

Needle Bearings





► NEEDLE BEARINGS 2008





NADFLLA

Specialist manufacturer of needle bearings since 1930.
1000 employees
2 manufacturing plants
80 million bearings per annum
4000 million needle rollers.

PRODUCT DEVELOPMENT

NADELLA needle roller products are under continual development both from the point of performance and their adaptability to specific applications. NADELLA have created many special products to meet various complex requirements: The RAX combined radial and axial roller bearings; Deltaflex bearings for steering columns and special bearings for the machine tool and aviation industries.

The design department at NADELLA, who hold an extensive file of successful patents, is in close contact with the market in order to respond rapidly with innovative and competitive solutions to its' customers needs.

QUALITY

NADELLA is committed to achieving "Quality" throughout production and in all departments. This is achieved through continuous research and development into methods and means of production; the use of high powered automatic presses, machines to cut and weld cages and automated machines for grinding and assembly, as well as machines for sorting and grading needle rollers.

RELIABILITY

The reliability of NADELLA bearings is maintained on two levels:

- firstly, the suitability of the bearing to satisfy the requirements of the customer
- secondly, manufacturing to zero defects.

These two features are permanently under verification and surveillance, on test rigs, by continual inspection from operators and furthermore, by statistical process control. The reliability of NADELLA products is confirmed every day in standard high volume applications as well as selected sophisticated and complex applications.

SUPPORT

NADELLA's engineers work closely with their customers, both in the design office and the workshop. Through their training and their experience, they can make a positive contribution to the technological evolution of their customer's products.

NADELLA PRESENT IN ALL INDUSTRIES

From the simple drawn cup needle roller bearings to the sophisticated bearings that articulate the nozzles on the three stages of the Ariane missile, NADELLA is present throughout all industries, both for mass produced volumes and specific applications at the frontiers of technology.

Our engineers, experienced in all types of application, are available to work with you throughout the design and development of your products and any future projects.

A great many industries have already put their confidence in the NADELLA products.



NADELLA BEARINGS - NEW CAPACITIES

Resulting from the significant progress made in the geometry of our bearings and in the quality of the steel used, NADELLA bearings now offer the user increased performance.

The new basic static capacities shown in the present catalogue (ISO standard) take into account this increased performance.

IMPORTANT: The correction factors have been revised to conform with the new specifications. Please don't forget to consult them.

PRINCIPAL UNITS



	S.I.SYSTEM		Multiple or Part		Equivalent
Unit	Title	Symbol	Title	Symbol	
length	metre	m	millimetre	mm	1 mm = 10 ⁻³ m
		i	Micrometre or micron	μ m	$_{1 \mu m} = _{10^{-6} m}$
time	second	sec	hour	h	1 h = 3600 sec
			minute	min	1 min = 60 sec
speed	metre per second	m/sec ²		:	
speed (rotational)	revolutions per minute	r.p.m.			
acceleration	metres per second per second	m/s ²			
mass	kilogramme	kg	gramme	g	1 g = 10 ⁻³ kg
force	newton	N		:	
moment of force	newton metre	Nm			
stress	pascal	Pa	Megapascal	MPa	1 MPa = 1N/mm ²
kinematic viscosity	square metres per second	m ² /s	square millimetres per second	mm²/s	1 mm ² /s = cSt
temperature	degrees centigrade	°C`			

COMMENTS

The information given in this catalogue can be subject to modification and deletions. NADELLA does not accept any responsibility for errors or omissions that may have escaped notice.

Information and advice contained herein may be insufficient given the conditions of

individual applications. For further assistance, please consult our Technical Department.

Certain products mentioned in this catalogue involve proprietary rights of manufacture (Trade Marks, Patents, etc.).



TECHNICAL INFORMATION

NEEDLE BUSHES DB HK **BEARINGS WITH CAGE GUIDED NEEDLES FULL COMPLEMENT NEEDLE BEARINGS NEEDLE ROLLERS** AIG ... BR AIG ... BP **CAM FOLLOWERS** GCR RNA 11000 THRUST BEARINGS WITH NEEDLES WITH ROLLERS AR 812 AR schwer ARZ AR leicht **RAX 700** ® RAXPZ 400 **COMBINED** RAX 500 RAXN 400 RAXN 500 RAXZ 500 RAXNPZ 400 **RAXF 700** ® **BEARINGS** RAXPZ 500 **AXNBT AXNB** ARNB ARNBT PRECISION COMBINED BEARINGS WITH ADJUSTABLE PRELOAD **SEALING RINGS**

IM

B1...R6

BEARING TOLERANCES (ISO 92) ISO SHAFT AND HOUSING FITS C/P FACTORS

SUMMARY TABLE — INNER RINGS SUMMARY TABLE — THRUST PLATES



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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, also the speeds and loads. At this stage the choice can be made from the many types of bearings offered from the NADELLA standard ranges and the notes given in this section will generally permit one to select 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 ancilliary 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 NADELLA, the bearings proposed frequently occupy less space and save material, machining and installation costs, which benefit the entire assembly.

As for all other types of bearing, the results obtained with needle bearing products 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.

2. CALCULATIONS FOR RADIAL AND THRUST BEARINGS

The details following enable one to evaluate radial bearings and thrust bearings and also combined bearings which comprise a radial and a thrust component. These are calculated separately without transforming the axial load into an equivalent radial load.

The calculations for linear bearings and recirculating roller linear bearings are covered in the relevant sections.

The calculation 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 the 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 operating conditions (see table page 11).

IMPORTANT

The correction factors (reliability, material, lubrication, hardness, operating conditions) have been revised to conform with the new basic capacities. Please don't forget to consult them.

In the case where a NADELLA bearing is used with a raceway provided by the customer, our Technical Service is available to your designers to define the correction factors applicable.



2.1. DYNAMIC CAPACITY 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 ring or rolling element. For a thrust bearing, the capacity for 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/I (French Std. E 22 392 - Dec. 1977). This does not apply to full complement needle bearing products where the dynamic capacity C has been established by NADELLA.

2.2. NOMINAL LIFE L₁₀

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 this expression p is equal to 10/3 for needle or roller bearings. In order to assess the importance of the influence of load on the life expectancy, one should note for example that, if the load on a bearing is doubled, its life is reduced by a factor of 10.

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

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

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

To make these calculations the table on page 183 gives the values for the factor C/P for various lives in hours and speeds in r.p.m. For intermediate speeds or lives one can interpolate the figures given.

One can also use the table on page 184 to establish the values for the factor C/P as a function of the product n x h (n speed in r.p.m. and h life in hours). For example for 800 r.p.m. and 6 000 hrs. $(800 \times 6000 = 4800000)$ 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 10 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, a 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 respectively to reliability, material and lubrication.

2.3.1. Reliability correction factor a₁

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 a 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 95 96 97 98 99	1 0.62 0.53 0.44 0.33 0.21	L ₁₀ L ₅ L ₄ L ₃ L ₂ L ₁

In order to select as an example a bearing of L₄ life (reliability 96%) it is necessary to consider a theoretical L₁₀ life (reliability 90%), equal to L₄/0.53 applied in the formula L₁₀ = (C/P)^{10/3} using the dynamic capacity C given in this catalogue.



2.3.2. Correction factor a2 for material and a3 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 bearings 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 too low at the operating temperature) one should use a factor $a_3 < 1$. It is therefore recommended that the product of the factors $a_2 \times a_3$ is always considered in its entirety.

The NADELLA 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 the 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 calculation:

1.0-1.2 machinery or mechanisms operating smoothly without repeated shocks

1.1-1.3 geared transmissions according to gear quality

1.5-3.0 machinery or equipment operating under repeated shocks or vibration.

As far as belt drive transmissions are concerned, 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:

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

$$n = m_1 n_1 + m_2 n_2 + ... + m_n n_n$$

In which:

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

 $n_1, n_2, ..., n_n$: Constant speeds corresponding respectively to intervals of time $m_1, m_2 ... m_n$ $P_1, P_2, ..., P_n$: Constant loads corresponding respectively to intervals of time $m_1, m_2 ... m_n$.

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

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:

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

 $n_{osc} = number of oscillations$ "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.

The static capacity Co given in the tables of dimensions has been established in conformance with ISO Specification 76. This takes into consideration the maximum admissible contact stress (Hertzian stress). The value currently being adopted in 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 .

	Limit load P _L for:					
Operating conditions	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 smooth- ness of function, silent operation, or accuracy of rotation	0.2 Co	0.25 Co	0.25 Co - 0.5 Co			
General applications	See loading limits in the tables		0.5 Co – Co			
Slow rotation or oscillatory motion	of dimens	0.7 Co - 1.2 Co				

(1) For studded cam followers the limit load P_L determined as a function of the static capacity of the bearing must not be in excess of the authorised 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 equal to 0.0001 of the diameter of the rolling element.

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 static capacity above 250°C.

Operating temperature (°C)	150	200	250	300
Capacity reduction coefficient: • dynamic • static	1 1	0.9	0.75 1	0.6 0.8

When the operating temperature is in excess of 120°C, some permanent dimensional change can occur in large ground bearing rings, which can prejudice their smooth operation. In such cases stabilisation heat treatment of the rings is recommended. The suffix HT is added to the bearing designation in accordance with the following table which also indicates the equivalent hardness of the rings at a temperature of 20°C:



Stabilisation heat treatment	HT 1	HT2	НТ3	HT4
Max. temperature of operation (°C)	150	200	250	300
Hardness HRC of rings at a temperature of 20°C	60	58	55	52

At the maximum operating temperature, the hardness of stabilised rings HT2-HT4 is reduced in accordance with the following table:

Stabilisation heat treatment	HT1	HT2	НТ3	HT4
Hardness HRC of stabilised rings at the maximum authorised temperature	60	55	52	49

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:

Hardness	HRC	60	58	56	54	52	50	48	45	40	35	30	25
	HV	697	653	613	577	545	512	485	447	392	346	302	267
Capacity reduction coefficients	Dyn. Stat.	1 1	1	0.93 1	0.84	0.73 0.96	0.63 0.86	0.52 0.77	0.43 0.65		0.23 0.39		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 (see French Standard A 04 202).

This 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 mini (mm)	0.3	0.5	0.7	0.9	1	1.2

2.8.3. Surface finish

The shafts or housing 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. = $0.35\mu m$ Outer raceway for radial bearings: C.L.A. = 0.4 µm Raceway for thrust bearings $: C.L.A. = 0.5 \mu m$

2.9. **COEFFICIENTS OF FRICTION**

The power dissipated within 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:

- lackbrack radial bearing: $M=f\times P imes rac{Ci}{2}$ (Ci being the diameter of the inner raceway of the bearing) lackbrack thrust bearing: $M=f\times P imes rac{dm}{2}$ with $dm=rac{d_1+d_2}{2}$ (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 high speed rotation is considered.

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

When satisfactory conditions exist, 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 NADELLA Technical Department is consulted with respect to the special characteristics of the particular bearing envisaged.

For needle or roller thrust bearings rotating at high speed, an oil circulatory system or oil mist must be achieved within the thrust bearing in the direction of the centrifugal force created by the effect of rotation. The lubricant can then reach the bearing through its bore. This arrangement is facilitated by using the intermediate thrust plates type PMH which possess radial oil holes connected to an external groove.

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

When a bearing is mounted incorporating the use of an ET sealing ring, it is the speed limit of the seal that must be taken into consideration.

For combined bearings, it is the thrust component which imposes the maximum permissible speed limits shown in the tables.

If shaft snap rings are to be used to maintain lateral control of inner rings or needle cages, it is recommended that the critical speed of these items be taken into consideration.

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 type ET	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 a 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).



2.11. CALCULATION EXAMPLES

Example 1 - Life calculation

What is the probable L₁₀ life for a caged needle bearing NBI 25 40 20 supporting a constant radial load P of 4 400 N at a speed of 1 000 r.p.m.?

What is the probable L_5 life (95% reliability)?

Dynamic capacity of bearing (page 50): Cr = 28 000 N.

Factor Cr/P =
$$\frac{28\,000}{4\,400}$$
 = 6.36

The table on page 183 gives for a speed of 1000 r.p.m. and a factor Cr/P = 6,37, L_{10} life of 8000 hours.

For L_5 life (95% reliability) the L_{10} life must be multiplied by the coefficient 0.62 according to table on page 9 giving:

 $L_5 = 8000 \times 0.62 = 4900$ hours.

Load as a function of Cor

Static capacity of bearing Cor = 44 500 N

Factor = $\frac{P}{Cor} = \frac{4400}{44500} = 0.10$ i.e. lower than limits shown on page 11.

Example 2 - Choice of bearing

A bearing is required to support a constant radial load P of 16 000 N at a speed of 750 r.p.m. Life required is 10 000 hours. Gear drive of average precision quality. What bearing is to be selected?

Taking account of the average precision quality of the gearing, one uses a factor of 1.2 from which equivalent load $P = 16\,000x\,1.2 = 19\,200\,N$.

For a life of 10000 hours and a speed of 750 r.p.m. the table on page 183 gives the factor Cr/P = 6.25.

Required capacity Cr = 6.25x P = 6.25x 19 200 = 120 000 N.

One must then select a bearing from the full complement range:

- either the Na 2 095 with capacity Cr = 120 000 N
- or the NA 3 060 with capacity Cr = 123 000 N.

One can then verify that in either case the equivalent load P as a factor of static capacity Cor for these bearings is within the limits shown (page 11).

Example 3 - Calculation of permissible load

Full complement needle bush DL 30 20 rotating at 300 r.p.m. on a shaft of hardness 512 HV. Life to be attained 5 000 hours. What radial load can be permitted?

Dynamic capacity of DL 30 20 (page 28): Cr = 26 000 N.

Reduction of dynamic capacity for hardness of 512 HV (page 12): Crx 0.63 = 16 400 N.

For a life of 5000 hours and a speed of 300 r.p.m. the table on page 183 gives Cr/P = 3.86.

Permissible load on the needle bush: $P = \frac{C_r}{3.86} = \frac{16400}{3.86} \approx 4200 \text{ N approx.}$

Control of limit load

For operation without special demands, the limit load is given in the table of dimensions, i.e. $18\,000\,N$ for DL $30\,20$. To take account of the hardness of the shaft $512\,HV$, the limit load is reduced to $18\,000x\,0.86 = 15\,480$ (0.86 being the reduction coefficient for static capacity given on page 12).

The permissible calculated load of 4 200 N can then be applied, being less than the limit load.

Example 4 - Choice of a needle bush

One requires a needle bush on a shaft hardened to 700 HV to support a radial load P of 8000 N at a speed of 40 r.p.m. The intermittent function of the machine permits a life expectancy of only 1000 hours. What needle bush should be chosen?



For a life of 1000 hours and a speed of 40 r.p.m. the table on page 183 gives a factor Cr/P = 1.30.

Dynamic capacity required: Cr = 1.3x P = 1.3x 8000 = 10400 N.

One could then select:

- either full complement needle cage DL 20 12 Cr = 10 200 N
- or caged needle bush HK 16 16 Cr = 10 800 N.

Control of limit load

The loading limits for these needle bushes shown in the table of dimensions are 6300 N for DL 20 12 and 5200 N for HK 16 16. These are insufficient to support a load of 8000 N.

One then has a choice:

- either full complement needle bush DL 18 16 (or DL 18 24 16 P) for which the limit load is 9 000 N
- or caged needle bush HK 20 20 for which the limit load is 8 700 N.

Example 5 - Choice of a needle cage for a gear wheel subject to variable loads and speeds.

It is intended to mount a cage with two rows of needles type BB in a precision reduction gear. The bore of the gear and supporting shaft are case hardened and tempered to a hardness of 58 to 64 HRC. The radial load and corresponding speed are variable on the bearings according to the intervals of time in operation as indicated below. The life required is 10 000 hours. What cage is to be selected?

n ₁ = 200	P ₁ = 32 000
	1 - 02 000
$n_2 = 320$	$P_2 = 21000$
$n_3 = 540$	$P_3 = 12000$
n ₄ = 1 100	$P_4 = 5000$
	n ₃ = 540

Equivalent load (see page 10):

$$P = \sqrt[\frac{\frac{10}{3}}{0.015 \times 200 \times (32000)^{\frac{10}{3}} + 0.025 \times 320 \times (21000)^{\frac{10}{3}} + 0.20 \times 540 \times (12000)^{\frac{10}{3}} + 0.76 \times 1100 \times (5000)^{\frac{10}{3}}}{0.015 \times 200 + 0.025 \times 320 + 0.20 \times 540 + 0.76 \times 1100}$$

Therefore P = 8340 N.

This load of 8 340 N is multiplied by 1.1 to take account of the geared transmission (see page 10) giving an equivalent load $P = 8 340 \times 1.1 = 9 174 \text{ N}$.

Equivalent speed:

n = 0.015x 200 + 0.025x 320 + 0.20x 540 + 0.76x 1 100 = 955 r.p.m.

For this speed and a life of 10 000 hours, the function Cr/P is approximately 6.72 (from the table on page 183).

Dynamic capacity required:

Cr = 6.72x P = 6.72x 9 174 = 61 649 N.

One can then consider the needle cage B 70 78 30, which has a capacity Cr = 69 000 N.

Control of limit load

Since the static capacity of this cage is 155 000 N, the function

P/Cor =
$$\frac{9174}{155000} \approx 0.06$$
 = is below the limits recommended on page 11.

Thickness of the case hardened and tempered layer

According to the table on page 12, for function P/Cor < 0.2, the hardened case depth should not be less than 0.3 mm after grinding.



Example 6 - Choice of a cam follower

One requires a studded carn follower to support a radial load varying linearly over a given time from P min = 3 000 N to P max = 15 000 N without shock loads and at a constant speed of 30 r.p.m. What is the smallest carn follower to be selected and what will be its life?

The maximum load of 15000 N demands the choice of GC 35, wich has a limit load corresponding to the strength of the stud of 24000 N given in the table of dimensions (page 95).

The ratio of the maximum load to the static capacity of this cam follower (Cor = 33 000 N) is $\frac{15\,000}{33\,000} = 0.45$. This is permissible according to the table on page 11.

Equivalent load

The equivalent load is given by P =
$$\frac{P_{mini} + 2P_{maxi}}{3}$$

therefore P = $\frac{3000 + 2 \times 15000}{3}$ = 11000 N.

Since the dynamic capacity Cr of GC 35 is 19 200 N, the function $Cr/P = \frac{19200}{11000} \simeq 1.75$.

The table on page 184 gives product n x h = 110 000 for a Cr/P ratio = 1.76

The probable life will then be $h = \frac{110000}{30} \simeq 3650$ hours.

Example 7 - Choice of a needle thrust bearing

One considers using a needle or roller thrust bearing to support a static centred axial load $P = 60\,000\,$ N with repetitive shock loads. The thrust bearing is required to rotate slowly under the same load but without shock loading. Which is the most suitable type to choose?

To take account of the shock loading one must consider an equivalent static load of $2x\ 60\ 000 = 120\ 000\ N$ (see page 10).

For slow rotation without shock loading one must accept that this load should not exceed Coa (see page 11).

The static capacity will then be Coa = 120 000 N.

The needle thrust bearing AX 55 78 with Coa = 164 000 N is the most suitable solution for this application.

Example 8 - Life of a combined bearing

A combined bearing RAX 735 is required to carry a constant radial load $Pr = 4\,400\,N$ and a constant centred axial load $Pa = 2\,500\,N$ at a speed of 750 r.p.m. What is the probable life?

Load capacities and limit loads for RAX 735

	Radial		Axial			
Basic ca	pacities	Limit load	Basic ca	Limit load		
Dynamic C _r N	Static C _{or} N	N	Dynamic C _a N	Static C _{oa} N	N	
24 500	45 000	14300	19 400	88 000	27000	

Since the radial load of 4 400 N and axial load of 2 500 N are significantly lower than the limit loads shown, the combined bearing RAX 735 can be used.

Calculation of life of the radial component

The function
$$\frac{Cr}{Pr} = \frac{24500}{4400} = 5.57$$

For a speed of 750 r.p.m. and a Cr/P ratio of 5.57 (lying between 5.36 and 5.62), the table on page 183 gives a life of 6 800 hours approx.



Calculation of life of the axial acomponent

The function
$$\frac{Ca}{Pa} = \frac{19400}{2500} = 7.76$$

This is higher than the ratio Cr/Pr for the radial component and would enable a longer life (20 000 hours). Advantage cannot be taken of this since the life of the bearing will be limited by the life of the radial component, i.e. 6 800 hours.

3. LUBRICATION

Our products are protected against oxydation, but normally supplied unlubricated. Please don't forget to lubricate them when mounting.

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 shaft 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 more economic. 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 indispensible 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 13) 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 the continuous mixing to which it is submitted. Therefore replenishment must take place at regular intervals, taking account of operating and environmental conditions (humidity, dirt, 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 oxydation 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 greases

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 —30°C to +120°C and even up to 150°C if they are of very good quality. Generally, they are supplied with anti-rust inhibitors and offer good protection against corrosion. NADELLA cam followers are supplied lubricated with a grease of this type.

Sodium soap greases are suitable for lubricating bearings up to 100°C 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 up to 50 or 60°C. 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 100°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, providing 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 the 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 the 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 (see page 14) 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

 $1.25 < \frac{n_G}{n} < 5 \qquad \begin{array}{l} 1/3 \ \text{to 2/3 of the available volume packed with grease of grade 2.} \\ \text{These quantities can be increased slightly for grease of grade 1} \end{array}$

 $\frac{n_G}{n} > 5$ 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 70° C, the re-lubrication interval T_{G} in hours can be determined approximately from the formula:

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

n : speed of rotation

n_G: permissible speed limit for grease lubrication (see page 13)

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.

For the bearings below, the diameter Ci is replaced by the following dimensions, given in the table of dimensions:

► Cam followers type FG and derivatives: dimension D1

Cam followers type GC and derivatives: average dimension $\frac{d+M}{2}$

Needle or roller thrust bearings: dimension d1.

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

In the case of very slow speed rotation, which would give interval $T_{\rm G}$ 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 11. For very small amplitudes of oscillation it is recommended to reduce by half the calculated re-lubrication period T_G.

3.2. OIL LUBRICATION

Refined mineral oils offer good chemical stability and resistance to oxydation and are useful for lubrication of bearings up to temperature of 120 to 130°C.

3.2.1. Viscosity

The essential characteristic of an oil is its basic kinematic viscosity in mm²/sec. at a reference temperature of 40° C according to ISO 3448 (French Std. 60 141). The old reference temperatures of 20 or 50° C are no longer used but their corresponding values appear on diagram 2 following. 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 the 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 mm²/sec. For higher loads greater than 1/5 of the dynamic capacity the min. viscosity V_F can be about 18 mm²/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 below gives the viscosity V_{F} required at the operating temperature from the

ratio $\frac{n_{H}}{n}$ (n_H: permitted speed limit for oil lubrication n: speed rotation).

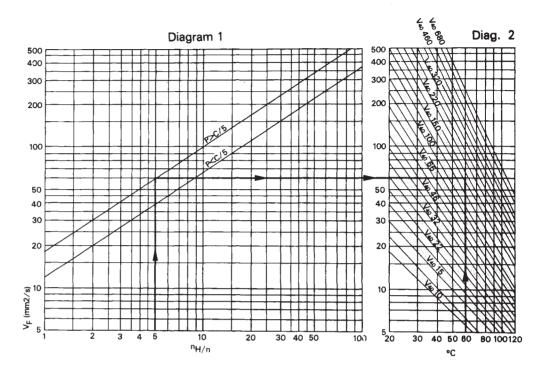
For the viscosity V_F required in operation, diagram 2 gives the base viscosity V_{40} at the reference temperature of 40° C for an oil of viscosity index 95.

Example: A bearing supporting a load P> $\frac{C}{5}$ and having a speed limit for oil lubrication of 10 000 r.p.m., must rotate at 2 000 r.p.m. at temperature up to 60°C.



The ratio $\frac{n_H}{n} = \frac{10\,000}{2\,000} = 5$ indicates a viscosity in operation $V_F = 60 \text{ mm}^2/\text{sec.}$

(diagram 1). For an operating temperature of 60° C, the horizontal $V_F = 60$ cuts the vertical of 60° C (diagram 2) in the 150 zone, which is therefore the base viscosity required at 40° C.



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 suitated 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 or to an assembly of thrust bearings with intermediate plate type PMH with oil hole. This method is suitable even for high speed applications and permits the application of the optimum quantity 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 the 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 intermediate thrust plates PMH with oil hole permit this arrangement as they are centred externally allowing entry of oil through the housing.

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 manufactured by specialised suppliers and offers advantages such as filtration, re-circulation, flow control and metering to each lubrication point.

3.3. LUBRICANTS-SUPPLY/STOCK

With the exception of cam followers types FG, GC, GCR and derivatives which are delivered lubricated with a lithium soap operating grease, all other needle or roller bearing products are supplied without grease, though protected against oxydation by an oil film compatible with most greases and mineral oil lubricants.

Radial and thrust bearings should be stocked in a clean dry environment and retained in their original wrapping until the last moment before assembly. Even when assembling the bearing, care should be taken to prevent contamination from dirt or metallic particles and humidity.

In case of doubt concerning cleanliness of the bearing, it may be necessary to wash it in filtered petroleum (1). In so doing the bearing must be rotated and then suitably drained and dried (avoid the use of compressed air, which may contain water particles). Smear the bearing with a suitable oil or grease to protect it against oxydation at the time of assembly.

(1) The use of trichlorethylene is not recommended on account of its tendency to cause oxydation.

4. SEALING

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

A carefully studied and accurately manufactured seal is of prime importance to the correct operation of a bearing. For studies undertaken by NADELLA Technical Department, the same attention is given to the sealing system as to the choice of bearings.

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 grove 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 (Figs. 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 (Figs. 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

4.2.1. Various types

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 that the rubbing surface 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 30° max.) in front of the rubbing surface in order to avoid damage from a sharp edge.

Felt seals can be used successfully with grease lubrication for speeds of 4 or 5 m/sec. and up to a temperature of about 100°C. Before fitting into place, felt seals should be heated in an oil bath at 80°C. 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 temperatures of -40 to +120°C. 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 the 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 the machine tool.

For speeds above 4 m/sec, a maximum roughness of $0.5\,\mu$ is recommended and above 8 m/sec, the rubbing surface must be heat treated and hardened to 60 HRC.

A number of different types of sealing rings are available from specialist manufacturers in respect to shape and material (double lip, rubbing face lip) any of which can be adapted to the particular ambient conditions and temperatures.

The toroidal seals and quadrilobed types, though not normally considered for rotating applications, can be used for oscillating movement or very slow speed applications with grease lubrication but they impose serious friction conditions.

4.2.2. Mounting

When using grease lubrication for bearings, the lip of the seal must be oriented to the 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.

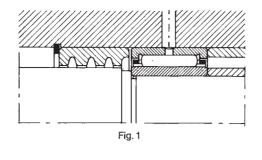
4.2.3. NADELLA Sealing Rings

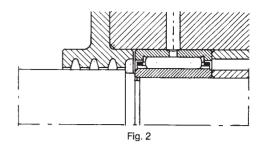
Sealing rings manufactured by NADELLA type ET (see page 161) are designed specially to be mounted with needle bushes of the same internal and external dimensions (Figs. 10 and 12).

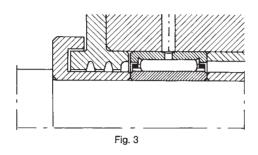
Needle bushes type DB...E and HK...E include a seal incorporated on one side (see page 34). They can equally be used with a sealing ring type ET to ensure the retention of grease on the opposite side (Fig. 11).

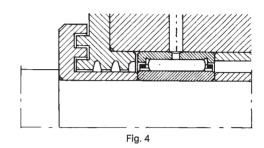
When a needle bush is used with an inner ring on a shaft which is not heat-treated, this inner ring can be selected wider than the cage to serve as running surface for the sealing ring type ET (Fig. 12).

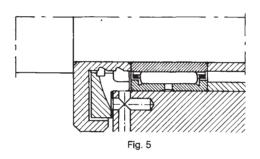


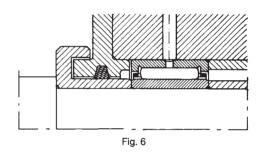


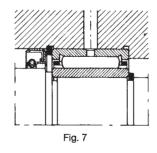


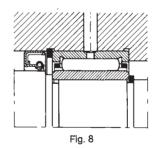


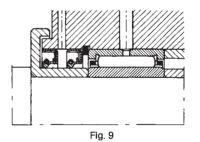


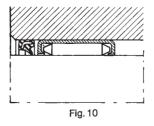


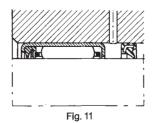


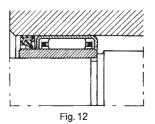
















NEEDLE BUSHES



IMPORTANT

The caged needle bushes manufactured to tolerances conforming to ISO standard 3245 now have new designations:

- HK series, open, formerly DB..P
- BK series, closed-end, formerly DBF..P
- HK..E series, open, with seal, formerly DB..PE

For a limited period, one or the other designations will be supplied in deliveries.



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 the outer ring by their ends or by grease; others have the 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 the 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 the needles of at least 650 HV. A lower hardness is acceptable if loads and required life permit. (See Technical Section.)

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

All needle bushes are normally supplied unlubricated (except where a special grease has been requested). However, they are coated with a thin film of grease to prevent corrosion.

TYPES OF NEEDLE BUSH — In metric dimensions — Without Oil hole.

	Full complemen	t needle bushe	Caged needle bushes				
open	d needles	open need	retained dles* closed end	open	closed end	open with seal	
(fig. 1)	(fig. 2)	(fig. 3)	(fig. 4)	(fig. 5)	(fig. 6)	(fig. 7)	
DL DLP	DLF DLFP	SL SLP	CN, CNS	DB HK	DBF BK	DBE HKE	

^{*} Dimensions on request.

Full complement needle bushes in inch dimensions open or with closed end can be supplied on demand.

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

Needle bushes HK, BK, and those with suffix P are manufactured to tolerances conforming to ISO standard 3245 (French standard E 22 372 September 1976).



Housing tolerances recommended for needle bushes without suffix P are identical to those recommended for combined bearings types RAX and RAXF 700.

- ▶ The full complement needle bush with needles retained in the outer ring (Figs. 1 and 2) incorporates 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 cheapness 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 the shaft is fitted. Dimensions on request.

► 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 re-lubrication and may even permit lubrication for life in certain applications.

- ► Caged needle bushes type HK...E, DB...E (Fig. 7) have a seal incorporated, thus dispensing with the need for separate sealing rings.
- ▶ 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 the shaft. Where a large axial load requires the additional use of a thrust bearing, one may consider the combined bearing with thin outer ring, type RAX 700 (see page 136). The low price and minimal space occupied and the ease of installation of this bearing provide a very acceptable solution in many cases.

INSPECTION

Needle bushes are not truly cylindrical in the free state and therefore they can be 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 dimensions of the "GO" and "NO-GO" plug-gauges are given in the tables of dimensions. For needle bushes with suffix P the inspection dimensions are in conformance with ISO standard 3245 (French standard E 22 372 September 1976) which applies to a ring gauge of tolerance N6. For needle bushes without suffix P the inspection dimensions relate to a 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.

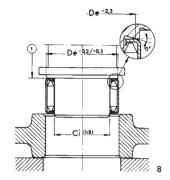
INSTALLATION

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 the 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.

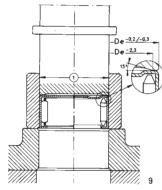
Bushes having one closed end should preferably have the open end presented to the housing bore (Fig. 9). If this is not possible, the force may be applied to the inside face of the closed end in the case of bushes type DLF (Fig. 10). (This must not be done in the case of bushes type DBF or BK.)

CAGED NEEDLE BUSHES INCORPORATING SEALS

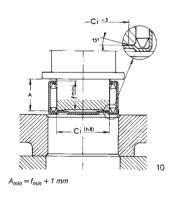
Caged needle bushes type DB..E (or HK..E) have a seal incorporated on the inside of the face marked with the bearing part number. To this face should be applied the force necessary for installation. Thus, after fitting, the seal will normally be situated towards the outside of the bearing to prevent loss of lubricant and the entry of dirt, etc. (Fig. 11). If sealing is also necessary on the opposite side, a separate sealing ring type ET, of the same internal and external diameters as the needle bush may be used. The bearing seal which is made of synthetic rubber permits operation up to 120° C. (Minimum running temperature -20° C.)



(1) Marked face



(1) Bore of Ring: D_e + 0.3 mm





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

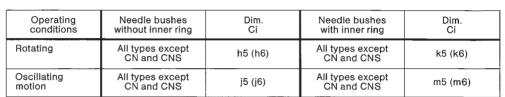
Inner Rings for needle bushes are normally supplied without oil hole and have a cylindrical needle track (series IM or IM..P). In those infrequent cases where lubrication is provided through the shaft, inner rings can be supplied on request with an oil hole (series IMC). Please consult NADELLA for details.

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 up to 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.



IM, IM ... P

SHAFT TOLERANCES





IMC. IMC...P

HOUSING TOLERANCES

		Housing Dimension De
Types of bush	Steel or cast iron	Non-ferrous metal (1) or thin casings in steel
DL, DLF – DB, DBF – DB E	H6 (H7)	M6 (M7)
DL P, DLF P HK, BK, HK E	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 (Standard ISO 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 the 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					
DLP, DLFP HK, BK, HKE	F8					
DL, DLF DB, DBF, DB E	Dimension Ci ≤ 22 mm 25 – 44 mm 45 – 55 mm	+ 15/ + 50 µm + 20/ + 60 µm + 20/ + 65 µm				

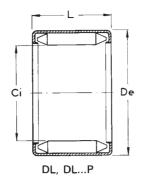
The radial play limits should also take into account the tolerance of the shaft used directly as a raceway or the outer diameter of the inner ring after it has been fitted on to the shaft.

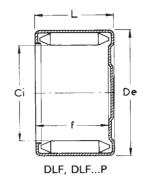
Where an inner ring is used on a shaft of recommended tolerance k5 (k6) or m5 (m6), the minimum play may be slightly lower and the maximum play slightly higher than for the case of an assembly without inner ring on a shaft of h5 (h6) tolerance.



Needle Bushes, full complement, retained

open seriesDL and DL...Pclosedend seriesDLF and DLF...P

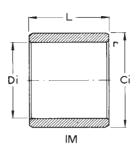


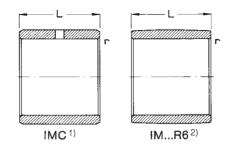


Limit load: See technical section page 11 and calculation examples pages 14 to 17.



^{*} on request





Inspection of bushes

Inner rings

Inner rings with lubrication hole, type IMC, available on request.
 Inner rings with convex raceways cannot be used with needle bushes with closed end (Series DLF or DLF...P).

Ring Gauge Bore	Plug Gauge GO	Plug Gauge NO-GO			
mm	mm	mm			
12,000	6,009	6,036			
14,000	8,009	8,036			
14,000	9,009	9,036			
 16,000	10,009	10,036			
18,000 18,000	12,009 12,009	12,035 12,035			
19,000	13,009	13,035			
20,000	14,009	14,035			
21,000	15,009	15,035			
22,000	16,009	16,035			
23,000 22,976	17,009 17,016	17,035 17,034			
24,000 24,000 23,976	18,009 18,009 18,016	18,035 18,035 18,034			
26,000 26,000	20,009 20,009	20,035 20,035			
28,000	22,009	22,035			
33,000 33,000	25,015 25,015	25,041 25,041			
36,000	28,015	28,041			
38,000 38,000 38,000	30,015 30,015 30,015	30,041 30,041 30,041			
 41,972 43,000 43,000	35,025 35,015 35,015	35,050 35,041 35,041			
48,000 48,000	40,015 40,015	40,041 40,041			
52,000	44,015	44,041			
51,967	45,025	45,050			
55,000	47,015	47,041			
58,000 58,000 58,000	50,015 50,015 50,015	50,041 50,041 50,041			
63,000	55,015	55,041			

Shaft Dia.	Designation	Di	Ci	L 0/-0.12	r mini	Weight approx.	Reference Needle bush
mm	IM Series	mm	mm	mm	mm	g	
8	IM 8 12 12,4	8	12	12,4	0,3	5,8	DL, DLF 12 12
9	IM 9 13 12,4	9	13	12,4	0,3	6,4	DL, DLF 13 12
10	IM 10 14 12,4	10	14	12,4	0,3	7	DL, DLF 14 12
12	IM 12 15 12,4	12	15	12,4	0,2	5,8	DL, DLF 15 12
14	IM 12 16 12,4	12	16	12,4	0,3	8,1	DL, DLF 16 12
	IM 13 17 12,4 IM 13 17 12,4	13 13	17 17	12,4 12,4	0,3 0,3	8,7 8,7	DL, DLF 17 12 DL, DLF 17 23 12 P
13	IM 13 18 12,4 IM 13 18 16,4 IM 13 18 16,4	13 13 13	18 18 18	12,4 16,4 16,4	0,35 0,35 0,35	11,2 15 15	DL, DLF 18 12 DL, DLF 18 16 DL, DLF 18 24 16 P
15	IM 15 20 12,4 IM 15 20 16,4	15 15	20 20	12,4 16,4	0,35 0,35	12,7 17	DL, DLF 20 12 DL, DLF 20 16
17	IM 17 22 16,4	17	22	16,4	0,35	18,8	DL, DLF 22 16
20	IM 20 25 16,4 IM 20 25 20,4	20 20	25 25	16,4 20,4	0,35 0,35	21,5 27	DL, DLF 25 16 DL, DLF 25 20
23	IM 23 28 20,4	23	28	20,4	0,35	30,5	DL, DLF 28 20
25	IM 25 30 16,4 IM 25 30 20,4 IM 25 30 25	25 25 25	30 30 30	16,4 20,4 25	0,35 0,35 0,35	26,5 33 40	DL, DLF 30 16 DL, DLF 30 20 DL, DLF 30 25
30	IM 30 35 16,4 IM 30 35 16,4 IM 30 35 20,4	30 30 30	35 35 35	16,4 16,4 20,4	0,35 0,35 0,35	31 31 39	DL, DLF 35 42 16 P DL, DLF 35 16 DL, DLF 35 20
35	IM 35 40 16,4 IM 35 40 20,4	35 35	40 40	16,4 20,4	0,35 0,35	36 45	DL, DLF 40 16 DL, DLF 40 20
40	IM 40 44 16,4	40	44	16,4	0,3	32	DL, DLF 44 16
40	IM 40 45 16,4 P*	40	45	16,4	0,3	32	DL, DLF 45 52 16 P
45	IM 45 50 20,4	45	50	20,4	0,6	56	DL, DLF 50 20
50	IM 50 55 20,4	50	55	20,4	0,6	62	DL, DLF 55 20

^{*} on request

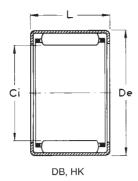


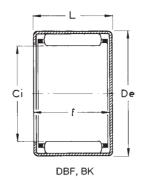
Caged needle **bushes**

open series

DB, HK

closed end
series DBF, BK





Limit load: See technical section page 11 and calculation examples pages 14 to 17.

_													
Shaft Dia.		nations	Ci	De	L 0/-0.25	f min	Basic ca	apacities	Limit load	Speed limit	Wei app	_	
mm	Series HK, BK to ISO tolerances	Series ²⁾ DB, DBF	mm	mm	mm	mm	Dyn. Cr N	Stat. Cor N	N	r.p.m.	DB g	DBF g	
5	HK, BK 5 9		5	9	9	7,9	2 150	1 950	670	80 000	2	2,1	
6	HK, BK 6 8 HK, BK 6 9		6 6	10 10	8 9	6,9 7,9	2 000 2 390	1 800 2 280	600 760	67 000 67 000	2 2,3	2,1 2,4	
7	HK, BK 7 9		7	11	9	7,9	2 750	2 850	930	57 000	2,7	2,9	
8	HK,*BK 8 8 HK, BK 8 10		8 8	12 12	8 10	6,9 8,9	2 500 3 500	2 580 3 900	820 1 250	50 000 50 000	2,6 3,2	2,8 3,4	
9	HK,*BK 9 10		9	13	10	8,9	3 800	4 500	1 400	44 000	3,5	3,8	
10	HK,*BK 10 10 HK,*BK 10 12	DB, DBF 10 12	10 10 10	14 14 16	10 12 12	8,9 10,9 10,5	3 950 5 000 5 700	4 900 6 600 6 000	1 500 2 100 2 200	40 000 40 000 40 000	3,9 4,7 7,5	4,2 5 8,2	
12	HK, BK 12 10 HK,*BK 12 12	DB, DBF 12 10	12 12 12 12	16 18 18 18	10 10 12 12	8,9 8,5 10,5 10,5	4 450 4 750 6 300 6 300	6 000 5 000 7 200 7 200	1 800 1 800 2 500 2 500	33 000 33 000 33 000 33 000	4,5 7 8,7 8,7	5 7,8 9,5 9,5	
13	HK, BK 13 12	DB, DBF 13 12	13 13	19 19	12 12	10,5 10,5	6 800 6 800	8 000 8 000	2 800 2 800	31 000 31 000	9,2 9,2	10 10	
14	HK,*BK 14 12 HK,*BK 14 16	DB, DBF 14 12	14 14 14	20 20 20	12 12 16	10,5 10,5 14,5	6 900 6 900 9 900	8 500 8 500 13 500	2 900 2 900 4 600	29 000 29 000 29 000	9,8 9,8 13	10,7 10,7 13,9	i I
15	HK,*BK 15 12 HK,*BK 15 22 1)	DB, DBF 15 12	15 15 15	21 21 21	12 12 22	10,5 10,5 20,5	7 400 7 400 12 700	9 300 9 300 18 500	3 100 3 100 6 200	27 000 27 000 27 000	10,5 10,5 19,8	11,5 11,5 20,8	
16	HK,*BK 16 12 HK,*BK 16 16	DB, DBF 16 12	16 16 16	22 22 22	12 12 16	10,5 10,5 14,5	7 400 7 400 10 800	9 800 9 800 15 700	3 300 3 300 5 200	25 000 25 000 25 000	11 11 14,7	12,3 12,3 16	
17	HK,*BK 17 12	DB, DBF 17 12	17 17	23 23	12 12	10,5 10,5	7 900 7 900	10 500 10 500	3 500 3 500	24 000 24 000	11,6 11,6	13 13	
18	HK,*BK 18 12 HK, BK 18 16	DB, DBF 18 16	18 18 18	24 24 24	12 16 16	10,5 14,5 14,5	7 900 11 400 11 500	11 000 17 500 17 700	3 600 5 800 5 800	22 000 22 000 22 000	12,7 17 17	14,3 18,6 18,6	
20	HK,*BK 20 10 HK,*BK 20 12	DB, DBF 20 12	20 20 20	26 26 26	10 12 12	8,5 10,5 10,5	6 300 8 400 8 400	8 500 12 300 12 300	2 800 4 000 4 000	20 000 20 000 20 000	11,5 13,8 13,8	13,5 15,8 15,8	
20	HK,*BK 20 16 HK,*BK 20 20	DB, DBF 20 16	20 20 20	26 26 26	16 16 20	14,5 14,5 18,5	12 200 12 200 15 500	19 500 19 500 27 000	6 400 6 400 8 700	20 000 20 000 20 000	18,4 18,4 23	20,4 20,4 25	

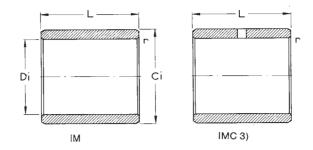
^{*} on request
1) Fitted with 2 needle cages.
2) The recommended housing tolerance for those bushes is identical with the appropriate tolerance for combined bearings RAX or RAXF 700 series of equivalent diameters.



