000	2300	3000	0.34	1	2.00	0.67	2.98	1	1.96
22316E B33	22316EK B33	80	170	58	420000	510000	2300	3100	0.34	1	2.00	0.67	2.98	1	1.96
22317E B33	22317EK B33	85	180	60	455000	560000	2200	2900	0.33	1	2.03	0.67	3.02	1	1.98
22318E B33	22318EK B33	90	190	64	520000	640000	2100	2700	0.33	1	2.03	0.67	3.02	1	1.98
22319E B33	22319EK B33	95	200	67	570000	700000	2000	2600	0.33	1	2.06	0.67	3.06	1	2.01
22320E B33	22320EK B33	100	125	73	670000	840000	1800	2400	0.34	1	2.00	0.67	2.98	1	1.96
22322E B33	22322EK B33	110	240	80	780000	990000	1700	2200	0.31	1	2.15	0.67	3.20	1	2.10

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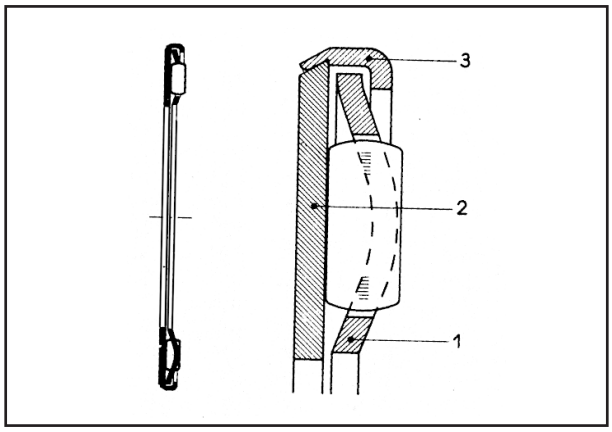
NEEDLE THRUST & ROLLER THRUST BEARINGS

NRB manufactures needle/roller thrust bearings in different constructional features. Design features of one of the types is explained below:

The rolling elements of a thrust bearing are retained and guided in the radial pockets within the cage (1). The latter



is itself retained in relation to the plate (2) by means of a steel ring (3). This assembly of parts is easy to handle and install and provides a high load capacity whilst occupying minimal space.

The design of NRB thrust bearing serves to reduce to a minimum the friction between the rolling elements and the cage that guides them. Given correct installation and adequate oil lubrication, the coefficient of friction will be between 0.003 and 0.004 for needle thrust bearings and between 0.004 and 0.005 for roller thrust bearings.

The result is due principally to the design of the one piece steel cage which has a special curvature that guides the rolling elements by their ends along their centre lines. Thus, the loads imposed on the cage by the rollers cannot create components parallel to the axis of rotation and therefore no increase in internal friction is generated, and correct operation without wear or overheating is ensured. In addition, this special curvature gives the steel cage great rigidity and being relatively thin provides maximum space for the lubricant.

THRUST PLATES

The plate incorporated in the thrust bearing is made from hardened bearing steel and forms one of the raceways for the rolling elements. The opposing raceway is generally provided by a separate thrust plate of similar design supplied by NRB. When the thrust bearing is centred by the revolving part, the thrust plate must be centred by the stationary part and vice versa. If the revolving part and the stationary part are noticeably eccentric to each other, the thrust bearing with integral plate must without exception be centred by the revolving part. The second raceway for the rolling elements may also be formed by the face of a shoulder or an inserted ring, provided these have the correct geometrical dimensions and hardness.

INTERMEDIATE PLATES

To ensure correct axial positioning in both directions, needle thrust bearings or roller thrust bearings may be mounted as a pair in a bearing arrangement on either side of a common intermediate plate, each face of which forms the second raceway for one of the thrust bearings.

OPERATION

When the ring of the rolling elements begins to rotate, it is automatically centred in relation to the shaft axis. Thus the thrust bearing does not need to be precisely centred by the incorporated plate. Hence it is possible to align the bearing (on the shaft or in the housing) allowing wide tolerances to be used and without surface hardening. This enables costs to be reduced. The same feature applies to centring of the thrust plate.

TYPES OF THRUST BEARING

- Needle Thrust Bearings
  - AX
  - AXN
- Roller Thrust Bearings
  - AR
  - JCT

SUPPORTING FACES

For smooth running operation of needle or roller thrust bearings, it is necessary that their supporting faces should be parallel. Thin needle thrust bearings and thin thrust plates must be supported on a flat, rigid and continuous face throughout the area of circulation of the needles bounded by dimensions d1 and d2 .

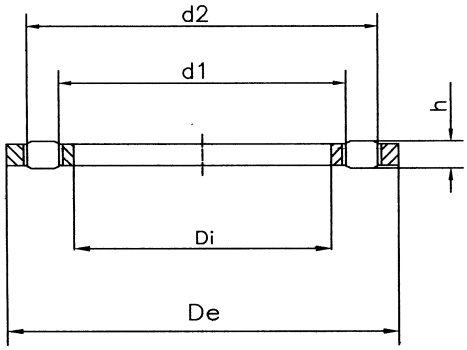
Thick needle thrust bearings and thick thrust plates can be supported on a more restricted or discontinuous shoulder, provided that the deflection of the plate under load does not endanger the smooth operation of the thrust bearing or the axial run out required. Since roller thrust bearings generally run under considerable loads, their incorporated plate and thrust plate should be supported on a shoulder covering the whole area of circulation of the rollers bounded by dimensions d1 and d2.

Where an application does not involve the use of a thrust plate, the surface forming the second raceway must:

- Extend at least across the whole area of circulation of the rolling elements between dimensions d1 and d2; and,
- Possess a suitable surface finish (≤ 0.5 µm C.L.A.) and sufficient hardness in relation to the load to be supported . A hardness of 58-64 HRC enables thrust bearings to carry their full load capacity. Lower hardness values reduce the capabilities shown in the tables of dimensions (see Technical Section).

TOLERANCES FOR CENTERING SUPPORTS

- Centering on the shaft : h10 on dimension Di for thrust bearings or thrust plates or dimension d for intermediate plates.
- Centering in the housing: H10 on dimension De for thrust bearings or outside diameter of thrust plates.



NEEDLE THRUST AND ROLLER THRUST BEARINGS

Designation	Shaft dia mm	Di max mm	De max mm	h mm	d1 mm	d2 mm	Basic capacities		Approx. weight	Limiting speed (oil)
							Dynamic Ca Newtons	Static Coa Newtons	gms	rpm
NTA 6 13	9.52	9.52	20.62	1.984	11.7	18	4700	11500	2.07	16800
AXN 2 10 24	10	10	24	2	12.3	21.3	8300	25300	2.64	14800
AXN 2.5 10 27	10	10	27	2.5	12.4	24.2	12500	32500	4.25	14500
AX 10 22	10.05	10.05	22	2.8	12	18.6	4850	5300	4	15500
AXN 2 12 26	12	12	26	2	13	23	8600	27100	2.98	13300
AXK 15 28	15	15	28	2	17	27	10200	36000	3	11400
AX 17 30	17	17	30	2.8	19	26.6	7600	24600	7.6	10500
AXN 5.5 17 32	17	17	32	5.5	22	29	7700	26000	19.89	10000
AXN 2.05 21 32	21	21	32	2.05	22.9	29.1	3038	6958	8.64	4500
AXK 25 42	25	25	42	2	29	41	12800	55400	6.37	7200
NTA 16 27	25.4	25.4	41.8	1.984	27.86	38.84	14600	65500	7.71	7400
JCT 1004A	28.225	28.225	59	13.66	35	51	33500	127000	170.00	-
AR 5 30 47*	30	30	47	5	32.24	44.8	30700	93500	17.52	6200
AR 2 30 47 *	30	30	47	6	34.5	44.5	13900	64000	5.3	6300

* Bearings with polyamide cage

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Designation	Shaft dia mm	Di max mm	De max mm	h mm	d1 mm	d2 mm	Basic capacities		Approx. weight	Limiting speed (oil)
							Dynamic Ca	Static Coa		
							Newtons	Newtons	gms	rpm
NTA 20 31	31.75	31.75	49.2	1.984	34	46.2	16400	47100	10.17	6100
JCT 1005	35.225	35.225	63	13.5	40.1	56.1	45500	165000	-	-
JCT 1003A	35.225	35.225	63	17	40.1	56.1	45500	165000	200.00	-
SAX 37 68 12	37	37	66	4	44.2	63.3	41800	179500	180	5600
AX 3.6 40 55	40	40	55	3.6	44	51	11450	54450	20.28	5000
AR 7 40 80 *	40	40	80	7	46	64.8	93982	362453	93.61	3870
JCT 1001	45.225	45.225	74	20	48.7	62.7	68000	177000	270	-
JCT 1001A	45.225	45.225	74	20	49.5	63.5	56000	182900	250	-
SAX 49 82 10	49	49	82	5	59.1	79.3	64000	289000	164	3600
AR 8 50 110 *	50	50	110	8	55.5	104	156751	696241	201	2730
JCT 1002	50.225	50.225	82	22	53.2	71.2	109000	285000	370	-
JCT 1002A	50.225	50.225	82	22	54	72	89500	289000	350	-
AR 7.5 75 100	75	75	100	7.5	78	97	95100	392700	98.5	2700
AX 90 120	90	90	120	4	94	118	64000	387200	220	2300
AX 9 100 135	100	100	135	4	105	133	802000	537000	332	2100

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TAPERED ROLLER THRUST BEARINGS

NRB manufactures two types of tapered roller thrust bearings that effectively counter the very high shock loads on the Steering King Pin.

These are :

- Full complement type (without cage)
- Caged type

These bearings consist of two tapered thrust races, rollers, cage (in case of Caged type) and an outer retainer which holds the components for the purpose of transporting and installation of bearings. Some of the standard sizes are listed below. Special sizes and types can be made available to suit specific requirements that customers would have.

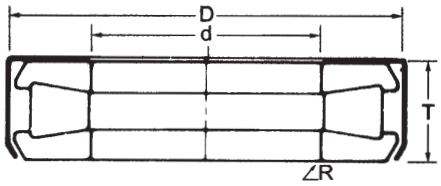

Fig. 1 : Full Complement type

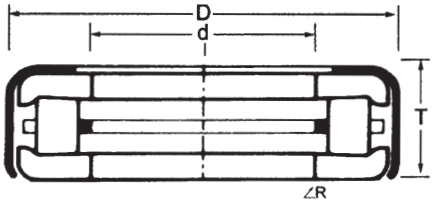

Fig. 2 : Caged type

Pin Dia	Designation		Dimensions			Shaft Radius R max	Basic capacities		Approx weight
	NRB Ref. No.	Fig.	d	D	T		Dynamic Ca	Static Coa	
mm			mm	mm	mm	mm	Newtons	Newtons	gms
25.654	T 101	2	25.654	50.800	15.875	0.8	47 000	104 900	130
30.416	T 119	2	30.416	55.562	15.875	0.8	55 800	128 400	150
32.004	T 126	2	32.004	55.562	15.875	0.8	50 900	115 700	140
35.179	T 138	1	35.179	66.675	19.446	0.8	17 600	312 800	300
36.754	T 144	1	36.754	66.675	19.446	1.5	105 900	316 700	290
38.354	T 151	1	38.354	72.619	21.433	0.8	114 700	337 300	370

Note : 1) NRB also manufactures these bearings with cylindrical rollers suffix SR (e.g. T 138 SR)

2) Bearings with bore diameter oversize are also available

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BALL BEARINGS

Single row deep groove ball bearing is the most popular of all rolling bearings. The design of uninterrupted raceway shoulders enables the bearings to support radial thrust (in either direction), or combined loads and these bearings are suitable for high speed operations.

Non-separable type of design make it easier to handle the bearing and can be mounted either fixed (Fig. 1) or floating (Fig.2).

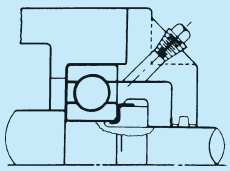


Fig. 1 : Fixed Mounting

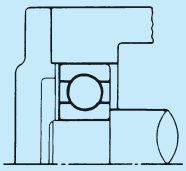
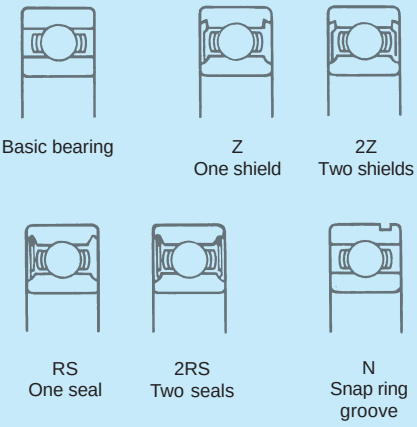


Fig. 2 : Floating Mounting

BEARING TYPES

NRB deep groove ball bearings are available in 60, 62 and 63 series and are available in different types as illustrated in Fig. 3. Please check for availability.



Different types of basic bearing

NRB also manufactures special sizes of ball bearings against specific requirements of customers. Some sizes are listed in the table of dimensions - Other sizes. NRB would be pleased to develop new special sizes provided the quantities are large.

PREFIXES

GB	Double row angular contact ball bearing, 40° contact angle
JB	NRB special ball bearing
QJ	Four Point contact ball bearing
E, L	Single row ball bearing (Magneto Type)
LS	Single row ball bearing (Inch series)

SUFFIXES

C2	Radial internal clearance less than Normal-marked C2
CN	Normal grade of radial internal clearance – not marked
C3	Radial internal clearance greater than Normal – marked C3
C4	Radial internal Clearance greater than C3-marked C4
C5	Radial internal Clearance greater than C4-marked C5
M	Machined brass cage, located on the rolling elements
MA	Machined brass cage, located in the outer ring bore
MB	Machined brass cage, located on the inner ring outside diameter
N	Snap ring groove on the outer ring outside diameter
NR	Snap ring groove with snap ring
RS	One synthetic rubber seal
2RS	Two synthetic rubber seals
Z	One metal shield
2Z	Two metal shields
B	40° angle of contact
E	High capacity bearing
TN	Polyamide cage

TOLERANCES

NRB standard metric bearings are manufactured in accordance with normal tolerance class of ISO 492 (DIN 620 class 0)

RADIAL INTERNAL CLEARANCE (RIC)

NRB ball bearings are generally available in normal radial internal clearances. Bearings in other RIC groups can be supplied on request. Following table gives the RIC values for standard bearings.

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RADIAL INTERNAL CLEARANCE VALUES FOR RADIAL CONTACT GROOVE BALL BEARINGS WITH CYLINDRICAL BORE

Clearance values in µm

Bore dia		Radial internal clearance groups									
mm		C2		CN		C3		C4		C5	
over	incl	min	max	min	max	min	max	min	max	min	max
2.5	6	0	7	2	13	8	23				
6	10	0	7	2	13	8	23	14	29	20	37
10	18	0	9	3	18	11	25	18	33	25	45
18	24	0	10	5	20	13	28	20	36	28	48
24	30	1	11	5	20	13	28	23	41	30	53
30	40	1	11	6	20	15	33	28	46	40	64
40	50	1	11	6	23	18	36	30	51	45	73
50	65	1	15	8	28	23	43	38	61	55	90
65	80	1	15	10	30	25	51	46	71	65	105
80	100	1	18	12	36	30	58	53	84	75	120
100	120	2	20	15	41	36	66	61	97	90	140
120	140	2	23	18	48	41	81	71	114	105	160

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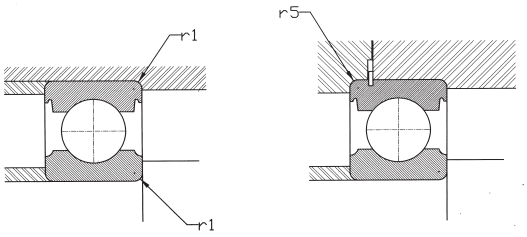
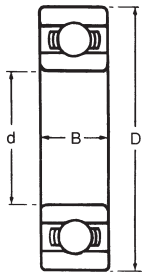
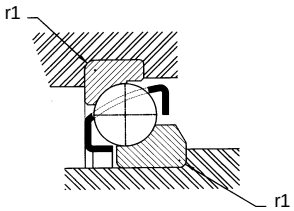
Ball Bearings