IMPORTANT
The caged needle bushes manufactured to tolerances conforming to ISO standard 3245 now have new designations:

 HK series, open, formerly DB...P - **BK** series, closed-end, formerly DBF...P

For a limited period, one or the other designations will be supplied in deliveries.



_	Inspection	of bushe	s
	Ring	Plug	Plug
	Gauge	Gauge	Gauge
	Bore	GO	NO-GO
	mm	mm	mm
	8,984	5,010	5,028
_	9,984	6,010	6,028
	9,984	6,010	6,028
	10,980	7,013	7,031
	11,980	8,013	8,031
	11,980	8,013	8,031
	12,980	9,013	9,031
_	13,980	10,013	10,031
	13,980	10,013	10,031
	16,000	10,009	10,036
	15,980	12,016	12,034
	18,000	12,009	12,035
	17,980	12,016	12,034
	18,000	12,009	12,035
-	18,976	13,016	13,034
	19,000	13,009	13,035
	19,976	14,016	14,034
	20,000	14,009	14,035
	19,976	14,016	14,034
_	20,976	15,016	15,034
	21,000	15,009	15,035
	20,976	15,016	15,034
	21,976	16,016	16,034
	22,000	16,009	16,035
	21,976	16,016	16,034
	22,976	17,016	17,034
	23,000	17,009	17,035
	23,976	18,016	18,034
	23,976	18,016	18,034
	24,000	18,009	18,035
	25,976	20,020	20,041
	25,976	20,020	20,041
	26,000	20,009	20,035
	25,976	20,020	20,041
	26,000	20,009	20,035
	25,976	20,020	20,041

Inner rings

3) Inner rings with lubrication hole type IMC, available on request.

Shaft Dia.	Designation	Di	Ci	L 0/-0,12	r min	Weight approx.	Reference Needle bush
mm	IM Series	mm	mm	mm	mm	g	
	IM 8 12 10 P	8	12	10	0,3	4,6	HK, BK 12 10
8	IM 8 12 12,4	8	12	12,4	0,3	5,8	HK, BK 12 12
	IM 8 12 12,4	8	12	12,4	0,3	5,8	DB, DBF 12 12
9	IM 9 13 12,4 IM 9 13 12,4	9	13 13	12,4 12,4	0,3 0,3	6,4 6,4	HK, BK 13 12 DB, DBF 13 12
10	IM 10 14 12,4	10	14	12,4	0,3	7	HK, BK 14 12
	IM 10 14 12,4	10	14	12,4	0,3	7	DB, DBF 14 12
	IM 10 14 16 P	10	14	16	0,3	9	HK, BK 14 16
12	IM 12 15 12,4	12	15	12,4	0,2	5,8	HK, BK 15 12
	IM 12 15 12,4	12	15	12,4	0,2	5,8	DB, DBF 15 12
	IM 12 15 22,4*	12	15	22,4	0,2	10,7	HK, BK 15 22
12	IM 12 16 12,4	12	16	12,4	0,3	8,1	HK, BK 16 12
	IM 12 16 12,4	12	16	12,4	0,3	8,1	DB, DBF 16 12
	IM 12 16 16 P	12	16	16	0,3	10,5	HK, BK 16 16
	IM 13 17 12,4	13	17	12,4	0,3	8,7	HK, BK 17 12
	IM 13 17 12,4	13	17	12,4	0,3	8,7	DB, DBF 17 12
13	IM 13 18 12,4	13	18	12,4	0,35	11,2	HK, BK 18 12
	IM 13 18 12,4	13	18	12,4	0,35	11,2	HK, BK 18 16
	IM 13 18 16 P	13	18	16,4	1,35	15	DB, DBF 18 16
15	IM 15 20 12,4 IM 15 20 12,4 IM 15 20 16 P IM 15 20 16,4 IM 15 20 20 P	15 15 15 15 15	20 20 20 20 20 20	12,4 12,4 16 16,4 20	0,35 0,35 0,35 0,35 0,35	12,7 12,7 16,5 17 20,5	HK, BK 20 12 DB, DBF 20 12 HK, BK 20 16 DB, DBF 20 16 HK, BK 20 20

^{*} on request

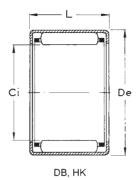


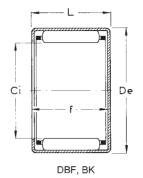
→ over

Caged needle bushes

open seriesDB, HK

closed end series DBF, BK





Limit load: See technical section page 11 and calculation examples pages 14 to 17.

\rightarrow	O	V	e	r

→ over									A				
Shaft Dia.	Desig Series	nations	Ci	De	L 0/-0.25	f min	Basic ca	apacities	Limit load	Speed limit		ight rox.	
mm	HK, BK to ISO tolerances	Series ¹⁾ DB, DBF	mm	mm	mm	mm	Dyn. Cr N	Stat. Cor N	N	r.p.m.	DB g	DBF g	
22	HK,*BK 22 12 HK,*BK 22 16	DB, DBF 22 16	22 22 22	28 28 28	12 16 16	10,5 14,5 14,5	8 900 12 800 12 800	13 500 21 700 21 500	4 300 7 000 7 000	18 000 18 000 18 000	15 20 20	18 23 23	
25	HK,*BK 25 12 HK,*BK 25 16 HK, BK 25 20	DB, DBF 25 16 DB, DBF 25 20	25 25 25 25 25 25	32 32 32 33 33	12 16 20 16 20	10,5 14,5 18,5 14,5 18,5	9 300 14 400 18 900 15 500 20 500	13 000 22 700 32 000 22 300 32 000	4 300 7 400 10 500 7 500 10 500	16 000 16 000 16 000 16 000 16 000	20 26 32 30 37	23 29 35 34 41	
28	HK,*BK 28 16 HK,*BK 28 20		28 28	35 35	16 20	14,5 18,5	15 000 19 800	25 000 35 500	8 100 11 400	14 300 14 300	28 35	32 39	
30	HK,*BK 30 12 HK,*BK 30 16 HK,*BK 30 20	DB, DBF 30 20	30 30 30 30	37 37 37 38	12 16 20 20	10,5 14,5 18,5 18,5	10 200 15 900 20 800 22 300	15 500 27 300 38 500 37 500	5 000 8 700 12 400 12 000	13 000 13 000 13 000 13 000	23 30 38 45	27 34 42 50	
35	HK,*BK 35 16 HK,*BK 35 20	DB, DBF 35 20	35 35 35	42 42 43	16 20 20	14,5 18,5 18,5	17 200 22 500 24 500	31 800 45 000 45 000	10 100 14 300 14 300	11 500 11 500 11 500	35 43 49	41 49 56	
40	HK,*BK 40 12 *HK,*BK 40 16 *HK,*BK 40 20	DB, DBF 40 20	40 40 40 40	47 47 47 48	12 16 20 20	10,5 14,5 18,5 18,5	11 400 17 500 23 000 26 200	19 500 34 000 48 500 51 000	6 300 10 700 15 200 16 000	10 000 10 000 10 000 10 000	30 39 49 55	37 46 56 63	
45	*HK,*BK 45 16 HK, BK 45 20	DB, DBF 45 20	45 45 45	52 52 52	16 20 20	14,5 18,5 18,5	18 800 24 800 24 800	39 000 55 000 55 000	12 000 17 000 17 000	9 000 9 000 9 000	43 54 54	53 64 64	
47		DB, DBF 47 16	47	55	16	14,5	21 700	42 000	13 200	8 500	50	61	
50	*HK,*BK 50 20 *HK,*BK 50 24	DB, DBF 50 20	50 50 50	58 58 58	20 20 24	18,5 18,5 22,5	29 500 29 500 36 000	64 000 64 000 83 000	20 000 20 000 25 500	8 000 8 000 8 000	70 70 84	83 83 97	
55	*HK,*BK 55 20 *HK,*BK 55 24		55 55	63 63	20 24	18,5 22,5	31 500 38 500	72 000 93 000	22 000 28 500	7 300 7 300	76 91	92 107	

^{*} on request

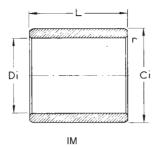
¹⁾ The recommended housing tolerance for these needle bearings is identical with the housing tolerance for combined bearings RAX or RAXF 700 series of equivalent diameters.

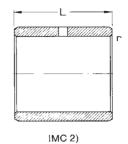


IMPORTANT
The caged needle bushes manufactured to tolerances conforming to ISO standard 3245 now have new designations:

HK series, open, formerly DB...P
BK series, closed-end, formerly

For a limited period, one or the other designations will be supplied in deliveries.





Inspection of bushes

	Inspection	of bushe	S
	Ring	Plug	Plug
	Gauge	Gauge	Gauge
	Bore	GO	NO-GO
	mm	mm	mm
	27,976	22,020	22,041
	27,976	22,020	22,041
	28,000	22,009	22,035
	31,972	25,020	25,041
	31,972	25,020	25,041
	31,972	25,020	25,041
	33,000	25,015	25,041
	33,000	25,015	25,041
	34,972	28,020	28,041
	34,972	28,020	28,041
-	36,972	30,020	30,041
	36,972	30,020	30,041
	36,972	30,020	30,041
	38,000	30,015	30,041
	41,972	35,025	35,050
	41,972	35,025	35,050
	43,000	35,015	35,041
	46,972	40,025	40,050
	46,972	40,025	40,050
	46,972	40,025	40,050
	48,000	40,015	40,041
	51,967	45,025	45,050
	51,967	45,025	45,050
	52,000	45,015	45,041
	55,000	47,015	47,041
	57,967	50,025	50,050
	58,000	50,015	50,041
	57,967	50,025	50,050
	62,967	55,030	55,060
	62,967	55,030	55,060

Inner rings

2) Inner rings with lubrication hole type IMC, available on request.

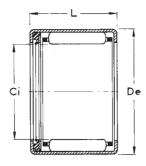
	7) Illings with labilication hole type live; available on request.											
Shaft Dia.	Designation	Di	Ci	L 0/-0.12	r min	Weight approx.	Refere Needle					
mm	IM Series	mm	mm	mm	mm	g						
17	*IM 17 22 13 P IM 17 22 16 P IM 17 22 16,4	17 17 17	22 22 22	13 16 16,4	0,35 0,35 0,35	14,9 18,5 18,8	HK, BK	22 12 22 16 22 16				
20	IM 20 25 16 P IM 20 25 20 P IM 20 25 16,4 IM 20 25 20,4	20 20 20 20	25 25 25 25	16 20 16,4 20,4	0,35 0,35 0,35 0,35	21 26,5 21,5 27	HK, BK	25 16 25 20 25 16 25 20				
23	IM 23 28 20 P	23	28	20	0,35	30	HK, BK	28 20				
25	IM 25 30 12,4 P IM 25 30 16,4 IM 25 30 20 P IM 25 30 20,4	25 25 25 25 25	30 30 30 30	12,4 16,4 20 20,4	0,35 0,35 0,35 0,35	19,7 26,5 32 33	HK, BK HK, BK	30 12 30 16 30 20 30 20				
30	IM 30 35 16,4 IM 30 35 20 P IM 30 35 20,4	30 30 30	35 35 35	16,4 20 20,4	0,35 0,35 0,35	31 38 39	,	35 16 35 20 35 20				
35	IM 35 40 16,4 IM 35 40 20 P IM 35 40 20,4	35 35 35	40 40 40	16,4 20 20,4	0,35 0,35 0,35	36 44 45	HK, BK	40 16 40 20 40 20				
40	*IM 40 45 16,4 P IM 40 45 20 P IM 40 45 20,4	40 40 40	45 45 45	16,4 20 20,4	0,35 0,35 0,35	41 50 51	HK, BK HK, BK DB, DBF	45 16 45 20 45 20				
45	IM 45 50 20,4 IM 45 50 20,4 IM 45 50 25 P	45 45 45	50 50 50	20,4 20,4 25	0,65 0,65 0,65	56 56 69	HK, BK DB, DBF HK, BK	50 20 50 20 50 24				
50	IM 50 55 20,4 IM 50 55 25 P	50 50	55 55	20,4 25	0,65 0,65	62 76	HK, BK HK, BK	55 20 55 24				

^{*} on request



Caged needle bushes with integral seal

● DB...E, HK...E



DB...E, HK...E

Limit load: See technical section page 11 and calculation examples pages 14 to 17.

Shaft Dia.	Ī	nations	Ci	De	L 0/-0.25	Basic ca	pacities	Limit load	Speed limit	Weight approx.	
mm	Series HKE to ISO tolerances	Series ²⁾ DBE	mm	mm	mm	Dyn. Cr N	Stat. Cor N	N	r.p.m.	g	
12		DB 12 14 E	12	18	14	6 300	7 200	2 500	16 600	9,5	
14	*HK 14 14 E	DB 14 14 E	14 14	20 20	14 14	6 900 6 900	8 500 8 500	2 900 2 900	14 300 14 300	10,8 10,8	
15	HK 15 14 E HK 15 24 E ¹⁾		15 15	21 21	14 24	7 400 12 700	9 300 18 500	3 100 6 200	13 300 13 300	11,3 20,8	
16	HK 16 14 E HK 16 18 E		16 16	22 22	14 18	7 400 10 800	9 800 15 700	3 300 5 200	12 500 12 500	12,2 16,2	
17		DB 17 14 E	17	23	14	7 900	10 500	3 500	11 700	12,6	
18	*HK 18 14 E	DB 18 18 E	18 18	24 24	14 18	7 900 11 500	11 000 17 700	3 600 5 800	11 100 11 100	13,7 18	
20	*HK 20 18 E	DB 20 18 E	20 20	26 26	18 18	12 200 12 200	19 500 19 500	6 400 6 400	10 000 10 000	19,8 19,8	
22	*HK 22 18 E	DB 22 18 E	22 22	28 28	18 18	12 800 12 800	21 700 21 500	7 000 7 000	9 100 9 100	21,6 21,6	
25	*HK 25 18 E	DB 25 22 E DB 25 36 E ¹⁾	25 25 25	32 33 33	18 22 36	14 400 20 500 26 500	22 700 32 000 44 500	7 400 10 500 18 000	8 000 8 000 8 000	28 39 63	
30	HK 30 18 E	DB 30 22 E	30 30	37 38	18 22	15 900 22 300	27 300 37 500	8 700 12 000	6 700 6 700	32 47	
35	*HK 35 18 E	DB 35 22 E	35 35	42 43	18 22	17 200 24 500	31 800 45 000	10 100 14 300	5 700 5 700	39 53	
40	*HK 40 18 E	DB 40 22 E	40 40	47 48	18 22	17 500 26 200	34 000 51 000	10 700 16 000	5 000 5 000	44 60	
45	*HK 45 18 E HK 45 22 E		45 45	52 52	18 22	18 800 24 800	39 000 55 000	12 000 17 000	4 400 4 400	47 58	
50	*HK 50 22 E	DB 50 22 E	50 50	58 58	22 22	29 500 29 500	64 000 64 000	20 000 20 000	4 000 4 000	76 76	

^{*} on request

²⁾ The recommended housing tolerance for these needle bearings is identical with the housing tolerance for combined bearings RAX or RAXF 700 series of equivalent diameters.

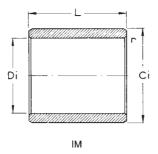


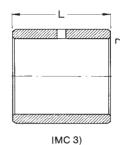
¹⁾ Fitted with 2 needle cages.

IMPORTANT
The caged needle bushes manufactured to tolerances conforming to ISO standard 3245 now have new designations:

- **HK...E** series, open, with seal, formerly DB...PE

For a limited period, one or the other designations will be supplied in deliveries.





Inspection of husbes

Inspection of bushes								
	Ring	Plug	Plug					
	Gauge	Gauge	Gauge					
	Bore	GO	NO-GO					
	mm	mm	mm					
	18,000	12,009	12,035					
	19,976	14,016	14,034					
	20,000	14,009	14,035					
	20,976	15,016	15,034					
	20,976	15,016	15,034					
	21,976	16,016	16,034					
	21,976	16,016	16,034					
	23,000	17,009	17,035					
	23,976	18,016	18,034					
	24,000	18,009	18,035					
	25,976	20,020	20,041					
	26,000	20,009	20,035					
	27,976	22,020	22,041					
	28,000	22,009	22,035					
	31,972	25,020	25,041					
	33,000	25,015	25,041					
	33,000	25,015	25,041					
	36,972	30,020	30,041					
	38,000	30,015	30,041					
	41,972	35,025	35,050					
	43,000	35,015	35,041					
	46,972	40,025	40,050					
	48,000	40,015	40,041					
	51,967	45,025	45,050					
	51,967	45,025	45,050					
	57,967	50,025	50,050					
	58,000	50,015	50,041					

Inner rings

3) Inner rings with lubrication hole type IMC, available on request.

	3) Inner rings with labrication riole type livic, available on request.						
Shaft Dia.	Designation	Di	Ci	L 0/-0.12	r min	Weight approx.	Reference Needle bush
mm	IM Series	mm	mm	mm	mm	g	
8	*IM 8 12 16	8	12	16	0,3	7,4	DB 12 14 E
10	IM 10 14 16 P	10	14	16	0,3	9	HK 14 14 E
	IM 10 14 16,4	10	14	16,4	0,3	9,2	DB 14 14 E
	IM 12 15 16 P	12	15	16	0,2	7,6	HK 15 14 E
12	IM 12 16 16 P	12	16	16	0,3	10,5	HK 16 14 E
	*IM 12 16 20 P	12	16	20	0,3	13,2	HK 16 18 E
13	IM 13 17 16,4	13	17	16,4	0,3	11,5	DB 17 14 E
14	IM 13 18 16 P	13	18	16	0,35	14,5	HK 18 14 E
	IM 14 18 20,4	14	18	20,4	0,3	15,5	DB 18 18 E
15	IM 15 20 20 P	15	20	20	0,35	20,5	HK 20 18 E
	IM 15 20 20	15	20	20	0,35	20,5	DB 20 18 E
17	IM 17 22 20 P	17	22	20	0,35	23	HK 22 18 E
	IM 17 22 20,4	17	22	20,4	0,35	23,5	DB 22 18 E
20	IM 20 25 20 P	20	25	20	0,35	26,5	HK 25 18 E
	IM 20 25 25	20	25	25	0,35	33	DB 25 22 E
25	IM 25 30 20 P	25	30	20	0,35	32	HK 30 18 E
	IM 25 30 25	25	30	25	0,35	40	DB 30 22 E
30	IM 30 35 20 P	30	35	20	0,35	38	HK 35 18 E
	IM 30 35 25	30	35	25	0,35	48	DB 35 22 E
35	IM 35 40 20 P	35	40	20	0,35	44	HK 40 18 E
	IM 35 40 25	35	40	25	0,35	55	DB 40 22 E
40	IM 40 45 20 P	40	45	20	0,35	50	HK 45 18 E
	*IM 40 45 25 P	40	45	25	0,35	62	HK 45 22 E
45	IM 45 50 25 P	45	50	25	0,65	69	HK 50 22 E
	IM 45 50 25	45	50	25	0,65	69	DB 50 22 E

^{*} on request





BEARINGS WITH CAGE - GUIDED NEEDLES





Caged needle bearings possess an outer ring made from through- hardened bearing steel. The cage, which guides the needles and retains them in the outer ring, is manufactured as explained in the section on needle cages.

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 the table of dimensions (see Technical Section).

TYPES OF BEARING

Without inner ring	With inner ring
NB	NBI
RNA	NA
Dimensions of series 4 ISO Stand (French Standard E	dard 1206

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 (French Standard E 22 370).

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

SHAFT AND HOUSING TOLERANCES

Type of operation	Load direction	without inner ring				
			_ ≤80	85-130		
	Fixed	h5	k5	m5	J6 (J7)	
Shaft revolving Housing stationary	Revolving at shaft speed	g5	h5	h5	M6 (M7)	
	Indeterminate	g5	k5*	m5*	M6 (M7)	
0	Fixed	g5	h5	h5	M6 (M7)	
Shaft stationary Housing revolving	Revolving at housing speed	h5	k5	m5	J6 (J7)	
	Indeterminate	g5	k5*	m5*	M6 (M7)	
Shaft and housing revolving	Variable	g5	k5*	m5*	M6 (M7)	
Oscillatory motion	Variable	h5	k5	k5	M6 (M7)	

^{*} class C3 bearing required in these cages

1), 2): see on page 44



The cylindrical tolerance defined as the difference in radii of two coaxial cylinders (ISO Standard 1101) should normally be less than a quarter of the manufacturing tolerance. However, for high precision or high speed applications, it is advisable to restrict this tolerance to one eighth of the 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

► 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 (French Standard E 22 370) 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 upper half of the tolerance (suffix TC). See table below:

Nominal d	limension	Tole	rance of diameter under nee	edles		
C mi		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		
		+ 50 + 79	+ 50 + 65	+ 64 + 79		
Examples of		NB 25 33 20	NB 25 33 20 TB	NB 25 33 20 TC		
bearing		RNA 4904	RNA 4904 TB	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 Standard 5753.

By prior agreement with our Technical Department, such 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 of 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 the 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 and outer rings of which are manufactured to class P6 and with play in class C2.



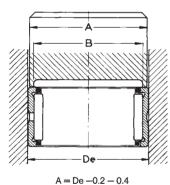
Examples of bearing designations:

Tal.	Normal F	Radial play	C2 Ra	dial play
Tolerance of inner and outer rings	standard	reduced	standard	reduced
	tolerance	tolerance ZS	tolerance	tolerance ZS
normal	NBI 20 33 20	NBI 20 33 20 ZS	NBI 20 33 20 C2	NBI 20 33 20 C2 ZS
	NA 4904	NA 4904 ZS	NA 4904 C2	NA 4904 C2 ZS
class P6	NBI 20 33 20 P6	NBI 20 33 20 P6 ZS	NBI 20 33 20 P62	NBI 20 33 20 P62 ZS
	NA 4904 P6	NA 4904 P6 ZS	NA 4904 P62	NA 4904 P62 ZS

► Radial play for bearings with cage-guided needles with inner ring:

Inr			C2 I	Play		r	normal play		у		C3 I	Play			C4 I	Play			Ç5 I	Play	
rir	-		inte	rval			interval				inte	rval			inte	rval		interval			
D	i	Z	S	stan	dard	z	S	stan	dard	Z	S	stan	dard	z	S	stan	dard	Z	S	stan	dard
m		μι		μ			m		m	μι		μι	m	μι	m	μι		μι		μ	m
Above	То	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	55	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, e.g. Inner ring for NBI 20 33 20



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.

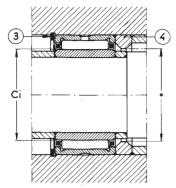
Where inner or outer rings of small diameter not requiring a tight fit are used, they should be fitted by lightly tapping on a mandrel (see figure). In other cases a press should be used, the force being applied direct on the bearing centre line.

De mm	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		

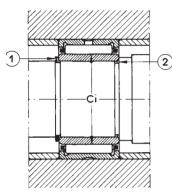
► Inner Rings

The smaller sizes of inner rings are installed in a 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.





*Ci + 0,2 maxi



- Snap ring
 Groove for extraction tool
- 3 Snap ring

 Guidance ring

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

The snap-rings must be inspected after positioning in their grooves for correct abutment.

► 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 the 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

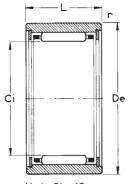
Inner rings may be laterally retained by snap rings. They can also seat against a shoulder on the shaft, provided that the radius between shoulder and shaft is smaller than the chamfer on the rings as shown in the table of dimensions. Whenever possible, an extraction groove should also be provided on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



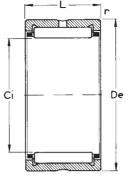
Bearings with cage-guided needles without inner ring NB, RNA 49 series

All bearings are not necessarily available.

Please consult us for delivery times and for special dimensions.







From Ci = 14 mm

Shaft Dia.	Designa	itions	Ci	De	L	r min	Basic ca	pacities	Speed limit	Weight approx.
mm	NB Series	RNA 49 Series	mm	mm	mm	mm	Dyn. Cr N	Stat. Cor N	r.p.m.	g
7	NB 7 14 12		7	14	12	0,35	3 600	3 400	57 000	8,5
8	NB 8 15 12		8	15	12	0,35	4 500	4 600	50 000	9,4
9	NB 9 16 12 NB 9 16 16		9 9	16 16	12 16	0,35 0,35	5 000 6 300	5 500 7 300	44 000 44 000	10,3 13,8
10	NB 10 17 12 NB 10 17 16		10 10	17 17	12 16	0,35 0,35	4 400 6 100	4 750 7 200	40 000 40 000	11,7 15,2
12	NB 12 19 12 NB 12 19 16		12 12	19 19	12 16	0,35 0,35	5 050 6 600	6 000 8 400	33 000 33 000	13,3 17,5
14	NB 14 22 16	RNA 4900	14 14	22 22	13 16	0,30 0,35	10 600 13 100	11 600 15 300	28 500 28 500	17 21
15	NB 15 23 16		15 .	23	16	0,35	13 800	16 500	27 000	22,3
16	NB 16 24 16	RNA 4901	16 16	24 24	13 16	0,30 0,35	11 700 14 500	13 700 18 000	25 000 25 000	19 23,5
18	NB 18 26 16		18	26	16	0,35	15 700	20 500	22 000	26
19	NB 19 27 16 NB 19 27 20		19 19	27 27	16 20	0,35 0,35	15 500 19 400	20 800 27 500	21 000 21 000	27 34
20	NB 20 28 16 NB 20 28 20	RNA 4902	20 20 20	28 28 28	13 16 20	0,30 0,35 0,35	13 100 16 200 20 000	16 900 22 000 29 000	20 000 20 000 20 000	22,5 28 35,5
21	NB 21 29 16 NB 21 29 20		21 21	29 29	16 20	0,35 0,35	16 800 20 800	23 500 31 000	19 000 19 000	29 37
22	NB 22 30 16 NB 22 30 20	RNA 4903	22 22 22	30 30 30	13 16 20	0,30 0,35 0,35	14 000 17 400 21 500	18 900 24 800 32 500	18 000 18 000 18 000	24,5 30,5 38
24	NB 24 32 16 NB 24 32 20		24 24	32 32	16 20	0,35 0,35	18 500 22 800	27 500 36 500	16 700 16 700	33 41
25	NB 25 33 16 NB 25 33 20	RNA 4904	25 25 25	33 33 37	16 20 17	0,35 0,35 0,30	19 000 22 500 25 000	29 000 36 500 30 000	16 000 16 000 16 000	34 43 56
26	NB 26 34 20		26	34	20	0,35	23 300	38 000	15 400	44
28	NB 28 37 20	RNA 49/22 17	28 28	37 39	20 17	0,35 0,30	27 500 27 000	42 500 34 500	14 000 14 000	53 54
29	NB 29 38 20 NB 29 38 30		29 29	38 38	20 30	0,35 0,35	27 300 41 500	42 500 73 000	13 800 13 800	54 82



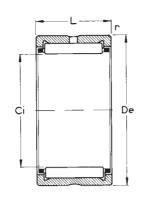


Bearings with cage-guided needles without inner ring

NB, RNA 49 series

All bearings are not necessarily available.

Please consult us for delivery times and for special dimensions.



Shaft Dia.	Designa	ations	Ci	De	L	r min	Basic ca	pacities	Speed limit	Weight approx.
mm	NB Series	RNA 49 Series	mm	mm	mm	mm	Dyn. Cr N	Stat. Cor N	r.p.m.	. g
30	NB 30 40 20 NB 30 40 30	RNA 4905	30 30 30	40 40 42	20 30 17	0,35 0,35 0,30	28 000 41 000 28 000	44 500 73 000 36 500	13 000 13 000 13 000	65 98 65
32	NB 32 42 20 NB 32 42 30		32 32	42 42	20 30	0,35 0,35	28 500 42 000	47 000 77 000	12 500 12 500	68 103
35	NB 35 45 20 NB 35 45 30	RNA 4906	35 35 35	45 45 47	20 30 17	0,35 0,35 0,30	30 500 44 000 30 500	53 000 84 000 43 000	11 000 11 000 11 000	74 112 75
37	NB 37 47 20		37	47	20	0,35	31 000	55 000	10 800	78
38	NB 38 48 20		38	48	20	0,35	32 000	57 000	10 500	80
40	NB 40 50 20 NB 40 50 30		40 40	50 50	20 30	0,35 0,35	32 500 47 500	59 000 97 000	10 000 10 000	83 125
42	NB 42 52 20	RNA 4907	42 42	52 55	20 20	0,35 0,60	33 500 40 000	63 000 64 000	9 500 9 500	87 115
45	NB 45 55 20 NB 45 55 30		45 45	55 55	20 30	0,35 0,35	34 500 45 500	67 000 95 000	9 000 9 000	92 140
47	NB 47 57 20		47	57	20	0,35	35 000	69 000	8 500	95
48		RNA 4908	48	62	22	0,60	44 500	77 000	8 500	158
50	NB 50 62 25 NB 50 62 35		50 50	62 62	25 35	0,65 0,65	44 000 61 000	95 000 144 000	8 000 8 000	162 230
52		RNA 4909	52	68	22	0,60	47 000	86 000	7 700	205
55	NB 55 68 25 NB 55 68 35		55 55	68 68	25 35	0,65 0,65	44 000 61 000	98 000 148 000	7 000 7 000	197 278
58		RNA 4910	58	72	22	0,60	49 500	95 000	6 900	185
60	NB 60 72 25 NB 60 72 35		60 60	72 72	25 35	0,65 0,65	48 000 66 000	113 000 170 000	6 700 6 700	190 270
63		RNA 4911	63	80	25	1	64 000	115 000	6 400	283
65	NB 65 78 25 NB 65 78 35		65 65	78 78	25 35	0,85 0,85	54 000 74 000	120 000 180 000	6 000 6 000	228 320
68	NB 68 82 25 NB 68 82 35	RNA 4912	68 68 68	82 82 85	25 35 25	0,85 0,85 1	54 000 75 000 66 000	123 000 185 000 124 000	5 900 5 900 5 900	253 355 300



Shaft Dia.	Design	ations	Ci	De	L	r min	Basic ca	pacities	Speed limit	Weight approx.
mm	NB Series	RNA 49 Series	mm	mm	mm	mm	Dyn. Cr N	Stat. Cor N	r.p.m.	g
70	NB 70 85 25 NB 70 85 35		70 70	85 85	25 35	0,85 0,85	56 000 77 000	129 000 185 000	5 700 5 700	285 405
73		RNA 4913	72	90	25	1	70 000	135 000	5 500	345
13	NB 73 90 35		73	90	35	0,85	98 000	210 000	5 500	460
75	NB 75 92 25 NB 75 92 35		75 75	92 92	25 35	0,85 0,85	64 000 88 000	143 000 215 000	5 300 5 300	350 490
80	NB 80 95 25 NB 80 95 35	RNA 4914	80 80 80	95 95 100	25 35 30	1,35 1,35 1	73 000 103 000 100 000	148 000 230 000 195 000	5 000 5 000 5 000	294 410 500
85	NB 85 105 35	RNA 4915	85 85	105 105	30 35	1 1,35	103 000 105 000	205 000 240 000	4 700 4 700	530 650
90	NB 90 110 25 NB 90 110 35	RNA 4916	90 90 90	110 110 110	25 30 35	1,35 1 1,35	77 000 106 000 108 000	165 000 219 000 255 000	4 400 4 400 4 400	480 560 680
95	NB 95 115 26 NB 95 115 36		95 95	115 115	26 36	1,35 1,35	79 000 128 000	174 000 280 000	4 200 4 200	530 700
100	NB100120 26 NB100120 36	RNA 4917	100 100 100	120 120 120	26 35 36	1,35 1,10 1,35	83 000 112 000 112 000	185 000 273 000 273 000	4 000 4 000 4 000	560 750 770
105	NB105125 26		105	125	26	1,35	85 000	195 000	3 800	580
107	NB107125 32		107	125	32	1,35	102 000	295 000	3 700	660
110	NB110130 30		110	130	30	1	118 000	268 000	3 600	660

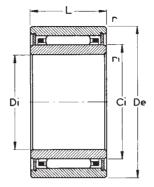


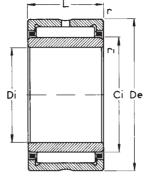
Bearings with cage-guided needles with inner ring

NBI, NA 49 series

All bearings are not necessarily available.

Please consult us for delivery times and for special dimensions.





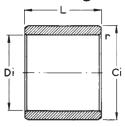
Up to Ci = 12 mm

From Ci = 14 mm

Shaft Dia.	Design	ations	Di .	De	L	Ci	r min	r1 min	Basic ca	pacities	Speed limit	Weight approx.
mm	NBI Series	NA 49 Series	mm	mm	mm	mm	mm	mm	Dyn. Cr N	Stat. Cor N	r.p.m.	9
5	NBI 5 15 12		5	15	12	8	0,35	0,20	4 500	4 600	50 000	12,1
6	NBI 6 16 12 NBI 6 16 16		6 6	16 16	12 16	9 9	0,35 0,35	0,20 0,20	5 000 6 300	5 500 7 300	44 000 44 000	13,4 18
7	NBI 7 17 12 NBI 7 17 16		7 7	17 17	12 16	10 10	0,35 0,35	0,20 0,20	4 400 6 100	4 750 7 200	40 000 40 000	15,3 20
9	NBI 9 19 12 NBI 9 19 16	-	9 9	19 19	12 16	12 12	0,35 0,35	0,20 0,20	5 050 6 600	6 000 8 400	33 000 33 000	17,7 23,3
10	NBI 10 22 16	NA 4900	10 10	22 22	13 16	14 14	0,30 0,35	0,30 0,30	10 600 13 100	11 600 15 300	28 500 28 500	24,3 30
12	NBI 12 23 16 NBI 12 24 16	NA 4901	12 12 12	23 24 24	16 13 16	15 16 16	0,35 0,30 0,35	0,20 0,30 0,30	13 800 11 700 14 500	16 500 13 700 18 000	27 000 25 000 25 000	30 27,5 34
13	NBI 13 26 16		13	26	16	18	0,35	0,35	15 700	20 500	22 000	40,5
15	NBI 15 27 16 NBI 15 27 20 NBI 15 28 16	NA 4902	15 15 15 15	27 27 28 28	16 20 13 16	19 19 20 20	0,35 0,35 0,30 0,35	0,30 0,30 0,30 0,35	15 500 19 400 13 100 16 200	20 800 27 500 16 900 22 000	21 000 21 000 20 000 20 000	40 50 36 44,5
17	NBI 15 28 20 NBI 17 29 16 NBI 17 29 20 NBI 17 30 16 NBI 17 30 20	NA 4903	15 17 17 17 17 17	28 29 29 30 30 30	16 20 13 16 20	20 21 21 22 22 22 22	0,35 0,35 0,35 0,30 0,35 0,35	0,35 0,30 0,30 0,30 0,35 0,35	20 000 16 800 20 800 14 000 17 400 21 500	29 000 23 500 31 000 18 900 24 800 32 500	19 000 19 000 18 000 18 000 18 000	56 43,5 55 39 49 61
20	NBI 20 32 16 NBI 20 32 20 NBI 20 33 16 NBI 20 33 20	NA 4904	20 20 20 20 20 20	32 32 33 33 37	16 20 16 20 17	24 24 25 25 25 25	0,35 0,35 0,35 0,35 0,30	0,30 0,30 0,35 0,35 0,30	18 500 22 800 19 000 22 500 25 000	27 500 36 500 29 000 36 500 30 000	16 700 16 700 16 000 16 000 16 000	49 62 55 69 79
22	NBI 22 34 20	NA 49/22 17	22 22	34 39	20 17	26 28	0,35 0,30	0,30 0,30	23 300 27 000	38 000 34 500	15 400 14 000	67 84
23	NBI 23 37 20		23	37	20	28	0,35	0,35	27 500	42 500	14 000	83
25	NBI 25 38 20 NBI 25 38 30 NBI 25 40 20 NBI 25 40 30	NA 4905	25 25 25 25 25 25	38 38 40 40 42	20 30 20 30 17	29 29 30 30 30	0,35 0,35 0,35 0,35 0,35 0,30	0,30 0,30 0,35 0,35 0,30	27 300 41 500 28 000 41 000 28 000	42 500 73 000 44 500 73 000 36 500	13 800 13 800 13 000 13 000 13 000	80 120 97 147 93
28	NBI 28 42 20 NBI 28 42 30		28 28	42 42	20 30	32 32	0,35 0,35	0,30 0,30	28 500 42 000	47 000 77 000	12 500 12 500	96 145

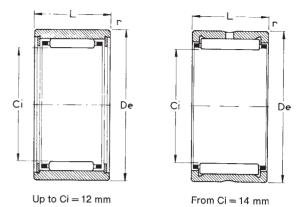


Inner rings



Shaft	Designations	Ci	L	r mini	weight approx.
Di		mm	mm	mm	g
5	IM 5 8 12 P	8	12	0,2	2,7
6	IM 6 9 12 P	9	12	0,2	3,1
-	IM 6 9 16 P	9	16	0,2	4,2
7	IM 7 10 12 P IM 7 10 16 P	10 10	12 16	0,2 0,2	3,6 4,8
9	IM 9 12 12 P IM 9 12 16 P	12 12	12 16	0,2 0,2	4,4 5,9
10	IM 4900 IM 10 14 16 P	14 14	13 16	0,35 0,3	7,3 9
12	IM 12 15 16 P IM 4 901 IM 12 16 16 P	15 16 16	16 13 16	0,2 0,35 0,3	7,6 8,5 10,5
13	IM 13 18 16 P	18	16	0,35	14,5
15	IM 15 19 16 P IM 15 19 20 P IM 4 902 IM 15 20 16 P IM 15 20 20 P	19 19 20 20 20	16 20 13 16 20	0,3 0,3 0,35 0,35 0,35 0,35	12,8 16 13,3 16,5 20,5
17	IM 17 21 16 P IM 17 21 20 P IM 4 903 IM 17 22 16 P IM 17 22 20 P	21 21 22 22 22 22	16 20 13 16 20	0,3 0,3 0,35 0,35 0,35	14,3 18 14,9 18,5 23
20	IM 20 24 16 P IM 20 24 20 P IM 20 25 16 P IM 20 25 20 P IM 4 904	24 24 25 25 25	16 20 16 20 17	0,3 0,3 0,35 0,35 0,35	16,5 20,5 21 26,5 22,5
22	IM 22 26 20 P IM 49 /22 17	26 28	20 17	0,3 0,35	22,5 30
23	IM 23 28 20 P	28	20	0,35	30
25	IM 25 29 20 P IM 25 29 30 P IM 25 30 20 P IM 25 30 30 P IM 4 905	29 29 30 30 30	20 30 20 30 17	0,3 0,3 0,35 0,35 0,35	25 38 32 49 27,5
28	IM 28 32 20 P IM 28 32 30 P	32 32	20 30	0,3 0,3	28 42

NB, RNA 49 series



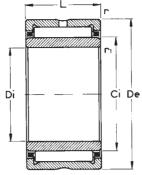
Design	nations
NB Series	RNA 49 Series
NB 8 15 12	
NB 9 16 12 NB 9 16 16	
NB 10 17 12 NB 10 17 16	
NB 12 19 12 NB 12 19 16	
NB 14 22 16	RNA 4 900
NB 15 23 16	RNA 4 901
NB 16 24 16	
NB 18 26 16	
NB 19 27 16 NB 19 27 20	RNA 4 902
NB 20 28 16 NB 20 28 20	
NB 21 29 16 NB 21 29 20	RNA 4 903
NB 22 30 16 NB 22 30 20	
NB 24 32 16 NB 24 32 20 NB 25 33 16	
NB 25 33 20	RNA 4 904
NB 26 34 20	RNA 49/22 17
NB 28 37 20	
NB 29 38 20 NB 29 38 30 NB 30 40 20 NB 30 40 30	RNA 4 905
NB 32 42 20 NB 32 42 30	





Bearings with cage-guided needles with inner ring NBI, NA 49 series

All bearings are not necessarily available.