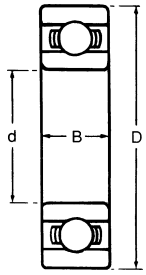




Shaft dia	Designation	Dimensions d	D	B	Basic capacities Dynamic C	Static Co	Limiting speeds (oil)	Approx. weight	Max fillet radii r1	r5
mm		mm	mm	mm	Newtons	Newtons	rpm	kg	mm	mm
10	6000	10	26	8	4760	1960	34500	0.02	0.3	
	6200	10	30	9	5964	2624	32000	0.031	0.6	
	6200 Z	10	30	9	5964	2624	32000	0.032	0.6	
	6300	10	35	11	8400	3700	29000	0.049	0.6	
12	6001	12	28	8	5300	2260	32000	0.023	0.3	
	6201	12	32	10	6790	2880	29500	0.034	0.6	
	6301	12	37	12	9700	4180	27000	0.061	1.0	
	6201 Z	12	32	10	6790	2880	29500	0.035	0.7	
	6201 2Z	12	32	10	6790	2880	29500	0.039	0.7	
	6301 Z	12	37	12	9700	4180	27000	0.065	1.1	
	6301 RS1	12	37	12	9700	4180	27000	0.065	1.1	
15	6002	15	32	9	5780	2500	28000	0.03	0.3	
	6202	15	35	11	7720	3750	26500	0.043	0.6	
	6302	15	42	13	11830	5270	2400	0.081	1.0	
	6202 Z	15	35	11	7720	3750	26500	0.046	0.6	
	6202 2Z	15	35	11	7720	3750	26500	0.05	0.6	
	E15	15	35	8	4500	1100	24000	0.036	0.3	
17	6003	17	35	10	7060	3040	26000	0.038	0.3	
	6203	17	40	12	10510	5250	24000	0.062	0.6	
	6303	17	47	14	13500	6500	21500	0.109	1.0	
	1203	17	40	12	8840	2200	22000	0.073	0.6	
	2203 ETN C3	17	40	16	11900	2900	20000	0.088	1.0	
20	6004	20	42	12	9370	5020	22500	0.069	0.6	
	6204	20	47	14	13690	6690	21000	0.099	1.0	
	6304	20	52	15	15910	7850	20000	0.144	1.0	
	6004 Z, 2Z	20	42	12	9370	5020	22500	0.069	0.7	
	6304 N	20	52	15	15910	7850	20000	0.144	0.5	0.5
	7204 ETN	20	47	14	14820	8170	17000	0.11	0.2	
22	AB 40087	22	57	16.8	20300	11000	15000	0.15	0.3	
	AB 40087 NR	22	57	16.8	20300	11000	15000	0.18	1.5	0.3
25	6005	25	47	12	10000	5800	19500	0.08	0.6	
	6205	25	52	15	14010	7830	19000	0.123	1.0	
	6305	25	62	17	20470	11060	16500	0.22	1.0	
	6305 N	25	62	17	20470	11060	16500	0.22	0.5	0.5
	98205	25	52	9	11610	6560	9500	0.1	1.0	
	AB 12390 SO2	25	62	17	20300	11000	15000	0.15	0.3	
	AB 12390 SO2 A	25	62	17	24700	12900	14000	0.213	1.0	1.0
	7205 BETN	25	52	15	15770	9370	15000	0.13	0.2	
30	6006	30	55	13	15690	7750	17000	0.116	1.0	
	6206	30	62	16	19450	11290	15500	0.198	1.0	
	6306	30	72	19	28160	15800	14300	0.331	1.0	
	7206 BETN	30	62	16	22580	14330	12000	0.2	0.2	
35	6007	35	62	14	16620	8530	15000	0.156	1.0	
	6207	35	72	17	25770	15360	13600	0.276	1.0	
	6307	35	80	21	34570	17900	12700	0.446	1.5	
	16007	35	62	9	12256	8796	13000	0.11	0.3	
	GB 10840 SO2	35	68	37	42500	36000	7500	0.5	0.5	
40	6008	40	68	15	19710	10300	13600	0.191	1.0	
	6208	40	80	18	32640	19950	12200	0.351	1.0	
	6308	40	90	23	46210	24710	11300	0.59	1.5	
	6208 N	40	80	18	32640	19950	12200	0.351	0.5	0.3



* Applicable for JB 1003, JB 1011, JB 1010



Shaft dia	Designation	Dimensions d	D	B	Basic capacities Dynamic C	Static Co	Limiting speeds (oil)	Approx. weight	Max fillet radii r1	r5
mm		mm	mm	mm	Newtons	Newtons	rpm	kg	mm	mm
45	6009	45	75	16	24420	13430	12300	0.245	1	
	6209	45	85	19	34030	17800	11400	0.397	1	
	6309	45	100	25	54920	29860	10200	0.794	1.5	
50	6010	50	80	16	22700	13090	11200	0.264	1	
	6210	50	90	20	36530	19810	10600	0.446	1	
	6310	50	110	27	64530	35600	9200	1.06	2	
55	6011	55	90	18	29420	17010	10300	0.394	1	
	6211	55	100	21	45110	25100	9500	0.59	1.5	
	6311	55	120	29	74530	41780	8400	1.35	2	
60	6012	60	95	18	33640	19710	9600	0.419	1	
	6212	60	110	22	54520	30890	8700	0.771	1.5	
	6312	60	130	31	85020	48490	7700	1.69	2	
65	6013	65	100	18	31820	19610	9000	0.449	1	
	6213	65	120	23	59530	34080	7900	0.966	1.5	
	6313	65	140	33	96550	55500	7100	2.07	2	
70	6014	70	110	20	42700	25690	8200	0.608	1	
	6214	70	125	24	64530	37410	7500	1.05	1.5	
	6314	70	150	35	108020	63500	6600	2.49	2	
75	6015	75	115	20	41090	26090	7800	0.68	1	
	6215	75	130	25	69.04	41190	7100	1.13	1.5	
	6315	75	160	37	118020	71490	6200	2.98	2	
80	16016	80	125	14	25360	25010	6300	0.6	1	

Ball Bearings - Other Sizes

Shaft dia	Designation	Dimensions d	D	B	Basic capacities Dynamic C	Static Co	Limiting speeds (oil)	(grease)	Approx. weight	Fillet radii r1 max	r5 max
mm		mm	mm	mm	Newtons	Newtons	rpm	rpm	gms	mm	mm
12	JB 1005	12	40	12	10510	5250	20000	17000	72.93	1.1	-
17	L 17	17	40	10	10730	6050	20000	17000	54.20	0.7	-
19.05	LS 8	19.05	47.625	14.288	13690	6690	14000	9000	113.68	1.2	-
19.6	JB 1003 *	19.6	51	14.5	16690	9590	-	-	111.95	0.8	0.2
-	JB 1011 *†	-	35	10.5	7350	3530	-	-	43.60	1.5	-
20	JB 1002	20	50	14	13690	6690	14000	9000	125.55	1.1	-
25	JB 1001	25	62	12	20470	11060	14000	11000	174.56	1.0	0.5
	JB 1010 *	25	62	19	27870	16070	-	-	-	1.8	1.3
35	JB 1008	35	56.6	14	10470	7210	-	-	100.95	-	-
38.1	JB 1014	38.1	67	16.5	13660	9330	-	-	194.70	-	-
45	QJ 209 MA	45	85	19	36140	25590	8500	6300	516.48	1.5	-
	QJ 309	45	100	25	76490	64230	7500	5600	945.48	1.5	1.5
	QJ 309 NR	45	100	25	76490	64230	7500	5600		1.5	0.5
69.855	JB 1023	69.855	103.38	21.8	24400	20800	-	-		-	-

† Without inner ring, Ball cage assembly and outer ring separable, Dia. under balls ∅ 15.2

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NEEDLE ROLLERS

In certain applications, the limited amount of space available for bearings and the loads to be supported require the use of a full complement of needles independent of any system of retention. The length of the needle is determined in relation to the load capacity required.

The needles are placed directly between the shaft and the housing without the use of inner or outer rings. Thus a shaft of maximum diameter is permissible to increase rigidity and load capacity.

In rotating applications where the load capacity requires the use of needles that are long in relation to the shaft diameter, it is preferable to employ two rows of needles of equal length separated by a spacer ring. In such cases, the needles must be selected with diameters in the same tolerance class. This arrangement is particularly recommended for mounting parts such as long idler wheels , especially where they are subjected to rotational torque.

RACEWAYS

Maximum load capacity is obtained with hardened inner and outer raceways of surface hardness 58-64 HRC. Parts used for lateral retention of needles at their ends should be of equivalent hardness.

The inner and outer raceways should both be aligned on installation and before operation under load. In the case of parts fitted with a single row of needles, the inner raceway may be ground convex to allow misalignment. A convexity permitting misalignment of 1 in 1000 (or up to 2 in 1000 in cases of instantaneous overloading) does not reduce the calculated load capacity. This convexity, which also depends on length of the needle, may be produced on a separate inner ring or directly on the shaft journal using a grinding wheel with concave profile obtained by inclining the diamond impregnated cutting wheel. Further technical information is available on request.

TYPES

Needle Rollers are available with the end forms as shown below:

Type BR : Rounded ends 

Type BP : Flat , unground ends

Type BPM : Flat , ground ends 

Type BR60 : Rounded corners 

Needle Rollers of special types and dimensions can be manufactured on request depending upon the quantities involved.

CHARACTERISTICS

NRB standard needles are made using through hardened bearing steel of hardness 58-65 HRC.

The surface finish is ≤ 0.2 µm C.L.A.

The profile of a needle is not cylindrical along its whole length as there is a very slight taper towards the ends. Therefore, precise measurement of the diameter can only be carried out in the central area of the needle. Needles having a greater taper at the end may be supplied on request. (suffix … ER)

MANUFACTURING TOLERANCES

The diameter of standard needles is produced to a tolerance upto – 10 µm from the nominal dimension. In normal category Needle Rollers will have a diameter tolerance range of 0 to – 6 µm. On request, Needle Rollers can be sorted (at extra cost) into groups having diameter variation as given in table 1 and colour codes in accordance with table 2.

The length of needles types BR, BP and BR60 is kept within h13 tolerance.

Table 1 : Tolerance on Needle Diameter

Grade G	Variation in diameter of one lot µm	Standard classes	Deviation from true circularity µm
2	2	0-2 –1-3 –2-4 –3-5 –4-6 -5-7 –6-8 –7-9 –8-10	1
3	3	0-3 –1.5-4.5 –3-6 -4.5-7.5 –6-9 –7-10	1.5
5	5	0-5 –3-8 -5-10	2.5

Table 2 : Colour codes for the classes of Grade 2

0-2	-1-3	-2-4	-3-5	-4-6	-5-7	-6-8	-7-9	-8-10
red	pink	blue	sky	white	grey	green	orange	yellow

These colour codes are used by prior agreement.

SHAFT AND HOUSING REQUIREMENTS

For optimum performance, the shaft and housing should conform to the tolerances as given in table 3.

Operating Space, B = L + 0.2 for L ≤ 34.8 mm
= L + 0.3 for L > 34.8 mm
(L, Nominal length of Needle Roller)

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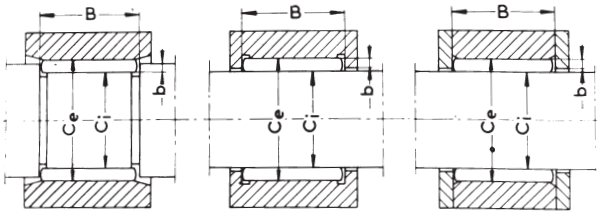

Tolerance on Operating Space, B = H12

Shoulder Height, b = 2/3 d mm (d, Nominal diameter of Needle Roller)

Table 3: Shaft and Housing Tolerances

Operating conditions	Parameter	Shaft Ci	Housing Ce
Rotation on a convex inner raceway	Tolerance on diameter	j5	F6
Rotation on a cylindrical inner raceway		h5	F6
Oscillatory motion		h5	G6
	Ovality and conicity	≤ ¼ of tol.range	≤ ¼ of tol.range
	Hardness	58 to 64 HRC	58 to 64 HRC
	Surface finish	0.35 µm C.L.A.	0.35 µm C.L.A.

LIMITING SPEED

With effective oil lubrication and good alignment, limiting speed may reach:

n (rpm) = 380 000 / Ci (Ci : diameter of inner raceway in mm)

Maximum speed of 70000 rpm.

For grease lubrication, use approximately half these values.

DYNAMIC AND STATIC CAPACITIES

The basic dynamic capacity C in newtons (N), is given by formula:

1) $C = K\,Lu^{7/9}$

K : variable factor relating to diameter of inner raceway Ci , according to table 4.

Lu (mm) : effective needle length, as shown in table of dimensions.

The basic static capacity Co in newtons(N), is given by formula :

2) $Co = 44\,\{1-d/(Ci+d)\}\,idLuZ$

d (mm) : diameter of needles

Lu (mm) : effective needle length as shown in the table of dimensions

Z : number of needles

Ci : dimension under the needles (shaft dia)

i : number of rows of needles

NUMBER OF NEEDLES – CIRCUMFRENTIAL PLAY

The number of needles Z is given, as a function of the proposed shaft diameter Ci and the needle diameter d, by formula :

3) $Z = \pi(Ci+d)/d$ adjusted to the nearest whole number.

To ensure the circuferential play jc, which should normally be between 0.3 and 1 mm, following formulae should be used:

4) $Ci = \gamma d + jc/\pi$

Where γ is a variable factor shown in tables on pg. 95 & 96, in respect to number of needles Z.

Example :

Needles of diameter d = 2.5 mm on a shaft of diameter Ci = approx. 30 mm

Number of needles $Z = \pi(30+2.5)/2.5$ or Z= 41 needles (adjusted up)

To ensure circumferential play jc = 0.3 mm, use formula 4 with γ = 12.06 for 41 needles (table on page 95 & 96), thus :

$Ci = 12.06x2.5+0.3/\pi = 30.25$ mm (adjusted up)

The shaft diameter Ci can therefore be designed at the nominal dimension adjusted upto 30.03 mm to take 41 needles of diameter 2.5 mm, with a circumferential play of approx. 0.3 mm.

Note: Having established the number of needles Z, reference may then be made to the table 4 giving corresponding Ci dimensions according to needle diameter d and for a circumferential play between 0.3 and 0.6 mm. Thus, for 41 needles of diameter 2.5, diameter Ci is 30.03 mm.

INSTALLATION

Because of the large number of shaft diameters possible, depending on the number of needles chosen and their diameter, needles cannot be packed in rings ready for installation.

The needles, which are supplied loose, should therefore be arranged in a ring around the inner or outer raceway, which must be pregreased to ensure their retention during installation of the parts that will retain them.

In cases where the shaft has to be introduced blind into a ring of needles (e.g. an idler wheel fitted on a yoke), it may be useful to retain needles in their housing by means of a mounting shaft of the same length as the needles. This can then be withdrawn when the shaft is introduced.

Arrangement of the needles in a ring may be carried out by hand where the number of installations is small. Where it is relatively high a simple and effective method is to use a manual appliance which in a single movement, permits the assembly on a rotating mandrel of a set of needles ready for installation (information on request).

The use of automatic machines with high-speed rotary loading should be considered only for production of quantities large enough to ensure that the high cost of investment can be absorbed.

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Table 4: Shaft diameter Ci for Z needles of diameter d and a circumferential clearance jc between 0.3 to 0.6 mm

Coefficient γ for formula 4) page 94

Coefficient K for formula 1) page 94

d mm		1		1.5		2		2.5		3		3.5		4		5	
Z	γ	Ci mm	K	Ci mm	K	Ci mm	K	Ci mm	K	Ci mm	K	Ci mm	K	Ci mm	K	Ci mm	K
10	2.24	2.30	531	3.50	823	4.60	1119	5.70	1420	6.90	1730	8.00	2040	9.10	2351	11.30	2985
11	2.55	2.70	586	4.00	905	5.20	1228	6.50	1561	7.80	1898	9.10	2241	10.30	2583	12.90	3283
12	2.86	3.00	635	4.40	978	5.90	1334	7.30	1693	8.70	2058	10.20	2429	11.60	2803	14.50	3562
13	3.18	3.30	680	4.90	1050	6.50	1430	8.10	1817	9.70	2210	11.30	2608	12.90	3010	16.00	3822
14	3.49	3.60	723	5.40	1118	7.10	1522	8.90	1935	10.60	2352	12.40	2776	14.10	3203	17.60	4070
15	3.81	3.90	765	5.90	1182	7.80	1609	9.70	2045	11.60	2488	13.50	2936	15.40	3388	19.20	4306
16	4.13	4.20	804	6.30	1242	8.40	1693	10.50	2151	12.50	2617	14.60	3088	16.60	3564	20.80	4530
17	4.44	4.50	841	6.80	1301	9.00	1772	11.20	2253	13.50	2740	15.70	3233	17.90	3732	22.30	4743
18	4.76	4.90	878	7.30	1356	9.70	1849	12.00	2349	14.40	2858	16.80	3372	19.20	3893	23.90	4948
19	5.08	5.20	913	7.80	1411	10.30	1921	12.80	2443	15.40	2971	17.90	3507	20.40	4048	25.50	5144
20	5.39	5.50	945	8.20	1463	10.90	1992	13.60	2532	16.30	3080	19.00	3635	21.70	4196	27.10	5333
21	5.71	5.80	978	8.70	1512	11.60	2059	14.40	2618	17.30	3185	20.10	3758	23.00	4339	28.70	5515
22	6.03	6.10	1010	9.20	1560	12.20	2125	15.20	2701	18.20	3286	21.20	3879	24.30	4477	30.30	5690
23	6.34	6.40	1039	9.60	1607	12.80	2189	16.00	2783	19.20	3385	22.30	3996	25.50	4611	31.80	5861
24	6.66	6.80	1067	10.10	1652	13.50	2250	16.80	2861	20.10	3481	24.60	4107	26.80	4741	33.40	6026
25	6.98	7.10	1097	10.60	1695	14.10	2311	17.60	2936	21.10	3572	25.70	4216	28.10	4866	35.00	6187
26	7.30	7.40	1124	11.10	1738	14.70	2369	18.40	3011	22.00	3664	26.80	4322	29.30	4991	36.60	6342
27	7.61	7.70	1151	11.60	1779	15.40	2425	19.20	3082	23.00	3751	27.90	4426	30.60	5109	38.20	6494
28	7.93	8.00	1178	12.00	1822	16.00	2481	20.00	3153	23.90	3836	29.00	4528	31.90	5225	39.80	6642
29	8.25	8.40	1202	12.50	1860	16.60	2535	20.80	3221	24.90	3919	30.10	4626	33.10	5341	41.40	6786
30	8.57	8.70	1228	13.00	1898	17.30	2587	21.60	3289	25.80	4002	31.20	4723	34.40	5451	43.00	6927
31	8.88	9.00	1252	13.50	1936	17.90	2639	22.30	3356	26.80	4081	32.30	4818	35.70	5560	44.50	7069
32	9.20	9.30	1277	13.90	1975	18.50	2691	23.10	3420	27.70	4161	33.50	4910	36.90	5668	46.10	7204
33	9.52	9.60	1301	14.40	2011	19.20	2739	23.90	3483	28.70	4236	34.60	4998	38.20	5772	47.70	7336
34	9.84	9.90	1325	14.90	2046	19.80	2788	24.70	3545	29.70	4311	35.70	5088	39.50	5874	49.30	7466
35	10.16	10.30	1345	15.40	2081	20.50	2835	25.50	3606	30.60	4386	36.80	5176	40.80	5974	50.90	7595
36	10.47	10.60	1368	15.80	2118	21.10	2883	26.30	3666	31.50	4460	37.90	5262	42.00	6075	52.50	7720
37	10.79	10.90	1390	16.30	2150	21.70	2930	27.10	3725	32.50	4530	39.00	5346	43.30	6172	54.10	7843
38	11.11	11.20	1413	16.80	2183	22.40	2974	27.90	3782	33.50	4600	40.10	5430	44.60	6267	55.70	7965
39	11.43	11.50	1434	17.30	2216	23.00	3020	28.70	3839	34.40	4670	41.30	5512	45.90	3360	57.30	8085
40	11.75	11.90	1453	17.80	2247	23.60	3065	29.50	3895	35.40	4738	42.30	5590	47.10	6455	58.90	8202
41	12.06					24.30	3107	30.30	3949	36.30	4805	43.50	5673	48.50	6546	60.40	8321
42	12.38					24.90	3150	31.10	4005	37.30	4871	44.60	5748	49.70	6635	62.00	8435
43	12.70					25.50	3194	31.90	4058	38.20	4938	45.70	5826	50.90	6726	63.60	8548
44	13.02					26.20	3233	32.70	4111	39.20	5001	46.80	5902	52.20	6813	65.20	8660
45	13.34					26.80	3275	33.50	4163	40.20	5064	47.90	5978	53.50	6899	66.80	8769
46	13.65					27.40	3317	34.30	4215	41.10	5127	49.00	6052	54.70	6986	68.40	8879
47	13.97					28.10	3356	35.10	4266	42.00	5190	50.20	6126	56.00	7071	70.00	8986
48	14.29					28.70	3396	35.90	4316	43.00	5251	51.00	6197	57.30	7153	71.60	9091
49	14.61					29.40	3434	36.70	4366	44.00	5311	51.30	6286	58.60	7236	73.20	9196
50	14.93					30.00	3474	37.50	4415	44.90	5372	52.40	6339	59.90	7317	74.80	9300
51	15.24					30.60	3513	38.20	4465	45.90	5430	53.50	6409	61.10	7399	76.30	9405
52	15.56					31.30	3550	39.00	4514	46.80	5490	54.60	6479	62.40	7479	77.90	9506
53	15.88					31.90	3588	39.80	4561	47.80	5547	55.70	6548	63.70	7556	79.50	9606
54	16.20					32.50	3626	40.60	4609	48.70	5606	56.80	6616	64.90	7637	81.10	9706
55	16.52					33.20	3661	41.40	4655	49.70	5661	58.00	6681	66.20	7713	82.70	9804