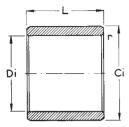


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Shaft Dia. mm	Desigr NBI Series	nations NA 49 Series	Di mm	De	L	Ci	r min mm	r1 min mm	Basic ca Dyn. Cr N	-
30	NBI 30 45 20 NBI 30 45 30	NA 4906	30 30 30	45 45 47	20 30 17	35 35 35	0,35 0,35 0,30	0,35 0,35 0,30	30 500 44 000 30 500	5: 8: 4:
32	NBI 32 47 20		32	47	20	37	0,35	0,35	31 000	5

Shaft Dia.	Desigr	nations	Di	De	L	Ci	r min	r1 min	Basic ca	pacities	Speed limit	Weight approx.
mm	NBI Series	NA 49 Series	mm	mm	mm	mm	mm	mm	Dyn. Cr N	Stat.Cor N	r.p.m.	g
30	NBI 30 45 20 NBI 30 45 30	NA 4906	30 30 30	45 45 47	20 30 17	35 35 35	0,35 0,35 0,30	0,35 0,35 0,30	30 500 44 000 30 500	53 000 84 000 43 000	11 000 11 000 11 000	112 170 107
32	NBI 32 47 20		32	47	20	37	0,35	0,35	31 000	55 000	10 800	118
33	NBI 33 48 20		33	48	20	38	0,35	0,35	32 000	57 000	10 500	120
35	NBI 35 50 20 NBI 35 50 30	NA 4907	35 35 35	50 50 55	20 30 20	40 40 42	0,35 0,35 0,60	0,35 0,35 0,60	32 500 47 500 40 000	59 000 97 000 64 000	10 000 10 000 9 500	127 192 178
37	NBI 37 52 20		37	52	20	42	0,35	0,35	33 500	53 000	9 500	133
40	NBI 40 55 20 NBI 40 55 30	NA 4908	40 40 40	55 55 62	20 30 22	45 45 48	0,35 0,35 0,60	0,35 0,35 0,60	34 500 45 500 44 500	67 000 95 000 77 000	9 000 9 000 8 500	142 215 250
42	NBI 42 57 20		42	57	20	47	0,35	0,35	35 000	69 000	8 500	148
45	NBI 45 62 25 NBI 45 62 35	NA 4909	45 45 45	62 62 68	25 35 22	50 50 52	0,65 0,65 0,60	0,65 0,65 0,60	44 000 61 000 47 000	95 000 144 000 86 000	8 000 8 000 7 700	230 325 290
50	NBI 50 68 25 NBI 50 68 35	NA 4910	50 50 50	68 68 72	25 35 22	55 55 58	0,65 0,65 0,60	0,65 0,65 0,60	44 000 61 000 49 500	98 000 148 000 95 000	7 000 7 000 6 900	275 385 295
55	NBI 55 72 25 NBI 55 72 35	NA 4911	55 55 55	72 72 80	25 35 25	60 60 63	0,65 0,65 1	0,65 0,65 1	66 000	113 000 170 000 115 000	6 700 6 700 6 400	275 385 420
58	NBI 58 78 25 NBI 58 78 35		58 58	78 78	25 35	65 65	0,85 0,85	0,85 0,85		120 000 180 000	6 000 6 000	355 500
60	NBI 60 82 25 NBI 60 82 35	NA 4912	60 60 60	82 82 85	25 35 25	68 68 68	0,85 0,85 1	0,85 0,85 1	75 000	123 000 185 000 124 000	5 900 5 900 5 900	400 570 450
62	NBI 62 85 25 NBI 62 85 35		62 62	85 85	25 35	70 70	0,85 0,85	0,85 0,85		129 000 185 000	5 700 5 700	440 620
65	NBI 65 90 35	NA 4913	65 65	90 90	25 35	72 73	1 0,85	1 0,85	1	135 000 210 000	5 500 5 500	480 690
67	NBI 67 92 25 NBI 67 92 35		67 67	92 92	25 35	75 75	0,85 0,85	0,85 0,85		143 000 215 000		520 730
70	NBI 70 95 25 NBI 70 95 35	NA 4914	70 70 70	95 95 100	25 35 30	80 80 80	1,35 1,35 1	1,35 1,35 1	103 000	148 000 230 000 195 000	5 000 5 000 5 000	520 720 760

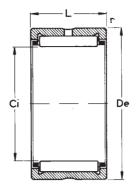


Inner rings



Shaft	Designations	Ci	L	r mini	weight approx.
Ø Di mm		mm	mm	mm	g
30	IM 30 35 20 P	35	20	0,35	38
	IM 30 35 30 P	35	30	0,35	57
	IM 4 906	35	17	0,35	32,5
32	IM 32 37 20 P	37	20	0,35	40
33	IM 33 38 20 P	38	20	0,35	42
35	IM 35 40 20 P	40	20	0,35	44
	IM 35 40 30 P	40	30	0,35	66
	IM 4 907	42	20	0,85	63
37	IM 37 42 20 P	42	20	0,35	46
40	IM 40 45 20 P	45	20	0,35	50
	IM 40 45 30 P	45	30	0,35	75
	IM 4 908	48	22	0,85	91
42	IM 42 47 20 P	47	20	0,35	52
45	IM 45 50 25 P	50	25	0,65	69
	IM 45 50 35 P	50	35	0,65	97
	IM 4 909	52	22	0,85	87
50	IM 50 55 25 P	55	25	0,65	76
	IM 50 55 35 P	55	35	0,65	107
	IM 4 910	58	22	0,85	111
55	IM 55 60 25 P	60	25	0,65	84
	IM 55 60 35 P	60	35	0,35	118
	IM 4 911	63	25	1,35	135
58	IM 58 65 25 P	65	25	0,85	125
	IM 58 65 35 P	65	35	0,85	177
60	IM 60 68 25 P	68	25	0,85	150
	IM 60 68 35 P	68	35	0,85	210
	IM 4 912	68	25	1,35	148
62	IM 62 70 25 P	70	25	0,85	155
	IM 62 70 35 P	70	35	0,85	215
65	IM 4913	72	25	1,35	138
	IM 65 73 35 P	73	35	0,85	225
67	IM 67 75 25 P	75	25	0,85	167
	IM 67 75 35 P	75	35	0,85	235
70	IM 70 80 25 P	80	25	1,35	222
	IM 70 80 35 P	80	35	1,35	310
	IM 4 914	80	30	1,35	265

NB, RNA 49 series



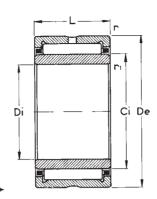
Desig	nations
NB Series	RNA 49 Series
NB 35 45 20 NB 35 45 30	RNA 4 906
NB 37 47 20	
NB 38 48 20	
NB 40 50 20 NB 40 50 30	RNA 4 907
NB 42 52 20	
NB 45 55 20 NB 45 55 30	RNA 4 908
NB 47 57 20	
NB 50 62 25 NB 50 62 35	RNA 4 909
NB 55 68 25 NB 55 68 35	RNA 4 910
NB 60 72 25 NB 60 72 35	RNA 4 911
NB 65 78 25 NB 65 78 35	
NB 68 82 25 NB 68 82 35	RNA 4 912
NB 70 85 25 NB 70 85 35	
NB 73 90 35	RNA 4913
NB 75 92 25 NB 75 92 35	
NB 80 95 25 NB 80 95 35	RNA 4 914





Bearings with cage-guided needles with inner ring NBI, NA 49 series

All bearings are not necessarily available. Please consult us for delivery times and for special dimensions.

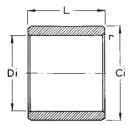


over –

Shaft Dia. mm	Desigi NBI Series	nations NA 49 Series	Di mm	De mm	L mm	Ci	r min mm	r1 min mm		apacities Stat.Cor N	Speed limit r.p.m.	Weight approx.
75	NBI 7510535	NA 4915	75 75	105 105	30 35	85 85	1 1,35	1 1,35	103 000 105 000	205 000 240 000	4 700 4 700	810 970
80	NBI 80110 25 NBI 80110 35	NA 4916	80 80 80	110 110 110	25 30 35	90 90 90	1,35 1 1,35	1,35 1 1,35	77 000 106 000 108 000	165 000 219 000 255 000	4 400 4 400 4 400	730 850 1 030
85	NBI 85115 26 NBI 85115 36	NA 4917	85 85 85	115 115 122	26 36 35	95 95 100	1,35 1,35 1,10	1,35 1,35 1,10	79 000 128 000 112 000	174 000 280 000 273 000	4 200 4 200 4 000	800 1 080 1 320
90	NBI 9012026 NBI 9012036		90 90	120 120	26 36	100 100	1,35 1,35	1,35 1,35	83 000 112 000	185 000 273 000	4 000 4 000	850 1 170
95	NBI 9512526 NBI 9512532		95 95	125 125	26 32	105 107	1,35 1,35	1,35 1,35	85 000 102 000	195 000 295 000		880 1 120
100	NBI10013030		100	130	30	110	1	1,35	118 000	268 000	3 600	1 030

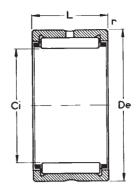


Inner rings



Shaft Ø	Designations	Ci	L	r mini	weight approx.
Di mm		mm	mm	mm	g
75	IM 4 915	85	30	1,35	280
	IM 75 85 35 P	85	35	1,35	330
80	IM 80 90 25 P	90	25	1,35	245
	IM 4 916	90	30	1,35	295
	IM 80 90 35 P	90	35	1,35	350
85	IM 85 95 26 P	95	26	1,35	270
	IM 85 95 36 P	95	36	1,35	380
	IM 4 917	100	35	1,85	570
90	IM 90 100 26 P	100	26	1,35	290
	IM 90 100 36 P	100	36	1,35	400
95	IM 95 105 26 P	105	26	1,35	300
	IM 95 107 32 P	107	32	1,35	450
100	IM 100 110 30 P	110	30	1,85	360

NB, RNA 49 series



Designations									
NB Series	RNA 49 Series								
NB 85 105 35	RNA 4915								
NB 90 110 25	RNA 4916								
NB 90 110 35									
NB 95 115 26 NB 95 115 36	RNA 4917								
NB 100 120 26 NB 100 120 36									
NB 105 125 26 NB 107 125 32									
NB 110 130 30									





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 vi-

They are particularly suitable for operations involving oscillating motion but may also accept high speed conditions where good alignment is necessary. This can more easily be achieved using a convex inner ring raceway.

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

These bearings are available with or without an inner ring from 12 mm bore size. Standard complete bearings type NA (and special types NA...BIR) 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.

STANDARD TYPES

Bearings without inner ring	Inner rings with cylindrical raceway Extra wide inner rings (2)						
	Same width as bearing (with lubrication hole)	with lubrication hole	without lubrication hole				
RNA 1) series 1 000, 2 000, 22 000, 3 000	BIC series 1000, 2000, 22000,3000	BICG	BIP, BIG, BIK				
	Complete bearings with o	convex inner raceway					
	NA series 1000, 200	00, 22 000, 3 000					

- Old designation Na....s/Bi
 Widths quoted on request.

SPECIAL TYPES

RNADER/SGT	Bearings without inner ring. Convex outer ring without lubrication hole or grease groove. Cylindrical inner rings available separately.
NABIR	Complete bearings with convex inner ring raceway for misalignment greater than 1 in 1000.



RNA

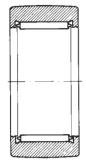
FULL COMPLEMENT BEARINGS WITHOUT INNER RING

► Standard type RNA(old designation Na..s/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 figures 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 a greater degree of misalignment but this will reduce the effective bearing load capacity. Further information is available on request.

► Special types RNA...DER/SGT



RNA...DER/SGT

These bearings have a convex outer ring which can swivel in the housing and must be used with a cylindrical bearing raceway. They are manufactured specially on request in the same dimensions as the standard RNA series 1 000, 2 000, 22 000 and 3 000. The convex outer ring radius is normally designed for a maximum misalignment of 10 in 1 000. In special cases a specific radius can be provided on request.

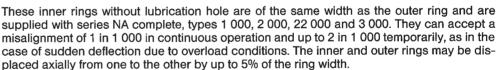
For these bearings the swivelling contact of the outer ring in the housing is improved by the elimination of the lubrication groove and hole (designated by the suffix...SGT).

If the outer ring is to move freely in the cylindrical housing, the latter must be machined to F7 (or F8) tolerance, though this fit is only suitable for operation under a load fixed in relation to the housing to prevent the outer ring slipping. The shoulders at the outer rings (snap rings or abutments) must leave sufficient lateral clearance to permit the ring to move. These bearings must be assembled with a cylindrical inner ring raceway with or without a lubrication hole. Please consult NADELLA Technical Department on each application.

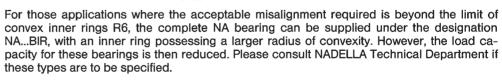
INNER RINGS (TYPE BIR)

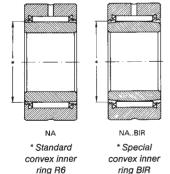
Inner rings made from high quality bearing steel heat treated and through-hardened avoid any necessity for heat treatment of the shaft and enable the bearings to operate within their full load capacity (with the exception of special convex inner rings).

► Inner Rings with convex raceway R6









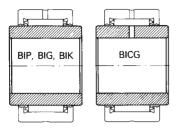


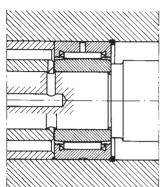
Inner Rings with cylindrical raceway

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.







In this last case, please consult NADELLA 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).

Cylindrical inner rings are recommended for use with special bearings type NA...DER with convex outer ring, since using a convex inner ring with these types could create an indeterminate system of alignment.

RING TOLERANCES

Inner and outer rings for full complement standard needle bearings are manufactured in accordance with the tolerance class of ISO Standard 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	Bearings without inner ring Dim Ci	without ring 1) inner ring Dim Di				
Shaft rotating housing	Fixed Rotating with shaft	h5 g5	k5 h5	m5 h5	n6 h6	p6 h6	J6 (J7) M6 (M7)
fixed	Unknown	g5	k5*	m5*	n6	р6	M6 (M7)
	Fixed	h5	k5	m5	n6	p6	J6 (J7)
Shaft fixed housing rotating	Rotating with shaft	g5	h5	h5	h6	h6	M6 (M7)
	Unknown	g5	k5*	m5*	n6	р6	M6 (M7)
Shaft and housing rotating	Any direction	g5	k5*	m5*	n6	p6	M6 (M7)
Oscillating motion	Any direction	h5	k5*	k5*	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 the case of precision applications or high speed operation it is recommended to reduce this tolerance to one eighth of the manufacturing tolerance.

- 1) Tolerances applicable for solid shafts in steel or cast iron. Tighter fit of the inner ring should be controlled to closer limits for hollow shafts or shafts of non-ferrous metals.
- 2) Tolerances applicable for solid shafts in steel or cast iron of rigid wall section. 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, it is 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.), NADELLA 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.

Nominal	dimension	Tolerance of diameter under needles						
(Di	normal F6	selected TB	selected TC				
m	ım	μm	μm	μm				
above	to							
5	15	+ 20 + 40	+20+ 31	+ 29 + 40				
15	25	+ 20 + 43	+20+ 33	+ 30 + 43				
25	30	+ 25 + 48	+ 25 + 38	+ 35+ 48				
30	35	+ 30 + 53	+ 30 + 43	+ 40 + 53				
35	60	+ 35 + 58	+ 35 + 48	+ 45+ 58				
60	80	+ 45 + 73	+45+60	+ 58+ 73				
80	115	+50+ 78	+50+65	+ 63 + 78				
115	180	+60+88	+60 + 75	+ 73 + 88				
180	220	+ 70 + 103	+70 + 88	+ 85 + 103				
220	270	+ 80 + 113	+80 + 98	+ 95 + 113				
270 350 + 90 + 128		+90+110	+ 108 + 128					
Examples of RNA 1020		RNA 1020 TB	RNA 1020 TC					

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 tolerances h5 or g5 would normally provide.

► Standard complete bearings with inner ring

Complete bearings type NA are offered with a radial play that is suitable for the 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 ${\rm Di}$ > 130 mm bearings NA...TB or NA...TC are supplied only on special request.

► Radial play of full complement bearings with convex inner ring "R6"

	Series 1 000, 2 000, 22 000							Series 3 000							
Inner ring bore Di mm	Stand pla pr	ay	Select µ	ted TB m	Select µ	ted TC m		Inner bo Di r	re	Stan pl: µ	ay		ted TB m		ted TC m
above to	min	max	min	max	min	max		above	to	min	max	min	max	min	max
12 20 20 25 25 30 30 50 50 55 55 65 65 70 105 105 125 120 140 140 170 170 190 210 230 230 260 260 290 290 310	20 25 30 35 45 45 45 50 80 100 120 130 160 180 180	50 60 65 70 85 90 95 100 115 145 165 200 205 235 260 265	20 25 30 35 45 45 50 60 80	35 43 48 53 65 68 70 75 88 113	35 42 47 52 65 67 70 75 87 112	50 60 65 70 85 90 95 100 115 145	:	30 45 55 65 70 100 105 130 140 170 190 210 230 260 290	45 55 65 70 100 105 130 140 190 210 230 260 290 310	35 45 45 50 60 60 80 120 130 130 180 180	70 85 90 95 100 115 145 165 200 205 235 260 265	35 45 45 50 60 60 80	53 65 68 73 75 85 88 113	52 65 67 72 75 85 87 112	70 85 90 95 100 110 115 145



► Radial play of full complement bearings with cylindrical inner ring

	Series 1000, 22 000										
Inner ring bore Di mm	Standard play µm	Selected TB µm	Selected TC µm								
above to	mini maxi	mini maxi	mini maxi								
12 17 17 20 20 25 25 30 30 35 35 50 50 55 55 65 65 70 70 90	20 50 30 60 35 70 40 75 45 80 50 85 60 100 60 105 60 115	20 35 30 45 35 53 40 58 45 63 50 68 60 80 60 83 60 85 65 90	35 50 45 60 52 70 57 75 62 80 67 85 80 100 82 105 85 110 90 115								

	Series 2 000									
bo	Inner ring Standard bore play Di mm µm			ted TB m	Selected TC µm					
above	to	mini	maxi	mini	maxi	mini	maxi			
15	20	30	60	30	45	45	60			
20	25	35	70	35	53	52	70			
25	30	40	75	40	58	57	75			
30	35	45	80	45	63	62	80			
35	50	50	85	50	68	67	85			
50	55	60	100	60	80	80	100			
55	65	60	105	60	83	82	105			
65	70	60	110	60	85	85	110			
70	105	65	115	65	90	90	115			
105	125	75	130	75	103	102	130			
125	140	95	160	95	128	127	160			
140	170	125	190				[
170	190	145	210							
190	210	160	230							
210	230	160	235							

	Series 3 000									
Inner o bor Di m	e	Standard play µm		Select µ	ted TB m	Selected TC µm				
above	to	mini	maxi	mini	maxi	mini	maxi			
30 45 55 65 70 100 105 130 140 170 190 210 230 260 290	45 55 65 70 100 105 130 140 170 190 210 230 260 290 310	50 60 65 65 75 75 95 125 145 160 190 210 210	85 100 105 110 115 125 130 160 190 210 230 235 265 290 295	50 60 65 65 75 75 95	68 80 83 88 90 100 103 128	67 80 82 87 90 100 102 127	65 100 105 110 115 125 130 160			

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

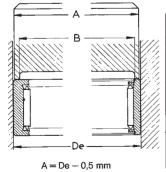
A radial play larger than normal may be necessary for certain applications, for example an inner ring subject to expansion mounted on a shaft running at high temperature (NA...TS...).

INSTALLATION OF RINGS

► Outer Rings

The force applied to the face of the ring must be exerted only on the area bounded by 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, providing the load exerted is on the centre line of the ring.



De	B	De	B	De	B	De	B	De	B	De	B
mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
16	13.5	52	46.5	100	90	145	135	205	190	300	280
19	16	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	65	58	115	105	160	148	230	215	340	315
28	24	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	90	81	135	125	190	175	280	260	385	360
47	41.5	95	85	140	130	195	180	290	270	395	370



► 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 up to 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 dimen-
- 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. NADELLA snap rings provide these conditions. Snap rings from other suppliers must be checked for correct seating in the groove during mounting.

► Fitting of outer rings

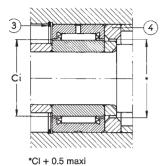
Whenever possible outer rings should be installed in through bored housings, which are easier to manufacture in cylindrical form without taper than housings with shoulders. Lateral retention of rings can then be assured by snap rings, etc.

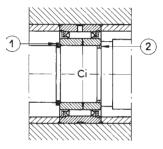
If the housing cannot be through bored, its base must possess grooves for engaging a bearing extraction tool.

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 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 providing that the shoulder radius is smaller than the chamfer on the ring - shown in the table of dimensions. Whenever possible, it is preferable to provide a groove for a bearing extraction tool on the shaft. If it is necessary to provide a large shoulder radius in order to retain the shaft strength, then a ring incorporating a large chamfer may be placed between the shoulder and the inner ring.



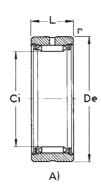


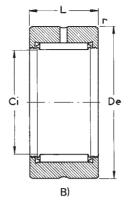
- ⑤ Snap Ring
- ① Groove for extraction tool
 ③ Snap ring
- Guidance ring for inserting shaft



Full complement needle bearings without inner ring RNA 1000, 2000, 22000, 3000 series

All bearings are not necessarily available. Please consult us for delivery times and for special dimensions.





RNA 1005 to RNA 1017 are not manufactured with a lubrication hole.

Shaft Dia.	Designa	ations 1)	Ci	De	L	r	Basic ca	pacities	Speed limit	Weight approx.
	1000, 2000 22000 Series	3 000 Series				min	Dyn. Cr	Stat. Cor		
mm	(fig. A)	(fig. B)	mm	mm	mm	mm	N N	N N	r.p.m.	g
7,3	RNA 1 005		7,3	16	12	0,35	3 950	4 450	52 000	10
9,7	RNA 1 007		9,7	19	12	0,35	4 800	5 900	39 000	13
12,1	RNA 1 009		12,1	22	12	0,35	5 600	7 400	31 000	18
14,4	RNA 1 010		14,4	24	12	0,35	6 350	8 900	26 000	20
17,6	RNA 1 012		17,6	28	15	0,35	11 000	16 500	21 600	34
20,8	RNA 1 015		20,8	32	15	0,65	12 400	19 500	18 300	44
22,1	RNA 2015		22,1	35	22	0,65	23 500	37 500	17 200	82
23,9	RNA 1 017		23,9	35	15	0,65	13 700	22 500	15 900	47
28,7	RNA 1 020 RNA 2 020		28,7 28,7	42 42	18 22	0,65 0,65	19 300 28 500	33 500 49 000	13 200 13 200	84 104
33,5	RNA 1 025 RNA 2 025 RNA 22 025		33,5 33,5 33,5	47 47 47	18 22 30	0,65 0,65 0,65	21 500 33 000 52 000	39 000 60 000 94 000	11 100 11 100 11 100	97 122 170
38,2	RNA 1 030 RNA 2 030 RNA 22 030		38,2 38,2 38,2	52 52 52	18 22 30	0,65 0,65 0,65	23 500 34 500 57 000	44 500 66 000 108 000	10 000 10 000 10 000	107 139 193
44	RNA 1 035 RNA 2 035 RNA 22 035	RNA 3 030	44 44 44 44	58 58 58 62	18 22 30 30	0,65 0,65 0,65 0,65	26 000 38 000 63 000 64 000	51 000 75 000 124 000 125 000	8 600 8 600 8 600 8 600	127 160 225 309
49,7	RNA 1 040 RNA 2 040 RNA 22 040	RNA 3 035	49,7 49,7 49,7 49,7	65 65 65 72	18 22 30 36	0,85 0,85 0,85 0,65	28 500 41 500 68 000 90 000	58 000 85 000 140 000 183 000	7 600 7 600 7 600 7 600	160 200 278 545
55,4	RNA 1 045 RNA 2 045	RNA 3 040	55,4 55,4 55,4	72 72 80	18 22 36	0,85 0,85 0,85	30 500 45 000 97 000	65 000 95 000 204 000	6 900 6 900 6 900	193 242 672
62,1	RNA 1 050 RNA 2 050	RNA 3 045	62,1 62,1 62,1	80 80 85	20 28 38	0,85 0,85 0,85	33 000 64 000 105 000	73 000 142 000 230 000	6 100 6 100 6 100	255 375 710
68,8	RNA 1 055 RNA 2 055	RNA 3 050	68,8 68,8 68,8	85 85 90	20 28 38	0,85 0,85 0,85	35 500 69 000 113 000	80 000 157 000 255 000	5 500 5 500 5 500	248 361 705
72,6	RNA 1 060 RNA 2 060	RNA 3 055	72,6 72,6 72,6	90 90 95	20 28 38	0,85 0,85 0,85	37 000 72 000 117 000	85 000 165 000 268 000	5 200 5 200 5 200	283 413 782

¹⁾ Old designation Na...s/Bi

over →



Full complement needle bearings without inner ring RNA 1000, 2000, 3000 series

All bearings are not necessarily available. Please consult us for delivery times and for special dimensions.

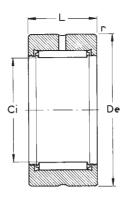
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Shaft Dia.	Designa	ations (1)	Ci	De	L	r	Basic ca	apacities	Speed limit	Weight approx.
mm	1000, 2000 Series	3 000 Series	mm	mm	mm	min mm	Dyn. Cr N	Stat. Cor N	r.p.m.	g
78,3	RNA 1 065 RNA 2 065	RNA 3 060	78,3 78,3 78,3	95 95 100	20 28 38	0,85 0,85 0,85	41 500 78 000 123 000	97 000 184 000 290 000	4 900 4 900 4 900	306 433 810
83,1	RNA 1 070 RNA 2 070	RNA 3 065	83,1 83,1 83,1	100 100 105	20 28 38	0,85 0,85 0,85	43 000 81 000 129 000	103 000 195 000 308 000	4 500 4 500 4 500	322 470 865
88	RNA 1 075 RNA 2 075	RNA 3 070	88 88 88	110 110 110	24 32 38	0,85 0,85 0,85	64 000 104 000 134 000	155 000 253 000 325 000	4 300 4 300 4 300	577 767 906
96	RNA 1 080 RNA 2 080	RNA 3 075	96 96 96	115 115 120	24 32 38	0,85 0,85 0,85	68 000 110 000 142 000	170 000 275 000 355 000	4 000 4 000 4 000	510 694 1 098
99,5	RNA 2 085	RNA 3 080	99,5 99,5	120 125	32 38	1,35 0,85	113 000 145 000	285 000 365 000	3 800 3 800	787 1 220
104,7	RNA 2 090	RNA 3 085	104,7 104,7	125 130	32 38	1,35 1,35	117 000 150 000	300 000 390 000	3 600 3 600	837 1 252
109,1	RNA 2 095	RNA 3 090	109,1 109,1	130 135	32 43	1,35 1,35	120 000 185 000	315 000 480 000	3 500 3 500	882 1 522
114,7	RNA 2100	RNA 3 095	114,7 114,7	135 140	32 43	1,35 1,35	125 000 190 000	330 000 505 000	3 300 3 300	677 1 551
119,2	RNA 2105	RNA 3 100	119,2 119,2	140 145	32 43	1,35 1,35	129 000 195 000	340 000 520 000	3 200 3 200	941 1 645
124,7	RNA 2110	RNA 3 105	124,7 124,7	145 150	34 45	1,35 1,35	133 000 203 000	360 000 550 000	3 000 3 000	1 015 1 762
132,5	RNA 2115	RNA 3 110	132,5 132,5	155 160	34 45	1,35 1,35	139 000 210 000	380 000 580 000	2 900 2 900	1 205 2 037
137	RNA 2 120	RNA 3 115	137 137	160 165	34 45	1,35 1,35	142 000 215 000	395 000 600 000	2 800 2 800	1 265 2 140
143,5	RNA 2 125	RNA 3 120	143,5 143,5	165 170	34 45	1,35 1,35	145 000 224 000	410 000 630 000	2 700 2 700	1 218 2 107
148	RNA 2130		148	170	34	1,35	150 000	425 000	2 600	1 292
158	RNA 2 140	RNA 3130	158 158	180 190	36 52	1,35 1,35	157 000 275 000	455 000 790 000	2 400 2 400	1 478 3 285
170,5	RNA 2150	RNA 3 140	170,5 170,5	195 205	36 52	1,35 1,35	165 000 290 000	490 000 860 000	2 200 2 200	1 790 3 840
179,3	RNA 2160	RNA 3 150	179,3 179,3	205 215	36 52	1,35 1,35	170 000 300 000	515 000 900 000	2 100 2 100	1 970 4 185

¹⁾ Old designation NA...s/Bi



Full complement needle bearings without inner ring RNA 2 000 and 3 000 series



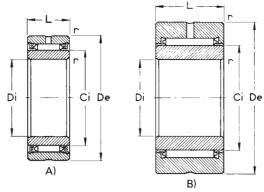
Shaft Dia.	-	Designations (1) 2 000 Series 3 000 Series		De	L	r mini	Basic ca	pacities	Speed limit	Weight approx.
mm	2000 Series	3000 Series	mm	mm	mm	mm	Dyn. Cr N	Stat. Cor N	r.p.m.	g
193,8	RNA 2 170	RNA 3 160	193,8 193,8	220 230	42 57	1,85 1,35	233 000 360 000	720 000 1 110 000	2 000 2 000	2 570 4 955
202,6	RNA 2 180	RNA 3 170	202,6 202,6	230 245	42 57	1,85 1,85	240 000 370 000	750 000 1 150 000	1 900 1 900	2 835 6 235
216	RNA 2 190	RNA 3 180	216 216	245 255	42 57	1,85 1,85	250 000 385 000	800 000 1 240 000	1 800 1 800	3 210 6 040
224,1	RNA 2 200	RNA 3 190	224,1 224,1	255 265	42 57	1,85 1,85	257 000 395 000	830 000 1 290 000	1 700 1 700	3 560 6 650
236		RNA 3 200	236	280	57	1,85	410 000	1 350 000	1 600	7 530
248,4	RNA 2 220		284,4	280	49	1,85	330 000	1 090 000	1 500	4 620
258,4		RNA 3 220	258,4	300	64	1,85	490 000	1 650 000	1 500	8 570
269,6	RNA 2 240		269,6	300	49	1,85	345 000	1 190 000	1 400	4 985
281,9		RNA 3 240	281,9	325	64	1,85	520 000	1 800 000	1 300	9 480
290,5	RNA 2 260		290,5	325	54	1,85	420 000	1 450 000	1 300	6 400
302		RNA 3 260	302	350	74	1,85	670 000	2 380 000	1 300	13 400
313,5	RNA 2 280		313,5	350	54	1,85	440 000	1 580 000	1 200	7 500
325		RNA 3 280	325	375	74	1,85	710 000	2 550 000	1 200	15 400
335	RNA 2 300		335	375	54	1,85	460 000	1 690 000	1 100	8 600
344	signation NA a/Di	RNA 3 300	344	395	74	1,85	740 000	2 700 000	1 100	16 500

¹⁾ Old designation NA...s/Bi



Full complement needle bearings without inner ring NA 1000, 2000, 22000, 3000 series

All bearings are not necessarily available. Please consult us for delivery times and for special dimensions.

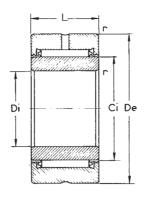


NA 1012, NA 1015, NA 1017 are not manufactured with a lubrication hole.

Shaft Dia.	Desigr 1000, 2000 – 22000 Series	nations 3 000 Series	Di	De	L	Ci	r mini	Basic ca	pacities	Speed limit	Weight approx.
mm	fig. (A) up to 60 mm fig. (B) above	fig. (B)	mm	mm	mm	mm	mm	Dyn. Cr N	Stat. Cor N	r.p.m.	g
12	NA 1 012	<u> </u>	12	28	15	17,6	0,35	11 000	16 500	21 600	50
15	NA 1 015 NA 2 015		15 15	32 35	15 22	20,8 22,1	0,65 0,65	12 400 23 500	19 500 37 500	18 300 17 200	62 117
17	NA 1 017		17	35	15	23,9	0,65	13 700	22 500	15 900	73
20	NA 1 020 NA 2 020		20 20	42 42	18 22	28,7 28,7	0,65 0,65	19 300 28 500	33 500 49 000	13 200 13 200	130 160
25	NA 1 025 NA 2 025 NA 22 025		25 25 25	47 47 47	18 22 30	33,5 33,5 33,5	0,65 0,65 0,65	21 500 33 000 52 000	39 000 60 000 94 000	11 100 11 100 11 100	151 187 259
30	NA 1 030 NA 2 030 NA 22 030	NA 3 030	30 30 30 30	52 52 52 52 62	18 22 30 30	38,2 38,2 38,2 44	0,65 0,65 0,65 0,65	23 500 34 500 57 000 64 000	44 500 66 000 108 000 125 000	10 000 10 000 10 000 8 600	167 213 293 497
35	NA 1 035 NA 2 035 NA 22 035	NA 3 035	35 35 35 35	58 58 58 72	18 22 30 36	44 44 44 49,7	0,65 0,65 0,65 0,65	26 000 38 000 63 000 90 000	51 000 75 000 124 000 183 000	8 600 8 600 8 600 7 600	204 253 352 815
40	NA 1 040 NA 2 040 NA 22 040	NA 3 040	40 40 40 40	65 65 65 80	18 22 30 36	49,7 49,7 49,7 55,4	0,85 0,85 0,85 0,85	28 500 41 500 68 000 97 000	58 000 85 000 140 000 204 000	7 600 7 600 7 600 6 900	254 315 434 993
45	NA 1 045 NA 2 045	NA 3 045	45 45 45	72 72 85	18 22 38	55,4 55,4 62,1	0,85 0,85 0,85	30 500 45 000 105 000	65 000 95 000 230 000	6 900 6 900 6 100	306 381 1 132
50	NA 1 050 NA 2 050	NA 3 050	50 50 50	80 80 90	20 28 38	62,1 62,1 68,8	0,85 0,85 0,85	33 000 64 000 113 000	73 000 142 000 255 000	6 100 6 100 5 500	418 603 1 220
55	NA 1 055 NA 2 055	NA 3 055	55 55 55	85 85 95	20 28 38	68,8 68,8 72,6	0,85 0,85 0,85	35 500 69 000 117 000	80 000 157 000 268 000	5 500 5 500 5 200	453 649 1 307
60	NA 1 060 NA 2 060	NA 3 060	60 60 60	90 90 100	20 28 38	72,6 72,6 78,3	0,85 0,85 0,85	37 000 72 000 123 000	85 000 165 000 290 000	5 200 5 200 4 900	485 695 1 393
65	NA 1 065 NA 2 065	NA 3 065	65 65 65	95 95 105	20 28 38	78,3 78,3 83,1	0,85 0,85 0,85	41 500 78 000 129 000	97 000 184 000 308 000	4 900 4 900 4 500	536 757 1 488
70	NA 1 070 NA 2 070	NA 3 070	70 70 70	100 100 110	20 28 38	83,1 83,1 88	0,85 0,85 0,85	43 000 81 000 134 000	103 000 195 000 325 000	4 500 4 500 4 300	567 805 1 568
75	NA 1 075 NA 2 075	NA 3 075	75 75 75	110 110 120	24 32 38	88 88 96	0,85 0,85 0,85	64 000 104 000 142 000	155 000 253 000 355 000	4 300 4 300 4 000	882 1 177 1 923



Full complement needle bearings with inner ring NA 1000, 2000 and 3000 series



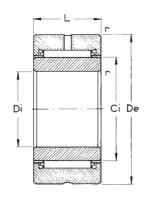
Shaft Dia.		Desig	nations	Di	De	L	Ci	r mini	Basic ca	apacities	Speed limit	Weight
Dia.		000 and 00 Series	3 000 Series					# 1 # 1 # 1 # 1 # 1 # 1 # 1 # 1 # 1 # 1	Dyn Cr	Stat. Cor	mint	approx.
mm	200	oo ocnes		mm	mm	mm	mm	mm	N N	N N	r.p.m.	g
80	NA NA	1 080 2 080	NA 3 080	80 80 80	115 115 125	24 32 38	96 96 99,5	0,85 0,85 0,85	68 000 110 000 145 000	170 000 275 000 365 000	4 000 4 000 3 800	920 1 239 2 025
85	NA	2 085	NA 3 085	85 85	120 130	32 38	99,5 104,7	1,35 1,35	113 000 150 000	285 000 390 000	3 800 3 600	1 302 2 117
90	NA	2 090	NA 3 090	90 90	125 135	32 43	104,7 109,7	1,35 1,35	117 000 185 000	300 000 480 000	3 600 3 500	1 368 2 512
95	NA	2 095	NA 3 095	95 95	130 140	32 43	109,1 114,7	1,35 1,35	120 000 190 000	315 000 505 000	3 500 3 300	1 430 2 626
100	NA	2 100	NA 3 100	100 100	135 145	32 43	114,7 119,2	1,35 1,35	125 000 195 000	330 000 520 000	3 300 3 200	1 497 2 735
105	NA	2 105	NA 3 105	105 105	140 150	32 45	119,2 124,7	1,35 1,35	129 000 203 000	340 000 550 000	3 200 3 000	1 556 2 987
110	NA	2110	NA 3 110	110 110	145 160	34 45	124,7 132,5	1,35 1,35	133 000 210 000	360 000 580 000	3 000 2 900	1 720 3 532
115	NA	2115	NA 3 115	115 115	155 165	34 45	132,5 137	1,35 1,35	139 000 215 000	380 000 600 000	2900 2800	2 100 3 660
120	NΑ	2 120	NA 3 120	120 120	160 170	34 45	137 143,5	1,35 1,35	142 000 224 000	395 000 630 000	2800 2700	2 167 3 792
125	NA	2 125		125	165	34	143,5	1,35	145 000	410 000	2700	2 240
130	NA	2 130	NA 3 130	130 130	170 190	34 52	148 158	1,35 1,35	150 000 275 000	425 000 790 000	2600 2400	2 325 5 815
140	NA	2 140	NA 3 140	140 140	180 205	36 52	158 170,5	1,35 1,35	157 000 290 000	455 000 860 000	2 400 2 200	2 643 6 840
150	NA	2 150	NA 3 150	150 150	195 215	36 52	170,5 179,3	1,35 1,35	165 000 300 000	490 000 900 000	2 200 2 100	3 230 7 230
160	NA	2160	NA 3 160	160 160	205 230	36 57	179,3 193,8		170 000 360 000	515 000 1 110 000		3 400 9 070
170	NA	2 170	NA 3 170	170 170	220 245	42 57	193,8 202,6		233 000 370 000	720 000 1 150 000		4 770 10 420
180	NA	2 180	NA 3 180	180 180	230 255	42 57	202,6 216	1,85 1,85	240 000 385 000	750 000 1 240 000	1 900 1 800	5 0 1 0 1 0 9 4 0
190	NA	2190	NA 3 190	190 190	245 265	42 57	216 224,1	1,85 1,85	250 000 395 000	800 000 1 290 000	1 800 1 700	5 890 11 450

over →



Full complement needle bearings with inner ring NA 1000, 2000 and 3000 series

All bearings are not necessarily available. Please consult us for delivery times and for special dimensions.



Shaft Dia.	1.0	Desig	nations 3 000 Series	Di	De	L	Ci	r mini	Basic ca	apacities	Speed limit	Weight approx.
mm		00 Series	3 000 Genes	mm	mm	mm	mm	mm	Dyn. Cr N	Stat. Cor N	r.p.m.	g
200	NA	2 200	NA 3 200	200 200	255 280	42 57	224,1 236	1,85 1,85	257 000 410 000	830 000 1 350 000	1 700 1 600	6 150 12 940
220	NA	2 220	NA 3 220	220 220	280 300	49 64	248,4 258,4	1,85 1,85	330 000 490 000	1 090 000 1 650 000	1 500 1 500	8 620 15 750
240	NA	2 240	NA 3 240	240 240	300 325	49 64	269,6 281,9	1,85 1,85	345 000 520 000	1 190 000 1 800 000	1 400 1 300	9 400 18 280
260	- NA	2 260	NA 3 260	260 260	325 350	54 74	290,5 302	1,85 1,85	420 000 670 000	1 450 000 2 380 000	1 300 1 300	11 800 24 100
280	NA	2 280	NA 3 280	280 280	350 375	54 74	313,5 325	1,85 1,85	440 000 710 000	1 580 000 2 550 000	1 200 1 200	13 850 27 800
300	NA	2 300	NA 3 300	300 300	375 395	54 74	335 344	1,85 1,85	460 000 740 000	1 690 000 2 700 000	1 100 1 100	16 100 29 300



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 shaft and 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 the 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 1 000 (or up to 2 in 1 000 in cases of instantaneous overloading) does not reduce the calculated load capacity. This convexity, which also depends on the length of the needles, 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 AND DIMENSIONS

The standard needle type BR has rounded ends. On request, NADELLA can also supply needles with flat ends, type BP.

The standard dimensions of the BR type needles are given in the table following. Needles of special dimensions may be manufactured on request where quantities are sufficiently large.



CHARACTERISTICS

NADELLA standard needles are made in through-hardened bearing steel of hardness 58–65 HRC. Needles in heat treated corrosion resistant steel (hardness 57–62 HRC) may be produced on request, the preferred diameters being 1.5, 2, 2.5, 3 and 4 mm.

The surface finish is \leq 0.2 μm C.L.A.

The profile of a needle is not cylindrical along its whole length as there is a very slight tape 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 ends may be supplied on request (suffix...DTN).

MANUFACTURING TOLERANCES

In general, the diameter of standard needles with rounded ends type BR and with flat ends type BP is produced to a tolerance up to $-10~\mu m$ from the nominal dimension. However, the maximum variation on any one production lot is $5~\mu m$ according to one of the classes of grade 5 in the table. On request, a variation of $3~\mu m$ may be obtained according to the classes of grade 3, and a variation of $2~\mu m$ according to the classes of grade 2.

Unless specified otherwise, quantities supplied are divided by NADELLA into different classes of each grade 2, 3 or 5. However, with automatic selection, diameters at 2 μm are generally available in grade 2 according to the classes printed in bold type. The colour codes shown for these classes are only used by agreement.

The length of needles type BR and BP is kept within tolerance h13.

TOLERANCES 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

Example: Needle 2.5x 15.8 BR/G2-2-4

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 blue	white	grey	green	orange	yellow

These colour codes are only used by prior agreement.

SHAFT AND HOUSING TOLERANCES

Operating conditions	Shaft	Housing			
	Ci	Ce	B1)		
Rotation on a convex inner raceway	j 5	F6	H12		
Rotation on a cylindrical inner raceway	h 5	F6	11.72		
Oscillatory motion	h 5	G 6			

¹⁾ Nominal dimension B = length of needle L + 0.2 mm

The cylindrical tolerance, defined as the difference in radii of two coaxial cylinders (ISO Standard 1101), should normally be less than a quarter of the manufacturing tolerance. However, for high precision or high speed applications, it is recommended to restrict this tolerance to one-eighth of the manufacturing tolerance.



LIMITING SPEED

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

 $n(r.p.m.) = \frac{380\,000}{Ci}$ (Ci: diameter of inner raceway in mm) up to a maximum speed of 70 000 r.p.m. For grease lubrication, use approximately half these values.

DYNAMIC AND STATIC CAPACITIES

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

1)
$$Cr = K Lu^{7/9}$$

K: variable factor relating to diameter of inner raceway Ci,

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

The basic static capacity Cor in newton (N), is given by the formula:

2)
$$Cor = 44 \left(1 - \frac{d}{Ci + d} \right) i dL_u Z.$$

d (mm): diameter of needles

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

Z: number of needles

Ci: number of needle rows.

NUMBER OF NEEDLES - CIRCUMFERENTIAL PLAY

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

3)
$$Z = \frac{\pi (Ci + d)}{d}$$

adjusted to the nearest whole number.

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

4)
$$Ci = \gamma d + \frac{jc}{\pi}$$

where γ is a variable factor shown in the tables on pages 68 and 69 in respect to the number of needles Z.

Example:

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

Number of needles
$$Z = \frac{\pi (30 + 2.5)}{2.5}$$

or Z = 41 needles (adjusted up)

To ensure circumferential play jc = 0.3 mm, use formula 4) with γ = 12.06 for 41 needles thus:

Ci = 12,06 x 2,5 +
$$\frac{0,3}{\pi}$$
 = 30,25 mm (adjusted up).

The shaft diameter Ci can therefore be designed at the nominal dimension adjusted up to 30.3 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 on page 82 giving the 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 mm, diameter Ci is 30.3 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 the 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).

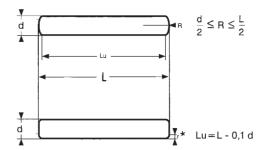
The use of automatic machines with high-speed rotary loading should be considered only for production quantities large enough to ensure that the high cost of investment can be absorbed.