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Table 4: Shaft diameter Ci for Z needles of diameter d and a circumferential clearance jc between 0.3 to 0.6 mm

Coefficient γ for formula 4) page 94

Coefficient K for formula 1) page 94

d mm		2		2.5		3		3.5		4		5	
Z	γ	Ci mm	K	Ci mm	K	Ci mm	K	Ci mm	K	Ci mm	K	Ci mm	K
56	16.83	33.80	3699	42.20	4701	50.60	5719	59.00	6750	67.50	7789	84.30	9901
57	17.15	34.40	3736	43.00	4747	51.60	5774	60.20	6814	68.70	7867	85.90	9997
58	17.47	35.10	3770	43.80	4793	52.50	5831	61.30	6880	70.00	7942	87.50	10093
59	17.79	35.70	3860	44.60	4837	53.50	5884	62.40	6944	71.30	8016	89.10	10188
60	18.11	36.40	3840	45.40	4882	57.50	5938	63.50	7009	72.60	8090	90.70	10282
61	18.43			46.20	4926	55.40	5992	64.60	7073	73.90	8162	92.30	10374
62	18.47			47.00	4970	56.40	6045	65.70	7136	75.10	8236	93.80	10468
63	19.06			47.80	5013	57.30	6100	66.80	7198	76.40	8307	95.40	10559
64	19.38			48.60	5056	58.30	6150	68.00	7258	77.70	8379	97.00	10651
65	19.70			49.40	5099	59.20	6204	69.10	7320	78.90	8451	98.60	10740
66	20.02			50.20	5141	60.20	6254	70.20	7381	80.20	8521	100.20	10829
67	20.33			51.00	5184	61.10	6306	71.30	7442	81.50	8590	101.80	10917
68	20.65			51.80	5225	62.10	6357	72.40	7502	82.70	8660	103.40	11005
69	20.97			52.60	5226	63.00	6408	73.50	7562	84.00	8729	105.00	11092
70	21.29			53.40	5308	64.00	6458	74.70	7620	85.30	8796	106.60	11179
71	21.61			54.20	5349	65.00	6506	75.80	7678	86.60	8863	108.20	11265
72	21.93			55.00	5389	65.90	6557	76.90	7737	87.90	8930	109.80	11350
73	22.24			55.70	5431	66.90	6604	78.00	7795	89.10	8998	111.30	11437
74	22.56			56.50	5471	67.80	6654	79.10	7852	90.40	9064	112.90	11520
75	22.88			57.30	5510	68.80	6702	80.20	7910	91.70	9129	114.50	11604
76	23.20			58.10	5550	69.70	6751	81.30	7966	92.90	9195	116.10	11686
77	23.52			58.90	5589	70.70	6798	82.50	8022	94.20	9260	117.70	11769
78	23.83			59.70	5628	71.60	6846	83.50	8079	95.50	9324	119.30	11851
79	24.15			60.50	5666	72.60	6892	84.70	8134	96.70	9389	120.90	11933
80	24.47			61.30	5704	73.050	6940	85.80	8189	98.00	9453	122.50	12013
81	24.79					74.50	6985	86.90	8243	99.30	9516	124.10	12093
82	25.11					75.50	7030	88.00	8298	100.60	9578	125.70	12173
83	25.43					76.40	7078	89.10	8353	101.90	9640	127.30	12252
84	25.74					77.40	7123	90.20	8407	103.1	9703	128.80	12332
85	26.06					78.30	7169	91.30	8461	104.4	9764	130.40	12410
86	26.38					79.30	7213	92.50	8512	105.7	9825	132.00	12488
87	26.70					80.20	7258	93.60	8565	106.9	9887	133.60	12566
88	27.07					81.20	7302	94.70	8618	108.20	9947	135.20	12643
89	27.34					82.20	7345	95.80	8670	109.50	10007	136.80	12720
90	27.65					83.10	7390	96.90	8723	110.70	10069	138.40	12796
91	27.97					84.00	7436	98.00	8775	112.00	10128	140.00	12871
92	28.29					85.00	7479	99.20	8825	113.30	10187	141.60	12947
93	28.61					86.00	7520	100.30	8876	114.60	10245	143.20	13021
94	28.93					86.90	7565	101.40	8927	115.90	10303	144.80	13096
95	29.24					87.90	7607	102.50	8978	117.10	10363	146.30	13172
96	29.56					88.80	7650	103.60	9028	118.40	10420	147.90	13245
97	29.88					89.80	7692	104.70	9079	119.70	10478	149.50	13318
98	30.20					90.70	7735	105.80	9129	120.90	10537	151.10	13391
99	30.52					91.70	7777	107.00	9177	122.20	10593	152.70	13464
100	30.84					92.70	7817	108.10	9227	123.50	10650	154.30	13536

Standard Needle Rollers

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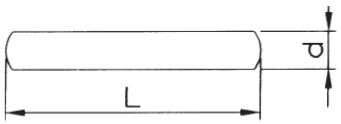
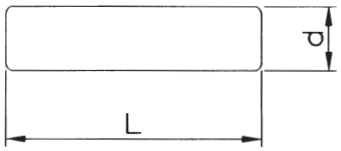


Type BR

d m m	L m m	Lu m m	Approx. weight (gms.) per 1000 nos.
1.5	9.8	8.9	132
1.5	13.6	12.4	181
1.587	9.88	8.9	153
1.811	10.57	9.6	204
1.811	13.46	12.4	273
1.994	16.25	15.2	398
2	7.8	6.8	182
2	9.8	8.8	230
2	10.8	9.8	254
2	11.8	10.8	280
2	13.8	12.8	325
2	15.8	14.8	375
2	19.8	18.8	470
2.015	10.3	9.3	257
2.275	12.7	11.7	389
2.381	10.57	9.6	322
2.382	19.84	18.7	668
2.387	12.55	11.5	384
2.387	16.85	15.7	543
2.41	17.1	16.0	578
2.5	7.8	6.7	285
2.5	11.8	10.7	430
2.5	13.8	12.7	510
2.5	15.8	14.7	580
2.5	17.8	16.7	660
2.5	19.8	18.7	730
2.5	23.8	22.7	880
2.778	11.17	10.4	508
3	9.8	8.5	510
3	13.8	12.5	730
3	15.8	14.5	840
3	17.8	16.5	940
3	19.8	18.5	1050
3	21.8	20.5	1150
3	23.8	22.5	1260
3	29.8	28.5	1600

Type BR

d mm	L mm	Lu mm	Approx. weight (gms.) per 1000 nos.
3	39.8	38.5	2208
3.0025	25.1	23.8	1383
3.0025	28.1	26.8	1447
3.175	16.84	15.5	889
3.175	19.05	17.7	1125
3.175	20.57	19.2	1218
3.175	21.8	20.4	1390
3.175	25.4	24.0	1550
3.195	19.05	17.6	1157
3.2	19.3	17.9	1153
3.457	23.9	22.4	1706
3.5	19.8	18.3	1437
3.5	29.8	28.3	2150
3.968	19.05	17.3	1760
4	29.8	28.1	2839
4.755	30.15	27.8	4135
4.757	25.4	23.1	3510
4.757	34.925	32.6	4640
5	49.8	47.5	7450
5.542	19.05	16.6	3227



Type BR 60

d mm	L mm	Lu mm	Approx. weight (gms.) per 1000 nos.
2	7.8	6.7	192
2.5	11.8	10.5	454
2.5	15.8	14.5	608
3	9.8	8.3	543

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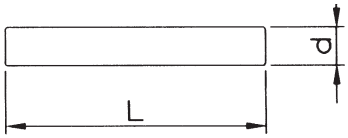
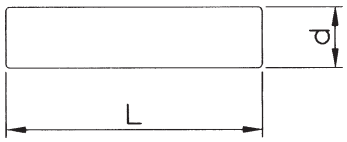


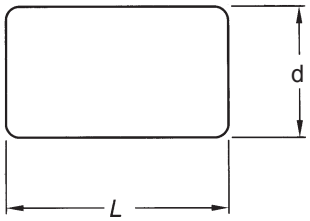


Type BP

d mm	L mm	Lu mm	Approx. weight (gms.) per 1000 nos.
2	11.8	10.8	276
3	8.5	7.4	470
3	5	4	280
4	5	4	493
4	6	5	560
4	8	7	788
4	11.8	10.8	1135
4	10	9	960
4	12	11	1242
4	15.8	14.8	1536
4	21.8	19.8	2363
4.55	7.75	5.6	990
5	12	11	2160
5	8	7	788
5	12.8	11.4	1902
5	49.8	48.2	7550
5.996	28.5	27	6229
6	6	5	1332
6	10	9	2136
6	12	11	2620
6	13	12	2885
7	7	6	2088
7	10	9	2975
7	20	19	6042
7.5	11.8	10.8	4050
8	8	7	3120
8	10	9	3854
8	12	10.8	4735
8.475	33.3	32.3	14524
9	9	8	4170
9.525	9.525	8.5	5240
9	14	13	6810
10	9.3	8.3	5734
10	10	9	5890
10	14	13	8488

Type BPM

d mm	L mm	Lu mm	Approx. weight (gms.) per 1000 nos.
4	8	7	788
4	10	9	985
4	12	11	1242
5	8	7	1193
5.5	10	-	1853
6	10	9	2136
6	12	11	2620
7	7	6	2088
7	10	9	2975
7.5	11.8	10.8	4050
9.525	9.525	8.6	5240
10	10	9	5890
10	14	13	8488



Rollers

d mm	L mm	Lu mm	Approx. weight (gms.) per 1000 nos.
2.5	5	3.60	192
4	13 TR90	11.90	1282
4	14.8	13.16	1410
5	42	38.20	6285
6	10	9.00	2144
7	17.3	16.50	5226
8	12	-	4630
9	19.9	-	9938

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PRECISION STEEL BALLS

ONE MORE STEP TOWARDS EXCELLENCE

In its constant endeavour to provide Indian industry with world class products, NRB now introduces high quality steel balls.

Designed to meet the requirements of a wide range of applications, NRB steel balls are manufactured in an entirely imported facility purchased from Torrington's FAFNIR division in U.K.

Superior quality raw materials, imported from the world's finest steel mills, combined with modern manufacturing technology, bring you the best available SAE 52100 steel balls.

SYMBOLS AND DEFINITIONS

D_w : Nominal Ball Diameter

The diameter value which is used for the purpose of general identification of a ball size.

D_{ws} : Single Diameter of a Ball

The distance between two parallel planes tangent to the surface of the ball.

D_{wm} : Mean Diameter of a Ball

The arithmetic mean of the largest and smallest actual single diameters of the ball.

V_{Dws} : Ball Diameter Variation

The difference between the largest and the smallest actual single diameter of one ball.

t_{Dw} : Deviation from spherical form

The greatest radial distance in any radial plane between a sphere circumscribed around the ball surface and any point on the ball surface.

LOT :

A definite quantity of balls manufactured under conditions which are presumed uniform and which is considered as an entity.

D_{WmL} : Lot Mean Diameter

The arithmetic mean of the mean diameter of the largest ball and that of the smallest ball in the lot.

V_{Dwl} : Lot Diameter Variation

The difference between the mean diameter of the largest ball and that of the smallest ball in the lot.

Ball Grade :

A specific combination of dimensional form, surface roughness, and sorting tolerances. A ball grade is identified by a number.

S : Ball gauge

The amount by which a lot mean diameter should differ from the nominal ball diameter, this amount being one of an established series.

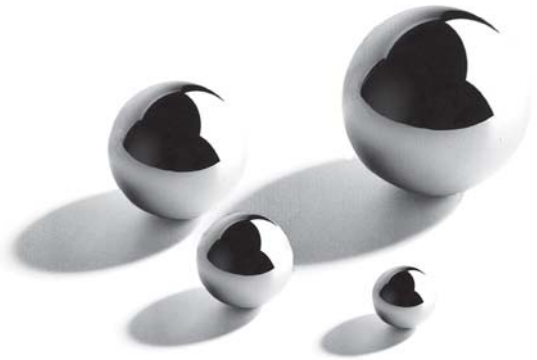
Each ball gauge is a whole multiple of the ball gauge interval established for the ball grade in question.

A ball gauge, in combination with the ball grade and nominal diameter, should as be considered the most exact ball size specification to be used by a customer for ordering purposes.

Δ S : Deviation from ball gauge

The difference between the lot mean diameter and the sum of the nominal diameter and the ball gauge.

$\Delta S = D_{Wml} - (D_W + S)$



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TOLERANCES

Quality of NRB hardened chrome alloy steel balls correspond to ISO 3290-2001 (E).
The tolerance values are given in the table below.

Grade	Ball Dia D_w		Tolerances				Gauge Interval	Preferred Gauges
			V_{Dws}	t_{Dw}	R_a	V_{Dwl}		
	over mm	incl mm	max	max	max	max	Value in Micrometers	
			Value in Micrometers					Value in Mircrometers
3	-	12.7	0.08	0.08	0.012	0.13	0.5	- 5, ... - 0.5, 0, + 0.5, ... + 5
5	-	12.7	0.13	0.13	0.020	0.25	1.0	- 5, ... - 1, 0, + 1, ... + 5
10	-	25.4	0.25	0.25	0.025	0.50	1.0	- 9, ... - 1, 0, + 1, ... + 9
16	-	25.4	0.40	0.40	0.032	0.80	2.0	-10, ... - 2, 0, + 2, ... + 10
20	-	38.1	0.50	0.50	0.040	1.00	2.0	-10, ... - 2, 0, + 2, ... + 10
28	-	38.1	0.70	0.70	0.050	1.40	2.0	-12, ... - 2, 0, + 2, ... + 12
40	-	50.8	1.00	1.00	0.080	2.00	4.0	-16, ... - 4, 0, + 4, ... + 16
100	-	All	2.50	2.50	0.125	5.00	10.0	-40, ... -10, 0, +10, ... + 40
200	-	All	5.00	5.00	0.200	10.00	15.0	-60, ... -15, 0, +15, ... + 60

MANUFACTURING RANGE

Some of the standard sizes which NRB manufactures as per AFBMA (Grade 10) are listed below.
Sizes as per customer's requirements can also be undertaken.