Standard needles with rounded ends type BR

Needles with flat ends type BP

Example of designation: AIG 3 x 23,8 BR



AIG 3 x 23,8 BP

d	BP	В	R	Weight approx.
mm	L mm	L mm	Lu mm	per 1 000 g
1		5,8 7,8	5 7	34 46
1,5	5,8 6,8 9,8	5,8 6,8 7,8 9,8 11,8 13,8	4,9 5,9 6,9 8,9 10,9 12,9 14,9	76 90 103 130 157 185 210
	7,8 8,8 9,8	3,8 5,8 7,8	2,8 4,8 6,8	87 135 182 230
2	12,8 13,8 15,8 19,8	11,8 13,8 15,8 17,8 19,8	10,8 12,8 14,8 16,8 18,8	280 325 375 420 470
	7,8 14	7,8 9,8 11,8 13,8	6,7 8,7 10,7 12,7	285 360 430 510
2,5	15,8 15,8 27,8	15,8 17,8 19,8 21,8 23,8	14,7 16,7 18,7 20,7 22,7	580 660 730 800 880
	9,8 11,8 12,8	9,8 11,8	8,5 10,5	510 620
3	13,8 15,8 17,8 19,8 21,8 23,8 25,4	13,8 15,8 17,8 19,8 21,8 23,8	12,5 14,5 16,5 18,5 20,5 22,5	730 840 940 1 050 1 150 1 260
	25,4 25,8 26,8 27,8 29,8	25,8 27,8 29,8	24,5 26,5 28,5	1 370 1 480 1 600



	d	in mm				
>	≤	r min.	r max.			
_	1	0,1	0,3			
1	3	0,1	0,4			
3	5	0,1	0,6			

d	ВР	1817	· ·	Weight approx. per 1 000
mm	L mm	L mm	Lu mm	g
3,5	8,8	11,8 13,8 15,8 17,8 19,8 21,8 23,8 25,8 27,8 29,8 34,8	10,3 12,3 14,3 16,3 18,3 20,3 22,3 24,3 26,3 28,3 33,3	840 990 1 130 1 280 1 430 1 510 1 720 1 850 2 000 2 150 2 500
4	8,8	13,8 15,8 17,8 19,8 21,8 23,8 25,8 27,8 29,8 34,8 39,8 44,8	12,1 14,1 16,1 18,1 20,1 22,1 24,1 26,1 28,1 33,1 38,1 43,1	1 280 1 480 1 650 1 850 2 050 2 250 2 450 2 600 2 800 3 300 3 800 4 200
5	8,8	19,8 21,8 23,8 25,8 27,8 29,8 34,8 39,8 49,8	17,5 19,5 21,5 23,5 25,5 27,5 32,5 37,5 47,5	2 900 3 200 3 500 3 800 4 100 4 400 5 100 5 900 7 400
				Unit Weight g
6		29,8 39,8 59,8	27,6 37,6 57,2	6,3 8,4 12,7
7 8		69,8 79,8	66,9 76,7	20,2



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

Coeffizient γ for formula 4) page 65 Coeffizient K for formula 1) page 65

d → 1		1	,5	2		2,	5	3	}	3,	5	4			5 :		
m	mm																
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	2,3	531	3,5	823	4,6	1 119	5,7	1 420	6,9	1 730	8,0	2 040	9,1	2 351	11,3	2 985
11	2,55	2,7	586	4	905	5,2	1 228	6,5	1 561	7,8	1 898	9,1	2 241	10,3	2 583	12,9	3 283
12	2,86	3	635	4,4	978	5,9	1 334	7,3	1 693	8,7	2 058	10,2	2 429	11,6	2 803	14,5	3 562
13	3,18	3,3	680	4,9	1 050	6,5	1 430	8,1	1 817	9,7	2 210	11,3	2 608	12,9	3 010	16	3 822
14	3,49	3,6	723	5,4	1 118	7,1	1 522	8,9	1 935	10,6	2 352	12,4	2 776	14,1	3 203	17,6	4 070
15	3,81	3,9	765	5,9	1 182	7,8	1 609	9,7	2 045	11,6	2 488	13,5	2 936	15,4	3 388	19,2	4 306
16	4,13	4,2	804	6,3	1 242	8,4	1 693	10,5	2 151	12,5	2 617	14,6	3 088	16,6	3 564	20,8	4 530
17	4,44	4,5	841	6,8	1 301	9	1 772	11,2	2 253	13,5	2 740	15,7	3 233	17,9	3 732	22,3	4 743
18	4,76	4,9	878	7,3	1 356	9,7	1 849	12,0	2 349	14,4	2 858	16,8	3 372	19,2	3 893	23,9	4 948
19	5,08	5,2	913	7,8	1 411	10,3	1 921	12,8	2 443	15,4	2 971	17,9	3 507	20,4	4 048	25,5	5 144
20	5,39	5,5	945	8,2	1 463	10,9	1 992	13,6	2 532	16,3	3 080	19	3 635	21,7	4 196	27,1	5 333
21	5,71	5,8	978	8,7	1 512	11,6	2 059	14,4	2 618	17,3	3 185	20,1	3 758	23	4 339	28,7	5 515
22	6,03	6,1	1 010	9,2	1 560	12,2	2 125	15,2	2 701	18,2	3 286	21,2	3 879	24,3	4 477	30,3	5 690
23	6,34	6,4	1 039	9,6	1 607	12,8	2 189	16	2 783	19,2	3 385	22,3	3 996	25,5	4 611	31,8	5 861
24	6,66	6,8	1 067	10,1	1 652	13,5	2 250	16,8	2 861	20,1	3 481	23,4	4 107	26,8	4 741	33,4	6 026
25	6,98	7,1	1 097	10,6	1 695	14,1	2 311	17,6	2 936	21,1	3 572	24,6	4 216	28,1	4 866	35	6 187
26	7,30	7,4	1 124	11,1	1 738	14,7	2 369	18,4	3 011	22	3 664	25,7	4 322	29,3	4 991	36,6	6 342
27	7,61	7,7	1 151	11,6	1 779	15,4	2 425	19,2	3 082	23	3 751	26,8	4 426	30,6	5 109	38,2	6 494
28	7,93	8	1 178	12	1 822	16	2 481	20	3 153	23,9	3 836	27,9	4 528	31,9	5 225	39,8	6 642
29	8,25	8,4	1 202	12,5	1 860	16,6	2 535	20,8	3 221	24,9	3 919	29	4 626	33,1	5 341	41,4	6786
30	8,57	8,7	1 228	13	1 898	17,3	2 587	21,6	3 289	25,8	4 002	30,1	4 723	34,4	5 451	43	6927
31	8,88	9	1 252	13,5	1 936	17,9	2 639	22,3	3 356	26,8	4 081	31,2	4 818	35,7	5 560	44,5	7 069
32	9,20	9,3	1 277	13,9	1 975	18,5	2 691	23,1	3 420	27,7	4 161	32,3	4 910	36,9	5 668	46,1	7 204
33	9,52	9,6	1 301	14,4	2 011	19,2	2 739	23,9	3 483	28,7	4 236	33,5	4 998	38,2	5 772	47,7	7 336
34	9,84	9,9	1 325	14,9	2 046	19,8	2 788	24,7	3 545	29,7	4 311	34,6	5 088	39,5	5 874	49,3	7 466
35	10,16	10,3	1 345	15,4	2 081	20,5	2 835	25,5	3 606	30,6	4 386	35,7	5 176	40,8	5 974	50,9	7 595
36	10,47	10,6	1 368	15,8	2 118	21,1	2 883	26,3	3 666	31,5	4 460	36,8	5 262	42	6 075	52,5	7 720
37	10,79	10,9	1 390	16,3	2 150	21,7	2 930	27,1	3 725	32,5	4 530	37,9	5 346	43,3	6 172	54,1	7 843
38	11,11	11,2	1 413	16,8	2 183	22,4	2 974	27,9	3 782	33,5	4 600	39	5 430	44,6	6 267	55,7	7 965
39	11,43	11,5	1 434	17,3	2 216	23	3 020	28,7	3 839	34,4	4 670	40,1	5 512	45,9	6 360	57,3	8 085
40	11,75	11,9	1 453	17,8	2 247	23,6	3 065	29,5	3 895	35,4	4 738	41,3	5 590	47,1	6 455	58,9	8 202
41 42 43 44 45	12,06 12,38 12,70 13,02 13,34					24,3 24,9 25,5 26,2 26,8	3 107 3 150 3 194 3 233 3 275	30,3 31,1 31,9 32,7 33,5	3 949 4 005 4 058 4 111 4 163	36,3 37,3 38,2 39,2 40,2	4 805 4 871 4 938 5 001 5 064	42,3 43,5 44,6 45,7 46,8	5 673 5 748 5 826 5 902 5 978	48,4 49,7 50,9 52,2 53,5	6 546 6 635 6 726 6 813 6 899	62 63,6 65,2	8 321 8 435 8 548 8 660 8 769
46 47 48 49 50	13,65 13,97 14,29 14,61 14,93					27,4 28,1 28,7 29,4 30	3 317 3 356 3 396 3 434 3 474	34,3 35,1 35,9 36,7 37,5	4 215 4 266 4 316 4 366 4 415	41,1 42 43 44 44,9	5 127 5 190 5 251 5 311 5 372	47,9 49 50,2 51,3 52,4	6 052 6 126 6 197 6 286 6 339	54,7 56 57,3 58,6 59,9	6 986 7 071 7 153 7 236 7 317	70 71,6	8 879 8 986 9 091 9 196 9 300
51 52 53 54 55	15,24 15,56 15,88 16,20 16,52					30,6 31,3 31,9 32,5 33,2	3 513 3 550 3 588 3 626 3 661	38,2 39 39,8 40,6 41,4	4 465 4 514 4 561 4 609 4 655	45,9 46,8 47,8 48,7 49,7	5 430 5 490 5 547 5 606 5 661	53,5 54,6 55,7 56,8 58	6 409 6 479 6 548 6 616 6 681	61,1 62,4 63,7 64,9 66,2	7 399 7 479 7 556 7 637 7 713	79,5 81,1	9 405 9 506 9 606 9 706 9 804



d m				2 2,5 3		Taga e	3,5		4	1	5		
Z	γ	Ci mm	К	Ci mm	К	Ci mm	К	Ci mm	K	Ci mm	К	Ci mm	К
56 57 58 59 60	16,83 17,15 17,47 17,79 18,11	33,8 34,4 35,1 35,7 36,4	3 699 3 736 3 770 3 806 3 840	42,2 43 43,8 44,6 45,4	4 701 4 747 4 793 4 837 4 882	50,6 51,6 52,5 53,5 54,5	5 719 5 774 5 831 5 884 5 938	59 60,2 61,3 62,4 63,5	6 750 6 814 6 880 6 944 7 009	67,5 68,7 70 71,3 72,6	7 789 7 867 7 942 8 016 8 090	84,3 85,9 87,5 89,1 90,7	9 901 9 997 10 093 10 188 10 282
61 62 63 64 65	18,43 18,74 19,06 19,38 19,70			46,2 47 47,8 48,6 49,4	4 926 4 970 5 013 5 056 5 099	55,4 56,4 57,3 58,3 59,2	5 992 6 045 6 100 6 150 6 204	64,6 65,7 66,8 68 69,1	7 073 7 136 7 198 7 258 7 320	73,9 75,1 76,4 77,7 78,9	8 162 8 236 8 307 8 379 8 451	92,3 93,8 95,4 97 98,6	10 374 10 468 10 559 10 651 10 740
66 67 68 69 70	20,02 20,33 20,65 20,97 21,29			50,2 51 51,8 52,6 53,4	5 141 5 184 5 225 5 266 5 308	60,2 61,1 62,1 63 64	6 254 6 306 6 357 6 408 6 458	70,2 71,3 72,4 73,5 74,7	7 381 7 442 7 502 7 562 7 620	80,2 81,5 82,7 84 85,3	8 521 8 590 8 660 8 729 8 796	100,2 101,8 103,4 105 106,6	10 829 10 917 11 005 11 092 11 179
71 72 73 74 75	21,61 21,93 22,24 22,56 22,88			54,2 55 55,7 56,5 57,3	5 349 5 389 5 431 5 471 5 510	65 65,9 66,9 67,8 68,8	6 506 6 557 6 604 6 654 6 702	75,8 76,9 78 79,1 80,2	7 678 7 737 7 795 7 852 7 910	86,6 87,9 89,1 90,4 91,7	8 863 8 930 8 998 9 064 9 129	108,2 109,8 111,3 112,9 114,5	11 265 11 350 11 437 11 520 11 604
76 77 78 79 80	23,20 23,52 23,83 24,15 24,47			58,1 58,9 59,7 60,5 61,3	5 550 5 589 5 628 5 666 5 704	69,7 70,7 71,6 72,6 73,5	6 751 6 798 6 846 6 892 6 940	81,3 82,5 83,5 84,7 85,8	7 966 8 022 8 079 8 134 8 189	92,9 94,2 95,5 96,7 98	9 195 9 260 9 324 9 389 9 453	116,1 117,7 119,3 120,9 122,5	11 686 11 769 11 851 11 933 12 013
81 82 83 84 85	24,79 25,11 25,43 25,74 26,06					74,5 75,5 76,4 77,4 78,3	6 985 7 030 7 078 7 123 7 169	86,9 88 89,1 90,2 91,3	8 243 8 298 8 353 8 407 8 461	99,3 100,6 101,9 103,1 104,4	9 516 9 578 9 640 9 703 9 764	124,1 125,7 127,3 128,8 130,4	12 093 12 173 12 252 12 332 12 410
86 87 88 89 90	26,38 26,70 27,07 27,34 27,65				:	79,3 80,2 81,2 82,2 83,1	7 213 7 258 7 302 7 345 7 390	92,5 93,6 94,7 95,8 96,9	8 512 8 565 8 618 8 670 8 723	105,7 106,9 108,2 109,5 110,7	9 825 9 887 9 947 10 007 10 069	132 133,6 135,2 136,8 138,4	12 488 12 566 12 643 12 720 12 796
91 92 93 94 95	27,97 28,29 28,61 28,93 29,24					84 85 86 86,9 87,9	7 436 7 479 7 520 7 565 7 607	98 99,2 100,3 101,4 102,5	8 775 8 825 8 876 8 927 8 978	112 113,3 114,6 115,9 117,1	10 128 10 187 10 245 10 303 10 363	140 141,6 143,2 144,8 146,3	12 871 12 947 13 021 13 096 13 172
96 97 98 99 100	29,56 29,88 30,20 30,52 30,84					88,8 89,8 90,7 91,7 92,7	7 650 7 692 7 735 7 777 7 817	103,6 104,7 105,8 107 108,1	9 028 9 079 9 129 9 177 9 227	118,4 119,7 120,9 122,2 123,5	10 420 10 478 10 537 10 593 10 650	147,9 149,5 151,1 152,7 154,3	13 245 13 318 13 391 13 464 13 536





CAM FOLLOWERS



NADELLA cam followers are designed to run directly on various types 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 NADELLA 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 and scaling and galling of 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 NADELLA Technical Department.

TYPES OF CAM FOLLOWER

	Convex outer ring		Cylindrical outer ring					
without	with	seals	without	with seals				
seals	plastic	metal	seals	plastic	metal			
FG FP GC GCR RNA 11 000B6 RNAB 11 000	GCEE GCREE	FGEEM FGUMM GCEEM GCUMM GCURMM	FGL FPL GCL GCRL RNAL11 000	GCLEE GCRLEE	FGLEEM FGULMM GCLEEM GCRLEEM GCULMM GCURLMM			

TO USE AS FOLLOWER

▶ Dynamic capacity Cg NADELLA: It is the constant radial load which a follower can support during 1 000 000 revolutions before the first signs of fatigue appear on a ring or rolling element.

This dynamic capacity enables to calculate the life of a cam follower.





LIMIT LOADS

- ▶ Dynamic limit load F: It is the load which should not be exceeded when follower is subject to repeated torques.
- ► Static limit load Fo: It is the maximum strength limit that the follower can exceptionally support.

OPERATING CONDITIONS

► Full complement needle followers types GC, FG, FP

These followers are recommended under following conditions:

- Intermediate speeds.
- High radial loads,
- Oscillating motions.
- ► Full complement roller followers types GCU, FGU (light series)

Their installation is especially recommended for:

- High speeds (increased grease content)
- Limited and intermittent axial loads,
- Heavy radial loads.
- ► Full complement roller followers type FGU (heavy series)

This type differs from the light series in that the outer ring is thicker, hence a larger outer diameter and thus can accept heavier loads.

► Cam followers types GCR, GCUR

Derivatives of GC and GCU, this type has an eccentric collar, which is tightly fitted on the stud enabling the mounting position to be adjusted. The position of the stud can vary \pm k (see table of dimensions) relative to the centre of the hole in the mating member.

► Full complement needle followers type RNA 11 000

These followers may be used without an inner ring on a hardened shaft. Inner rings can be supplied with inner ring for shaft diameters of 12 mm and above. This type is recommended under the following conditions:

- Intermediate speeds,
- High radial loads,
- Oscillating motions.

MISALIGNMENT TOLERANCES

Followers with a convex outer ring permit displacement in relation to the track surface up to a maximum slope of:

1.5 in 1 000 for RNA 11 000 B6 15.0 in 1 000 for RNAB 11 000 7.0 in 1 000 for FG, GC and GCR.

TOLERANCES ON OUTER DIAMETER

For all types of follower:

- convex outer ring h9 on dim. De
- ocylindrical outer ring h7 on dim. De
- out of roundness; in accordance ISO Standard 492 (class zero according to DIN 620).

SHAFT TOLERANCES

For RNA 11 000 fitted with inner ring, FG and derivatives	Dim. Di
Load fixed in relation to the inner ring	h5
Load rotating in relation to the inner ring	k5
For RNA 11 000 without inner ring	Dim. Ci h5

The cylindrical tolerance, defined as the difference in radii of two coaxial cylinders (ISO Standard 1101), should normally be less than a quarter of the manufacturing tolerance. However, for high precision or high speed applications it is advised to restrict this tolerance to one eighth of the manufacturing tolerance.

Where followers are used as bearings, please consult NADELLA Technical Department for shaft and housing tolerances.



RACEWAY STRENGTH

The stress capacity of the raceway on which the follower rotates depends on several factors such as load and speed, possibility of shock and width of follower. In the case of high loads, raceway stress may be calculated approximately by the formula:

$$R \ge 45 \frac{P}{De \times L}$$
 where:

R in megapascals 1)

= raceway stress

P in newtons

= applied load on follower

De in mm

= outer diameter of follower

L in mm

= width of follower

1) 1 megapascal (MPa) = 1 newton (N) per mm²

RIGIDITY CONCEPT

The design of NADELLA full complement needle or roller followers provides applications with the high degree of rigidity necessary for precise motion.

This is essentially due to the rigidity of the stud and the rolling elements, to the bending under load of the outer ring, to the rigid contact between the outer ring and the cam, and above all to the thickness of the outer ring.

Owing to their inner design, the full complement followers types GC, FG... limit the load on the rolling elements and consequently the load on the outer ring.

For K values, please see table of dimensions.

ADVICE ON ASSEMBLY

Positioning of the radial lubrication hole

In cases where the follower is subjected to high loads, shock or vibration, the lubrication hole situated under the needles should be positioned outside the loaded zone. The lubrication hole which is not visible on the cam follower with threaded stud is parallel to the screw-driver slot in the head of the stud. (The GC 13 does not possess a lubrication hole.) Where the head of the stud has a hexagonal socket, the position of the lubrication hole is indicated by the marking NA.

► Lateral support of FG type followers

Shoulders on the shaft or other parts serving to retain the follower on the faces of the inner ring should have an outer diameter not less than dimensions D1. Where there is considerable axial load or operation is subject to vibration, this outer diameter should be equal to dimension M.

▶ Mounting cam followers with threaded studs type GC, GCR, and derivatives

The stud should fit easily into the hole in the mating member having a bore of tolerance H7. To ensure contact over the entire surface area of the yoke, the supporting face of the mating member should have a diameter of at least equal to dimension M. The locking torque applied to the nuts, as shown in the table of dimensions, is calculated to provide effective fixing of the followers.

ACCESSORIES FOR FOLLOWERS GC AND GCR

Cam followers GC and GCR with threaded studs are supplied with the parts:

Type GC	Type GCR
two nuts	one nut one lock washer one flat washer
one grease nipple for followers up	to De = 28 mm (except GC 10 to 15)
	e and one plug for n De = 30 mm

The stud of GC 10 to 15 has no axial hole. The stud of types GC and GCR up to De = 28 mm inclusive has a single threaded hole at its top end for a grease nipple. If this grease nipple is not used, an additional plug can be supplied on request as a substitute.



From De = 30 mm upwards the stud of the followers has a hole at each end for a grease nipple. Having fitted the grease nipple into one of the holes, the other should be blanked by means of the plug supplied. If greasing is effected by means of the hole at right angles to the stud, the arrangement described still applies as the grease nipple will act as a plug in this case. However, if obstruction results from the protruding head of the grease nipple, this can be replaced by a second plug available on request.

Cam followers with threaded stud types GC and GCR have a screwdriver slot at the top end. From D = 30 mm up to 52 mm, these types may either have a screwdriver slot or a hexagonal socket at the discretion of NADELLA, unless a specific type is requested.

LUBRICATION - OPERATING TEMPERATURE

Type RNA 11 000 followers are supplied with a coating of protective grease compatible with a lithium base grease.

Types FG, GC, GCR and derivatives with or without seals are supplied with a coating of lithium soap grease permitting operation in temperatures from -20 to +120°C. On request, these followers can be supplied without grease (but protected) in case where lubrication is to be effected by oil or a special lubricant.

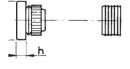
Type of follower	Lubrication	Operating temperature
Followers without seals type RNA 11 000	Protective grease	according to lubricant used for operation (see section on lubrication)
Followers without seals type FG (FGL), GC (GCL) and GCR (GCRL)		-20 to +120°C limits permitted by lithium soap grease
Followers with plastic seals…EE	Lithium soap grease	-20 to +100 °C limits permitted by plastic seals
Followers with metal sealsEEM		-20 to +120°C ¹⁾ limits permitted by lithium soap grease

- ▶ At temperatures of 150°C and above, cam followers must be specially heat treated and calculation of life should take account of reduced load capacity (see page 12).
- ▶ Use of a special grease for high temperatures may reduce the limiting speeds shown in the tables of dimentions.
- 1) The metal seal...EEM enables operation up to 200°C with a suitable lubricant.

ACCESSORY DETAILS FOR FOLLOWERS GC AND GCR

The nuts, grease nipples and plugs provided with GC and GCR type followers can be supplied separately. The references and principal dimensions of these accessories are shown in the table below:

For Follower	NUTS		GRI	EASE NIPP	LES	PLU	IGS
no.	Reference	h mm	Ref.	g mm	h mm	Ref.	ø mm
10 11 12 13 14 15	Hm 4 x 0.7 Hm 4 x 0.7 Hm 5 x 0.8 Hm 5 x 1.0 Hm 6 x 1.0	2.2 2.2 2.7 2.7 3.2 3.2					
16 19 22 24 26 28	Hm 6 x 1.0 Hm 8 x 1.25 Hm 10 x 1.25* Hm 10 x 1.25* Hm 10 x 1.25* Hm 10 x 1.25*	3.2 4 5 5 5	GN 4	6	2.5 to	OB 4	4
30 32	Hm 12 x 1.5 Hm 12 x 1.5	6 6	* *		3 mm max.	* *	
35 40 47 52	Hm 16 x 1.5 Hm 18 x 1.5 Hm 20 x 1.5 Hm 20 x 1.5	8 9 10 10	GN 6	8		ОВ 6	6
62 72 80 85 90	Hm 24 x 1.5 Hm 24 x 1.5 Hm 30 x 1.5 Hm 30 x 1.5 Hm 30 x 1.5	12 12 15 15	GN 8	10		OB 8	8



These threads may be supplied with the old pitch of 1 mm. For followers of De 30 and 32 mm with screwdriver slot: grease nipple GN 6 and plug OB 6. For followers of De 30 and 32 mm with hexagonal socket: grease nipple GN 4 and plug OB 4.

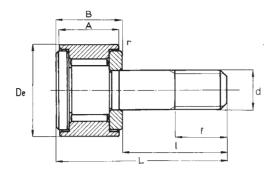




Small cam followers with threaded stud

GC: convex outer ring GCL: cylindrical outer ring

GC series: without seals



Outer Dia. De	Designations 1)	Α	B maxi	d	L maxi	l maxi	f	Pitch	r mini	M 7)	
mm	GC	mm	mm	mm	mm	mm	mm	mm	mm	mm	
10	10	8	8,5	4	19,5	11	6	0,7	0,2	8,4	
11	11	8	8,5	4	19,5	11	6	0,7	0,2	8,4	
12	12	9	9,5	5	22,5	13	7	0,8	0,2	10,3	
13	13	9	9,5	5	22,5	13	7	0,8	0,2	10,3	
14	14	9	10	6	26	16	8	1	0,3	11,8	
15	15	9	10	6	26	16	8	1	0,3	11,8	



						1		1
	ed as a bearing 2) us		cities when follower 3) Dyn. Cg		loads 4) Stat. Fo	Speed limits grease lubrication	torque	Designations
ISO N	NADELLA N	Stat. Co N	Dyll. Cg	N N	N N	5) r.p.m.	6) Nm	GC
2 380 2 380 3 200	2 700 2 700 3 650	2 800 2 800 4 400	2 130 2 480 2 980	520 520 900	960 960 1 680	13 800 13 800 11 400	0,9 0,9 1,8	10 11 12
3 200 3 500 3 500	3 650 3 950 3 950	4 400 5 050 5 050	3 350 3 500 3 750	900 1 480 1 480	1 680 2 750 2 750	11 400 10 100 10 100	1,8 3 3	13 14 15

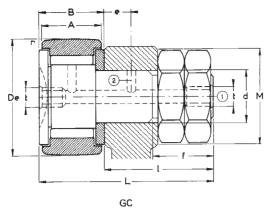
- 1) For followers with cylindrical outer ring, designation:GCL.
- 2) These capacities are to be used only for followers GCL, when the cylindrical outer ring is mounted in a housing.
- 3) These capacities are to be used for all types when the cylindrical or convex outer ring rotates directly on a cam. They take account of the repetitive loads on the follower and consequent elastic deformation of the outer ring.
- 4) The load shown is limited by the strengths of the stud or outer ring. With oil lubrication of followers without seals GC or GCL types, these speeds can be increased by 30% for continuous rotation or, up to 50% momentarily.
- 5) With oil lubrication of followers, these speeds can be increased by 30% for continuous rotation or, up to 50% momentarily.
- 6) These torques are shown for dry threads. For lubricated threads, take 0,7 to 0,8 of these values.
- 7) Minimum recommended abutment diameter.

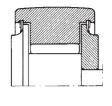


Cam followers with threaded stud

convex outer ring GC cylindrical outer ring GCL

GC...series: without seals GC...EE series: with plastic seals GC...EEM series: with metal seals





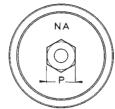
GC..EE, GC..EEM

Outer Dia. De	Designations 1) GC GCEE	Α	B maxi	đ	L maxi	l maxi	f	Pitch	r mini	t	е	M 7)	P 2)	. :
mm	GCEEM	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	
16 19 22	16 19 22	11 11 12	12,2 12,2 13,2	6 8 10	28,7 32,7 36,7	16,5 20,5 23,5	8 10 12	1 1,25 1,25*	0,3 0,3 0,3	4 4 4		13,3 15,3 18,2	ł	
24 26 28	24 26 28	12 12 12	13,2 13,2 13,2	10 10 10	36,7 36,7 36,7	23,5 23,5 23,5	12 12 12	1,25* 1,25* 1,25*	0,3 0,3 0,3	4 4 4		18,2 20,8 20,8		
30 32 35	30 32 35	14 14 18	15,2 15,2 19,6	12 12 16	40,7 40,7 52,6	25,5 25,5 33	13 13 17	1,5 1,5 1,5	0,6 0,6 0,6	** ** 6	6 6 8	24,8 24,8 28,8	8 8 10	
40 47 52	40 47 52	20 24 24	21,6 25,6 25,6	18 20 20	58,6 66,6 66,6	37 41 41	19 21 21	1,5 1,5 1,5	1 1 1	6 6 6	8 9 9	33,8 38,7 38,7	12 14 14	
62 72 80	62 72 80	29 29 35	30,6 30,6 37	24 24 30	80,6 80,6 100,5	50 50 63,5	25 25 32	1,5 1,5 1,5	1 1 1	6 6 8	11 11 15	52 52 68	12 12 14	
85 90	85 90	35 35	37 37	30 30	100,5 100,5	63,5 63,5	32 32	1,5 1,5	1	8	15 15	68 68	14 14	

^{*} These threads may be supplied with the old pitch of 1 mm (clamping torque 13 Nm).
** t=6 mm for followers 30 and 32 with screw driver slot. t=4 mm for followers 30 and 32 with hexagonal socket.







See note 2)

Basic capacities 3) Dyn. Cg NADELLA N	Limit 4 Dyn. F N	loads !) Stat. Fo N	Speed limits grease lubrication 5) r.p.m.	Clamping torque 6) Nm	Weight with nuts (approx.)	Designations GC GCEE GCEEM
5 050	1 180	2 200	9 300	3	21	16
5 750	2 830	5 200	7 600	8	34	19
6 300	4 900	8 100	6 300	20	58	22
6 900	5 200	9 200	6 300	20	67	24
8 900	5 200	9 600	5 500	20	72	26
9 600	5 200	9 600	5 500	20	80	28
12 900	7 700	14 300	4 800	26	115	30
13 800	7 700	14 300	4 800	26	120	32
19 200	11 400	24 000	3 850	64	208	35
20 000	14 200	27 000	3 150	90	301	40
28 300	21 400	40 000	2 700	120	477	47
34 000	21 400	40 000	2 700	120	542	52
42 000	31 000	57 500	2 330	220	944	62
44 000	31 000	57 500	2 330	220	1 165	72
60 000	50 000	93 000	1 700	450	1 915	80
64 000	50 000	93 000	1 700	450	2 096	85
65 000	50 000	93 000	1 700	450	2 287	90

¹⁾ Under the suffix ...AK, NADELLA can supply on request followers with cylindrical outer ring GCL, GCL...EE, GCL...EEM, possessing a screw driver slot at the threaded end of the stud.



²⁾ Followers with outer diameter up to 28 mm possess a screw driver slot. Followers with outer diameter 30 to 52 mm possess a screw driver slot or hexagonal socket at the discretion of NADELLA, except where one or other type has been specifically requested. Followers with outer diameter above 52 mm possess an hexagonal socket.

³⁾ These capacities are to be used for all types when the cylindrical or convex outer ring rotates directly on a cam. They take account of the repetitive loads on the follower and consequent elastic deformation of the outer ring.

⁴⁾ The load shown is limited by the strengths of the stud or outer ring.

⁵⁾ With oil lubrication of followers without seals GC or GCL types, these speeds can be increased by 30% for continuous rotation or, up to 50% momentarily.

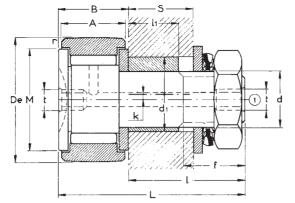
⁶⁾ These torques are shown for dry threads. For lubricated threads, take 0,7 to 0,8 of these values.

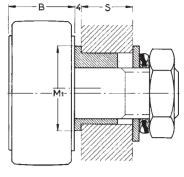
⁷⁾ Minimum recommended abutment diameter.

Eccentric cam followers with threaded stud

GCR: convex outer ring GCRL 1): cylindrical outer ring

GCR... series: without seals GCR...EE series: with plastic seals GCR...EEM series: with metal seals





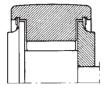
GCR 16 - 52

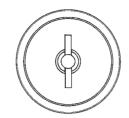
GCR 62-90

Outer Dia. De	Designations 1) GCR GCREE GCREEM	A	d1 7) mm	k mm		L maxi mm	l maxi mm	f mm	d mm	Pitch mm	r mini mm	t mm	M 8) mm	M1	P 2) mm	l ₁		S maxi mm	
16 19 22	16 19 22	11 11 12	9 11 14	0,5 0,5 1	12,2 12,2 13,2	28,7 32,7 36,7	20,5	8 10 12	6 8 10	1 1,25 1,25*	0,3 0,3 0,3	4 4 4	13,3 15,3 18,2			8 10 11	8,5 10,5 11,5	10 13 14	
24 26 28	24 26 28	12 12 12	14 14 14	1 1 1	13,2 13,2 13,2	36,7 36,7 36,7	23,5	12 12 12	10 10 10	1,25* 1,25* 1,25*	0,3 0,3 0,3	4 4 4	18,2 20,8 20,8			11 11 11	11,5 11,5 11,5	14 14 14	
30 32 35	30 32 35	14 14 18	16 16 21	1 1 1,5	15,2 15,2 19,6	40,7 40,7 52,6		13 13 17	12 12 16	1,5 1,5 1,5	0,6 0,6 0,6	** ** 6	24,8 24,8 28,8		8 8 10	11 11 14	11,5 11,5 14,5	14,5	
40 47 52	40 47 52	20 24 24	24 27 27	1,5 2 2	21,6 25,6 25,6	58,6 66,6 66,6	41	19 21 21	18 20 20	1,5 1,5 1,5	1 1 1	6 6 6	33,8 38,7 38,7		12 14 14	16 17,5 17,5	16,5 18 18	22 25 25	
62 72 80	62 72 80	29 29 35	36 36 42	3 3 3	30,6 30,6 37	80,6 80,6 100,5	50	25 25 32	24 24 30	1,5 1,5 1,5	1 1 1	8 8 8	52 52 68	44 44 50	12 12 14	18 18 27	18,5 18,5 27,5		
85 90	85 90	35 35	42 42	3	37 37	100,5 100,5		32 32	30 30	1,5 1,5	1	8 8	68 68	50 50	14 14	27 27	27,5 27,5		

^{*} These threads may be supplied with the old pitch of 1 mm (clamping torque 13 Nm).
** t=6 mm for followers 30 and 32 with screw driver slot. t=4 mm for followers 30 and 32 with hexagonal socket.









GCR..EE, GCR..EEM

See note 2)

Basic capacities 3) Dyn. Cg NADELLA N		loads t) Stat. Fo N	Speed limits grease lubrication 5) r.p.m.	Clamping torque 6) Nm	Weight with nuts (approx.)	Designations GCR GCREE GCREEM
5 050	1 180	2 000	9 300	2	24	16
5 750	2 830	4 500	7 600	5	39	19
6 300	4 900	5 600	6 300	16	57	22
6 900	5 200	5 600	6 300	16	72	24
8 900	5 200	6 100	5 500	16	80	26
9 600	5 200	6 100	5 500	16	88	28
12 900	7 700	10 400	4 800	22	118	30
13 800	7 700	10 400	4 800	22	126	32
19 200	11 000	11 000	3 850	55	220	35
20 000	12 300	12 300	3 150	75	321	40
28 300	21 400	23 700	2 700	100	500	47
34 000	21 400	23 700	2 700	100	568	52
42 000	28 800	28 800	2 330	180	1 035	62
44 000	28 800	28 800	2 330	180	1 278	72
60 000	50 000	54 000	1 700	370	2 074	80
64 000	50 000	54 000	1 700	370	2 235	85
65 000	50 000	54 000	1 700	370	2 435	90

¹⁾ Under the suffix ...AK, NADELLA can supply on request followers with cylindrical outer ring GCL, GCL...EE, GCL...EEM, possessing a screw driver slot at the threaded end of the stud.



Followers with outer diameter up to 28 mm possess a screw driver slot.
 Followers with outer diameter 30 to 52 mm possess a screw driver slot or hexagonal socket at the discretion of NADELLA, except where one or other type has been specifically requested.
 Followers with outer diameter above 52 mm possess an hexagonal socket.

These capacities are to be used for all types when the cylindrical or convex outer ring rotates directly on a cam. They take account of the repetitive loads on the follower and consequent elastic deformation of the outer ring.

⁴⁾ The load shown is limited by the strengths of the stud or outer ring.

⁵⁾ With oil lubrication of followers without seals GC or GCL types, these speeds can be increased by 30% for continuous rotation or, up to 50% momentarily.

⁶⁾ These torques are shown for dry threads. For lubricated threads, take 0,7 to 0,8 of these values.

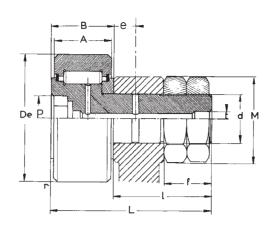
⁷⁾ The eccentric collar is tightly fitted on the stud.

⁸⁾ Minimum recommended abutment diameter.

Roller cam followers with threaded stud

GCU: convex outer ring GCUL: cylindrical outer ring

GCU...MM series: with metal seals 5).



Outer Dia. De	Designations 1)	A	B maxi	d	L maxi	l maxi	f	Pitch	r mini	t	e	M 6)	P wrench size	
mm	GCUMM	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	
35	35	18	19,7	16	52,5	32,8	17	1,5	0,6	6	8	26	10	
40	40	20	21,7	18	58,5	36,8	19	1,5	1	6	8	28,6	12	
47	47	24	25,7	20	66,5	40,8	21	1,5	1	6	9	33,6	14	
52	52	24	25,7	20	66,5	40,8	21	1,5	1	6	9	33,6	14	
62	62	29	30,7	24	80,5	49,8	25	1,5	1	6	11	38,9	12	
72	72	29	30,7	24	80,5	49,8	25	1,5	1,1	6	11	38,9	12	
80	80	35	37,2	30	100,5	63,3	32	1,5	1,1	8	15	51,8	14	
85	85	35	37,2	30	100,5	63,3	32	1,5	1,1	8	15	51,8	14	
90	90	35	37,2	30	100,5	63,3	32	1,5	1,1	8	15	51,8	14	
100	100	40	42,2	36	117,5	75,3	38	3	2	8	20	61	17	
110	110	40	42,2	36	117,5	75,3	38	3	2	8	20	61	17	
120	120	46	48,2	42	136,5	88,3	44	3	2	8	24	71	19	
130	130	46	48,2	42	136,5	88,3	44	3	2	8	24	71	19	



Basic capacities 2) Dyn. Cg NADELLA N		loads 3) Stat. Fo N	Speed limits grease lubrication r.p.m.	Clamping torque 4) Nm	Designations GCUMM
17 000	7 800	17 200	5 700	64	35
20 000	11 500	22 000	5 200	90	40
29 500	15 500	33 000	4 350	120	47
36 500	21 500	40 000	4 350	120	52
52 000	31 000	58 000	3 650	220	62
63 000	31 000	58 000	3 650	220	72
76 000	48 000	93 000	2 730	450	80
86 000	50 000	93 000	2 730	450	85
94 000	50 000	93 000	2 730	450	90
115 000	76 000	142 000	2 300	740	100
129 000	76 000	142 000	2 300	740	110
150 000	120 000	200 00	1 990	1 200	120
163 000	121 000	223 000	1 990	1 200	

¹⁾ Under the suffix ...AK, NADELLA can supply on request followers with cylindrical outer ring GCUL...MM, possessing a screw driver slot at the threaded end of the stud.



²⁾ These capacities are to be used for all types when the cylindrical or convex outer ring rotates directly on a cam. They take account of the repetitive loads on the follower and consequent elastic deformation of the outer ring.

³⁾ The load shown is limited by the strengths of the stud or outer ring.

⁴⁾ These torques are shown for dry threads. For lubricated threads, take 0,7 to 0,8 of these values.

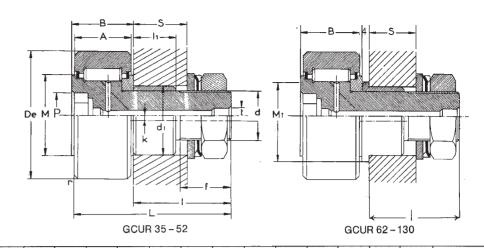
⁵⁾ Roller followers without seals are available on request by cancelling the suffix ...MM on the designation.

⁶⁾ Minimum recommended abutment diameter.

Eccentric roller cam followers with threaded stud

GCUR: convex outer ring GCURL: cylindrical outer ring

GCUR...MM series: with metal seals. 6)



Outer Dia.	Designations 1)	A	d1 5)	k	B maxi	L maxi	l maxi	f	d	Pitch	r mini	įt.	M 7)	M1	P wrench size	l ₁	mini	S maxi	
mm	GCURMM	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	
35 40 47	35 40 47	18 20 24	21 24 27	1,5 1,5 2	19,7 21,7 25,7	52,5 58,5 66,5	36,8	17 19 21	16 18 20	1,5 1,5 1,5	0,6 1 1	6 6 6	26 28,6 33,6		10 12 14	14 16 17,5	14,5 16,5 18	19 22 25	
52 62 72	52 62 72	24 29 29	27 36 36	2 3 3	25,7 30,7 30,7	66,5 80,5 80,5	49,8	21 25 25	20 24 24	1,5 1,5 1,5	1 1 1,1	6 6	33,6 38,9 38,9	44 44	14 12 12	17,5 18 18	18 18,5 18,5	25 25,5 25,5	
80 85 90	80 85 90	35 35 35	42 42 42	3 3 3	37,2	100,5 100,5 100,5	63,3	32 32 32	30 30 30	1,5 1,5 1,5	1,1 1,1 1,1	8 8 8	51,8 51,8 51,8	50 50 50	14 14 14	27 27 27	27,5 27,5 27,5	36 36 36	
100 110 120	100 110 120	40 40 46	48 48 54	3 3 3	42,2	117,5 117,5 136,5	75,3	38 38 44	36 36 42	3 3 3	2 2 2	8 8 8	61 61 71	56 56 62	17 17 19	32 32 39	32,5 32,5 39,5	41 41 48	
130	130	46	54	3	48,2	136,5	88,3	44	42	3	2	8	71	62	19	39	39,5	48	



	Basic capacities 2) Dyn. Cg NADELLA N		loads 3) Stat. Fo N	Speed limits grease lubrication r.p.m.	Clamping torque 4) Nm	Designations GCURMM
	17 000 20 000 29 500	7 800 10 900 15 500	10 000 10 900 21 300	5 700 5 200 4 350	55 75 100	35 40 47
	36 500 52 000 63 000	21 300 28 800 28 800	21 300 28 800 28 800	4 350 3 650 3 650	100 180 180	52 62 72
	76 000 86 000 94 000	48 000 50 000 50 000	54 000 54 000 54 000	2 730 2 730 2 730	370 370 370	80 90 90
	115 000 129 000 150 000	76 000 76 000 120 000	83 000 83 000 130 000	2 300 2 300 1 990	610 610 1 000	100 110 120
	163 000	121 000	130 000	1 990	1 000	130

¹⁾ Under the suffix ...AK, NADELLA can supply on request followers with cylindrical outer ring GCURL...MM, possessing a screw driver slot at the threaded end of the stud.



These capacities are to be used for all types when the cylindrical or convex outer ring rotates directly on a cam. They take account of the repetitive loads on the follower and consequent elastic deformation of the outer ring.

³⁾ The load shown is limited by the strengths of the stud or outer ring.

⁴⁾ These torques are shown for dry threads. For lubricated threads, take 0,7 to 0,8 of these values.

⁵⁾ The eccentric collar is tightly fitted on the stud.

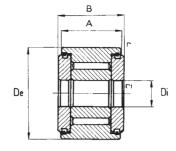
⁶⁾ Roller followers without seals are available on request by cancelling the suffix ...MM on the designation.

⁷⁾ Minimum recommended abutment diameter.

Small cam followers

(non separable inner and outer rings) FP: convex outer ring FPL: cylindrical outer ring

FP series: without seals



Outer Dia. De mm	Designations 1) FP	Di mm	A mm	B maxi mm	r mini mm	rl mini mm	M 2) mini mm	
10	3 10	3	8	8,7	0,2	0,15	8,4	
11	3 11	3	8	8,7	0,2	0,15	8,4	
12	4 12	4	9	9,7	0,2	0,15	10,3	
13	4 13	4	9	9,7	0,2	0,15	10,3	
14	4 14	4	9	10,2	0,3	0,15	11,8	
15	4 15	4	9	10,2	0,3	0,15	11,8	



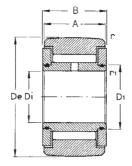
for bea Dyn. C ISO N	Basic ca rings 3) Dyn. C NADELLA N	apacities for follo Stat. Co N	wers 4) Dyn. Cg N	Limit 5 Dyn. F N	loads 5) Stat. Fo N	Speed limits grease lubrication 6) r.p.m.	Designations FP
2 380	2 700	2 800	2 130	1 160	2 050	13 800	3 10
2 380	2 700	2 800	2 480	1 680	2 520	13 800	3 11
3 200	3 650	4 400	2 980	1 820	3 350	11 400	4 12
3 200	3 650	4 400	3 350	2 450	3 950	11 400	4 13
3 500	3 950	5 050	3 500	2 550	4 350	10 100	4 14
3 500	3 950	5 050	3 750	3 200	4 750	10 100	4 15

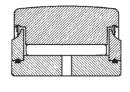
- 1) For followers with cylindrical outer ring, designation: FPL.
- 2) Minimum recommended abutment diameter.
- 3) These capacities are to be used only for followers FPL, when the cylindrical outer ring is mounted in a housing.
- 4) These capacities are to be used for all types when the cylindrical or convex outer ring rotates directly on a cam. They take account of the repetitive loads on the follower and consequent elastic deformation of the outer ring.
- 5) The load shown is limited by the strength of the outer ring when mounted in a housing.
- 6) With oil lubrication of followers without seals FP or FPL types, these speeds can be increased by 30% for continuous rotation or, up to 50% momentarily.



Cam followers

(non separable inner and outer rings)
FG, FG...EE, FG...EEM series: convex outer ring
FGL, FGL...EE, FGL...EEM series: cylindrical outer ring





FG

FG...EE. FG...EEM

Outer Dia.	followers without seals	Designations with convex oute with plastic	with metal	Di	A	B maxi	D1	M 2) mini	r mini	r1 mini	
mm	FG Series	seals FGEE Series	seals FGEEM Series	mm	mm	mm	mm	mm .	mm	mm	
			1								
16 19 24	5 16 6 19 8 24 6)	5 16 6 19 8 24	5 16 6 19	5 6 8	11 11 12	12 12 13	7,1 8,5 10,8	10 12 14,5	0,3 0,3 0,3	0,3 0,3 0,3	
24 30 32	8 24 15 10 30 12 32	8 24 15 10 30 12 32	8 24 15 10 30 12 32	8 10 12	14 14 14	15 15 15	10,8 13,8 16	14,5 19,5 21,5	0,3 0,6 0,6	0,3 0,3 0,3	
35 40 47	15 35 17 40 20 47	15 35 17 40 20 47	15 35 17 40 20 47	15 17 20	18 20 24	19 21 25	18,7 22 25,7	24 28 32,5	0,6 0,6 1	0,3 0,3 0,3	
52 62 72	25 52 30 62 35 72	25 52 30 62 35 72	25 52 30 62 35 72	25 30 35	24 28 28	25 29 29	30,5 35,2 41	37 44 50	1 1 1	0,3 0,3 0,6	
80 85 90	40 80 45 85 50 90	40 80 45 85 50 90	40 80 45 85 50 90	40 45 50	30 30 30	32 32 32	46,7 52,4 59,1	56 62 69	1 1 1	0,6 0,6 0,6	
100 110 120	55 100 60 110 65 120		55 100 60 110 65 120	55 60 65	34 34 40	36 36,2 42	65 70 74	75 82 90	1,5 1,5 1,5	0,6 0,6 0,6	
125 130 140	70 125 75 130* 80 140		70 125 75 130* 80 140	70 75 80	40 40 46	42 42 48	79 84 92	92 96 105	1,5 1,5 2	0,6 0,6 1	
150 160 170	85 150* 90 160 95 170*		85 150* 90 160 95 170*	85 90 95	46 52 52	48 54 54	99 105 110	112 120 125	2 2 2	1 1 1	
180 200 215	100 180 110 200* 120 215	_	100 180 110 200* 120 215	100 110 120	63 63 63	65 65 65	116 128 138	135 150 160	2 2 2	1,5 1,5 1,5	
230 250 270	130 230* 140 250 150 270*		130 230* 140 250 150 270*	130 140 150	75 75 75	78 78 78	147 158 170	170 180 195	3 3 3	1,5 1,5 1,5	

^{*} on request



:	Basic capacities 3)		loads 4)	Speed limits grease	Weight approx.	Designations
	Dyn. Cg NADELLA N	Dyn. F N	Stat. Fo	lubrication 5) r.p.m.	g	FG FGEE FGEEM
	5 050	3 250	5 400	9 300	16	5 16
	5 800	4 050	6 700	7 600	19	6 19
	6 900	6 600	9 200	6 300	37	8 24 6)
	8 700	8 500	12 300	6 300	44	8 24 15
	12 900	8 500	15 500	4 800	66	10 30
	12 900	8 300	16 200	4 200	77	12 32
	18 000	12 200	25 600	3 750	103	15 35
	22 300	14 200	31 000	3 150	155	17 40
	28 300	21 400	44 500	2 700	295	20 47
	29 000	23 600	48 000	2 330	310	25 52
	38 500	38 000	73 000	2 050	490	30 62
	43 500	49 000	90 000	1 800	670	35 72
	54 000	66 000	123 000	1 620	890	40 80
	53 000	69 000	125 000	1 450	970	45 85
	51 000	74 000	123 000	1 300	1 040	50 90
	60 000	88 000	142 000	1 150	1 350	55 100
	67 000	102 000	168 000	1 090	1 650	60 110
	83 000	135 000	223 000	1 020	2 350	65 120
	83 000	144 000	228 000	960	2 500	70 125
	84 000	155 000	234 000	910	2 650	75 130*
	99 000	197 000	275 000	820	3 400	80 140
	105 000	220 000	300 000	770	4 000	85 150 *
	120 000	288 000	370 000	710	5 300	90 160
	129 000	302 000	410 000	690	6 000	95 170 *
	175 000	353 000	530 000	650	8 050	100 180
	189 000	420 000	600 000	590	10 000	110 200*
	199 000	486 000	660 000	550	11 500	120 215
	255 000	560 000	820 000	510	15 500	130 230 *
	280 000	630 000	930 000	480	18 500	140 250
	290 000	710 000	1 020 000	440	22 000	150 270 *

¹⁾ For followers with cylindrical outer ring, designation: FGL...EE, FGL..EEM.



²⁾ Minimum recommended abutment diameter.

These capacities are to be used for all types when the cylindrical or convex outer ring rotates directly on a cam. They
take account of the repetitive loads on the follower and consequent elastic deformation of the outer ring.

⁴⁾ The load shown is limited by the strength of the outer ring when mounted in a housing.

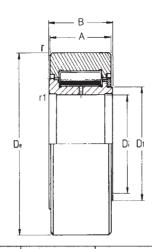
⁵⁾ With oil lubrication of followers without seals FG, FGL types, these speeds can be increased by 30% for continuous rotation or, up to 50% momentarily.

⁶⁾ Special followers, for replacement only. For new applications, use the FG 8 24 15.

Roller cam followers

(non separable inner and outer rings) FGU: convex outer ring FGUL: cylindrical outer ring

Light series FGU...MM series: with metal seals



Outer Dia.	Designations 1)	Di	A	B maxi	D1 mini	M 2) mini	r mini	r1 mini	
mm	FGUMM	mm	mm	mm	mm	mm	mm	mm	
35	15 35	15	18	19	19	25,4	0,6	0,3	
40	17 40	17	20	21	22	28	0,6	0,3	
47	20 47	20	24	25	25,8	33,5	1	0,3	
52	25 52	25	24	25	30	38,2	1	0,3	
62	30 62	30	28	29	36,8	45,9	1	0,3	
72	35 72	35	28	29	44	53,6	1	0,6	
80	40 80	40	30	32	49,5	59,3	1	0,6	
85	45 85	45	30	32	54	63,1	1	0,6	
90	50 90	50	30	32	59,5	68,8	1	0,6	
100	55 100	55	34	36	64	75,8	1,5	0,6	
110	60 110	60	34	36	69,5	81,5	1,5	0,6	
120	65 120	65	40	42	74,5	86,7	1,5	0,6	
125	70 125	70	40	42	79,6	91,8	1,5	0,6	
130	75 130	75	40	42	84	97	1,5	0,6	
140	80 140	80	46	48	90	102	2	1	
150	85 150	85	46	48	94	108,5	2	1	
160	90 160	90	52	54	100	114,7	2	1	
170	95 170	95	52	54	106,7	121,2	2	1	
180	100 180	100	63	65	113	127,6	2	1,5	
200	110 200	110	63	65	122	137	2	1,5	
215	120 215	120	63	65	132	149,3	2	1,5	
230	130 230	130	75	78	143	160,6	3	1,5	
250	140 250	140	75	78	151	168	3	1,5	
270	150 270	150	75	78	162	179,5	3	1,5	



Basic capacities 3) Dyn. Cg	limit I 4 Dyn. F		Speed limits grease lubrication	Designations
NADELLA N	N N	N N	r.p.m.	FGUMM
17 000	7 800	17 000	5 700	15 35
20 000	11 500	21 500	5 200	17 40
29 500	15 500	32 300	4 350	20 47
31 500	17 300	36 000	3 800	25 52
44 500	24 500	540 000	3 150	30 62
50 000	31 300	66 000	2 700	35 72
59 000	40 600	84 000	2 440	40 80
62 000	45 000	91 000	2 290	45 85
62 000	49 000	94 000	2 100	50 90
 79 000	53 400	109 000	1 900	55 100
88 000	64 000	129 000	1 770	60 110
110 000	89 000	174 000	1 650	65 120
 110 000	93 000	180 000	1 570	70 125
112 000	97 000	185 000	1 480	75 130
138 000	130 000	250 000	1 400	80 140
 158 000	130 000	258 000	1 330	85 150
188 000	166 000	327 000	1 250	90 160
198 000	184 000	356 000	1 190	95 170
 250 000	250 000	490 000	1 130	100 180
280 000	310 000	590 000	1 050	110 200
310 000	310 000	600 000	960	120 215
375 000	406 000	790 000	890	130 230
420 000	490 000	920 000	850	140 250
445 000	560 000	1 030 000	800	150 270

¹⁾ For followers with cylindrical outer ring, designation: FGUL...MM.



²⁾ Minimum recommended abutment diameter.

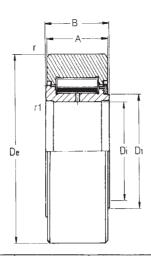
³⁾ These capacities are to be used for all types when the cylindrical or convex outer ring rotates directly on a cam. They take account of the repetitive loads on the follower and consequent elastic deformation of the outer ring.

⁴⁾ The load shown is limited by the strength of the outer ring when mounted in a housing.

Roller cam followers

(non separable inner and outer rings) FGU: convex outer ring FGUL: cylindrical outer ring

Heavy series FGU...MM series: with metal seals



Outer Dia.	Designations 1)	Di	Α	B maxi	D1 mini	M 2) mini	r mini	r1 mini	
mm	FGUMM	mm	mm	mm	mm	mm	mm	mm	
42	15 42	15	18	19	19	25,4	1	0,3	
47	17 47	17	20	21	22	28	1	0,3	
52	20 52	20	24	25	25,8	33,5	1	0,3	
62	25 62	25	24	25	30	38,2	1	0,3	
72	30 72	30	28	29	36,8	45,9	1	0,3	
80	35 80	35	28	29	44	53,6	1	0,6	
90	40 90	40	30	32	49,5	59,3	1	0,6	
100	45 100	45	30	32	54	63,1	1,5	0,6	
110	50 110	50	30	32	59,5	68,8	1,5	0,6	
120	55 120	55	34	36	64	75,8	1,5	0,6	
130	60 130	60	34	36	69,5	81,5	1,5	0,6	
140	65 140	65	40	42	74,5	86,7	2	0,6	
150	70 150	70	40	42	79,6	91,8	2	0,6	
160	75 160	75	40	42	84	97	2	0,6	
170	80 170	80	46	48	90	102	2	1	
180	85 180	85	46	48	94	108,5	2	1	
190	90 190	90	52	54	100	114,7	2	1	
200	95 200	95	52	54	106,7	121,2	2	1	
215	100 215	100	63	65	113	127,6	2	1,5	
240	110 240	110	63	65	122	137	3	1,5	
260	120 260	120	63	65	132	149,3	3	1,5	
280	130 280	130	75	78	143	160,6	3	1,5	
300	140 300	140	75	78	151	168	3	1,5	
320	150 320	150	75	78	162	179,5	3	1,5	



Basic capacities 3) Dyn. Cg	Limit 4 Dyn. F		Speed limits grease lubrication	Designations
NADELLA N	N	, N . A, 148	r.p.m.	FGUMM
24 000	16 500	27 000	5 700	15 42
26 700	22 000	32 000	5 200	17 47
36 500	23 700	42 500	4 350	20 52
44 000	34 400	57 000	3 800	25 62
60 000	43 400	80 000	3 150	30 72
62 000	45 600	88 000	2 700	35 80
75 000	61 000	116 000	2 440	40 90
85 000	78 000	138 000	2 290	45 100
91 000	91 000	157 000	2 100	50 110
113 000	98 000	176 000	1 900	55 120
121 000	114 000	197 000	1 770	60 130
145 000	153 000	254 000	1 650	65 140
153 000	172 000	277 000	1 570	70 150
160 000	193 000	300 000	1 480	75 160
190 000	247 000	380 000	1 400	80 170
215 000	243 000	390 000	1 330	85 180
250 000	297 000	480 000	1 250	90 190
259 000	317 000	510 000	1 190	95 200
325 000	446 000	700 000	1 130	100 215
345 000	550 000	770 000	1 050	110 240
395 000	570 000	830 000	960	120 260
480 000	760 000	1 100 000	890	130 280
500 000	860 000	1 160 000	850	140 300
515 000	940 000	1 250 000	800	150 320

¹⁾ For followers with cylindrical outer ring, designation: FGUL...MM.



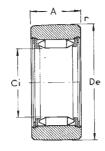
²⁾ Minimum recommended abutment diameter.

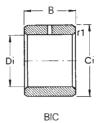
³⁾ These capacities are to be used for all types when the cylindrical or convex outer ring rotates directly on a cam. They take account of the repetitive loads on the follower and consequent elastic deformation of the outer ring.

⁴⁾ The load shown is limited by the strength of the outer ring when mounted in a housing.

Cam followers without inner ring

RNA...B6, RNAB, RNAL Series: without seals





RNA...B6

Outer Dia.		Designations		Ci	De	nom.	tol.	r mini		Basic capacities 1) Dyn. Cg	
mm	RNAB6 Series	RNAB Series	RNAL Series	mm	mm	mm	mm	mm		NADELLA N	
19	11 005 B6	11 005	11 005	7,3	19	12	0 - 0,10	0,35	19	5 100	
22	11 007 B6	11 007	11 007	9,7	22	12	0 - 0,10	0,35	25	6 000	
24	14 601 B6	14 601	14 601	12,1	24	12	0 - 0,10	0,35	27	6 200	
28	11 009 B6	11 009	11 009	12,1	28	12	0 - 0,10	0,35	42	7 400	
32	11 012 B6	11 012	11 012	17,6	32	15	- 0,20 - 0,30	0,35	57	10 800	
35	11 015 B6	11 015	11 015	20,8	35	15	- 0,20 - 0,30	0,65	62	10 800	
42	11 017 B6	11 017	11 017	23,9	42	15	- 0,20 - 0,30	0,65	98	13 400	
47	11 020 B6	11 020	11 020	28,7	47	18	- 0,20 - 0,30	0,65	133	16 800	
52	11 025 B6	11 025	11 025	33,5	52	18	- 0,20 - 0,30	0,65	152	17 200	
62	11 030 B6	11 030	11 030	38,2	62	22	- 0,20 - 0,30	0,65	275	28 500	
72	11 035 B6	11 035		44	72	22	- 0,22 - 0,34	0,65	370	32 000	
80	11 040 B6	11 040		49,7	80	22	- 0,22 - 0,34	0,85	450	34 000	
85	11 045 B6	11 045		55,4	85	22	- 0,22 - 0,34	0,85	480	33 500	
90	11 050 B6	11 050		62,1	90	24	- 0,22 - 0,34	0,85	540	32 500	



RNA...B6: Convex outer

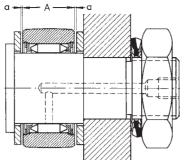
ring to maximum slope of 0.15%. Tolerance h9

on dim. DE.

RNAB: Convex outer ring to maximum slope of 1.5%. Tolerance h9 on dim. DE.

RNAL: Cylindrical outer ring. Tolerance h7 on dim. DE.

Example of mounting*



Total axial play: 2a=0.2 mm. approx.

Example of mounting*

Inner rings

	loads 2) Stat. Fo	Speed limits grease lubrication 3)	Shaft Dia.	Designation BIC	Di	Ci	nom.	tol.	r1 mini		For follower
N	Ν	r.p.m.	mm		mm	mm	mm	mm	mm		
4 050	4 050	8 700									
5 100	5 200	7 000									
 4 700	5 600	5 800									
7 100	7 100	5 800									
9 100	12 700	4 200	12	BIC 1012	12	17,6	15	0 - 0,10	0,35	16	11 012
9 100	13 400	3 650	15	BIC 1015	15	20,8	15	0 - 0,10	0,65	18	11 015
13 900	18 500	3 200	17	BIC 1017	17	23,9	15	0 - 0,10	0,65	26	11 017
15 400	23 000	2 700	20	BIC 2020	20	28,7	18	0 - 0,10	0,65	46	11 020
 16 500	24 700	2 330	25	BIC 1025	25	33,5	18	- 0 - 0,10	0,65	54	11 025
31 500	49 500	2 050	30	BIC 2030	30	38,2	22	- 0 - 0,10	0,65	74	11 030
41 000	61 000	1 800	35	BIC 2035	35	44	22	- 0 - 0,12	0,65	93	11 035
 47 000	68 000	1 620	40	BIC 2040	40	49,7	22	- 0 - 0,12	0,85	115	11 040
47 500	69 000	1 450	45	BIC 2045	45	55,4	22	- 0 - 0,12	0,85	139	11 045
51 000	68 000	1 300	50	BIC 11 050	50	62,1	24	- 0 - 0,12	0,85	196	11 050

These capacities are to be used for all types when the cylindrical or convex outer ring rotates directly on a cam. They
take account of the repetitive loads on the follower and consequent elastic deformation of the outer ring.



²⁾ The load shown is limited by the strength of the outer ring when mounted in a housing.

³⁾ With oil lubrication of followers, these speeds can be increased by 30% for continuous rotation or, up to 50% momentarily.

^{*} Stud not delivered by NADELLA.



NEEDLE THRUST BEARINGS-ROLLER THRUST BEARINGS



The rolling elements of a thrust bearing are retained and guided in 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 axial load capacity whilst occupying minimal space.

The design of NADELLA thrust bearings 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.

This result is due principally to the design of the one-piece steel cage (1) 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.



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 NADELLA. 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.

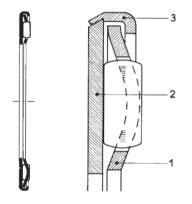
The second raceway for the rolling elements may also be formed by the face of a shoulder or an inserted ring, provided these have the correct geometrical dimensions and hardness.

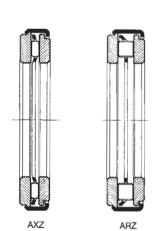
THRUST BEARINGS WITH TWO THRUST PLATES

Thrust bearings type AXZ and ARZ have two thrust plates retained by a steel ring giving protection against the entry of dirt and metal particles whilst at the same time assisting retention of the lubricant.

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. NADELLA manufactures two series of intermediate plates in hardened bearing-steel. One series to match needle thrust bearings type AX (both thick or thin) and the other to match roller thrust bearings type AR (light series).









The intermediate plates in the PM series may be used under normal loads without risk of excessive deflection. They can be centred on the shaft, the thrust bearings being centred in the housing, or *vice versa*.

Where heavy loads are involved, particularly when using roller thrust bearings type AR (light series), it is advisable to employ intermediate plates of the PMH series. The thickness and deep supporting surface of this plate gives better axial rigidity. PMH series plates are intended to be centred in the housing. They have radial holes (linked by an exterior groove) allowing oil to reach the bore of the thrust bearings, thereby ensuring effective circulation of lubricant by centrifugal force.

OPERATION

When the ring of 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

Thrust bearings with incorporated plate	Separate thrust plates	Intermediate plates	Thrust bearings with two thrust plates		
Needle thrust bearings AX – Thin Series AX – Thick Series	CP - Thin Series	PM without oil hole	Needle thrust bearings AXZ Thick Series		
Roller thrust bearings AR – Light Series	CP – Thick Series	PMH with oil hole	Roller thrust bearings ARZ Light Series		
AR 812 Series AR – Heavy Series	CPR 812 Series CPR – Heavy Series		ARZ Heavy Series		

Needle thrust bearings with a thin plate are of minimal thickness and are particularly economic to use. They should be considered whenever the degree of support and rotational accuracy permits.

Standard needle thrust bearings with a thick plate and standard roller thrust bearings provide rotational accuracy and axial run-out equal to or better than class 6 according to ISO Standard 199 for ball thrust bearings. They can be supplied in High Precision "HP" quality providing a precision grade superior to that of class 5.



THICKNESS AND AXIAL RUN-OUT TOLERANCES

	Bore Di mm	Thickness tolerance µm		Axial run-out µm		
Needle thrust bearings (thin)	DI ≤ 60 60 < DI ≤ 90 90 < DI ≤ 120	+ 30 /- 40 ¹⁾ + 50 /- 60 ²⁾ + 50 /- 60 ²⁾	20 ¹⁾ 25 ²⁾ 30 ²⁾			
Needle thrust bearings (thick) Roller thrust bearings	DI ≤ 60 60 < DI ≤ 90	+ 30 /- 30 ¹⁾ + 50 /- 50 ²⁾	20 ¹⁾ 25 ²⁾ 30 ²⁾	Quality		
Holler till dat bearings	90 < Di ≥ 120	+ 50 /~ 50 ²⁾		HP	HSP	
Thrust plates (thin)	DI ≤ 120 120 < DI ≤ 180 180 < DI ≤ 250	+ 50 /- 60 + 50 /- 110 + 50 /- 160	5* 7* 10*	2 3 4	1 1,5 2	
Thrust plates (thick) Intermediate plates	DI ≤ 120 120 < DI ≤ 180 180 < DI ≤ 250	+ 50 /- 50 + 50 /- 100 + 50 /- 150	5* 7* 10*	2 3 4	1 1,5 2	

^{*} HP quality

SUPPORTING FACES

For smooth running operation of needle or roller thrust bearings, it is necessary that their supporting faces should be parallel.

For a thrust bearing with intermediate thrust plate, the permissible degree of deviation from true parallelism between the two supporting faces should be no more than 1 min. (or approx. 0.3 per 1 000).

For a thrust bearing without intermediate thrust plate, the deviation must be no more than 1 min 30. sec. (or approx. 0.45 per 1 000).

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 d_1 and d_2 .

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 d_1 and d_2 .

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 d_1 and d_2 ; and,
- possess a suitable surface finish (\leqq 0.5 μ m 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 capacities shown in the tables of dimensions (see Technical Section).

TOLERANCES FOR CENTRING SUPPORTS

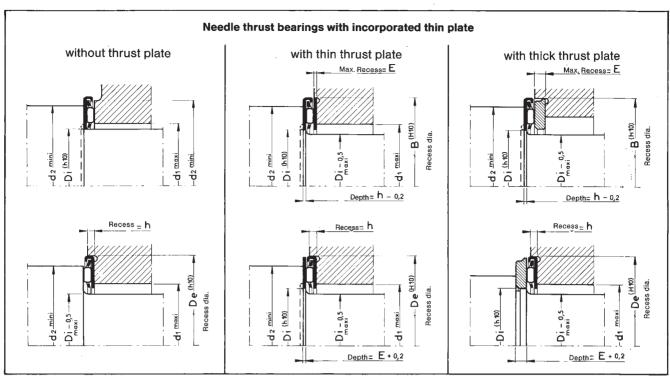
- ► Centring on the shaft: h10 on dimensions Di for thrust bearings or thrust plates or dimension d for intermediate plates.
- ► Centring in the housing: H10 on dimension De for thrust bearings or dimension B for thrust plates and dimension D for intermediate plates.

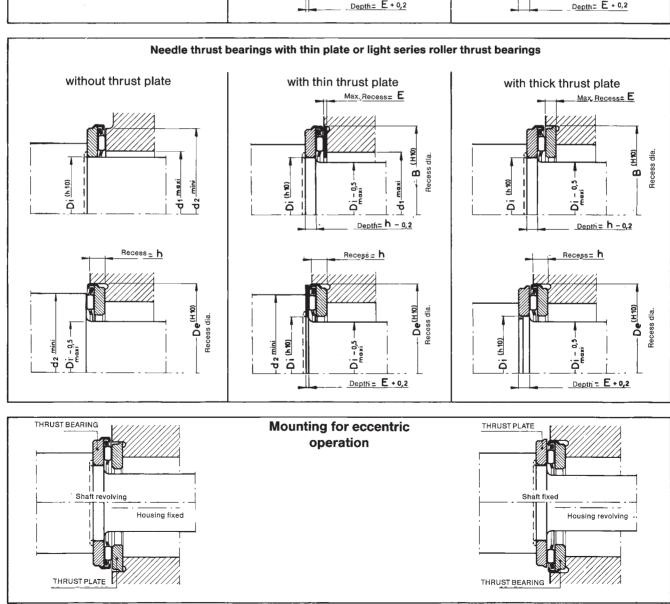


¹⁾ Under min. load of 150 N

²⁾ Under min. load of 250 N

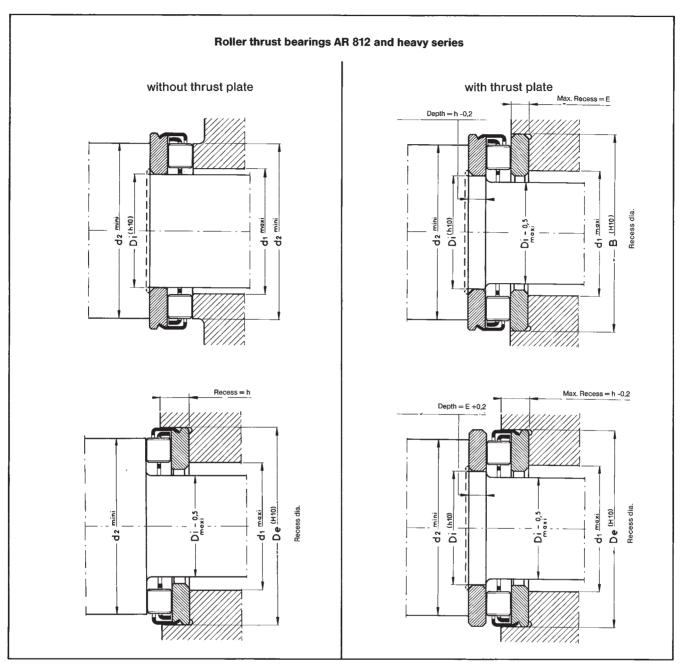
MOUNTING ARRANGEMENTS

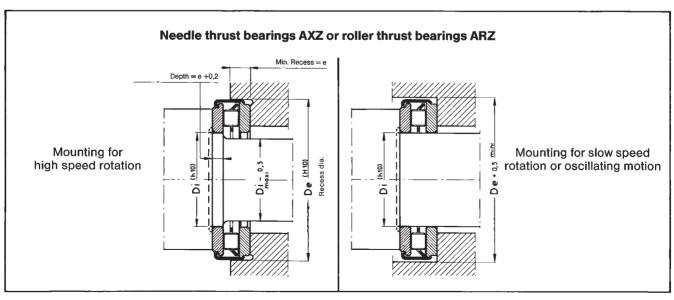






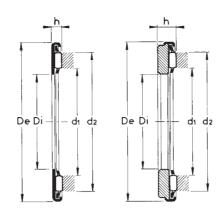
MOUNTING ARRANGEMENTS







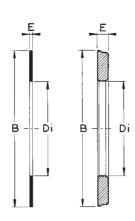
Needle thrust bearings AX thin and thick series



Shaft Dia.	Designations AX AX				Di nom.	De max.	h	d1	d2	Basic ca	pacities	Speed limit	Weight approx.			
mm	Th			Th		Ser	ies	mm	mm	mm	mm	mm	Dyn. Ca N	Stat. Coa N	r.p.m.	g
5	AX	5	13	AX 3	3,5	5	13	5 5	13 13	2,3 3,5	6,3 6,3	10,9 10,9	3 000 3 000	5 700 5 700	25 000 25 000	1,3 2,3
6	AX	6	14	AX :	3,5	6	14	6 6	14 14	2,3 3,5	7,3 7,3	11,9 11,9	3 150 3 150	6 350 6 350	22 000 22 000	1,4 2,4
7	AX	7	15	AX :	3,5	7	15	7 7	15 15	2,3 3,5	8,3 8,3	12,9 12,9	3 550 3 550	7 600 7 600	22 000 22 000	1,7 2,9
8	АХ	8	16	AX :	3,5	8	16	8 8	16 16	2,3 3,5	9,3 9,3	13,9 13,9	3 700 3 700	8 300 8 300	22 000 22 000	1,7 3
9	АХ	9	17	AX :	3,5	9	17	9 9	17 17	2,3 3,5	10,3 10,3	14,9 14,9	4 050 4 050	9 500 9 500	19 000 19 000	2,1 3,6
10	АХ	10	22	AX	4	10	22	10 10	22 22	2,8 4	12 12	18,6 18,6	5 000 5 000	10 900 10 900	15 500 15 500	4 6,6
12	АХ	12	26	AX	4	12	26	12 12	26 26	2,8 4	15 15	22,6 22,6	6 900 6 900	17 700 17 700	13 000 13 000	6 10
13	АХ	13	26	AX	4	13	26	13 13	26 26	2,8 4	15 15	22,6 22,6	6 900 6 900	17 700 17 700	13 000 13 000	6 9,8
15	АХ	15	28	AX	4	15	28	15 15	28 28	2,8 4	17 17	24,6 24,6	7 400 7 400	20 000 20 000	11 500 11 500	6,9 9
17	АХ	17	30	AX	4	17	30	17 17	30 30	2,8 4	19 19	26,6 26,6	7 800 7 800	22 000 22 000	10 500 10 500	7,6 10
19	АХ	19	32	AX	4	19	32	19 19	32 32	2,8 4	21 21	28,6 28,6	8 000 8 000	23 300 23 300	10 000 10 000	8,6 13
20	AX	20	35	AX	5	20	35	20 20	35 35	2,8 5	22 22	31,6 31,6	11 800 11 800	39 000 39 000	9 000 9 000	10,2 18
25	AX	25	42	AX	5	25	42	25 25	42 42	2,8 5	27,7 27,7	37,4 37,4	13 300 13 300	49 000 49 000	7 500 7 500	11,5 25
27	AX	27	44					27	44	2,8	30	39,6	13 700	52 000	7 200	12,1
30	AX	30	47	AX	5	30	47	30 30	47 47	2,8 5	32,7 32,7	42,4 42,4	14 500 14 500	57 000 57 000	6 500 6 500	13,7 29
0=	AX	35	52	AX	5	35	52	35 35	52 52	2,8 5	37,2 37,2	49 49	18 900 18 900	84 000 84 000	5 500 5 500	18,5 35
35	AX	35	53	AX	5	35	53	35 35	53 53	2,8 5	37,2 37,2	49 49	18 900 18 900	84 000 84 000	5 500 5 500	19,3 36
40	АХ	40	60	AX	5	40	60	40 40	60 60	2,8 5	43 43	54,9 54,9	20 400 20 400	96 000 96 000	5 000 5 000	23,9 46
45	АХ	45	65	AX	5	45	65	45 45	65 65	2,8 5	48 48	59,9 59,9	21 800 21 800	109 000 109 000	4 500 4 500	24,7 50



Thrust plates CP thin and thick series

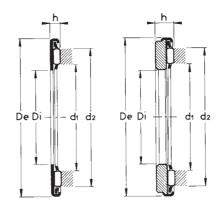


Shaft Dia.	Desig	nations	Di nom.	B max.	E	Weight approx.	Thrust I	pearings
mm	CP Thin Series	CP Thick Series	mm	mm	mm	g	AX Thin Series	AX Thick Series
5	CP 5 13	CP 2 5 13	5 5	12,4 12,4	0,8 2	0,6 1,6	AX 5 13	AX 3,5 513
6	CP 6 14	CP 2 6 14	6 6	13,4 13,4	0,8 2	0,7 1,7	AX 6 14	AX 3,5 614
7	CP 7 15	CP 2 7 15	7 7	14,4 14,4	0,8 2	0,8 2	AX 7 15	AX 3,5 715
8	CP 8 16	CP 2 8 16	8 8	15,4 15,4	0,8 2	0,8 2,1	AX 8 16	AX 3,5 816
9	CP 9 17	CP 2 9 17	9	16,4 16,4	0,8 2	0,9 2,3	AX 9 17	AX 3,5 917
10	CP 10 22	CP 2 10 22	10 10	21,5 21,5	0,8 2	1,7 4,3	AX 10 22	AX 4 10 22
12	CP 12 26	CP 2 12 26	12 12	25,5 25,5	0,8 2	2,5 6,2	AX 12 26	AX 4 12 26
13	CP 13 26	CP 2 13 26	13 13	25,5 25,5	0,8 2	2,4 5,9	AX 13 26	AX 4 13 26
15	CP 15 28	CP 2 15 28	15 15	27,5 27,5	0,8 2	2,5 6	AX 15 28	AX 4 1528
17	CP 17 30	CP 2 17 30	17 17	29,5 29,5	0,8 2	2,8 7	AX 17 30	AX 4 1730
19	CP 19 32	CP 2 19 32	19 19	31,5 31,5	0,8 2	3,5 9	AX 19 32	AX 4 1932
20	CP 20 35	CP 3 20 35	20 20	34,5 34,5	0,8 3	3,8 13	AX 20 35	AX 5 2035
25	CP 25 42	CP 3 25 42	25 25	41,5 41,5	0,8 3	5,3 19	AX 25 42	AX 5 25 42
27	CP 27 44		27	43,7	0,8	5,8	AX 27 44	
30	CP 30 47	CP 3 30 47	30 30	46,5 46,5	0,8 3	6 22	AX 30 47	AX 5 30 47
0.5	CP 35 52	CP 3 35 52	35 35	51,5 51,5	0,8 3	7 26	AX 35 52	AX 5 35 52
35	CP 35 53	CP 3 35 53	35 35	52,5 52,5	0,8 3	7,4 27	AX 35 53	AX 5 35 53
40	CP 40 60	CP 3 40 60	40 40	59,5 59,5	0,8 3	9,3 34	AX 40 60	AX 5 40 60
45	CP 45 65	CP 3 45 65	45 45	64,4 64,4	0,8 3	10 37	AX 45 65	AX 5 45 65

over →



Needle thrust bearings AX thin and thick series

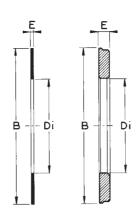


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over → Shaft Dia.	Desig	nations	Di nom.	De max.	h	d1	d2	Basic ca	pacities	Speed	Weight approx.
mm	AX Thin Series	AX Thick Series	mm	mm	mm	mm	mm	Dyn. Ca N	Stat. Coa N	r.p.m.	g
50	AX 50 70	AX 5 50 70	50 50	70 70	2,8 5	53,3 53,3	65,7 65,7	22 500 22 500	118 000 118 000	4 000 4 000	25,5 55
55	AX 55 78	AX 6 55 78	55 55	78 78	2,8 6	58,4 58,4	72,5 72,5	28 500 28 500	164 000 164 000	3 800 3 800	34 89
60	AX 60 85	AX 6 60 85	60 60	85 85	2,8 6	63,5 63,5	79,2 79,2	31 500 31 500	193 000 193 000	3 500 3 500	40 106
65	AX 3,5 65 90	AX 6 65 90	65 65	90 90	3,5 6	68,5 68,5	84,2 84,2	33 500 33 500	210 000 210 000	3 200 3 200	59 114
70	AX 3,5 70 95	AX 6 70 95	70 70	95 95	3,5 6	73,5 73,5	89,2 89,2	34 500 34 500	223 000 223 000	3 000 3 000	61 120
75	AX 3,5 75 100	AX 6 75 100	75 75	100 100	3,5 6	78,5 78,5	94,2 94,2	36 000 36 000	240 000 240 000	2 900 2 900	65 127
80	AX 3,5 80 105	AX 6 80 105	80 80	105 105	3,5 6	83,5 83,5	99,2 99,2	36 500 36 500	253 000 253 000	2 700 2 700	69 134
85	AX 3,5 85 110	AX 6 85 110	85 85	110 110	3,5 6	88,5 88,5	104,2 104,2	38 000 38 000	270 000 270 000	2 600 2 600	78 142
90	AX 4,5 90 120	AX 8 90 120	90 90	120 120	4,5 8	94,2 94,2	112,9 112,9	59 000 59 000	360 000 360 000	2 400 2 400	117 238
100	AX 4,5 100 135	AX 9 100 135	100 100	135 135	4,5 9	104,2 104,2		73 000 73 000	490 000 490 000	2 100 2 100	155 364
110	AX 4,5 110 145	AX 9 110 145	110 110	145 145	4,5 9	114,2 114,2		77 000 77 000	550 000 550 000	2 000	168 393
120	AX 4,5 120 155	AX 9 120 155	120 120	155 155	4,5 9	124,2 124,2		80 000 80 000	590 000 590 000	1 800 1 800	182 424
130		AX 11 130 170	130	170	11	135	161	106 000	710 000	1 700	660
140		AX 11 140 180	140	180	11	145	171	111 000	770 000	1 600	670
150		AX 11 150 190	150	190	11	155	181	115 000	830 000	1 500	710
160		AX 11 160 200	160	200	11	165	191	118 000	870 000		760
170		AX 12 170 215	170	215	12	175	207	- -	1 160 000		1 000
180		AX 12 180 225	180	225	12	185	217	-	1 250 000		1 050
190		AX 14 190 240	190	240	14	196	232		1 650 000	1 200	1 400
200		AX 14 200 250	200	250	14	206	242	 	1 730 000		1 500
220		AX 14 220 270	220	270	14	226	262		1 850 000	1 000	1 600
240		AX 15 240 300	240	300	15	246	286	280 000	2 240 000	900	2 300



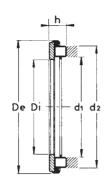
Thrust plates CP thin and thick series

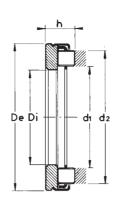


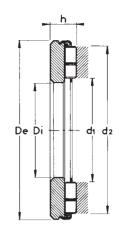
Shaft Dia.	Desig	nations	Di nom.	B max.	E	Weight approx.	Thrust I	pearings
mm	CP Thin Series	CP Thick Series	mm	mm	mm	g	AX Thin Series	AX Thick Series
50	CP 50 70	CP 3 50 70	50 50	69,4 69,4	0,8 3	11 40	AX 50 70	AX 5 50 70
55	CP 55 78	CP 4 55 78	55 55	77,4 77,4	0,8 4	14 69	AX 55 78	AX 6 55 78
60	CP 60 85	CP 4 60 85	60 60	84,3 84,3	0,8 4	16,6 83	AX 60 85	AX 6 60 85
65	CP 1,5 65 90	CP 4 65 90	65 65	89,3 89,3	1,5 4	33 88	AX 3,5 65 90	AX 6 65 90
70	CP 1,5 70 95	CP 4 70 95	70 70	94,3 94,3	1,5 4	34,4 93	AX 3,5 70 95	AX 6 70 95
75	CP 1,5 75 100	CP 4 75 100	75 75	99,3 99,3	1,5 4	37 99	AX 3,5 75 100	AX 6 75 100
80	CP 1,5 80 105	CP 4 80 105	80 80	104,3 104,3	1,5 4	39 104	AX 3,5 80 105	AX 6 80 105
85	CP 1,5 85 110	CP 4 85 110	85 85	109,3 109,3	1,5 4	46,6 111	AX 3,5 85 110	AX 6 85 110
90	CP 1,5 90 120	CP 5 90 120	90 90	118,8 118,8	1,5 5	52 173	AX 4,5 90 120	AX 8 90 120
100	CP 1,5 100 135	CP 6 100 135	100 100	133,8 133,8	1,5 6	68 277	AX 4,5 100 135	AX 9 100 135
110	CP 1,5 110 145	CP 6 110 145	110 110	143,8 143,8	1,5 6	75 300	AX 4,5 110 145	AX 9 110 145
120	CP 1,5 120 155	CP 6 120 155	120 120	153,8 153,8	1,5 6	81 323	AX 4,5 120 155	AX 9 120 155
130		CP 7 130 170	130	168,7	7	480		AX 11 130 170
140		CP 7 140 180	140	178,7	7	500		AX 11 140 180
150		CP 7 150 190	150	188,7	7	530	- 100	AX 11 150 190
160		CP 7 160 200	160	198,7	7	560		AX 11 160 200
170		CP 7 170 215	170	213,5	7	700		AX 12 170 215
180		CP 7 180 225	180	223,5	7	735		AX 12 180 225
190		CP 8 190 240	190	238,3	8	950		AX 14 190 240
200		CP 8 200 250	200	248,3	8	1 000		AX 14 200 250
220		CP 8 220 270	220	268,5	8	1 100		AX 14 220 270
240		CP 9 240 300	240	298,5	9	1 600		AX 15 240 300



Roller thrust bearings AR light series, 812 series and heavy series



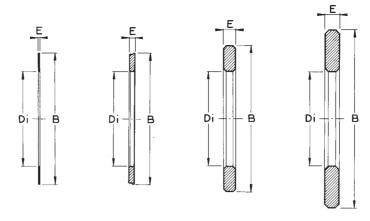




Shaft Dia.				Di nom	De max	h	d1	d2	Basic ca	apacities	Speed limit	Weight approx.
mm	AR Light Series	AR 812 Series	AR Heavy Series	mm	mm	mm	mm	mm	Dyn. Ca N	Stat. Coa N	r.p.m.	g
10	AR 4,5 10 22			10	22	4,5	12,2	18,5	8 200	17 900	15 500	7,3
12	AR 5 12 26			12	26	5	14,8	22,9	12 700	29 500	13 000	11
15	AR 5 15 28			15	28	5	16,8	24,9	14 000	34 000	11 500	11
17	AR 5 17 30			17	30	5	18,8	26,9	15 000	39 000	10 500	12,5
20	AR 7 20 35			20	35	7	22	31,6	22 000	54 000	9 000	22
25	AR 7 25 42			25	42	7	27,7	37,3	25 500	70 000	7 500	31
			AR 7 25 52	25	52	7	29	47	32 500	122 000	6 500	70
30	AR 7 30 47			30	47	7	32,7	42,3	26 500	77 000	6 500	36
30		AR 8 12 06	AR 9 30 60	30 30	52 60	11,75 9	32,8 33,5	47 53,5	49 000 46 000	117 000 162 000	6 300 5 600	85 113
35	AR 8 35 53,4			35	53,4	8	37,8	47,8	33 800	94 000	5 500	52
33		AR 8 12 07	AR 9 35 68	35 35	62 68	12,75 9	38,6 39	54,8 60,6	66 000 51 000	165 000 194 000	5 300 4 900	132 144
40	AR 9 40 60,4			40	60,4	9	42,8	54 ,8	46 000	129 000	5 000	70
40		AR 8 12 08	AR 11 40 78	40 40	68 78	14 11	43,6 44	61,8 70	82 000 71 000	209 000 265 000	4 800 4 200	169 225
45	AR 9 45 65,4			45	65,4	9	47,8	59,8	49 000	143 000	4 500	77
45		AR 8 12 09	AR 14 45 85	45 45	73 85	14,5 14	48,6 49	66,8 77	85 000 92 000	225 000 340 000	4 300 3 800	197 350
E 0	AR 9 50 70,4			50	70,4	9	52,8	64,8	51 000	157 000	4 000	82
50		AR 8 12 10	AR 14 50 95	50 50	78 95	15,5 14	53,6 54	71,8 86	93 000 108 000	255 000 430 000	4 000 3 400	234 448
55	AR 10 55 78,4			55	78,4	10	58,5	72,5	61 000	203 000	3 800	125
33		AR 8 12 11	AR 14 55 105	55 55	90 105	18 14	59,8 60,2	82 96,2	124 000 125 000	335 000 530 000	3 600 3 100	381 537