Designation	Ball size mm	Weight per 1000 nos. kg.
JSB - 6	6.0000	0.88
JSB - 6.35	6.3500	1.03
JSB - 7.144	7.1438	1.50
JSB - 7.938	7.9375	2.06
JSB - 8.731	8.7312	2.66
JSB - 9	9.0000	3.00
JSB - 9.525	9.5250	3.55
JSB - 10.319	10.3188	4.43
JSB - 12.7	12.7000	8.42
JSB - 14.288	14.2875	12.00
JSB - 17.463	17.4625	21.90

CAPACITY/LOAD VALUES $\frac{C}{P}$ IN TERMS OF SPEED AND LIFE

Speed	LIFE IN HOURS																							
r.p.m.	100	250	500	1 000	1 500	2 000	2 500	3 000	4 000	5 000	6 000	7 000	8 000	9 000	10 000	15 000	20 000	25 000	30 000	40 000	50 000	60 000	80 000	100 000
10	-	-	-	-	-	1,05	1,13	1,19	1,30	1,39	1,47	1,54	1,60	1,66	1,71	1,93	2,11	2,25	2,38	2,59	2,77	2,93	3,19	3,42
20	-	-	-	1,05	1,19	1,30	1,39	1,47	1,60	1,71	1,81	1,89	1,97	2,04	2,11	2,38	2,59	2,77	2,93	3,19	3,42	3,61	3,93	4,20
30	-	-	-	1,19	1,35	1,47	1,57	1,66	1,81	1,93	2,04	2,15	2,23	2,31	2,38	2,69	2,93	3,13	3,31	3,61	3,86	4,07	4,44	4,75
40	-	-	1,05	1,30	1.47	1,60	1,71	1,81	1,97	2,11	2,23	2,33	2,43	2,51	2,59	2,93	3,19	3,42	3,61	3,93	4,20	4,44	4,84	5,18
50	-	-	1,13	1,39	1.57	1,71	1,83	1,93	2,11	2,25	2,38	2,49	2,59	2,69	2,77	3,13	3,42	3,66	3,86	4,20	4,50	4,75	5,18	5,54
60	-	-	1,19	1,47	1,66	1,81	1,93	2,04	2,23	2,38	2,51	2,63	2,74	2,84	2,93	3,31	3,61	3,86	4,07	4,44	4,75	5,02	5,47	5,85
70	-	-	1,25	1,54	1,74	1,89	2,02	2,15	2,33	2,49	2,63	2,76	2,87	2,97	3,07	3,46	3,78	4,04	4,27	4,65	4,97	5,25	5,73	6,12
80	-	1,05	1,30	1,60	1,81	1,97	2,11	2,23	2,43	2,59	2,74	2,87	2,99	3,10	3,19	3,61	3,93	4,20	4,44	4,84	5,18	5,47	5,96	6,37
90	-	1,09	1,35	1,66	1,87	2,04	2,18	2,31	2,51	2,69	2,84	2,97	3,10	3,21	3,31	3,74	4,07	4,36	4,59	5,02	5,36	5,66	6,18	6,60
100	-	1,13	1,39	1,71	1,93	2,11	2,25	2,38	2,59	2,77	2,93	3,07	3,19	3,31	3,42	3,86	4,20	4,50	4,75	5,18	5,54	5,85	6,37	6,81
125	-	1,21	1,49	1,83	2,07	2,25	2,41	2,54	2,77	2,97	3,13	3,28	3,42	3,54	3,66	4,12	4,50	4,81	5,08	5,54	5,92	6,25	6,81	7,29
150	-	1,28	1,57	1,93	2,18	2,38	2,54	2,69	2,93	3,13	3,31	3,47	3,61	3,74	3,86	4,36	4,75	5,08	5,36	5,85	6,25	6,60	7,20	7,70
175	-	1,34	1,64	2,02	2,29	2,49	2,66	2,82	3,07	3,28	3,47	3,63	3,78	3,91	4,04	4,56	4,97	5,32	5,62	6,12	6,55	6,92	7,54	8,06
200	1,05	1,39	1,71	2,11	2,38	2,59	2,77	2,93	3,19	3,42	3,61	3,78	3,93	4,07	4,20	4,75	5,18	5,54	5,85	6,37	6,81	7,20	7,85	8,39
225	1,09	1,44	1,77	2,18	2,47	2,69	2,88	3,04	3,31	3,54	3,74	3,91	4,07	4,22	4,36	4,92	5,36	5,73	6,06	6,60	7,06	7,46	8,13	8,69
250	1,13	1,49	1,83	2,25	2,54	2,77	2,97	3,13	3,42	3,66	3,86	4,04	4,20,	4,36	4,50	5,08	5,54	5,92	6,25	6,81	7,29	7,70	8,39	8,97
275	1,16	1,53	1,88	2,32	2,62	2,85	3,05	3,22	3,51	3,76	3,97	4,15	4,33	4,48	4,63	5,22	5,70	6,09	6,43	7,01	7,50	7,92	8,63	9,23
300	1,19	1,57	1,93	2,38	2,69	2,93	3,13	3,31	3,61	3,86	4,07	4,27	4,44	4,59	4,75	5,36	5,85	6,25	6,60	7,20	7,70	8,13	8,86	9,47
325	1,22	1,61	1,98	2,44	2,75	3,00	3,21	3,39	3,69	3,95	4,17	4,37	4,55	4,71	4,86	5,49	5,99	6,40	6,76	7,37	7,88	8,33	9,08	9,74
350	1,25	1,64	2,02	2,49	2,82	3,07	3,28	3,47	3,78	4,04	4,27	4,47	4,65	4,82	4,97	5,62	6,12	6,55	6,92	7,54	8,06	8,51	9,28	9,92
375	1,28	1,68	2,07	2,54	2,88	3,13	3,35	3,54	3,86	4,12	4,36	4,56	4,75	4,92	5,08	5,73	6,25	6,68	7,06	7,70	8,23	8,69	9,47	10,1
400	1,30	1,71	2,11	2,59	2,93	3,19	3,42	3,61	3,93	4,20	4,44	4,65	4,84	5,02	5,18	5,85	6,37	6,81	7,20	7,85	8,39	8,86	9,66	10,4
425	1,32	1,74	2,15	2,64	2,98	3,26	3,48	3,67	4,00	4,28	4,52	4,74	4,93	5,11	5,27	5,95	6,49	6,94	7,33	7,99	8,54	9,02	9,84	10,5
450	1,35	1,87	2,18	2,69	3,04	3,31	3,54	3,74	4,07	3,36	4,59	4,82	5,02	5,20	5,36	6,06	6,60	7,06	7,45	8,13	8,69	9,18	10,0	10,7
475	1,37	1,80	2,22	2,73	3,08	3,36	3,60	3,80	4,14	4,43	4,68	4,90	5,10	5,28	5,45	6,16	6,71	7,18	7,58	8,26	8,83	9,33	10,2	10,9
500	1,39	1,83	2,25	2,77	3,13	3,42	3,66	3,86	4,20	4,50	4,75	4,97	5,18	5,36	5,54	6,25	6,81	7,26	7,70	8,39	8,97	9,47	10,4	11,1
550	1,43	1,88	2,32	2,85	3,22	3,51	3,76	3,97	4,33	4,63	4,89	5,12	5,33	5,52	5,70	6,43	7,01	7,50	7,92	8,83	9,23	9,76	10,6	11,3
600	1,47	1,93	2,38	2,93	3,31	3,61	3,86	4,07	4,44	4,75	5,02	5,25	5,47	5,66	5,85	6,60	7,20	7,70	8,13	8,86	9,47	10,0	10,9	11,7
650	1,50	1,98	2,44	3,00	3,39	3,69	3,95	4,17	4,55	4,86	5,14	5,38	5,60	5,80	5,99	6,76	7,37	7,88	8,33	9,08	9,74	10,4	11,2	11,9
700	1,54	2,02	2,49	3,07	3,47	3,78	4,04	4,27	4,65	4,97	5,25	5,50	5,73	5,93	6,12	6,92	7,54	8,06	8,51	9,28	9,92	10,5	11,3	12,2
750	1,57	2,07	2,54	3,13	3,54	3,85	4,12	4,36	4,75	5,08	5,36	5,62	5,85	6,06	6,25	7,06	7,70	8,23	8,69	9,47	10,1	10,7	11,7	12,5
800	1,60	2,11	2,59	3,19	3,61	3,93	4,20	4,44	4,84	5,18	5,47	5,73	5,96	6,18	6,37	7,20	7,85	8,39	8,86	9,66	10,4	10,9	11,9	12,7
850	1,63	2,15	2,64	3,26	3,67	4,00	4,28	4,52	4,93	5,27	5,57	5,83	6,07	6,29	6,49	7,33	7,99	8,54	9,02	9,84	10,5	11,1	12,1	13,0
900	1,66	2,18	2,69	3,31	3,74	4,07	4,36	4,59	5,02	5,36	5,66	5,93	6,18	6,40	6,60	7,46	8,13	8,69	9,18	10,0	10,7	11,3	12,3	13,2
950	1,69	2,22	2,73	3,36	3,80	4,14	4,43	4,68	5,10	5,45	5,76	6,03	6,28	6,50	6,71	7,58	8,26	8,83	9,33	10,2	10,9	11,5	12,5	13,4
1000	1,71	2,25	2,77	3,42	3,86	4,20	4,50	4,75	5,18	5,54	5,85	6,12	6,37	6,60	6,81	7,70	8,39	8,97	9,47	10,4	11,1	11,7	12,7	13,6
1100	1,76	2,32	2,85	3,51	3,97	4,33	4,63	4,89	5,33	5,70	6,02	6,30	6,56	6,79	7,01	7,92	8,63	9,23	9,76	10,6	11,3	12,0	13,1	13,9
1200	1,81	2,38	2,93	3,61	4,07	4,44	4,75	5,02	5,47	5,85	6,18	6,47	6,73	6,97	7,20	8,13	8,86	9,47	10,0	10,9	11,7	12,3	13,4	14,4
1300	1,85	2,44	3,00	3,69	4,17	4,55	4,86	5,14	5,60	5,99	6,33	6,62	6,90	7,14	7,37	8,33	9,08	9,74	10,4	11,2	11,9	12,6	13,8	14,7
1400	1,89	2,49	3,07	3,78	4,27	4,65	4,97	5,25	5,73	6,12	6,47	6,77	7,05	7,30	7,54	8,51	9,28	9,92	10,5	11,3	12,2	12,9	14,1	15,0
1500	1,93	2,54	3,13	3,86	4,36	4,75	5,08	5,36	5,85	6,25	6,60	6,92	7,20	7,46	7,70	8,69	9,47	10,1	10,7	11,7	12,5	13,2	14,4	15,4
1600	1,97	2,59	3,19	3,93	4,44	4,84	5,18	5,47	5,96	6,37	6,73	7,05	7,34	7,60	7,85	8,86	9,66	10,4	10,9	11,9	12,7	13,4	14,5	15,7
1700	2,01	2,64	3,26	4,00	4,52	4,93	5,27	5,57	6,07	6,49	6,85	7,18	7,47	7,74	7,99	9,02	9,84	10,5	11,1	12,1	13,0	13,7	14,9	15,9
1800	2,04	2,69	3,31	4,07	4,59	5,02	5,36	5,66	6,18	6,60	6,97	7,30	7,62	7,88	8,13	9,18	10,0	10,7	11,3	12,3	13,2	13,9	15,2	16,2
1900	2,07	2,73	3,36	4,14	4,68	5,10	5,45	5,76	6,28	6,71	7,09	7,42	7,73	8,01	8,26	9,33	10,2	10,9	11,5	12,5	13,4	14,1	15,4	16,5
2000	2,11	2,77	3,42	4,20	4,75	5,18	5,54	5,85	6,37	6,81	7,20	7,54	7,85	8,13	8,39	9,47	10,4	11,1	11,7	12,7	13,6	14,4	15,7	16,7
2250	2,18	2,87	3,54	4,36	4,92	5,36	5,73	6,06	6,60	7,06	7,46	7,81	8,13	8,42	8,69	9,82	10,7	11,3	12,1	13,2	14,1	14,9	16,2	17,3
2500	2,25	2,97	3,66	4,50	5,08	5,54	5,92	6,25	6,81	7,29	7,70	8,06	8,39	8,69	8,97	10,1	11,1	11,8	12,5	13,6	14,5	15,4	16,7	17,9
2750	2,32	3,05	3,76	4,63	5,22	5,70	6,09	6,43	7,01	7,50	7,92	8,29	8,63	8,94	9,23	10,4	11,3	12,2	12,9	13,9	15,0	15,8	17,2	18,4
3000	2,38	3,13	3,86	4,75	5,36	5,85	6,25	6,60	7,20	7,70	8,13	8,51	8,86	9,18	9,47	10,7	11,7	12,5	13,2	14,4	15,4	16,2	17,7	18,9
3250	2,44	3,21	3,95	4,86	5,49	5,99	6,40	6,76	7,37	7,88	8,33	8,72	9,10	9,40	9,74	11,1	11,9	12,9	13,5	14,7	15,7	16,6	18,1	19,4
3600	2,49	3,28	4,04	4,97	5,62	6,12	6,55	6,92	7,54	8,06	8,51	8,92	9,28	9,61	9,92	11,2	12,2	13,1	13,8	15,0	16,1	17,0	18,5	19,8
3750	2,54	3,35	4,12	5,08	5,73	6,25	6,68	7,06	7,70	8,23	8,69	9,10	9,47	9,82	10,1	11,3	12,5	13,3	14,1	15,4	16,4	17,3	18,9	20,2
4000	2,59	3,42	4,20	5,18	5,85	6,37	6,81	7,20	7,85	8,39	8,86	9,28	9,66	10,0	10,4	11,7	12,7	13,6	14,4	15,7	16,7	17,7	19,3	20,6
4250	2,64	3,48	4,28	5,27	5,95	6,49	6,94	7,33	7,99	8,54	9,02	9,45	9,84	10,2	10,5	11,9	13,0	13,8	14,6	15,9	17,0	18,0	19,6	-
4500	2,69	3,54	4,36	5,36	6,06	6,60	7,06	7,46	8,13	8,69	9,18	9,61	10,0	10,4	10,7	12,1	13,2	14,1	14,9	16,2	17,3	18,3	20,0	-
4750	2,73	3,60	4,43	5,45	6,16	6,71	7,18	7,58	8,26	8,83	9,33	9,77	10,2	10,5	10,9	12,3	13,4	14,3	15,1	16,5	17,6	18,6	20,3	-
5000	2,77	3,66	4,50	5,54	6,25	6,81	7,29	7,70	8,39	8,97	9,47	9,92	10,4	10,7	11,1	12,5	13,6	14,5	15,4	16,7	17,9	18,9	20,6	-
5500	2,85	3,76	4,63	5,70	6,43	7,01	7,50	7,92	8,63	9,23	9,76	10,2	10,6	11,1	11,3	12,9	13,9	15,0	15,8	17,2	18,4	19,5	-	-
6000	2,93	3,86	4,75	5,85	6,60	7,20	7,70	8,13	8,86	9,47	10,0	10,5	10,9	11,3	11,7	13,2	14,4	15,4	16,2	17,7	18,9	20,0	-	-
6500	3,00	3,95	4,86	5,99	6,76	7,37	7,88	8,33	9,08	9,74	10,4	10,7	11,2	11,6	11,9	13,5	14,7	15,7	16,6	18,1	19,4	20,5	-	-
7000	3,07	4,04	4,97	6,12	6,92	7,54	8,06	8,51	9,28	9,92	10,5	11,1	11,3	11,8	12,2	13,8	15,0	16,1	17,0	18,5	19,8	-	-	-
7500	3,13	4,12	5,08	6,25	7,06	7,70	8,23	8,69	9,47	10,1	10,7	11,2	11,7	12,1	12,5	14,1	15,4	16,4	17,3	18,9	20.2	-	-	-
8000	3,19	4,20	5,18	6,37	7,20	7,85	8,39	8,86	9,66	10.4	10,9	11,3	11,9	12,3	12,7	14,4	15,7	16,7	17,7	19,3	20,6	-	-	-
8500	3,26	4,28	5,27	6,49	7,33	7,99	8,54	9,02	9,84	10,5	11,1	11,6	12,1	12,5	13,0	14,6	15,9	17,0	18,0	19,6	-	-	-	-
9000	3,31	4,36	5,36	6,60	7,46	8,13	8,69	9,18	10,0	10,7	11,3	11,8	12,3	12,9	13,2	14,9	16,2	17,3	18,3	20,0	-	-	-	-
9500	3,36	4,43	5,45	6,71	7,58	8,26	8,83	9,33	10,2	10,9	11,5	12,0	12,5	13,0	13,4	15,1	16,5	17,6	18,6	20,3	-	-	-	-
10000	3,42	4,50	5,54	6,81	7,70	8,39	8,97	9,47	10,4	11,1	11,7	12,2	12,7	13,2	13,6	15,4	16,7	17,9	18,9	20,6	-	-	-	-

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Noida Dadri Road,
Greater Noida - 201 301
Tel : (0120) 2350902

GURGAON:

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Shiv Ashram Complex,
Delhi Palam Road,
Village Area, Dundhahera,
Post Office: Maruti,
Gurgaon (Haryana).
Tel: (91-124) 6365417

KANPUR:

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Fazal Ganj,
Kanpur 208 012.
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NAGPUR:

C/o. Perfect Logistics Solutions
Plot no. X-47, Commercial Zone,
M.I.D.C., Hingna Road,
Nagpur - 440 016
Tel : (07104) 237417

NRB PLANTS

Jalna

Hyderabad

Thane

Aurangabad

Waluj

NRB BEARINGS LIMITED

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PLANTS

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AURANGABAD : E-40, M.I.D.C. Industrial Area,
Chikalthana - 431 210. Dist. Aurangabad.

JALNA : C-6, M.I.D.C. Additional Industrial Area,
Jalna - 431 203.

WALUJ : E-72 (1), M.I.D.C. Waluj,
Taluka Gangapur,
Dist. Aurangabad - 431 133.

HYDERABAD : A-5, Uppal Industrial Estate,
Hyderabad - 500 039.

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