Thrust plates
CP thin and thick series,
CPR 812 series and
heavy series

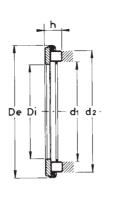


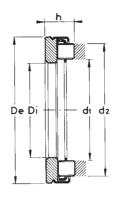
Shaft Dia.		Desigr	nations	Di nom	B max	E	Weight approx.	
mm	CP Thin Series	CP Thick Series	CP 812 Series	CP Heavy Series	mm	mm	mm	g
10	CP 10 22	CP 2 10 22			10 10	21,5 21,5	0,8 2	1,7 4,3
12	CP 12 26	CP 2 12 26			12 12	25,5 25,5	0,8 2	2,5 6,2
15	CP 15 28	CP 2 15 28			15 15	27,5 27,5	0,8 2	2,5 6
17	CP 17 30	CP 2 17 30			17 17	29,5 29,5	0,8 2	2,8 7
20	CP 20 35	CP 3 20 35			20 20	34,5 34,5	0,8 3	3,8 13
25	CP 25 42	CP 3 25 42			25 25	41,5 41,5	0,8 3	5,3 19
				CPR 4 25 52	25	52	4	52
30	CP 30 47	CP 3 30 47			30 30	46,5 46,5	0,8 3	6 22
30			CPR 812 06	CPR 5 30 60	30 30	52 60	4,25 5	42 83
35	CP 35 52	CP 3 35 52			35 35	51,5 51,5	0,8 3	7 26
33			CPR 812 07	CPR 5 35 68	35 35	62 68	5,25 5	78 102
40	CP 40 60	CP 3 40 60			40 40	59,5 59,5	0,8 3	9,3 34
40			CPR 812 08	CPR 6 40 78	40 40	68 78	5 6	86 162
45	CP 45 65	CP 3 45 65		- "	45 45	64,4 64,4	0,8 3	10 37
40		-	CPR 812 09	CPR 8 45 85	45 45	73 85	5,5 8	104 245
E0	CP 50 70	CP 3 50 70			50 50	69,4 69,4	0,8 3	11 40
50			CPR 812 10	CPR 8 50 95	50 50	78 95	6,5 8	131 308
55	CP 55 78	CP 4 55 78			55 55	77,4 77,4	0,8 4	14 69
J5			CPR 812 11	CPR 8 55 105	55 55	90 105	7 8	206 380

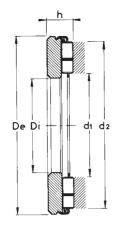
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Roller thrust bearings AR light series, 812 series and heavy series





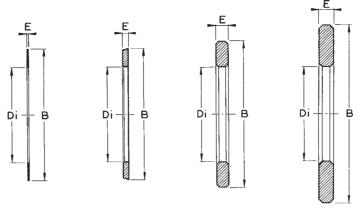


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Shaft Dia.		Designation	S	Di nom	De max	h	d1	d2	Basic ca	apacities	Speed limit	Weight approx.
mm	AR Light Series	AR 812 Series	AR Heavy Series	mm	mm	mm	mm	mm	Dyn. Ca N	Stat. Coa N	r.p.m.	g
00	AR 10 60 85,4			60	85,4	10	63,5	79,5	71 000	255 000	3 500	150
60		AR 812 12	AR 14 60 110	60 60	95 110	18,5 14	64,8 65,2	87 101,2	128 000 130 000	360 000 580 000	3 300 2 900	419 572
CE	AR 10 65 90,4			65	90,4	10	68,5	84,5	74 000	275 000	3 200	160
65		AR 812 13	AR 14 65 115	65 65	100 115	19 14	69,8 70,2	92 106,2	133 000 135 000	385 000 620 000	3 100 2 800	461 610
70	AR 10 70 95,4			70	95,4	10	73,5	89,5	77 000	295 000	3 000	170
70		AR 812 14	AR 16 70 125	70 70	105 125	19 16	74,8 76	97 116	143 000 174 000	430 000 710 000	2 900 2 600	493 775
75	AR 10 75 100,4			75	100,4	10	78,5	94,5	80 000	313 000	2800	180
75		AR 812 15	AR 16 75 135	75 75	110 135	19 16	79,8 82	102 126	147 000 198 000	455 000 860 000	2 800 2 400	521 893
00	AR 10 80 105,4			80	105,4	10	83,5	99,5	82 000	330 000	2700	190
80		AR 812 16	AR 16 80 140	80 80	115 140	19,5 16	84,8 87	107 131	150 000 208 000	480 000 940 000	2 600 2 300	574 960
85		AR 812 17	AR 18 85 150	85 85	125 150	21,5 18	90,8 92	115 138	178 000 230 000	570 000 1 010 000	2 400 2 100	785 1 256
90		AR 812 18	AR 18 90 155	90 90	135 155	24,5 18	95,8 97	124 143	223 000 245 000	700 000 1 090 000	2 300 2 000	1 062 1 330
100		AR 812 20	AR 20 100 170	100 100	150 170	26,5 20	107,8 109	138 157	260 000 280 000	850 000 1 250 000	2 000 1 800	1 400 1 740
110		AR 812 22	AR 24 110 190	110 110	160 190	26,5 24	117,8 118	148 178	275 000 365 000	940 000 1 600 000	1 900 1 700	1 538 2 500
120			AR 24 120 210	120	210	24	127	199	470 000	2300000	1 500	3 200
130			AR 24 130 225	130	225	24	138	214	510 000	2 640 000	1 400	3 600
140			AR 28 140 240	140	240	28	149	229	600 000	2 980 000	1 300	4 800
150			AR 28 150 250	150	250	28	159	239	630 000	3 200 000		5 000
160			AR 30 160 270	160	270	30	170	258	730 000	3 800 000		6400
170			AR 30 170 280	170	280	30	180	268	760 000	4 050 000	1 100	6 700



Thrust plates
CP thin and thick series,
CPR 812 series and
heavy series

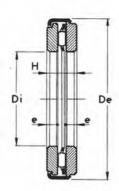


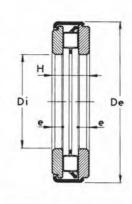
Shaft	1	Design	nations		Di	В	E	Weight
Dia.		-			nom	max		approx.
mm	CP Thin Series	CP Thick Series	CP 812 Series	CP Heavy Series	mm	mm	mm	g
CO	CP 60 85	CP 4 60 85			60 60	84,3 84,3	0,8 4	16,6 83
60			CPR 81212	CPR 8 60 110	60 60	95 110	7,5 8	228 405
GE	CP 1,5 65 90	CP 4 65 90			65 65	89,3 89,3	1,5 4	33 88
65			CPR 81213	CPR 8 75 115	65 65	100 115	8 8	267 430
70	CP 1,5 70 95	CP 4 70 95			70 70	94,3 94,3	1,5 4	34,4 93
70			CPR 81214	CPR 8 70 125	70 70	105 125	8 8	277 510
75	CP1,5 75 100	CP 4 75100			75 75	99,3 99,3	1,5 4	37 99
75			CPR 81215	CPR 8 75 135	75 75	110 135	8 8	295 595
80	CP 1,5 80 105	CP 4 80 105			80 80	104,3 104,3	1,5 4	39 104
00			CPR 81216	CPR 8 80 140	80 80	115 140	8,5 8	336 630
85			CPR 812 17	CPR 9 85 150	85 85	125 150	9,5 9	464 815
90			CPR 812 18	CPR 9 90 155	90 90	135 155	10,5 9	624 840
100			CPR 812 20	CPR10 100 170	100 100	150 170	11,5 10	825 1 130
110			CPR 812 22	CPR12 110 190	110 110	160 190	11,5 12	895 1 700
120				CPR12 120 210	120	210	12	2 100
130				CPR12 130 225	130	225	12	2 400
140				CPR14 140 240	140	240	14	3 200
150				CPR14 150 250	150	250	14	3 300
160				CPR15 160 270	160	270	15	4 200
170				CPR15 170 280	170	280	15	4 400

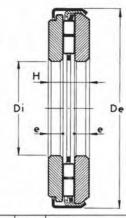


Needle or roller thrust bearings

two plates incorporated AXZ, ARZ, light and heavy series







Shaft Dia.	1	Designations		Di nom	De nom	Н	е		pacities Stat. Co	Speed limit	Weight approx.
mm	AXZ	ARZ Light Series	ARZ Heavy Series	mm	mm	mm	mm	N N	N N	r.p.m.	g
5	AXZ 5,5 5 13			5	13	5,5	2	3 000	5 700	25 000	3,64
6	AXZ 5,5 6 14			6	14	5,5	2	3 150	6 350	22 000	4,20
7	AXZ 5,5 7 15			7	15	5,5	2	3 550	7 600	22 000	4,69
8	AXZ 5,5 8 16			8	16	5,5		3700	8 300	22 000	5,09
9	AXZ 5,5 5 13			9	17	5,5		4 050	9 500	19 000	5,34
10	AXZ 6 10 22,4	ARZ 6,510 22,4		10 10	22,4 22,4	6 6,5		5 000 8 200	10 900 17 900	15 500 15 500	11,4 12
12	AXZ 6 12 26,4	ARZ 712 26,4		12 12	26,4 26,4	6 7	2 2	6 900 12 700	17 700 29 500	13 000 13 000	16,7 17
15	AXZ 6 15 28,4	ARZ 715 28,4		15 15	28,4 28,4	6 7	2 2	7 400 14 000	20 000 34 000	11 500 11 500	15,5 19
17	AXZ 6 17 30,4	ARZ 717 30,4		17 17	30,4 30,4		2 2	7 800 15 000	22 000 39 000	10 500 10 500	17,5 22
20	AXZ 8 20 35,4	ARZ 10 20 35,4		20 20	35,4 35,4		3	11 800 22 000	39 000 54 000	9 000	32,5 38
25	AXZ 8 25 43	ARZ 10 25 43	ARZ 11 25 53	25 25 25	43 43 53	8 10 11	3 4	13 300 25 500 32 500	49 000 70 000 122 000	7 500 7 500 6 500	47 57 122
30	AXZ 8 30 48	ARZ 10 30 48	ARZ 14 30 61	30 30 30	48 48 61	8 10 14	3 3 5	14 500 26 500 46 000	57 000 77 000 162 000	6 500 6 500 5 600	54 65 196
35	AXZ 8 35 54	ARZ 11 35 54	ARZ 14 35 69	35 35 35	54 54 69	8 11 14	3 3 5	18 900 33 800 51 000	84 000 94 000 194 000	5 500 5 500 4 900	66 87 246
40	AXZ 8 40 61	ARZ 1240 61	ARZ 17 40 79	40 40 40	61 61 79	8 12 17	3 3 6	20 400 46 000 71 000	96 000 129 000 265 000	5 000 5 000 4 200	84 114 387
45	AXZ 8 45 66	ARZ 12 45 66	ARZ 22 45 86	45 45 45	66 66 86	8 12 22	3 3 8		109 000 143 000 340 000	4 500 4 500 3 800	92 126 595
50	AXZ 8 50 71	ARZ 1250 71	ARZ 22 50 96	50 50 50	71 71 96	8 12 22	3 3 8	51 000	118 000 157 000 430 000	4 000 4 000 3 400	100 137 756
55			ARZ 22 55 106	55	106	22	8	125 000	530 000	3 100	917
60	AXZ 10 60 86	ARZ 1460 86	ARZ 22 60 111	60 60 60	86 86 111	10 14 22	4 4 8	71 000	193 000 255 000 580 000	3 500 3 500 2 900	194 246 977
65			ARZ 22 65 116	65	116	22	8	135 000	620 000	2800	1 040
70	AXZ 10 70 96	ARZ 1470 96		70 70	96 96	10 14	4 4		223 000 295 000	3 000 3 000	220 279
80	AXZ 10 80 106	ARZ 1480 106		80 80	106 106	10 14	4 4		253 000 330 000	2700 2700	256 312



COMBINED BEARINGS













NADELLA combined needle bearings type RAX and derivatives are designed to support simultaneously both a radial and an axial load.

They comprise a needle thrust bearing (or roller thrust bearing) and needle cage retained in a common outer ring.

The technical characteristics of the thrust bearing and the needle cage are set out in the appropriate sections.

These bearings form one integral unit permitting easy storage, handling and fitting. Their high radial and axial load capacities and small space requirement enable cost effective solutions to be achieved.

Calculations for combined bearings are carried out taking the axial component and the radial component separately without transforming the axial load into an equivalent radial load.

The operation of the thrust bearing and the needle cage independent of one another preciudes any interaction harmful to precise axial and radial rotation. Axial expansion of the shaft, for example, will have no effect on the accuracy of the radial component.

The bearings can be used without inner rings or thrust plates, if the shaft journals serving as raceways are of sufficient hardness and possess a suitable surface finish. Hardness of 58–64 HRC will ensure that the full capacity of these bearings is attained. Lower hardness figures will entail a reduction in the static and dynamic capacities (both axial and radial) as shown in the tables of dimensions (see Technical Section).

TYPES OF COMBINED BEARINGS

Standard Series

		With needle t	With roller thrust bearing				
	Thin or	uter ring	Thick o	uter ring	Thick outer ring		
-	open	closed-end	without retained thrust plate	with retained thrust plate	without retained thrust plate	with retained thrust plate	
Bearings	RAX 700	RAXF 700	RAX 400	RAXPZ 400	RAX 500	RAXZ 500	
Separate thrust plates		thick thin	CP thick or thin		CP thick or thin		
	is 1)			Р	IMP		

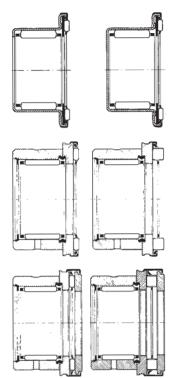
¹⁾ Inner rings with oil hole type IMC on request.





Machine-tool quality

	With needle	thrust bearing	With roller thrust bearing			
	without thrust plate	with retained thrust plate	without thrust plate	with retained thrust plate		
Bearings	RAXN 400	RAXNPZ 400	RAXN 500	RAXNZ 500		
Separate thrust plates	CPN		CPN			
Inner rings		9 000 0 600	IM 2	0 600		



Combined bearings type RAX 700 and RAXF 700

Combined bearings type *RAX 700* possess a one-piece outer ring formed from thin sheet steel accurately controlled and hardened by suitable heat treatment. The shape of this outer ring prevents weakness in the area between the axial component and the radial component, even after the latter has been tightly fitted into a housing.

This type of combined bearing is inexpensive and occupies little space, thus providing a very economical solution. Because they are easy to use and can be fitted rapidly, they are often employed in preference to an arrangement with two separate needle bearings. Closedend combined bearings type *RAXF 700* ensure perfect sealing at the end of a shaft and do not require the use of blind housings or end caps.

Standard combined bearings type RAX 400 and RAX 500

Combined needle bearings type *RAX 400* and *RAX 500* comprise a thrust plate and an outer ring machined separately and joined by a strong metal insert. This arrangement prevents localised stresses and weakness in the area between the two components, thus eliminating the risk of damage during mounting or operation.

Although combined bearings type RAX 700 should be considered first on grounds of economy, combined bearings with thick outer ring type RAX 400 or RAX 500 should be used when operating conditions require higher limit loads or greater rotational accuracy. Moreover, they can be supplied in machine-tool quality type RAXN (see below).

Standard combined bearings type RAXPZ 400 and RAXZ 500

These bearings have an incorporated plate retained by a steel ring set on the thrust plate. They are better protected against the introduction of dust and metal particles and are therefore recommended for spindles of drilling machines, etc.

Machine-tool quality combined bearings types RAXN 400, RAXN 500, and derivatives

The combined bearings in the *RAXN 400* and *RAXN 500* series are manufactured to the same dimensions as the RAX 400 and RAX 500 series in higher precision with respect to out-of- roundness and thickness of the rings and axial run-out of the thrust bearing. These bearings, which are also available with retained thrust plate *RAXNPZ 400* and *RAXNPZ 500*, are particularly recommended for use in drilling machine spindles.

TOLERANCES OF COMBINED BEARINGS

Combined bearings types RAX 700 and RAXF 700

Because types RAX 700 and RAXF 700 have an outer ring formed from thin sheet steel, the radial component of these bearings can only be inspected using a ring-gauge having sufficient thickness to withstand deformation and with a bore ground with great accuracy. The diameters of the ring-gauge and the "GO" and "NO-GO" plug-gauges are identical to those given on pages 26 and 27 in the inspection table for caged needle bushes type DB (without suffix P), having identical inner and outer diameters.

Thickness tolerance of the axial component h: \pm 0.1 mm.



Standard combined bearings type RAX 400, RAX 500 and derivatives

► Radial component

Diameter under the needles Ci: tolerance F6 (ISO Standard 1206).

Width I: -0.1/-0.2 mm

Outer diameter D1 Out-of-roundness Inner rings IM...P

Normal tolerance class according to ISO Standard

1206 (French Standard F 22 370).

► Axial component

Thickness h: +0.05/-0.06 mm

Axial run-out: 0.010 mm

► Thrust plates

Tolerance	Thin thru	st plates	Thick thrust plates
	Bore A ≤ 60 mm	Bore A > 60 mm	mm
Thickness Axial run-out	E±0.030 ¹⁾ 0.020 ¹⁾	$E \pm 0.050^{2)} \\ 0.025^{2)}$	E±0.050 0.005

¹⁾ Under minimum load of 150 N 2) Under minimum load of 250 N

Machine-tool quality combined bearings types RAXN 400, RAXN 500 and derivatives

► Radial component

Diameter under the needles Ci: tolerance F5 (ISO Standard 1206).

Width I: -0.1/-0.2 mm.

Outer diameter D1: Normal tolerance class according to ISO Standard 1206 (French Standard E 22 370).

Out-of-roundness: Precision class 5 according to ISO Recommendation 492 (DIN 620).

Inner rings IM 19 000 and IM 20 600:

inner diameter Di: 0/-0.010 mm outer diameter Ci: 0/-0.005 mm

width L1: 0/-0.130 mm up to Di = 40 mm0/-0.160 mm for Di > 40 mm

out-of-roundness: 0.005 mm.

► Axial component

Thickness h: 0/-0.012 mm Axial run-out: 0.005 mm

► Thrust plates

Thickness E: selected to obtain tolerance h8 on total thickness E + h. Axial run-out: 0.005 mm.

RADIAL PLAY

Combined bearings types RAX 700, RAXF 700

The fit of a combined bearing with thin outer ring in the housing determines, to a large extent, the dimension under the needles and consequently the radial play during operation.

The recommended shaft and housing tolerances give a radial play whose limits 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 bearings, after the latter have been fitted into their housings.

The possible differences in the stiffness of housings and the variations of clamping force resulting from the tolerance build up do not permit NADELLA 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 dimensions under the needles after installation will be within the tolerances given below:

- $+15/+50 \mu m$ up to Ci = 20 mm
- $+20/+60 \mu m Ci = 25 to 40 mm$
- $+20/+65 \mu m Ci = 45 mm.$

The limits of radial play should also take into account the tolerance of the shaft used directly as a raceway or of 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 (or m5), 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 with tolerance h5.

Standard combined bearings type RAX 400, 500 and derivatives

► Bearings without inner ring

The radial play of these bearings when used without inner rings is the difference between the diameter under the needles, which is kept within tolerance F6, and the diameter of the shaft which is machined to the tolerances recommended for dimensions Ci according to the table below.

This type of combined bearing without inner ring can be supplied having a diameter under the needles selected in the lower half of tolerance F6 (suffix TB) or in the upper half (suffix TC).

Nominal dimension	Tolerance of diameter under the needles							
Ci mm	Normal F6 µm	TB µm	TC μm					
Above To								
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					

► Bearings with inner ring

The radial play prior to installation of standard combined bearings with inner ring is in conformance with the normal group of ISO Standard 5753. The closely controlled play provided by this standard can be provided on request (symbol ZS according to table for bearings with cage guided needles).

Machine-tool quality combined bearings types RAXN 400, RAXN 500 and derivatives

► Bearings without inner ring

The radial play prior to installation of machine-tool quality combined bearings results from tolerance F5 on the diameter under the needles and tolerances k5 on the diameter of the shaft.

Nominal dimension Ci mm	Tolerance of diameter under the needles F5 μm
Above To	
6-10	+ 13/+ 19
10-18	+ 16/+ 24
18-30	+ 20/+ 29
30 – 50	+ 25/+ 36
50 – 80	+ 30/+ 43

► Bearings with inner ring

The radial play prior to installation of machine-tool quality combined bearings results from tolerance F5 on the diameter under the needles and tolerance 0/—0.005 mm on the outer diameter Ci of inner ring IM 19 000 or IM 20 600.



SHAFT AND HOUSING TOLERANCES

		SH	AFT		HOUSING			
Combined bearings	for be	nsion Ci earings inner ring	for b	nsion Di earings iner ring	Di Steel or	mension D1 Non-ferrous metal 1) or thin		
	Rotation	Oscillation	Rotation	Oscillation	cast-iron	castings in steel		
RAX, RAXF 700	h5 (h6)	j5 (j6)	k5 (k6)	m5 (m6)	H6 (H7)	M6 (M7)		
RAX, RAXPZ, RAXZ Series 400 to 500	h5	j5	k5	m5	K6	M6		
RAXN, RAXNPZ, RAXNZ, Series 400 to 500	k5	k5	k5	m5	K6	М6		

The cylindrical tolerance defined as the difference in radii of two coaxial cylinders (ISO Standard 1101) should normally be less than a quarter of the manufacturing tolerance. However, for high precision or high speed applications, it is advisable to restrict this tolerance to the one-eighth of the manufacturing tolerance.

 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 outer race of the bearing and suitable adjustments to the fits should be made.

SUPPORTING FACES - RACEWAYS

The bearing shoulder must be a flat face at right angles to the housing axis, otherwise axial precision will be affected and the smooth running characteristics of the thrust bearing will be diminished.

Similarly, the shaft shoulder, on which the needles of the thrust bearing rotate or on which the thrust plate is supported, must be flat and square to the axis.

The deviation from true parallelism between the two supporting faces must be no more than:

- 1 minute for a combined bearing with thrust plate (or approx. 0.3 in 1 000).
- 1 minute 30 seconds for a combined bearing without thrust plate (or approx. 0.45 in 1 000).

In the case of an assembly where neither thrust plate nor inner ring is used, the shaft journal on which the needle rotate must have sufficient hardness, i. e. 58–64 HRC to ensure maximum load capacities are attained.

If the shaft shoulder is used directly as a raceway for the needles of the thrust bearing or, if it supports a thin thrust plate (thickness 0.8 or 1.5 mm), it must be rigid and continuous throughout the area of circulation of the needles bounded by dimensions d1 and d2. A thick thrust plate can be supported on a smaller shaft shoulder or on one that is discontinuous (as in the case of splines), provided the deflection of the plate does not affect the smooth running or required accuracy of the thrust bearing.

INSTALLATION

The bearing must be correctly aligned with the housing. It is wise to use a small press fitted with a mandrel having a supporting face square to the axis and covering the whole area bounded by dimensions d1 and d2. This method prevents the thrust component from undergoing shock load which might damage the bearing. When RAX or RAXF 700 bearings are placed in position during installation care must be taken to ensure that the force exerted by the press does not exceed the axial limit load shown in the table of dimensions.

The fitting of inner rings on shafts manufactured to the recommended tolerances is usually sufficient to render the use of retaining rings unnecessary. However, if it is necessary to employ a ring to support an adjacent pinion, this ring must have an outer diameter slightly smaller than dimension Ci to enable it to pass smoothly into the bearing when the shaft is introduced.

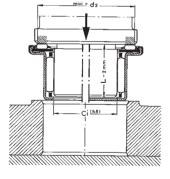


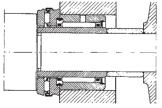
RAX and RAXF 700.

RAX 400 (or 500) and RAXPZ 400 (or RAXZ 500).

RAXN 400 (or 500) and RAXNPZ 400 (or RAXNZ 500): the typical applications for these machine-tool quality combined bearings used without inner ring and with or without thick thrust plate are identical to those for the corresponding standard combined bearings.

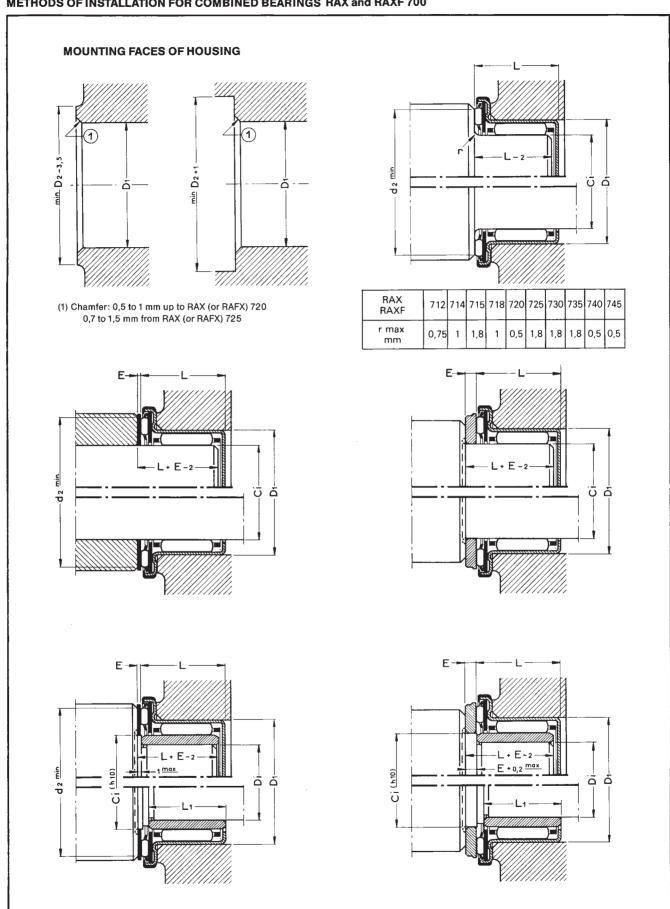
The special inner rings (series 19 000 or 20 600) designed for machine-tool quality combined bearings are of sufficient width to permit centring of the thrust plate and thus eliminate the need for a shaft shoulder (see diagram opposite).





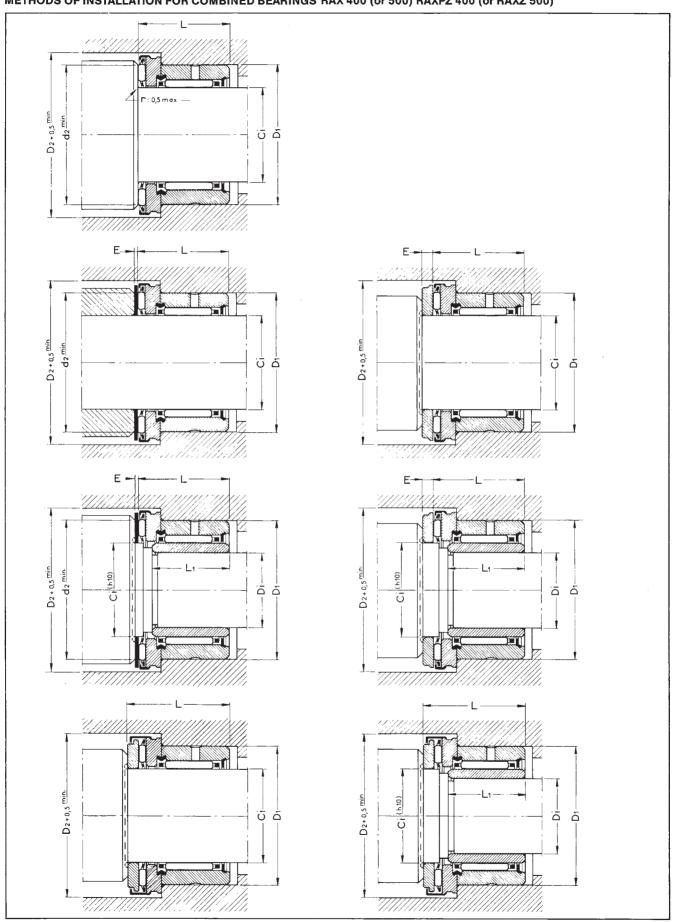


METHODS OF INSTALLATION FOR COMBINED BEARINGS RAX and RAXF 700





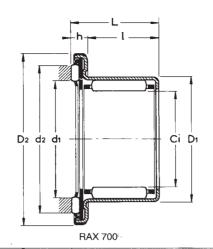
METHODS OF INSTALLATION FOR COMBINED BEARINGS RAX 400 (or 500) RAXPZ 400 (or RAXZ 500)

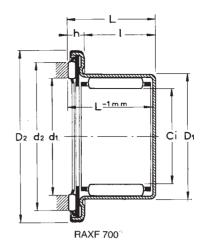




Combined bearings

- open RAX 700 seriesclosed-endRAXF 700 series





Shaft Dia.		nations	Ci	D1	D2 max		H	· L	d1	d2		ight rox. RAXF	-
mm	RAX 700 Series	RAXF 700 Series	mm	mm	mm	mm	mm	mm	mm	mm	g	g	
5	RAX 705			9	15,5	7,7	3,3	11	7,2	11,2	4,5		
12	RAX 712	RAXF 712	12	18	27,5	10	4,2	14,2	15	22,6	16,5	17,5	
14	RAX 714	RAXF 714	14	20	29,5	10	4,2	14,2	17	24,6	18	20	
15	RAX 715	RAXF 715	15	21	31,5	10	4,2	14,2	19	26,6	20	22	
18	RAX 718	RAXF 718	18	24	33,5	14	4,2	18,2	21	28,6	27	30	
20	RAX 720	RAXF 720	20	26	36,5	14	4,2	18,2	22	31,6	31	35	
25	RAX 725	RAXF 725	25	33	45,5	18	4,2	22,2	30	39,6	55	60	
30	RAX 730	RAXF 730	30	38	50,5	18	4,2	22,2	35	44,7	63	70	
35	RAX 735	RAXF 735	35	43	56,5	18	4,2	22,2	39	50,9	75	84	
40	RAX 740	RAXF 740	40	48	61,5	18	4,2	22,2	43	54,9	86	96	
45	RAX 745	RAXF 745	45	52	66,5	18	4,2	22,2	48	59,9	88	99	

Thrust plates and inner rings see pages 142 & 143



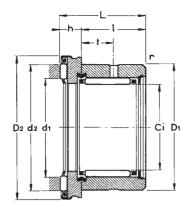
Limit loads: See Technical Section page 11 and calculation examples page 14 to 17.

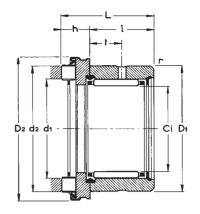
				and calculation e			11.			
Ra			xial	Limit Radial	loads Axial			Bearing signations		
Dyn. Cr N	Stat. Cor N	Dyn. Ca N	Stat. Coa N	N	N	r.p.m.	Series RAX 700	Series RAXF 700		
2 150	1 950	3 150	6 350	740	3 500	25 000	RAX 705			
6 300	7 200	6 900	17 700	2 500	11 000	13 000	RAX 712	RAXF 712		
6 900	8 500	7 400	20 000	2 900	12 500	11 500	RAX 714	RAXF 714		
7 400	9 300	7 800	22 000	3 100	14 000	10 500	RAX 715	RAXF 715		
11 500	17 700	8 000	23 000	5 800	16 000	10 000	RAX 718	RAXF 718		
12 200	19 500	11 800	39 000	6 400	18 000	9 000	RAX 720	RAXF 720		
20 500	32 000	13 700	52 000	10 500	22 000	7 200	RAX 725	RAXF 725		
22 300	37 500	14 900	60 000	12 000	25 000	6 300	RAX 730	RAXF 730		
24 500	45 000	19 400	88 000	14 300	27 000	5 500	RAX 735	RAXF 735		
26 200	51 000	20 400	96 000	16 000	30 000	5 000	RAX 740	RAXF 740		
24 800	55 000	21 800	109 000	17 000	32 000	4 500	RAX 745	RAXF 745		
	Dyn. Cr N 2 150 6 300 6 900 7 400 11 500 12 200 20 500 22 300 24 500 26 200	Radial Dyn. Cr N 2 150 1 950 6 300 7 200 6 900 8 500 7 400 9 300 11 500 17 700 12 200 19 500 20 500 32 000 22 300 37 500 24 500 45 000 26 200 51 000	Dyn. Cr N Stat. Cor N Dyn. Ca N 2 150 1 950 3 150 6 300 7 200 6 900 6 900 8 500 7 400 7 400 9 300 7 800 11 500 17 700 8 000 12 200 19 500 11 800 20 500 32 000 13 700 22 300 37 500 14 900 24 500 45 000 19 400 26 200 51 000 20 400	Radial Axial Dyn. Cr N Stat. Cor N Dyn. Ca N Stat. Coa N 2 150 1 950 3 150 6 350 6 300 7 200 6 900 17 700 6 900 8 500 7 400 20 000 7 400 9 300 7 800 22 000 11 500 17 700 8 000 23 000 12 200 19 500 11 800 39 000 20 500 32 000 13 700 52 000 22 300 37 500 14 900 60 000 24 500 45 000 19 400 88 000 26 200 51 000 20 400 96 000	Basic capacities Axial Limit Radial Dyn. Cr N Stat. Cor N Dyn. Ca N Stat. Coa N N 2 150 1 950 3 150 6 350 740 6 300 7 200 6 900 17 700 2 500 6 900 8 500 7 400 20 000 2 900 7 400 9 300 7 800 22 000 3 100 11 500 17 700 8 000 23 000 5 800 12 200 19 500 11 800 39 000 6 400 20 500 32 000 13 700 52 000 10 500 22 300 37 500 14 900 60 000 12 000 24 500 45 000 19 400 88 000 14 300 26 200 51 000 20 400 96 000 16 000	Basic capacities Axial Dyn. Cr Stat. Cor N Dyn. Ca Stat. Coa N N N	Basic capacities Axial Padial Axial Padial Axial Padial Pad	Basic capacities Radial Limit loads Radial Speed limit Besidesigned Dyn. Cr N Stat. Cor N Dyn. Ca N Stat. Coa N N N N r.p.m. Speed limit Series RAX 700 2 150 1 950 3 150 6 350 740 3 500 25 000 RAX 705 6 300 7 200 6 900 17 700 2 500 11 000 13 000 RAX 712 6 900 8 500 7 400 20 000 2 900 12 500 11 500 RAX 714 7 400 9 300 7 800 22 000 3 100 14 000 10 500 RAX 715 11 500 17 700 8 000 23 000 5 800 16 000 10 000 RAX 718 12 200 19 500 11 800 39 000 6 400 18 000 9 000 RAX 720 20 500 32 000 13 700 52 000 10 500 22 000 7 200 RAX 725 22 300 37 500 14 900 60 000		



Combined bearings

RAX 400, RAX 500 series precision bearings in machine tool quality RAXN 400, RAXN 500 series





RAX 400

RAX 500

				RAX 400		RAX 500					
Shaft Dia.	Desig	nations	Ci	D1	D2 maxi	1	h	L	t .	r mini	
mm	RAX 400 Series	RAX 500 Series	mm	mm	mm	mm	mm	mm	mm	mm	
10	RAX 410	RAX 510	10 10	19 19	22 22	14 14	5 5,5	19 19,5	6 6	0,35 0,35	
12	RAX 412	RAX 512	12 12	21 21	26 26	14 14	5 6	19 20	6 6	0,35 0,35	
15	RAX 415	RAX 515	15 15	24 24	28 28	14 14	5 6	19 20	6 6	0,35 0,35	
17	RAX 417	RAX 517	17 17	26 26	30 30	16 16	5 6	21 22	8 8	0,65 0,65	
20	RAX 420	RAX 520	20 20	30 30	35 35	18 18	6 8	24 26	9	0,85 0,85	_
25	RAX 425	RAX 525	25 25	37 37	42 42	18 18	6 8	24 26	9	0,85 0,85	
30	RAX 430	RAX 530	30 30	42 42	47 47	18 18	6 8	24 26	9	0,85 0,85	_
35	RAX 435	RAX 535	35 35	47 47	53 53,4	18 18	6 9	24 27	9 9	0,85 0,85	
40	RAX 440	RAX 540	40 40	52 52	60 60,4	18 18	6 10	24 28	9	0,85 0,85	_
45	RAX 445	RAX 545	45 45	58 58	65 65,4	18 18	6 10	24 28	9 9	0,85 0,85	_
50	RAX 450	RAX 550	50 50	62 62	70 70,4	21 21	6 10	27 31	11 11	1,3 1,3	
60	RAX 460	RAX 560	60 60	72 72	85 85,4	21 21	7 11	28 32	11 11	1,3 1,3	_
70	RAX 470	RAX 570	70 70	85 85	95 95,4	21 21	7 11	28 32	11 11	1,3 1,3	_

Thrust plates and inner rings for combined bearings RAX 400 & RAX 500 series: see pages 142 & 143, for precision combined bearings in machine tool quality RAXN 400 & RAXN 500 series: see pages 144 & 145.

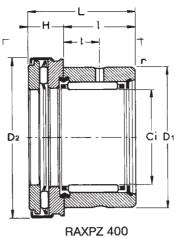


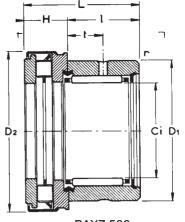
	d1	d2	Ra	Basic ca dial	pacities A	kial	Speed limit	Weight approx.	Bearing designations
	mm	mm	Dyn. Cr N	Stat. Cor	Dyn. Ca N	Stat. Coa N	r.p.m.	g	
	12	18,6	6 100	7 200	5 000	10 900	15 500	25	RAX 410
	12,2	18,5	6 100	7 200	8 200	17 900	15 500	26	RAX 510
	15	22,6	6 600	8 400	7 100	18 500	13 000	32	RAX 412
	14,8	22,9	6 600	8 400	12 700	29 500	13 000	33	RAX 512
	17	24,6	9 400	11 700	7 600	20 800	11 500	34	RAX 415
	16,8	24,9	9 400	11 700	14 000	34 000	11 500	36	RAX 515
	19	26,6	11 800	16 300	8 100	23 000	10 500	41	RAX 417
	18,8	26,9	11 800	16 300	15 000	39 000	10 500	44	RAX 517
	22	31,6	14 700	22 800	11 800	39 000	9 000	66	RAX 420
	22	31,6	14 700	22 800	22 000	54 000	9 000	70	RAX 520
	27,7	37,4	16 000	27 500	13 300	49 000	7 500	99	RAX 425
	27,7	37,4	16 000	27 500	25 500	70 000	7 500	105	RAX 525
_	32,7	42,4	20 500	34 000	14 500	57 000	6 500	111	RAX 430
	32,7	42,3	20 500	34 000	26 500	77 000	6 500	118	RAX 530
	37,2	49	22 000	39 500	18 900	84 000	5 500	130	RAX 435
	37,8	47,8	22 000	39 500	33 800	94 000	5 500	146	RAX 535
_	43	54,9	23 800	45 000	20 400	96 000	5 000	150	RAX 440
	42,8	54,8	23 800	45 000	46 000	129 000	5 000	174	RAX 540
	48	59,9	25 300	51 000	21 800	109 000	4 500	179	RAX 445
	47,8	59,8	25 300	51 000	49 000	143 000	4 500	206	RAX 545
_	53,3	65,7	28 300	61 000	22 500	118 000	4 000	205	RAX 450
	52,8	64,8	23 800	61 000	51 000	157 000	4 000	232	RAX 550
_	63,5	79,2	31 000	72 000	31 500	193 000	3 500	282	RAX 460
	63,5	79,5	31 000	72 000	71 000	255 000	3 500	327	RAX 560
	73,5	89,2	37 500	86 000	34 500	223 000	3 000	386	RAX 470
	73,5	89,5	37 500	86 000	77 000	295 000	3 000	435	RAX 570



Combined bearings with incorporated thrust plate RAXPZ 400 & RAXZ 500

series machine tool quality RAXNPZ 400 & RAXNZ 500 series





(PZ 400	RAXZ 500

				17001 2 400							
Shaft Dia.	Design	ations	Ci	D1	D2 maxi	1	H	L	t	r mini	
mm	RAXPZ 400 Series	RAXZ 500 Series	mm	mm	mm	mm	mm	mm -	mm	mm	
10	RAXPZ 410	RAXZ 510	10 10	19 19	22,4 22,4	14 14	7 7,5	21 21,5	6	0,35 0,35	
12	RAXPZ 412	RAXZ 512	12 12	21 21	26,4 26,4	14 14	7 8	21 22	6 6	0,35 0,35	
15	RAXPZ 415	RAXZ 515	15 15	24 24	28,4 28,4	14 14	7 8	21 22	6 6	0,35 0,35	
17	RAXPZ 417	RAXZ 517	17 17	26 26	30,4 30,4	16 16	7	23 24	8 8	0,65 0,65	
20	RAXPZ 420	RAXZ 520	20 20	30 30	35,4 35,4	18 18	9 11	27 29	9	0,85 0,85	
25	RAXPZ 425	RAXZ 525	25 25	37 37	43 43	18 18	9 11	27 29	9	0,85 0,85	
30	RAXPZ 430	RAXZ 530	30 30	42 42	48 48	18 18	9	27 29	9 9	0,85 0,85	
35	RAXPZ 435	RAXZ 535	35 35	47 47	54 54	18 18	9 12	27 30	9	0,85 0,85	
40	RAXPZ 440	RAXZ 540	40 40	52 52	61 61	18 18	9 13	27 31	9 9	0,85 0,85	
45	RAXPZ 445	RAXZ 545	45 45	58 58	66 66	18 18	9 13	27 31	9	0,85 0,85	
50	RAXPZ 450	RAXZ 550	50 50	62 62	71 71	21 21	9 13	30 34	11 11	1,3 1,3	
60	RAXPZ 460	RAXZ 560	60 60	72 72	86 86	21 21	11 15	32 36	11 11	1,3 1,3	
70	RAXPZ 470	RAXZ 570	70 70	85 85	96 96	21 21	11 15	32 36	11 11	1,3 1,3	

Inner rings for combined bearings RAXPZ 400 & RAXZ 500 series: see page 143, for precision combined bearings in machine tool quality RAXNPZ 400 & RAXNZ 500: see page 145.



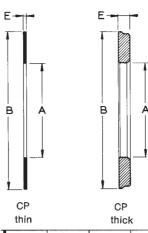
Combined bearings with retained, overthick thrust plate Type RAXTZ 400 Consult our Technical Department for details.

	Ra	Basic ca dial	pacities A	kial	Speed limit	Weight approx.	Bearing designations
	Dyn. Cr N	Stat. Cor N	Dyn. Ca N	Stat. Coa N	r.p.m.	g	
	6 100	7 200	5 000	10 900	15 500	29	RAXPZ 410
	6 100	7 200	8 200	17 900	15 500	31	RAXZ 510
,	6 600	8 400	7 100	18 500	13 000	38	RAXPZ 412
	6 600	8 400	12 700	29 500	13 000	39	RAXZ 512
	9 400	11 700	7 600	20 800	11 500	40	RAXPZ 415
	9 400	11 700	14 000	34 000	11 500	44	RAXZ 515
	11 800	16 300	8 100	23 000	10 500	48	RAXPZ 417
	11 800	16 300	15 000	39 000	10 500	53	RAXZ 517
	14 700	22 800	11 800	39 000	9 000	79	RAXPZ 420
	14 700	22 800	22 000	54 000	9 000	86	RAXZ 520
	16 000	27 500	13 300	49 000	7 500	118	RAXPZ 425
	16 000	27 500	25 500	70 000	7 500	131	RAXZ 525
	20 500	34 000	14 500	57 000	6 500	133	RAXPZ 430
	20 500	34 000	26 500	77 000	6 500	147	RAXZ 530
	22 000	39 500	18 900	84 000	5 500	157	RAXPZ 435
	22 000	39 500	33 800	94 000	5 500	181	RAXZ 535
	23 800	45 000	20 400	96 000	5 000	184	RAXPZ 440
	23 800	45 000	46 000	129 000	5 000	218	RAXZ 540
	25 300	51 000	21 800	109 000	4 500	216	RAXPZ 445
	25 300	51 000	49 000	143 000	4 500	255	RAXZ 545
	28 300	61 000	22 500	118 000	4 000	245	RAXPZ 450
	28 300	61 000	51 000	157 000	4 000	287	RAXZ 550
_	31 000	72 000	31 500	193 000	3 500	365	RAXPZ 460
	31 000	72 000	71 000	255 000	3 500	423	RAXZ 560
	37 500	86 000	34 500	223 000	3 000	479	RAXPZ 470
	37 500	86 000	77 000	295 000	3 000	545	RAXZ 570



Thrust plates for standard combined

bearings
CP thin and thick series
thrust plates for precision
bearings in machine tool
quality: see page 126.

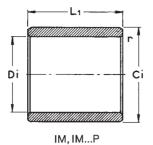


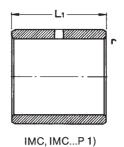
Bore Dia.	Desigr	nations	A nom	B max	Е	Weight approx.		combined bear	ings
mm	CP Thin Series	CP Thick Series	mm	mm	mm	g	RAX 700 RAXF 700	RAX 500	
10	CP 10 22	CP 2 10 22	10 10	21,5 21,5	0,8 2	1,7 4,3		RAX 410	RAX 510
12	CP 12 26	CP 2 12 26	12 12	25,5 25,5	0,8 2	2,5 6,2	RAX, RAXF 712	RAX 412	RAX 512
14	CP 14 26	CP 2 14 26	14 14	25,5 25,5	0,8 2	2,3 5,6	RAX, RAXF 714		
15	CP 15 28	CP 2 15 28	15 15	27,5 27,5	0,8 2	2,8 6	RAX, RAXF 715	RAX 415	RAX 515
17	CP 17 30	CP 2 17 30	17 17	29,5 29,5	0,8 2	2,5 7		RAX 417	RAX 517
18	CP 18 30	CP 2 18 30	18 18	29,5 29,5	0,8 2	2,3 5,7	RAX, RAXF 718		
20	CP 20 35	CP 3 20 35	20 20	34,5 34,5	0,8	3,8 13	RAX, RAXF 720	RAX 420	RAX 520
25	CP 25 42	CP 3 25 42	25 25	41,5 41,5	0,8 3	5,3 19	RAX, RAXF 725	RAX 425	RAX 525
30	CP 30 47	CP 3 30 47	30 30	46,5 46,5	0,8 3	6 22	RAX, RAXF 730	RAX 430	RAX 530
35	CP 35 52	CP 3 35 52	35 35	51,5 51,5	0,8 3	7 26	RAX, RAXF 735	RAX 435	RAX 535
40	CP 40 60	CP 3 40 60	40 40	59,5 59,5	0,8 3	9,3 34	RAX, RAXF 740	RAX 440	RAX 540
45	CP 45 65	CP 3 45 65	45 45	64,4 64,4	0,8 3	10 37	RAX, RAXF 745	RAX 445	RAX 545
50	CP 50 70	CP 3 50 70	50 50	69,4 69,4	0,8 3	11 40		RAX 450	RAX 550
60	CP 60 85	CP 4 60 85	60 60	84,3 84,3	0,8 4	17 83		RAX 460	RAX 560
70	CP 1,5 70 95	CP 4 70 95	70 70	94,3 94,3	1,5 4	32 93		RAX 470	RAX 570



Inner rings for standard combined bearings

bearings
IM and IM...P series
inner rings for precision
bearings in machine tool
quality: see page 127.



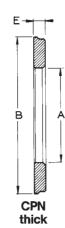


1) Inner rings with lubrication hole, type IMC & IMC...P available on request

Shaft Dia.	Desigr	nations	Di nom.	Ci maxi	L1	r	Weight approx.	For	combined bea	rings
Dia.	IM Series	IMP Series	nom.	IIIaai			αρρίολ.	RAX 700 RAXF 700	RAX 400 RAXPZ 400	RAX 500 RAXZ 500
mm			mm	mm	mm	mm	g	Nr.	Nr.	Nr.
7		IM 7 10 16 P	7	10	16	0,2	4,8		410	510
8	IM 8 12 12,4		8	12	12,4	0,3	5,8	712		
9		IM 9 12 16 P	9	12	16	0,2	5,9		412	512
10	IM 10 14 12,4		10	14	12,4	0,3	7	714		
12	IM 12 15 12,4	IM 15 12 16 P	12 12	15 15	12,4 16	0,2 0,2	5,8 7,6	715	415	515
13	IM 13 18 16,4		13	18	16,4	0,35	15	718		
14		IM 14 17 17 P	14	17	17	0,2	9,3		417	517
15	IM 15 20 16,4	IM 15 20 20 P	15 15	20 20	16,4 20	0,35 0,35	17 20,5	720	420	520
20	IM 20 25 20,4	IM 20 25 20 P	20 20	25 25	20 20,4	0,35 0,35	26,5 27	725	425	525
25	IM 25 30 20,4	IM 25 30 20 P	25 25	30 30	20 20,4	0,35 0,35	32 33	730	430	530
30	IM 30 35 20,4	IM 30 35 20 P	30 30	35 35	20 20,4	0,35 0,35	38 39	735	435	535
35	IM 35 40 20,4	IM 35 40 20 P	35 35	40 40	20 20,4	0,35 0,35	44 45	740	440	540
40	IM 40 45 20,4	IM 40 45 20 P	40 40	45 45	20 20,4	0,35 0,35	50 51	745	445	545
45		IM 45 50 25 P	45	50	25	0,65	69		450	550
55		IM 55 60 25 P	55	60	25	0,65	84		460	560
60		IM 60 70 25 P	60	70	25	0,85	190		470	570
62		IM 62 70 25 P	62	70	25	0,85	155			_



Thrust plates for precision combined bearings in machine tool quality CPN series

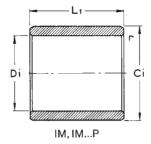


Cer	ntred	Design	nations	А	В	E	Weight
On shaft	On inner ring		Supplementary CPN Series	nom	max		approx.
Dia.	Ci	CPN Series	CPN Series	N.			
mm	mm			mm	mm	mm	g
40		CPN 2 10 22		10	21,5	2	4,3
10			CPN 2,510 22 CPN 4 10 22	10 10	21,7 21,7	2,5 4	5 9
		ODN 0 40 00	0111 1 10 22				
12	!	CPN 2 12 26	CPN 3 12 26	12 12	25,5 25,7	2 3	6,2 9,5
			CPN 4 12 26	12	25,7	4	12
		CPN 2 15 28		15	27,5	2	6
15			CPN 4 15 28 CPN 7 15 28	15 15	27,7 27,7	4 7	13 24
		0701 0 47 00	0111 7 10 20				
17		CPN 2 17 30	CPN 4 17 30	17 17	29,5 29,7	2 4	7 14
"			CPN 7 17 30	17	29,7	7	25
	20	CPN 3 20 35		20	34,5	3	13
	20		CPN 5 20 35	20	34,7	5	24
	25	CPN 3 25 42	0711 - 07 40	25	41,5	3	19
	25		CPN 5 25 42	25	41,77	5	33
:	30	CPN 3 30 47	CPN 5 30 47	30 30	46,5 46,7	3 5	22 37
			CFN 5 30 47		,	_	-
	35	CPN 3 35 52	CPN 4 35 52	35 35	51,5 52	3 4	26 34
	40	ODN 0. 40. C0	0111 1 00 02		_		34
	40	CPN 3 40 60		40	59,5	3	
	45	CPN 3 45 65		45	64,4	3	37
	50	CPN 2 50 70		50	69,4	3	40
	60	CPN 4 60 85		60	84,3	4	83
	70	CPN 4 70 95		70	94,3	4	93



Inner rings for precision combined bearings in machine tool quality

IM 19 000 & IM 20 600 series

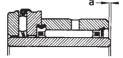


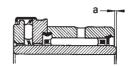
r $\begin{cases} 0.2 \text{ for Di} = 17 \\ 0.5 \text{ for Di} > 17 \end{cases}$

Shaft Dia.	·	Designations	Di	Ci	L1	Weight approx.
mm	IM 19 000 Series	IM 20 600 Series	mm	mm	mm	g
17	IM 19 017	IM 20 617	17 17	20 20	27,5 31,5	19 21
20	IM 19 020	IM 20 620	20 20	25 25	27,5 31,5	38 44
25	IM 19 025	IM 20 625	25 25	30 30	27,5 31,5	42 48
30	IM 19 030	IM 20 630	30 30	35 35	27,5 31,5	55 63
35	IM 19 035	IM 20 635	35 35	40 40	27,5 31,5	63 72
40	IM 19 040	IM 20 640	40 40	45 45	27,5 31,5	69 80
45	IM 19 045	IM 20 645	45 45	50 50	30,5 34,5	85 96
50	IM 19 050	IM 20 650	50 50	60 60	32,5 38,5	208 250
60	IM 19 060	IM 20 660	60 60	70 70	32,5 39,5	247 300

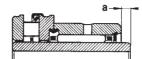


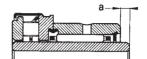
Bearing assemblies combined bearings thrust plates inner rings • machine tool quality





For combined bearings with retained, over-thick thrust plate, Type RAXNTZ 400, use only the IM rings of the 20 000 series.





Combined bearings and separate thrust plates	Combined bearings with retained thrust plate	Inner rings	а
tili ust plates	unusi piate		mm
RAXN 420 + CPN 3 20 35	RAXNPZ 420	IM 19 017 IM 20 617	0,5 4,5
RAXN 420 + CPN 5 20 35		IM 20 617	2,5
RAXN 520 + CPN 3 20 35 RAXN 520 + CPN 5 20 35	RAXNZ 520	IM 20 617 IM 20 617	2,5 0,5
RAXN 425 + CPN 3 25 42	RAXNPZ 425	IM 19 020 IM 20 620	0,5 4,5
RAXN 425 + CPN 5 25 42		IM 20 620	2,5
RAXN 525 + CPN 3 25 42 RAXN 525 + CPN 5 25 42	RAXNZ 525	IM 20 620 IM 20 620	2,5 0,5
RAXN 430 + CPN 3 30 47	RAXNPZ 430	IM 19 025 IM 20 625	0,5 4,5
RAXN 430 + CPN 5 30 47		IM 20 625	2,5
RAXN 530 + CPN 3 30 47 RAXN 530 + CPN 5 30 47	RAXNZ 530	IM 20 625 IM 20 625	2,5 0,5
RAXN 435 + CPN 3 35 52	RAXNPZ 435	IM 19 030 IM 20 630	0,5 4,5
RAXN 435 + CPN 4 35 52		IM 20 630	3,5
RAXN 535 + CPN 3 35 52 RAXN 535 + CPN 4 35 52	RAXNZ 535	IM 20 630 IM 20 630	1,5 0,5
RAXN 440 + CPN 3 40 60	RAXNPZ 440	IM 19 035 IM 20 635	0,5 4,5
RAXN 540 + CPN 3 40 60	RAXNZ 540	IM 20 635	0,5
RAXN 445 + CPN 3 45 65	RAXNPZ 445	IM 19 040 IM 20 640	0,5 4,5
RAXN 545 + CPN 3 45 65	RAXNZ 545	IM 20 640	0,5
RAXN 450 + CPN 3 50 70	RAXNPZ 450	IM 19 045 IM 20 645	0,4 4,5
RAXN 550 + CPN 3 50 70	RAXNZ 550	IM 20 645	0,5
RAXN 460 + CPN 4 60 85	RAXNPZ 460	IM 19 050 IM 20 650	0,5 6,5
RAXN 560 + CPN 4 60 85	RAXNZ 560	IM 20 650	2,5
RAXN 470 + CPN 4 70 95	RAXNPZ 470	IM 19 060 IM 20 660	0,5 7,5
RAXN 570 + CPN 4 70 95	RAXNZ 570	IM 20 660	3,5



PRECISION COMBINED BEARINGS, WITH ADJUSTABLE AXIAL PRELOAD.





Types AXNA, AXNB and ARNB combined bearings and their derivatives consist of a needle bearing with or without a cage, in an outer race, with a high radial thickness, each face of which acts as a raceway for a needle or roller thrust bearing. The inner ring, secured laterally between the thrust plates, acts as the inner radial raceway.

These bearings which take up very little space, are particularly recommended for shafts requiring very precise axial positioning, operating under load, such as leading spindles, ball-screws for numerically-controlled machine tools, drive shafts on control apparatus, etc.

SERIES TYP	E						
	With	Radial	Thrust bearing				
	attachment holes	caged bearing	needle	roller			
AXNA			•				
AXNAT	•		•				
AXNB		•	•				
AXNBT	•	•	•				
ARNB		•		•			
ARNBT	•	•		•			

SELECTION OF BEARING TYPE

Subject to calculations made for each application, the following general classifications can be made:

AXNA, AXNAT and AXNB, AXNBT bearings for slow speed assemblies with low operating loads: the particularly high axial rigidity of needle thrust bearings, together with the advantages of preloading, ensure a very high axial precision and satisfactory working life.

For example: displacement drive shafts on control apparatus.

ARNB and ARNBT, series 1 and 2 bearings generally enable preloading to be chosen which suit the precision and working life required of production machine tools.

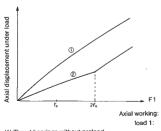
ARNB series 3 bearings for machine tools, machining units or special equipment requiring very high axial rigidity with high loads and slow speeds.

PRELOAD

This technique consists in subjecting the thrust bearings to controlled preload during assembly, using an adjusting nut, in order to eliminate play and reduce the axial displacement caused by the operating stress regardless of the direction or the axial load.

NADELLA has always made the inner ring slightly longer than the space between the thrust plates before adjustment. This means that when the nut is tightened, the inner ring is compressed between the thrust plates and exerts a stress, by reaction, on the internal thread of the screw. This prevents it from being loosened and loss of adjustment occurring.

In an assembly with an axial preload of Fo, an operating stress F1 overloads one of the thrust bearings and frees the other of a load approximately equal to F1/2. In an assembly without preload, the loaded thrust bearing must carry the entire stress F1.



Thrust bearings without preload.
 Thrust bearings under a preload Fo





In a preloaded assembly, the axial rigidity is therefore approximately twice that of an assembly without preload. This result is obtained as long as the operating stress F1 remains less than about twice the preload stress Fo. When F1 > 2 Fo, one of the thrust bearings is total freed and the other thrust bearing completely carries the load F1; in this case, the axial runout remains less than it would have been for an assembly without preload (see figure).

DETERMINING OF PRELOAD

Preload should be determined according to the axial precision required under maximum load and the working life required.

The working life of the thrust bearing carrying the greater load depends on the resulting stress applied, i.e. Fo + F1/2 when F1 < 2 Fo or when F1 > 2 Fo. Since these two cases can both occur on the same machine according to the type of machining carried out, the calculations must take into account the running time ratios under the various loads and speeds.

For more usual assemblies, a preload stress Fo of 5 to 10% of the dynamical load carrying capacity C of the thrust bearing, is usually suitable.

For certain applications, with slow rotating speeds, for example, the preload stress can be increased to allow for a higher operating load while remaining within the limit of the preload effect, and achieving a satisfactory working life.

ADJUSTMENT OF PRELOAD

For a given assembly, the shaft torque is defined first, which corresponds to the preload required. Series adjustments can then be made on each machine by simply checking the torque. If, as a result of assembly, this is not possible, the nut tightening torque needed to obtain preload is determined separately on the test assemblies. The torque must then be respected for series adjustments. The torque must be measured after starting up the thrust bearing, since it can be up to 50% higher at the beginning of rotation.

BEARING TOLERANCES

The outer and inner rings of the combined bearings are manufactured with class 5 tolerances according to ISO Standard 492 (class P6 of standard DIN 620).

The radial play before assembly is kept within the limits of group 2 given for inner and outer paired rings according to ISO Standard 5753 (class C2 "paired rings" of standard DIN 620). See table page 45 (play C2ZS).

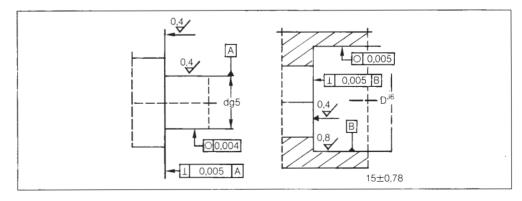
The axial run-out of the thrust bearing plates is in accordance with tolerance class 4 according to ISO Standard 199 (class P4 of standard DIN 620).

ASSEMBLY RECOMMENDATIONS

Shaft tolerance: g5 on dimension Di.

Tolerance of outer ring housing: J6 on dimension De.

The bearing parts of the thrust bearings must be rigid, with plane faces, perpendicular to the rotation axis and of very good surface quality to avoid caulking during use as this decreases the preloading. Their outside diameter must be at least equal to the average diameter of the race, dimension Dm.





The outer ring of the combined bearings should be blocked against a shoulder in order to avoid any axial displacement under load.

In type AXNA, AXNB and ARNB bearings, they are usually blocked by a spacer positioned lengthways during assembly. A flange attached by screws to the frame is located against the spacer.

The outer ring of type AXNAT, AXNBT and ARNBT bearings has three attachment screw holes for direct attachment to the frame.

Apart from watertight bearings (AXNBT.../2 or ARNBT.../2) or the use of long plates (AXNB (T).../1 or ARNB (T).../1), friction of joints on the outside diameter of the thrust bearing plates (dimension A) can be envisaged. In this case, please consult us for positioning.

NADELLA's technical services will supply any further information concerning the choice or assembly of these bearings, on request, together with calculation and adjustment of the axial preload.

LUBRICATION

The oil used to lubricate the other parts of the assembly is generally suitable for combined bearings whose outer ring has three 120° holes connected by a groove. Grease can generally be used if the rotating speed is in the order of 50% of the maximum speeds given in the dimensional tables. However, special top quality greases enable higher speeds to be reached. By way of information, oils with viscosities of 30 to 150 cSt are recommended.

EXAMPLES OF CALCULATIONS

Choice of bearing

P: stress under which precision is needed.

P < 2 x Preloading.

In this field of preloading, the axial rigidity is equal to 2K.

The interference is
$$\frac{1}{2K}$$
 P

Example: If P = 7000 N, ARNB 50 90 will be chosen, since the preloading value is 3800 N and

 $2 \times 3800 = 7600 \text{ N} > \text{P}.$

Rigidity in this field $k = 2 K = 3900 N/\mu m$.

Under P, the interference will be

$$\frac{1}{3900}$$
 x 7000 = 1,79 µm.

► Working life

The hypotheses given in the table below enable the equivalent speed and an equivalent load to be determined according to the maximum load and maximum speed, which enables a rapid calculation of the theoretical working life to be made under average operating conditions.

	1	2	3	4
Loads	Pmax	0,8 x Pmax	0,5 x Pmax	0,2 x Pmax
Speeds	0,05 x Vmax	0,2 x Vmax	0,5 x Vmax	Vmax
Fraction of time	0,15	0,40	0,30	0,15

► Calculation of equivalent speed:

$$V_{\text{eq.}} = (0.15 \times 0.05 + 0.40 \times 0.2 + 0.30 \times 0.5 + 0.15) V_{\text{max}} \approx 0.39 \times V_{\text{max}}$$

Calculation of equivalent load:

$$P_{\text{eq}} \approx \sqrt{\frac{P_{\text{max}}^{P} \times n_{\text{max}} (0,0075 + 0,08 \times 0,8^{P} + 0,15 \times 0,5^{P} + 0,15 \times 0,2^{P})}{0,39 \times V_{\text{max}}}}$$

$$P_{\text{\'eq}} \approx 0,575 \text{ x } P_{\text{max}}$$

$$p = 10/3$$



This comparative method can be used for traverse mechanisms on conventional machine tools.

For special machines and control apparatus, the breakdown of loads and speeds can be different and the formula must be applied with caution.

Note: in this rapid calculation, preload is not taken into consideration; its influence on the working life of the bearings is actually very low for most applications if the adjustment conditions given in the literature are respected: preload between 5 and 10% of the dynamic capacity of the thrust bearings.

Example: for a maximum load P of 14 000 N and a maximum speed of 1000 r.p.m.

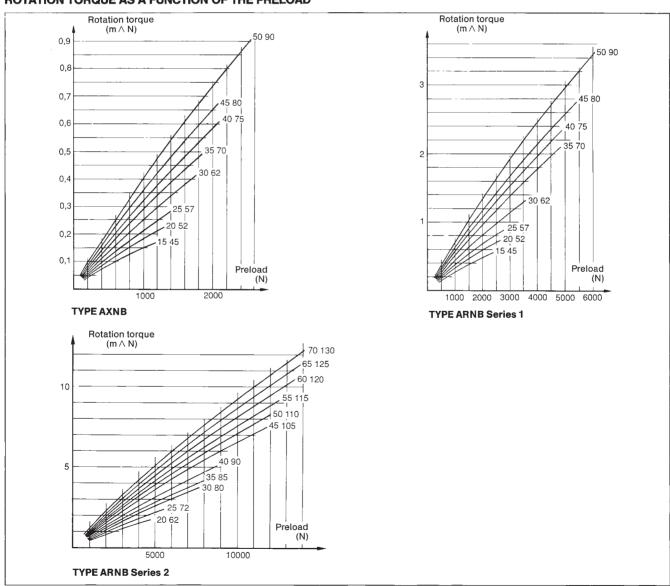
Equivalent speed: $0.39 \times 1000 = 390 \text{ r.p.m.}$ Equivalent load: $0.575 \times 14000 = 8050 \text{ N.}$

Theoretical working life of ARNB 50 90:

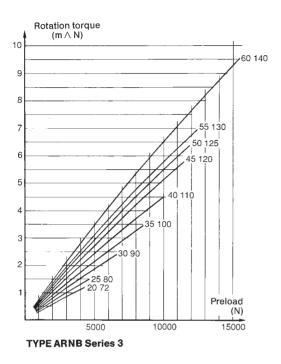
$$\frac{\left(\frac{C}{P}\right)^{\frac{10}{3}} \times 10^6}{60n} = \frac{\left(\frac{60.000}{8050}\right)^{\frac{10}{3}} \times 10^6}{60 \times 390} = 34\,600 \text{ hours}$$

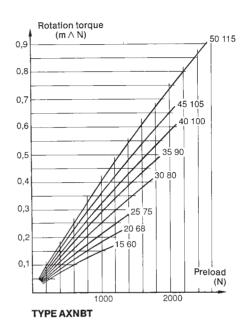
In this example, it is assumed that the time fraction n^{o} 2 is a time fraction when precision machining is not required.

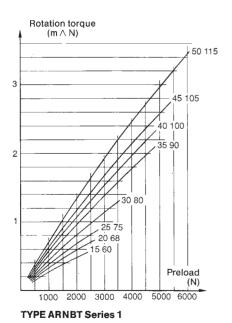
ROTATION TORQUE AS A FUNCTION OF THE PRELOAD

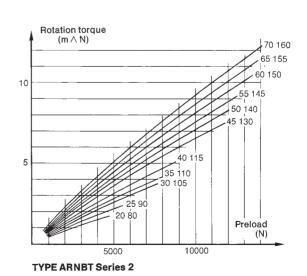








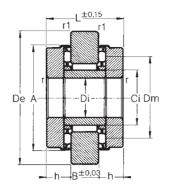






Precision combined bearings with adjustable axial preload.

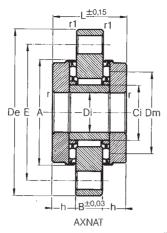
AXNA and **AXNAT** series



AXNA

Sha	ft Desig	gnation		Dimensions in mm							Attachment						
ø mm	# 1 × 1	AXNAT	Di	De	Ci	Α	Dm	L	В	h	r mini	r1 mini	CHC screw grade (M)	N ^o of screws	E mm	Torque Nm	
5	5 22	5 32	5 5	22 32	7,3 7,3	17 17	12,5 12,5	12 12	4 4	4 4	0,35 0,35	0,35 0,35	3 x 10	4	24	1,4	
6	6 28	6 38	6 6	28 38	8,7 8,7	22 22	15,3 15,3	16 16	6	5 5		0,35 0,35	4 x 12	4	30	3	
7	7 32	742	7 7	32 42	11,1 11,1	26 26	18,8 18,8	18 18	6 6	6 6		0,35 0,35	4 x 12	6	34	3	
8	8 32	8 42	8 8	32 42	11,1 11,1	26 26	18,8 18,8	18 18	6 6	6 6		0,35 0,35	4 x 12	6	34	3	
9	9 35	9 45	9 9	35 45	12,8 12,8	28 28	20,8 20,8	20 20	8	6	0,35 0,35	0,35 0,35	4 x 16	6	37	3	
10	10 37	10 48	10 10	37 48	14,1 14,1	30 30	22,8 22,8	22 22	8	7 7	0,35 0,35	0,35 0,35	5 x 16	6	39	6	
12	12 40	12 50	12 12	40 50	16,6 16,6	32 32	24,8 24,8	22 22	8	7 7	0,35 0,35	0,35 0,35	5 x 16	6	41	6	





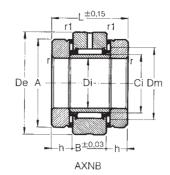
rac		oads (N)	ial	Maximum speed	Preload 1)	Residual torque 2)	Rigidity K 3)	Threading (M)	Bearing reference
Dyn. Cr	Stat. Cor	Dyn. Ca	Stat. Coa	r.p.m.	N	Nmm	N/µm	(M)	
2 350	2 650	4 000	9 400	19 000	252	55	32	5 x 0,8	AXNA 5 22
2 350	2 650	4 000	9 400	19 000	252	55	32	5 x 0,8	AXNAT 5 32
4 900	5 800	7 200	17 500	15 500	340	70	50	6 x 1	AXNA 628
4 900	5 800	7 200	17 500	15 500	340	70	50	6 x 1	AXNAT 638
5 800	7 400	7 900	21 000	13 000	469	130	100	7 x 1	AXNA 7 32
5 800	7 400	7 900	21 000	13 000	469	130	100	7 x 1	AXNAT 7 42
5 800	7 400	7 900	21 000	13 000	469	130	100	8 x 1	AXNA 832
5 800	7 400	7 900	21 000	13 000	469	130	100	8 x 1	AXNAT 842
9 000	11 900	8 500	23 800	11 500	497	190	116	9 x 1	AXNA 935
9 000	11 900	8 500	23 800	11 500	497	1 90	116	9 x 1	AXNAT 945
9 700	13 100	9 000	26 500	10 500	525	180	119	10 x 1	AXNA 10 37
9 700	13 100	9 000	26 500	10 500	525	180	119	10 x 1	AXNAT 10 48
10 900	15 500	9 200	27 800	10 000	532	220	120	12 x 1,5	AXNA 12 40
10 900	15 500	9 200	27 800	10 000	532	220	120	12 x 1,5	AXNAT 12 50



 ^{6% ≈} of basic dynamic axial load.
 With axial load equal to preload.
 Rigidity of a single thrust bearing with load equal to preload.

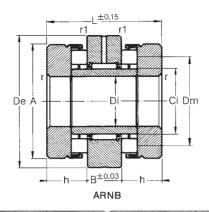
Precision combined bearings with adjustable axial preload

AXNB and **ARNB** series



Shaft Ø	. 10 194411	Desig	nation					Di	mensio	ns in r	nm			:-	
mm	AXNB	ARNB Series 1	ARNB Series 2	ARNB Series 3	Di	De	Ci	A	Dm	L	В	h	r mini.	r1 mini.	
15	15 45	15 45			15 15	45 45	20 20	35 35	26,8 26,8	40 46	16 16	12 15	0,85 0,85	0,85 0,85	
20	20 52	20 52	20 62	20 72	20 20 20 20 20	52 52 62 72	25 25 30 30	42 42 52 60	32,5 32,5 39,9 43,5	40 46 60 60	16 16 20 20	12 15 20 20	0,85 0,85 1,3 1,3	0,85 0,85 0,85 0,85	_
25	25 57	25 57	25 72	25 80	25 25 25 25 25	57 57 72 80	30 30 35 35	47 47 62 68	37,5 37,5 46,7 49,8	44 50 60 60	20 20 20 20	12 15 20 20	0,85 0,85 1,3 1,3	0,85 0,85 0,85 0,85	_
30	30 62	30 62	30 80	30 90	30 30 30 30	62 62 80 90	35 35 40 40	53 53,4 68 78	43,1 42,8 52,7 57	44 50 66 66	20 20 20 20	12 15 23 23	0,85 0,85 1,3 1,3	0,85 0,85 0,85 0,85	
35	35 70	35 70	35 85	35 100	35 35 35 35	70 70 85 100	40 40 45 45	60 60,4 73 85	48,9 48,8 57,7 63	48 54 66 66	20 20 20 20	14 17 23 23	1,3 1,3 1,3 1,3	0,85 0,85 0,85 0,85	_
40	40 75	40 75	40 90	40 110	40 40 40 40	75 75 90 110	45 45 50 50	65 65,4 78 95	53,9 53,8 62,7 70	48 54 75 75	20 20 25 25	14 17 25 25	1,3 1,3 1,3 1,3	0,85 0,85 0,85 0,85	_
45	45 80	45 80	45 105	45 120	45 45 45 45	80 80 105 120	50 50 55 55	70 70,4 90 105	59,5 58,8 70,9 78,2	54 60 82 82	25 25 25 25 25	14,5 17,5 28,5 28,5	1,3 1,3 1,3 1,3	0,85 0,85 0,85 0,85	_
50	50 90	50 90	50 110	50 125	50 50 50 50	90 90 110 125	55 55 60 60	78 78,4 95 110	65,5 65,5 75,9 83,2	54 60 82 82	25 25 25 25 25	14,5 17,5 28,5 28,5	1,3 1,3 1,75 1,75	0,85 0,85 0,85 0,85	
55			55 115	55 130	55 55	115 130	65 65	100 115	80,9 88,2	82 82	25 25	28,5 28,5	1,75 1,75	0,85 0,85	_
60			60 120	60 140	60 60	120 140	70 70	105 125	85,9 96	82 82	25 25	28,5 28,5	1,75 1,75	0,85 0,85	
65			65 125		65	125	75	110	90,9	82	25	28,5	1,75	0,85	
70			70 130		70	130	80	115	95,9	82	25	28,5	1,75	0,85	
75		-	75 155		75	155	90	135	109,9		30	35	1,75	0,85	<u> </u>
90			90 180		90	180	110	160	132,9	110	35	37,5	1,75	0,85	





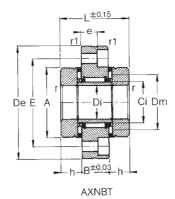
	Basic Id	ads (N)		Maximum	Preload	Residual	Rigidity K	Mass	Bearing reference
rac	dial	ax	ial	speed	1)	torque 2)	3)		reference
Dyn. Cr	Stat. Cor	Dyn. Ca	Stat. Coa	r.p.m.	N	Nmm	N/µm	g	
 16 200	22 000	12 000	40 000	9 000	735	120	1 250	296	AXNB 15 45
16 200	22 000	20 500	49 000	9 000	1 340	350	780	316	ARNB 15 45
18 900	28 800	13 500	50 000	7 500	820	160	1 480	392	AXNB 20 52
18 900	28 800	23 500	63 000	7 500	1 550	500	950	418	ARNB 20 52
28 000	44 500	48 000	115 000	6 300	3 010	1 200	1 130	875	ARNB 20 62
28 000	44 500	42 500	148 000	5 600	2 765	800	1 700	1 300	ARNB 20 72
 28 000	44 500	14 800	58 500	6 500	880	200	1 780	515	AXNB 25 57
28 000	44 500	24 800	70 000	6 500	1 620	550	1 090	543	ARNB 25 57
30 500	53 000	66 000	165 000	5 300	4 130	1 900	1 270	1 180	ARNB 25 72
30 500	53 000	48 000	179 000	4 900	3 060	1 000	1 900	1 565	ARNB 25 80
30 500	53 000	19 000	85 000	5 500	1 130	300	1 880	585	AXNB 30 62
30 500	53 000	32 000	88 000	5 500	2 100	850	1 070	620	ARNB 30 62
32 500	59 000	83 000	210 000	4 800	5 040	2 600	1 450	1 520	ARNB 30 80
32 500	59 000	68 000	250 000	4 200	4 340	1 600	2 300	2 145	ARNB 30 90
32 500	59 000	20 500	97 000	5 000	1 210	350	2 250	787	AXNB 35 70
32 500	59 000	45 000	124 000	5 000	2 910	1 350	1 300	815	ARNB 35 70
34 500	67 000	86 000	228 000	4 300	5 250	2 900	1 520	1 642	ARNB 35 85
34 500	67 000	90 000	328 000	3 800	5 770	2 400	2 500	2 535	ARNB 35 100
34 500	67 000	22 000	110 000	4 500	1 300	400	2 630	860	AXNB 40 75
34 500	67 000	47 500	138 000	4 500	3 070	1 550	1 470	908	ARNB 40 75
44 000	95 000	93 000	260 000	4 000	5 740	3 500	1 620	2 110	ARNB 40 90
44 000	95 000	106 000	420 000	3 400	6 750	3 200	3 000	3 570	ARNB 40 110
44 000	95 000	22 700	119 000	4 000	1 340	450	2 980	1 100	AXNB 45 80
44 000	95 000	50 000	150 000	4 000	3 230	1 750	1 480	1 232	ARNB 45 80
44 000	98 000	127 000	345 000	3 600	7 770	5 300	1 930	3 060	ARNB 45 105
44 000	98 000	122 000	520 000	3 100	7 700	4 100	3 400	4 700	ARNB 45 120
44 000	98 000	28 500	164 000	3 800	1 680	650	3 500	1 385	AXNB 50 90
44 000	98 000	60 000	197 000	3 800	3 800	2 350	1 950	1 440	ARNB 50 90
48 000	113 000	131 000	370 000	3 300	8 120	5 900	2 020	3 320	ARNB 50 110
48 000	113 000	128 000	560 000	2 900	8 050	4 600	3 450	4 945	ARNB 50 125
53 500	119 000	135 000	395 000	3 100	8 400	6 500	2 170	3 535	ARNB 55 115
53 500	119 000	134 000	610 000	2 800	8 330	4 900	3 750	5 256	ARNB 55 130
56 000	128 000	147 000	445 000	2 900	9 100	7 500	2 500	3 717	ARNB 60 120
56 000	128 000	174 000	710 000	2 600	10 640	6 800	4 100	5 976	ARNB 60 140
64 000	143 000	150 000	470 000	2 800	9 310	8 100	2 550	3 960	ARNB 65 125
 73 000	148 000	155 000	495 000	2 600	9 520	8 800	2 720	4 136	ARNB 70 130
77 000	165 000	230 000	730 000	2 300	14 140	14 800	3 050	7 700	ARNB 75 155
 118 000	268 000	288 00	990 000	1 900	17 640	22 200	3 700	11 654	

^{1) 6% ≈} of basic dynamic axial load.
2) With axial load equal to preload.
3) Rigidity of a single thrust bearing with load equal to preload.



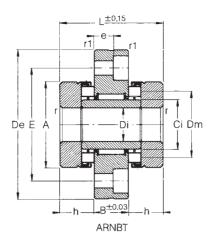
Precision combined bearings with adjustable axial preload

AXNBT and ARNBT series



Shaft		esignatio					Dim	ensio	ne in	mm					Δtta	chme	nt		
Ø	AXNBT	ARNBT	ARNBT Series 2	Di	De	Ci	A	Dm	L	В	h	r mini	r1 mini	CHC screw	N° of	E	e	Torque	
mm														grade (M)	screws	mm	mm	Nm	
15	15 60	15 60		15 15	60 60	20 20	35 35	26,8 26,8	40 46	16 16	12 15	0,85 0,85	0,85 0,85	6 x 20 6 x 20	6 6	46 46	9	10 10	
20	20 68	20 68	20 80	20 20 20	68 68 80	25 25 30	42 42 52	32,5 32,5 39,9	40 46 60	16 16 20	12 15 20	0,85 0,85 1,30	0,85 0,85 0,85	6 x 20 6 x 20 6 x 25	8 8 12	53 53 63	9 9 13	10 10 10	
25	25 75	25 75	25 90	25 25 25	75 75 90	30 30 35	47 47 62	37,5 37,5 46,7	44 50 60	20 20 20	12 15 20	0,85 0,85 1,30	0,85 0,85 0,85	6 x 25 6 x 25 6 x 25	8 8 12	58 58 73	13 13 13	10 10 10	
30	30 80	30 80	30 105	30 30 30	80 80 105	35 35 40	53 53,4 68	43,1 42,8 52,7	44 50 66	20 20 20	12 15 23	0,85 0,85 1,30	0,85 0,85 0,85	6 x 25 6 x 25 8 x 25	12 12 12	63 63 85	13 13 11	10 10 24	
35	35 90	35 90	35 110	35 35 35	90 90 110	40 40 45	60 60,4 73	48,9 48,8 57,7	48 54 66	20 20 20	14 17 23	1,30 1,30 1,30	0,85 0,85 0,85	6 x 25 6 x 25 8 x 25	12 12 12	73 73 88	13 13 11	10 10 24	
40	40 100	40 100	40 115	40 40 40	100 100 115	45 45 50	65 65,4 78	53,9 53,8 62,7	48 54 75	20 20 25	14 17 25	1,30 1,30 1,30	0,85 0,85 0,85	8 x 25 8 x 25 8 x 30	8 8 12	80 80 94	11 11 16	24 24 24	
45	45 105	45 105	45 130	45 45 45	105 105 130	50 50 55	70 70,4 90	59,5 58,8 70,9	54 60 82	25 25 25	14,5 17,5 28,5	1,30 1,30 1,30	0,85 0,85 0,85	8 x 30 8 x 30 8 x 30	8 8 12	85 85 105	16 16 16	24 24 24	
50	50 115	50 115	50 140	50 50 50	115 115 140	55 55 60	78 78,4 95	65,5 65,5 75,9	54 60 82	25 25 25	14,5 17,5 28,5	1,30 1,30 1,75	0,85 0,85 0,85	8 x 30 8 x 30 10 x 30	12 12 12	94 94 113	16 16 14	24 24 48	
55			55 145	55	145	65	100	80,9	82	25	28,5	1,75	0,85	10 x 30	12	118	14	48	
60			60 150	60	150	70	105	85,9	82	25	28,5	1,75	0,85	10 x 30	12	123	14	48	
65			65 155	65	155	75	110	90,9	82	25	28,5	1,75	0,85	10 x 30	12	128	14	48	
70			70 160	70	160	80	115	95,9	82	25	28,5	1,75		10 x 30	12	133	14	48	
75			75 185	75	185	90	135	109,9		30	35	1,75	1	12 x 35	12	155	17	80	
90			90 210	90	210	110	160	132,9	110	35	37,5	1,75	1,30	12 x 40	16	180	22	80	





rac		oads (N)	ial	Maximum speed	Preload 1)	Residual torque 2)	Rigidity K 3)	Mass	Bearing reference
Dyn. Cr	Stat. Cor	Dyn. Ca	Stat. Coa	r.p.m.	N	Nmm	N/µm	g	
16 200	22 000	12 000	40 000	9 000	735	120	1 250	406	AXNBT 15 60
16 200	22 000	20 500	49 000	9 000	1 340	350	780	427	ARNBT 15 60
18 900	28 800	13 500	50 000	7 500	820	160	1 480	521	AXNBT 20 68
18 900	28 800	23 500	63 000	7 500	1 550	500	950	548	ARNBT 20 68
28 000	44 500	48 000	115 000	6 300	3 010	1 200	1 130	1 088	ARNBT 20 80
28 000	44 500	14 800	58 500	6 500	880	200	1 780	740	AXNBT 25 75
28 000	44 500	24 800	70 000	6 500	1 620	550	1 090	768	ARNBT 25 75
30 500	53 000	66 000	165 000	5 300	4 130	1 900	1 270	1 438	ARNBT 25 90
30 500	53 000	19 000	85 000	5 500	1 130	300	1 880	798	AXNBT 30 80
30 500	53 000	32 000	88 000	5 500	2 100	850	1 070	833	ARNBT 30 80
32 500	59 000	83 000	210 000	4 800	5 040	2 600	1 450	1 876	ARNBT 30 105
32 500	59 000	20 500	97 000	5 000	1 210	350	2 250	1 079	AXNBT 35 90
32 500	59 000	45 000	124 000	5 000	2 910	1 350	1 300	1 108	ARNBT 35 90
34 500	67 000	86 000	228 000	4 300	5 250	2 900	1 520	2 029	ARNBT 35 110
34 500	67 000	22 000	110 000	4 500	1 300	400	2 630	1 257	AXNBT 40 100
34 500	67 000	47 500	138 000	4 500	3 070	1 550	1 470	1 306	ARNBT 40 100
44 000	95 000	93 000	260 000	4 000	5 740	3 500	1 620	2 657	ARNBT 40 115
44 000	95 000	22 700	119 000	4 000	1 340	450	2 980	1 652	AXNBT 45 105
44 000	95 000	50 000	150 000	4 000	3 230	1 750	1 480	1 684	ARNBT 45 105
44 000	98 000	127 000	345 000	3 600	7 770	5 300	1 930	3 723	ARNBT 45 130
44 000	98 000	28 500	164 000	3 800	1 680	650	3 500	1 932	AXNBT 50 115
44 000	98 000	60 000	197 000	3 800	3 800	2 350	1 950	1 987	ARNBT 50 115
48 000	113 000	131 000	370 000	3 300	8 120	5 900	2 020	4 091	ARNBT 50 140
53 500	119 000	135 000	395 000	3 100	8 400	6 500	2 170	4 353	ARNBT 55 145
 56 000	128 000	147 000	445 000	2 900	9 100	7 500	2 500	4 581	ARNBT 60 150
 64 000	143 000	150 000	470 000	2 800	9 310	8 100	2 550	4 871	ARNBT 65 155
 73 000	148 000	155 000	495 000	2 600	9 520	8 800	2 720	5 093	ARNBT 70 160
 77 000	165 000	230 000	730 000	2 300	14 140	14 800	3 050	8 915	ARNBT 75 185
 118 000	268 000	288 000	990 000	1 900	17 640	22 200	3 700	13 200	



 ^{6% ≈} of basic dynamic axial load.
 With axial load equal to preload.
 Rigidity of a single thrust bearing with load equal to preload.

Precision combined bearings with adjustable axial preload and thick plates for tight mounting

A D -#

AXNB (T).. .../1 ARNB (T).. .../1

AXNB (T) and ARNB (T).. .../1 or 11 series

AXNB (T).. .../11 ARNB (T).. .../11

Shaft Ø mm	AXNB /1 /11	AXNBT /1 /11	Design ARNB /1 /11 Series 1	nation ARNBT /1 /11 Series 1	ARNB /1 /11 Series 2	ARNBT /1 /11 Series 2	A	D	H	h	(suffix) /1 mm	(suffix) /1
15	15 45	15 60	15 45	15 60			35 35	25 25	11 11	27 29	55 60	70 74
20	20 52	20 68	20 52	20 68	20 62	20 80	42 42 52	30 30 40	11 11 11	27 29 35	55 60 75	70 74 90
25	25 57	25 75	25 57	25 75	25 72	25 90	47 47 62	35 35 45	11 11 11	28 30 35	60 65 75	76 80 90
30	30 62	30 80	30 62	30 80	30 80	30 105	53 53,4 68	40 40 50	12 12 11	27 30 39	59 65 82	74 80 98
35	35 70	35 90	35 70	35 90	35 85	35 110	60 60,4 73	45 45 60	12 12 12	29 33 39	63 70 82	78 86 98
40	40 75	40 100	40 75	40 100	40 90	40 115	65 65,4 78	50 50 60	12 12 12	29 33 43	63 70 93	78 86 111
45	45 80	45 105	45 80	45 105	45 105	45 130	70 70,4 90	55 55 70	12 12 15	28,5 32,5 49,5	68 75 103	82 90 124
50	50 90	50 115	50 90	50 115	50 110	50 140	78 78,4 95	60 60 75	12 12 15	31,5 35,5 49,5	71 78 103	88 96 124
55					55 115	55 145	100	80	15	49,5	103	124
60					60 120	60 150	105	90	16	49,5	103	124
65 70					65 125	65 155	110	90	16	49,5	103	124
75					70 130	70 160	115	100	16	49,5	103	124
90					75 155 90 180	75 185 90 210	135 160	110	16 16	60 62,5	125 135	150



Tight precision combined bearings with adjustable axial preload

AXNBT..../2
ARNBT..../2

B
F
F
G

G



AXNBT and ARNBT.. .../2 or 21 series

AXNBT.. .../21 ARNBT.. .../21 Position of lubricating holes.

Shaft	Desig	nation	De	В	G	С	F	Attacl	nment
ø mm	AXNBT /2 /21	ARNBT /2 /21	mm	mm	mm	mm	mm	4 x CHC screws (M)	E mm
15	15 60	15 60	60 60	12 14	46 46	36 36	3,9 3,9	3 x 16 3 x 18	52,5 52,5
20	20 68	20 68 20 80	68 68 80	13 15 18	53 53 63	43 43 53	3,9 3,9 3,9	3 x 18 3 x 20 3 x 25	61 61 73
25	25 75	25 75 25 90	75 75 90	13 15 19	58 58 73	48 48 63	3,9 3,9 3,9	3 x 18 3 x 20 3 x 25	67,5 67,5 82
30	30 80	30 80 30 105	80 80 105	13 16 20,5	63 63 85	54,5 54,5 69	3,9 3,9 3,9	3 x 18 3 x 20 3 x 25	73 73 93
35	35 90	35 90 35 110	90 90 110	13 17 22,5	73 73 88	61,5 61,5 74	3,9 3,9 3,9	4 x 20 4 x 25 4 x 35	81,5 81,5 101,5
40	40 100	40 100 40 15	100 100 115	13 17 22,5	80 80 94	66,5 66,5 79	3,9 3,9 3,9	4 x 20 4 x 25 4 x 35	89 89 106,5
45	45 105	45 105 45 130	105 105 130	15 19 25	85 85 105	71,5 71,5 91,5	3,9 3,9 7,9	4 x 20 4 x 25 5 x 35	95,5 95,5 117,5
50	50 115	50 115 50 140	115 115 140	15 19 25	94 94 113	79,5 79,5 96,5	3,9 3,9 7,9	4x 20 4x 25 5 x 35	106,5 106,5 124
55		55 145	145	25	118	101,5	7,9	5 x 35	129
60		60 150	150	25	123	106,5	7,9	5 x 35	134
65		65 155	155	26,5	128	111,5	7,9	5 x 35	140,5
70		70 160	160	26,5	133	116,5	7,9	6 x 35	145,5
75		70 185	185	30	155	136,5	7,9	5 x 40	170
90		20 210	210	32,5	180	161,5	7,9	5 x 40	194,5



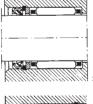


SEALING RINGS

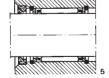












NADELLA sealing rings type ET, made in synthetic rubber and incorporating a metal insert, have the same inner and outer dimensions as NADELLA needle bushes and the radial portion of the combined bearings type RAX 700. The recommended housing and shaft tolerances for these bearings ensure a tight fit of the sealing ring in the housing bore and the optimum friction between lip and shaft. The simple installation of this low-cost seal, requiring no special machining, provides a very economical seal within a minimum space. A caged needle bush, type DB...E (or HK...E) incorporating a sealing ring at one end, may also be used with a type ET sealing ring installed adjoining the other end of the bearing, thus creating a completely sealed bearing (Fig. 1).

In the case of grease lubrication, the seal should be installed with the lip facing away from the bearing (Fig. 1) to enable expulsion of old grease when replenishing by means of a pump. For oil lubrication, installation the opposite way is recommended (Fig. 2). If the prevailing conditions are particularly dirty, it may be necessary to protect the seal additionally by means of a labyrinth.

ET sealing rings may also be used with NADELLA needle cages having the same shaft and housing diameters (Fig. 3) or with those having larger or smaller housing diameters than that of the seal (Fig. 4 and Fig. 5).

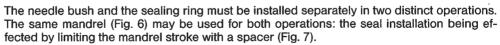
The hardness and surface finish required for the raceway on the shaft enable these sealing rings to operate at circumferential speeds of 10–12 m/s, providing lubrication is adequate (for higher speeds – please consult NADELLA Technical Department).

Standard type ET sealing rings will operate satisfactorily at temperatures from -20°C to +120°C. For conditions outside this temperature range, please consult NADELLA.

INSTALLATION

Type ET sealing rings should be smeared with grease before mounting — on the outside diameter (to facilitate assembly and avoid damage) and on the inside (to prevent dry operation when starting from rest).

The edge of the housing bore should be chamfered to prevent damage to the seal and to facilitate assembly. A small press should be used for this purpose — such as that used to install needle bushes, in order to guide the sealing ring parallel to the axis of the housing bore.



In order to prevent the risk of damage to the seal lip, the shaft end must be chamfered.





SEALING RINGS

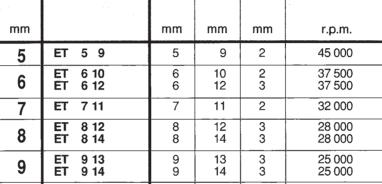
Shaft Dia.

Designation



Speed limit

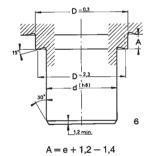
Weight approx.

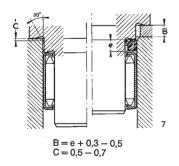


d

D

е





mm		mm	mm	mm	r.p.m.	g
5	ET 5 9	5	9	2	45 000	0,37
6	ET 6 10 ET 6 12	6 6	10 12	2	37 500 37 500	0,43 0,67
7	ET 711	7	11	2	32 000	0,45
8	ET 8 12 ET 8 14	8 8	12 14	3	28 000 28 000	0,70 0,80
9	ET 9 13 ET 9 14	99	13 14	3 3	25 000 25 000	0,85 1,15
10	ET 10 14 ET 10 16	10 10	14 16	3 3	22 500 22 500	0,90 0,95
12	ET 12 16 ET 12 18	12 12	16 18	3 3	19 000 19 000	1,06 1,12
13	ET 13 19	13	19	3	17 500	1,20
14	ET 14 20	14	20	3	16 000	1,25
15	ET 15 21	15	21	4	15 000	1,70
16	ET 16 22	16	22	3	14 000	1,40
17	ET 17 23	17	23	3	13 200	1,50
18	ET 18 24	18	24	4	12 500	1,80
20	ET 20 26 ET 20 28	20 20	26 28	4 4	11 200 11 200	2,10 2,90
22	ET 22 28	22	28	4	10 200	2,20
24	ET 24 32	24	32	4	9 400	3,25
25	ET 25 32 ET 25 33	25 25	32 33	4 4	9 000 9 000	2,95 3,30
28	ET 28 35 ET 28 36	28 28	35 36	4	8 000 8 000	3,30 3,80
30	ET 30 37 ET 30 38	30 30	37 38	4 4	7 500 7 500	3,40 3,90
35	ET 35 42 ET 34 43	35 55	42 43	4 4	6 500 6 500	4,90 5,40
40	ET 40 47 ET 40 48	40 40	47 48	4 4	5 600 5 600	5,30 6,05
44	ET 44 52	44	52	4	5 100	6,55
45	ET 45 52	45	52	4	5 000	5,80
50	ET 50 58	50	58	4	4 500	7,50
55	ET 55 63	55	63	4	4 000	8,40



INNER RINGS IM

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

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

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, a cylindrical inner ring wider than the bearing may be used to permit the fitting of a sealing ring, which would 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 NADELLA Technical Department) with needle bushes other than BK, HK, HK...E, and 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 needle bushes, to increase the allowable misalignment tolerance (see page 27) and must always be positioned immediately below the needle bush, the maximum axial displacement being 5% of the bearing width.

MANUFACTURING TOLERANCES

		Nom	m Tolerances				
Inner r	ing types	dia Di mm	Bore Di µm	Width L μm	Out of round µm	Outer dia Ci	
Inner rings listed	with suffix…P		to ISO 1206 (NFE 22370) or ISO 492 Std (DIN 620-0)				
under their three dimensions	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	
Inne Ser	to ISO 1206 (NFE 22370) or ISO 492 Std (DIN 620-0)				1)		
Series	r Rings IM 19 000 // 20 600	17 to 40 45 to 60	0/-10 0/-10	0/-130 0/-160	5 5	μm 0/-5 0/-5	

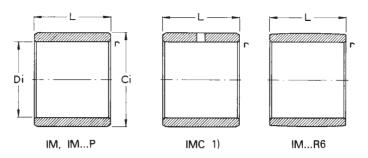
¹⁾ Please consult NADELLA Technical Department.



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Table of inner rings

Summary



¹⁾ For inner rings with lubrication hole, IMC series, please consult NADELLA
* These inner rings are also available with convex raceway on Ci diameter – designation IM...R6.

Shaft Dia. Di	Designation	Ci	L.	r mini	Weight approx.
mm		mm	mm	mm	g
5	IM 5 8 12 P	8	12	0,2	2,7
6	IM 6 912 P IM 6 916 P	9	12 16	0,2 0,2	3,1 4,2
7	IM 7 10 12 P	10	12	0,2	3,6
	IM 7 10 16 P	10	16	0,2	4,8
8	IM 8 12 10 P	12	10	0,3	4,6
	IM 8 12 12,4*	12	12,4	0,3	5,8
	IM 8 12 16	12	16	0,3	7,4
9	IM 9 12 12 P	12	12	0,2	4,4
	IM 9 12 16 P	12	16	0,2	5,9
	IM 9 13 12,4*	13	12,4	0,3	6,4
10	IM10 14 12,4*	14	12,4	0,3	7
	IM4 900	14	13	0,35	7,3
	IM10 14 16 P	14	16	0,3	9
	IM10 14 16,4	14	16,4	0,3	9,2
12	IM12 15 12,4* IM12 15 16 P IM12 15 22,4 P IM12 16 12,4* IM4 901 IM12 16 16 P IM12 16 20 P	15 15 15 16 16 16	12,4 16 22,4 12,4 13 16 20	0,2 0,2 0,2 0,3 0,35 0,3 0,3	5,8 7,6 10,7 8,1 8,5 10,5 13,2
13	IM13 17 12,4*	17	12,4	0,3	8,7
	IM13 17 16,4	17	16,4	0,3	11,5
	IM13 18 12,4*	18	12,4	0,35	11,2
	IM13 18 16 P	18	16	0,35	14,5
	IM13 18 16,4*	18	16,4	0,35	15
14	IM14 17 17 P	17	17	0,2	9,3
	IM14 18 20,4	18	20,4	0,3	15,5
15	IM15 19 16 P IM15 19 20 P IM15 20 12,4* IM 4 902 IM15 20 16 P IM15 20 16,4* IM15 20 20 P IM15 20 20	19 19 20 20 20 20 20 20	16 20 12,4 13 16 16,4 20	0,3 0,35 0,35 0,35 0,35 0,35 0,35	12,8 16 12,7 13,3 16,5 17 20,5 20,5

	alion iivino.			,	
Shaft Dia. Di	Designation	Ci	L	r mini	Weight approx.
mm		mm	mm	mm	g
17	IM 19 017 IM 20 617 IM 17 21 16 P IM 17 21 20 P IM 4 903 IM 17 22 13 P IM 17 22 16 P IM 17 22 16,4* IM 17 22 20 P IM 17 22 20,4	20 20 21 21 22 22 22 22 22 22	27,5 31,5 16 20 13 13 16 16,4 20 20,4	0,2 0,2 0,3 0,35 0,35 0,35 0,35 0,35 0,35	19 21 14,3 18 14,9 14,9 18,5 18,8 23 23,5
20	IM 20 24 16 P IM 20 24 20 P IM 20 25 16 P IM 20 25 16,4* IM 4 904 IM 20 25 20 P IM 20 25 20,4* IM 20 25 25 IM 19 020 IM 20 620	24 24 25 25 25 25 25 25 25 25 25	16 20 16 16,4 17 20 20,4 25 27,5 31,5	0,3 0,3 0,35 0,35 0,35 0,35 0,35 0,35 0,	16,5 20,5 21 21,5 22,5 26,5 27 33 38 44
22	IM 22 26 20 P IM 49/22 17	26 28	20 17	0,3 0,35	22,5 30
23	IM 23 28 20 P IM 23 20,4*	28 28	20 20,4	0,35 0,35	30 30,5
25	IM 25 29 20 P IM 25 29 30 P IM 25 30 12,4 P IM 25 30 16,4* IM 4 905 IM 25 30 20 P IM 25 30 20,4* IM 25 30 25* IM 19 025 IM 25 30 30 P IM 26 625	29 30 30 30 30 30 30 30 30 30	20 30 12,4 16,4 17 20 20,4 25 27,5 30 31,5	0,3 0,3 0,35 0,35 0,35 0,35 0,35 0,35 0,	25 38 19,7 26,5 27,5 32 33 40 42 49 52
28	IM 28 32 20 P IM 28 32 30 P	32 32	20 30	0,3 0,3	28 42



Shaft Dia.	Designation	Ci	L	r mini	Weight approx.
Dia.	·			141144	αρρίολ.
mm		mm	mm	mm	g
30	IM 30 35 16,4* IM 4 906 IM 30 35 20 P IM 30 35 20,4* IM 30 35 25 IM 19 030 IM 30 35 30 P IM 20 630	35 35 35 35 35 35 35 35	16,4 17 20 20,4 25 27,5 30 31,5	0,35 0,35 0,35 0,35 0,35 0,35 0,35 0,35	31 32,5 38 39 48 53 57 61
32	IM 32 37 20 P	37	20	0,35	40
33	IM 33 38 20 P	38	20	0,35	42
35	IM 35 40 16,4* IM 35 40 20 P IM 35 40 20,4* IM 35 40 25 IM 19 035 IM 35 40 30 P IM 20 635 IM 4 907	40 40 40 40 40 40 40 42	16,4 20 20,4 25 27,5 30 31,5	0,35 0,35 0,35 0,35 0,35 0,35 0,35 0,85	36 44 45 55 63 66 72 63
37	IM 37 42 20 P	42	20	0,35	46
40	IM 40 44 16,4* IM 40 45 16,4 P* IM 40 45 20 P IM 40 45 20,4 IM 40 45 25 P IM 19 040 IM 40 45 30 P IM 20 640 IM 4 908	44 45 45 45 45 45 45 45 48	16,4 16,4 20 20,4 25 27,5 30 31,5	0,3 0,35 0,35 0,35 0,35 0,35 0,35 0,35 0	32 41 50 51 62 69 75 80 91
42	IM 42 47 20 P	47	20	0,35	52
45	IM 45 50 20,4* IM 45 50 25 P IM 45 50 25 IM 19 045 IM 20 645 IM 45 50 35 P IM 4 909	50 50 50 50 50 50 50 52	20,4 25 25 30,5 34,5 35 22	0,65 0,65 0,65 0,65 0,65 0,65 0,85	56 69 69 85 96 97 87

Shaft Dia. Di	Designation	Ci	L	r mini	Weight approx.
mm	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	mm	mm	mm	g
50	IM 50 55 20,4*	55	20,4	0,65	62
	IM 50 55 25 P	55	25	0,65	76
	IM 50 55 35 P	55	35	0,65	107
	IM 4 910	58	22	0,85	111
	IM 19 050	60	32,5	0,65	208
	IM 20 650	60	38,5	0,65	250
55	IM 55 60 25 P	60	25	0,65	84
	IM 55 60 35 P	60	35	0,65	118
	IM 4 911	63	25	1,35	135
58	IM 58 65 25 P	65	25	0,85	125
	IM 58 65 35 P	65	35	0,85	177
60	IM 4 912	68	25	1,35	148
	IM 60 68 25 P	68	25	0,85	150
	IM 60 68 35 P	68	35	0,85	210
	IM 60 70 25 P	70	25	0,85	190
	IM 19 060	70	32,5	0,85	247
	IM 20 660	70	39,5	0,85	300
62	IM 62 70 25 P	70	25	0,85	155
	IM 62 70 35 P	70	35	0,85	215
65	IM 4913	72	25	1,35	138
	IM 65 73 35 P	73	35	0,85	225
67	IM 67 75 25 P	75	25	0,85	167
	IM 67 75 35 P	75	35	0,85	235
70	IM 4914	80	30	1,35	265
	IM 70 80 25 P	80	25	1,35	222
75	IM 4915	85	30	1,35	280
	IM 75 85 35 P	85	35	1,35	330
80	IM 80 90 25 P	90	25	1,35	245
	IM 4 916	90	30	1,35	295
	IM 80 90 35 P	90	35	1,35	350
85	IM 85 95 26 P	95	26	1,35	270
	IM 85 95 36 P	95	36	1,35	380
	IM 4 917	100	35	1,85	570
90	IM 90 100 26 P	100	26	1,35	290
	IM 90 100 36 P	100	36	1,35	400
95	IM 95 105 26 P	105	26	1,35	300
	IM 95 107 32 P	107	32	1,35	450
100	IM 100 110 30 P	110	30	1,85	360





INNER RINGS - WITH OIL HOLES





for bearings type RNA BIC, BIP, BIG, BICG

Inner rings having oil holes enable oil to be supplied from the shaft directly below the needles.

Inner rings which are wider than the outer rings allow an axial displacement of the shaft with or without simultaneous rotational movement (please consult the NADELLA Technical Department on these special applications).

All the inner rings with oil holes and those of width wider than the outer rings, have a cylindrical needle track (o/dia). For this reason, the housings and shaft seatings must be well aligned when mounting and while functioning under load. Whenever possible, complete bearings, type Na, should be used. These have inner and outer rings of the same width and the convex needle track formed on the inner rings ensures good running (see page 52).

When lubricant is being supplied through the shaft, the use of an inner ring having an oil hole can usually be avoided by putting the oil outlet hole at the side of the ring.

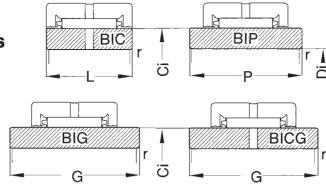
For complete bearings consisting of an outer ring RNA and a wide inner ring (or one with oil hole), the shaft and housing tolerances are given in table 1 on page 53. The fit of the rings must also be considered when choosing a bearing.

Installation and lateral retention of inner rings; see page 55.



Inner rings extra wide Inner rings with oil holes for bearings

Type RNA



	Code	;	Comm	on dime	nsions		Wi	dth	1	Tolerance	Apr	prox. we	ight
			D _i	C _i	r mm	BIC L mm	BIP P mm	BIG G mm	BICG G mm	on L, P, G mm	BIC g	BIP g	BIG BICG g
	BIC, BIP	1012	12	17,6	1	15	20				16	20	
	BIC, BIP	1015	15	20,6	1	15	20				18	25	
	BIC, BIG	2015	15	22,1	1	22		32			35		52
	BIC, BIP	1017	17	23,9	1	15	20				26	35	
	BIC, BIP BIC, BIG	1020 2020	20 20	28,7 28,	1	18 22	22	32	:	0 -0,10	46 56	56	80
	BIC, BIP BIC, BIG	1025 2025	25 25	33,5 33,5	1 1	18 22	22	32			54 65	65	95
BIC,	BIC, BIP BIC, BIG BIG, BICG	1030 2030 3030	30 30 30	38,2 38,2 44	1 1 1	18 22 30	22	32 40	40		60 74 188	74	108 247
BIC,	BIC, BIP BIC, BIG BIG, BICG	1035 2035 3035	35 35 35	44 44 49,7	1 1 1	18 22 36	22	32 46	46		77 93 270	93	135 345
BIC,	BIC, BIP BIC, BIG BIG, BICG	1040 2040 3040	40 40 40	49,7 49,7 55,4	1,5 1,5 1,5	18 22 36	22	32 46	46	0	94 115 321	115	170 408
BIC,	BIC, BIP BIC, BIG BIG, BICG	1045 2045 3045	45 45 45	55,4 55,4 62,1	1,5 1,5 1,5	18 22 38	22	32 48	48	- 0,12	113 139 422	139	210 530
BIC,	BIC, BIP BIG, BICG BIG, BICG		50 50 50	62,1 62,1 68,8	2 2 2	20 28 38	28	38 48	38 48		163 228 515	228	312 650
	BIC, BIP BIG, BICG BIG, BICG		55 55 55	68,8 68,8 72,6	2 2 2	20 28 38	28	38 48	38 48		205 288 525	288	390 660
	BIC, BIP BIG, BICG BIG, BICG		60 60 60	72,6 72,6 78,3	2 2 2	20 28 38	28	38 48	38 48		202 282 583	282	385 768
BIC,	BIC, BIP BIG, BICG BIG, BICG	1065 2065 3065	65 65 65	78,3 78,3 83,1	2 2 2	20 28 38	28	38 48	38 48		230 324 623	324	437 785
	BIC, BIP BIG, BICG BIG, BICG		70 70 70	83,1 83,1 88	2 2 2	20 28 38	28	38 48	38 48	0 -0,15	245 335 662	335	456 820
	BIC, BIP BIG, BICG BIG, BICG		75 75 75	88 88 96	2 2 2	24 32 38	32	42 48	42 48		305 410 825	410	538 1 040
	BIC, BIP BIG, BICG BIG, BICG		80 80 80	96 96 99,5	2 2 2	24 32 38	32	42 48	42 48		410 545 805	545	714 1 035



Specially wide inner rings BIK can be supplied if required. K = G + 10 mm.

These inner rings are normally intended for RNA bearings having the same number. For example:

- BIP 1 012 for RNA 1 012
- BIC 2 020 for RNA 2 020
- BIG 3 030 for RNA 3 030.

Inner rings BIG 2000 (except BIG 2015) may also be used with outer rings of series 1000. For example, BIG 2020 could go with RNA 1020. Numerous other combinations are possible of bearings without inner rings and inner rings of different numbers if the C_i dimension is common. For these cases, the agreement of the NADELLA Technical Department should be obtained.

Codes	Com	mon dimen	sions	Wi	dth	Tolerance		. weight
	D _i	C _i	r	BIC L	BIG BICG G	on L and G	BIC	BIG BICG
	mm	mm	mm	mm	mm	mm	g	g
BIC, BIG, BICG 2085 BIC, BIG, BICG 3085	85 85	99,5 104,7	2 2	32 38	42 48		515 865	685 1 085
BIC, BIG, BICG 2 090	90	104,7	2	32	42		531	735
BIC, BIG, BICG 3 090	90	109,1	2	43	53		990	1 220
BIC, BIG, BICG 2095	95	109,1	2	32	42		548	740
BIC, BIG, BICG 3095	95	114,7	2	43	53		1 075	1 325
BIC, BIG, BICG 2100	100	114,7	2	32	42	0	620	800
BIC, BIG, BICG 3100	100	119,2	2	43	53	-0,20	1 090	1 348
BIC, BIG, BICG 2105	105	119,2	2	32	42		615	810
BIC, BIG, BICG 3105	105	124,7	2	45	55		1 225	1 505
BIC, BIG, BICG 2110	110	124,7	2	34	44		705	920
BIC, BIG, BICG 3110	110	132,5	2	45	55		1 495	1 800
BIC, BIG, BICG 2115	115	132,5	2	34	44		895	1 150
BIC, BIG, BICG 3115	115	137	2	45	55		1 520	1 850
BIC, BIG, BICG 2 120	120	137	2	34	44		902	1 165
BIC, BIG, BICG 3 120	120	143,5	2	45	55		1 685	2 060
BIC, BIG, BICG 3125	125	143,5	2	34	44		1 022	1 325
BIC, BIG, BICG 2130	130	148	2	34	44		1 033	1 340
BIC, BIG, BICG 3130	130	158	2	52	62		2 530	3 035
BIC, BIG, BICG 2140	140	158	2	36	46		1 165	1 490
BIC, BIG, BICG 3140	140	170,5	2	52	62		3 000	3 560
BIC, BIG, BICG 2150	150	170,5	2	36	46	0	1 440	1 835
BIC, BIG, BICG 3150	150	179,3	2	52	62	-0,25	3 045	3 615
BIC, BIG, BICG 2160 BIC, BIG, BICG 3160	160 160	179,3 193,8	2	36 57	46 67		1 430 4 115	1 820 4 820
BIC, BIG, BICG 2170	170	193,8	3	42	52		2 200	2 940
BIC, BIG, BICG 3170	170	202,6	3	57	67		4 185	4 935
BIC, BIG, BICG 2180	180	202,6	3	42	52		2 175	2 720
BIC, BIG, BICG 3180	180	216	3	57	67		4 900	5 750
BIC, BIG, BICG 2 190	190	216	3	42	52		2 680	3 300
BIC, BIG, BICG 3 190	190	224,1	3	57	67		4 800	5 650
BIC, BIG, BICG 2 200	200	224,1	3	42	52		2 590	3 225
BIC, BIG, BICG 3 200	200	236	3	57	67		5 410	6 370
BIC, BIG, BICG 2 220	220	248,4	3	49	59	0	4 000	5 000
BIC, BIG, BICG 3 220	220	258,4	3	64	74	-0,30	7 180	8 300
BIC, BIG, BICG 2 240	240	269,6	3	49	59		4 415	5 450
BIC, BIG, BICG 3 240	240	281,9	3	64	74		8 800	10 200
BIC, BIG, BICG 2 260	260	290,5	3	54	64		5 400	6 400
BIC, BIG, BICG 3 260	260	302	3	74	84		10 700	12 100
BIC, BIG, BICG 2280	280	313,5	3	54	64	0	6 350	7 600
BIC, BIG, BICG 3280	280	325	3	74	84	-0,35	12 400	14 000
BIC, BIG, BICG 2300	300	335	3	64	64		7 500	8 900
BIC, BIG, BICG 3300	300	344	3	84	84		12 800	14 600





MANUFACTURING TOLERANCES OF BEARING RINGS

Standard tolerance class¹⁾

Inner rings

Bore nominal Di mm from to		Di min +	i _m - Di max 2 m min	Out of round µm max		Wid ance m min	Ith Max variation on a ring µm max
2,5	10	0	- 8	10	0 0	- 120	15
10	18	0	- 8	10		- 120	20
18	30	0	- 10	13		- 120	20
30	50	0	- 12	15	0 0 0	- 120	20
50	80	0	- 15	20		- 150	25
80	120	0	- 20	25		- 200	25
120	180	0	- 25	30	0	- 250	30
180	250	0	- 30	40	0	- 300	30
250	315	0	- 35	50	0	- 350	35
315	400	0	- 40	60	0	- 400	40

Outer rings

dian nomir	ernal neter nal De* im to	De (<u>De min +</u> 2 µi max	De max	Out of round µm max	Width
6 18 30	18 30 50	0 0	- 8 - 9 - 11	15 15 20	a ring are inner ing bearing
50 80 120	80 120 150	0 0 0	- 13 - 15 - 18	25 35 40	iations on a ose of the in rresponding
150 180 250	180 250 315	0 0	- 25 - 30 - 35	45 50 60	Tolerance variations on a ring are identical to those of the inner ring for the corresponding bearing
315	400	0	- 40	70	다 호 든

¹⁾ According to ISO Norm. 1206 (French Std. E 22370) or ISO 492 (DIN 620 Class zero).

* Or Dim D1 for combined bearings RAX and RAXN 400 or 500.

Tolerance class 6th

Inner rings

Bore nominal Di mm from to		$ \begin{pmatrix} \text{Di}_{\text{m}} \\ \left(\frac{\text{Di min} + \text{Di max}}{2} \right) \\ \mu\text{m} \\ \text{max} & \mid \text{ min} \end{pmatrix} $		Out of round µm max	Wid Tolerance µm max min		lth Max variation on a ring µm max
2,5 10 18	10 18 30	0 0	- 7 - 7 - 8	6 7 8	0 0	- 120 - 120 - 120	15 20 20
30 50 80	50 80 120	0 0	- 10 - 12 - 15	10 10 13	0 0	- 120 - 150 - 200	20 25 25
120 180 250	180 250 315	0 0 0	- 18 - 22 - 25	18 20 25	0 0 0	- 250 - 300 - 350	30 30 35
315	400	0	- 30	30	0	- 400	40

Outer rings

dian nomin	ernal neter ial De* m to	De (De min + 2 µr max	De max	Out of round µm max	Width
6 18 30	18 30 50	0 0	- 7 - 8 - 9	8 9 10	ring are ner y bearing
50 80 120	80 120 150	0 0	- 11 - 13 - 15	13 18 20	Tolerance variations on a ring are identical to those of the inner ring for the corresponding bearing
150 180 250	180 250 315	0 0 0	- 18 - 20 - 25	23 25 30	elerance vari entical to the ig for the co
315	400	0	- 28	35	12 2 E

Tolerance class 5¹⁾

Inner rings

1111101 11							
2,5	10	0 0 0	- 5	3,5	0	- 40	5
10	18		- 5	3,5	0	- 80	5
18	30		- 6	4	0	- 120	5
30	50	0 0	- 8	5	0	- 120	5
50	80		- 9	5	0	- 150	6
80	120		- 10	6	0	- 200	7
120	180	0 0	- 13	8	0	- 250	8
180	250		- 15	10	0	- 300	10
250	315		- 18	13	0	- 350	13
315	400	0	- 23	15	0	- 400	15

Outer rings

Outor I					
6 18 30	18 30 50	0 0	- 5 - 6 - 7	5 6 7	ring are ner j bearing
50 80 120	80 120 150	0 0 0	- 9 - 10 - 11	8 10 11	iations on a ose of the in rresponding
150 180 250	180 250 315	0 0	- 13 - 15 - 18	13 15 18	Tolerance variations on a ring are identical to those of the inner ring for the corresponding bearing
315	400	0	- 20	20	다 할 듣

¹⁾ According to Norm. ISO 492 (DIN 620). For tolerances of Class 4 please consult Nadella.

NOTE – For the particular tolerances of a bearing type, please consult the corresponding chapter. In view of the relative thinness of inner and outer rings of needle bearings, their circularity (or ovality) is of little significance, because it is influenced by the shape of the appropriate shafts and housings after installation. This characteristic does not figure in the tables above.



ISO HOUSING TOLERANCES in μm (.001mm)

			F		G				Н				J		K	٨	Λ		N		Р	F	3
		F6	F7	F8	G6	H6	H7	Н8	H10	H11	H12	J6	J7	Js12	K6	M6	M7	N6	N7	N11	P7	R6	R7
6	10	+ 22 + 13	+ 28 + 13	+ 35 + 13	+ 14 + 5	+ 9 0	+ 15 0	+ 22 0	+ 58 0	+ 90 0	+ 150 0	+ 5 - 4	+ 8 - 7	± 75	+ 2 - 7	- 3 - 12	0 - 15	- 7 - 16	- 4 - 19	0 - 90	- 9 - 24	- 16 - 25	- 13 - 28
10	18	+ 27 + 16	+ 34 + 16	+ 43 + 16	+ 17 + 6	+ 11 0	+ 18	+ 27 0	+ 70 0	+ 110 0	+ 180 0	+ 6	+ 10	± 90	+ 2	- 4 - 15	0 - 18	- 9 - 20	- 5 - 23	0 - 110	- 11 - 29	- 20 - 31	- 16 - 34
18	30	+ 33 + 20	+ 41 + 20	+ 53 + 20	+ 20 + 7	+ 13 0	+ 21	+ 33	+ 84 0	+ 130 0	+ 210 0	+ 8 - 5	+ 12	± 105	+ 2 - 11	- 4 - 17	0 - 21	- 11 - 24	- 7 - 28	0 - 130	- 14 - 35	- 24 - 37	- 20 - 41
30	50	+ 41 + 25	+ 50 + 25	+ 64 + 25	+ 25 + 9	+ 16 0	+ 25	+ 39	+ 100 0	+ 160 0	+ 250 0	+ 10 - 6	+ 14	± 125	+ 3 - 13	- 4 - 20	0 - 25	- 12 - 28	- 8 - 33	0 - 160	- 17 - 42	- 29 - 45	- 25 - 50
50	65	+ 49 + 30	+ 60 + 30	+ 76 + 30	+ 29 + 10	+ 19	+ 30	+ 46 0	+ 120 0	+ 190 0	+ 300	+ 13 - 6	+ 18 - 12	± 150	+ 4 - 15	- 5 - 24	0 - 30	- 14 - 33	- 9 - 39	0 - 190	- 21 - 51	- 35 - 54	- 30 - 60
65	80	+ 49 + 30	+ 60 + 30	+ 76 + 30	+ 29 + 10	+ 19 0	+ 30	+ 46 0	+ 120 0	+ 190 0	+ 300	+ 13 - 6	+ 18 - 12	± 150	+ 4 - 15	- 5 - 24	0 - 30	- 14 - 33	- 9 - 39	0 - 190	- 21 - 51	- 37 - 56	- 32 - 62
80	100	+ 58 + 36	+ 71 + 36	+ 90 + 36	+ 34 + 12	+ 22 0	+ 35 0	+ 54 0	+ 140 0	+ 220 0	+ 350 0	+ 16 - 6	+ 22 - 13	± 175	+ 4 - 18	- 6 - 28	0 - 35	- 16 - 38	- 10 - 45	0 - 220	- 24 - 59	- 44 - 66	- 38 - 73
100	120	+ 58 + 36	+ 71 + 36	+ 90 + 36	+ 34 + 12	+ 22	+ 35 0	+ 54 0	+ 140 0	+ 220 0	+ 350 0	+ 16 - 6	+ 22 - 13	± 175	+ 4 - 18	- 6 - 28	0 - 35	- 16 - 38	- 10 - 45	0 - 220	- 24 - 59	- 47 - 69	- 41 - 76
120	140	+ 68 + 43	+ 83 + 43	+ 106 + 43	+ 39 + 14	+ 25 0	+ 40 0	+ 63 0	+ 160 0	+ 250 0	+ 400	+ 18 - 7	+ 26 - 14	± 200	+ 4 - 21	- 8 - 33	0 - 40	- 20 - 45	- 12 - 52	0 - 250	- 28 - 68	- 56 - 81	- 48 - 88
140	160	+ 68 + 43	+ 83 + 43	+ 106 + 43	+ 39 + 14	+ 25 0	+ 40 0	+ 63 0	+ 160 0	+ 250	+ 400	+ 18 - 7	+ 26 - 14	± 200	+ 4 - 21	- 8 - 33	0 - 40	- 20 - 45	- 12 - 52	0 - 250	- 28 - 68	- 58 - 83	- 50 - 90
160	180	+ 68 + 43	+ 83 + 43	+ 106 + 43	+ 39 + 14	+ 25 0	+ 4 0 0	+ 63 0	+ 160 0	+ 250 0	+ 400	+ 18 - 7	+ 26 - 14	± 200	+ 4 - 21	- 8 - 33	0 - 40	- 20 - 45	- 12 - 52	0 - 250	- 28 - 68	- 61 - 86	- 53 - 93
180	200	+ 79 + 50	+ 96 + 50	+ 122 + 50	+ 44 + 15	+ 29	+ 46 0	+ 72 0	+ 185 0	+ 290 0	+ 460	+ 22	+ 30	± 230	+ 5 - 24	- 8 - 37	0 - 46	- 22 - 51	- 14 - 60	0 - 290	- 33 - 79	- 68 - 97	- 60 - 106
200	225	+ 79 + 50	+ 96 + 50	+ 122 + 50	+ 44 + 15	+ 29 0	+ 46 0	+ 72 0	+ 185 0	+ 290 0	+ 460 0	+ 22 - 7	+ 30 - 16	± 230	+ 5 - 24	- 8 - 37	0 - 46	- 22 - 51	- 14 - 60	0 - 290	- 33 - 79	- 71 - 100	- 63 - 109
225	250	+ 79 + 50	+ 96 + 50	+ 122 + 50	+ 44 + 15	+ 29 0	+ 46 0	+ 72 0	+ 185 0	+ 290 0	+ 460 0	+ 22	+ 30	± 230	+ 5 - 24	- 8 - 37	0 - 46	- 22 - 51	- 14 - 60	0 - 290	- 33 - 79	- 75 - 104	- 67 - 113
250	280	+ 88 + 56	+ 108 + 56	+ 137 + 56	+ 49 + 17	+ 32	+ 52 0	+81	+ 210	+ 320 0	+ 520 0	+ 25	+ 36 - 16	± 260	+ 5 - 27	- 9 - 41	0 - 52	- 25 - 57	- 14 - 66	0 - 320	- 36 - 88	- 85 - 117	- 74 - 126
280	315	+ 88 + 56	+ 108 + 56	+ 137 + 56	+ 49 + 17	+ 32	+ 52 0	+ 81 0	+ 210	+ 320 0	+ 520 0	+ 25	+ 36 - 16	± 260	+ 5 - 27	- 9 - 41	0 - 52	- 25 - 57	- 14 - 66	0 - 320	- 36 - 88	- 89 - 121	- 78 - 130
315	355	+ 98 + 62	+ 119 + 62	+ 151 + 62	+ 54 + 18	+ 36	+ 57 0	+ 89	+ 230 0	+ 360 0	+ 570 0	+ 29 - 7	+ 39 - 18	± 285	+ 7 - 29	- 10 - 46	0 - 57	- 26 - 62	- 16 - 73	0 - 360	- 41 - 98	- 97 - 133	- 87 - 144
355	400	+ 98 + 62	+ 119 + 62	+ 151 + 62	+ 54 + 18	+ 36 0	+ 57 0	+ 89 0	+ 230 0	+ 360 0	+ 570 0	+ 29 - 7	+ 39	± 285	+ 7 - 29	- 10 - 46	0 - 57	- 26 - 62	- 16 - 73	0 - 360	- 41 - 98	- 103 - 139	- 93 - 150

ISO SHAFT TOLERANCES in µm (.001mm)

		f g						h				j		k	m		n	р
		f6	g5	g6	h5	h6	h7	h8	h10	h13	j5	j6	k5	k6	m5	m6	n6	p6
3	6	- 10 - 18	- 4 - 9	- 4 - 12	0 - 5	- 8	0 - 12	0 - 18	0 - 48	0 - 180	+ 3	+ 6 - 2	+ 6 + 1	+ 9 + 1	+ 9 + 4	+ 12 + 4	+ 16 + 8	+ 20 + 12
6	10	- 13 - 22	- 5 - 11	- 5 - 14	0 - 6	0 - 9	0 - 15	0 - 22	0 - 58	0 - 220	+ 4	+ 7	+ 7 + 1	+ 10 + 1	+ 12 + 6	+ 15 + 6	+ 19 + 10	+ 24 + 15
10	18	- 16 - 27	- 6 - 14	- 6 - 17	0 - 8	0 - 11	0 - 18	0 - 27	0 - 70	0 - 270	+ 5 - 3	+ 8	+ 9 + 1	+ 12 + 1	+ 1 5 + 7	+ 18 + 7	+ 23 + 12	+ 29 + 18
18	30	- 20 - 33	- 7 - 16	- 7 - 20	0 - 9	0 - 13	0 - 21	0 - 33	0 - 84	0 - 330	+ 5 - 4	+ 9	+ 11 + 2	+ 15 + 2	+ 17 + 8	+ 21 + 8	+ 28 + 15	+ 35 + 22
30	50	- 25 - 41	- 9 - 20	- 9 - 25	0 - 11	0 - 16	0 - 25	0 - 39	0 - 100	0 - 390	+ 6 - 5	+ 11 - 5	+ 13 + 2	+ 18 + 2	+ 20 + 9	+ 25 + 9	+ 33 + 17	+ 42 + 26
50	80	- 30 - 49	- 10 - 23	- 10 - 29	0 - 13	0 - 19	0 - 30	0 - 46	0 - 120	0 - 460	+ 6 - 7	+ 12 - 7	+ 15 + 2	+21 + 2	+ 24 + 11	+ 30 + 11	+ 39 + 20	+ 51 + 32
80	120	- 36 - 58	- 12 - 27	- 12 - 34	0 - 15	0 - 22	0 - 35	0 - 54	0 - 140	0 - 540	+ 6 - 9	+ 13	+ 18 + 3	+ 25 + 3	+ 28 + 13	+ 35 + 13	+ 45 + 23	+ 59 + 37
120	180	- 43 - 68	- 14 - 32	- 14 - 39	0 - 18	0 - 25	0 - 40	0 - 63	0 - 160	0 - 630	+ 7 - 11	+ 14	+ 21 + 3	+ 28 + 3	+ 33 + 15	+ 40 + 15	+ 52 + 27	+ 68 + 43
180	250	- 50 - 79	- 15 - 35	- 15 - 44	0 - 20	0 - 29	0 - 46	0 - 72	0 - 185	0 - 720	+ 7 - 13	+ 16 - 13	+ 24 + 4	+ 33 + 4	+ 37 + 17	+ 46 + 17	+ 60 + 31	+ 79 + 50
250	315	- 56 - 88	- 17 - 40	- 17 - 49	0 - 23	0 - 32	0 - 52	0 - 81	0 - 210	0 - 810	+ 7 - 16	+ 16 - 16	+ 27 + 4	+ 36 + 4	+ 43 + 20	+ 52 + 20	+ 66 + 34	+ 88 + 56
315	400	- 62 - 98	- 18 - 43	- 18 - 54	0 - 25	0 - 36	0 - 57	0 - 89	0 - 230	0 - 890	+ 7 - 18	+ 18 - 18	+ 29 + 4	+ 40 + 4	+ 46 + 21	+ 57 + 21	+ 73 + 37	+ 98 + 62



SYMBOLS

		A	Page
AIG		Needle.	63
AR ARNB ARNBT ARZ		Roller thrust bearing - one retained plate. Precision combined bearing with adjustable preload using roller thrust bearings. Combined bearing ARNB with screw locations. Roller thrust bearing - two retained plates.	97 129 129 97
AX AXJ AXNA		Needle thrust bearing - one retained plate. Special needle thrust bearing for high speed. Precision combined bearing with adjustable preload using needle thrust bearings	97 98 129
AXNAT AXNB AXNBT AXZ		Combined bearing AXNA with screw locations. Precision combined bearing with adjustable preload using needle thrust bearings. Combined bearing AXNB with screw locations. Needle thrust bearing -two retained plates.	129 129 129 97
		В	
B BB	B6	Needle cage, one-piece with one row of needles. Needle cage, one-piece with two rows of needles. Convex outer diameter for RNA 11 000 series cam followers.	- - 71
BIC	50	Cylindrical inner ring with lubrication holes for full complement needle bearings type RNA.	149
BICG		Wide cylindrical inner ring with lubrication holes for full complement needle bearings type RNA 1000, 2000 and 3000 series.	149
BIG-BIK		Wide cylindrical inner ring without lubrication hole for full complement needle bearings type RNA 1000, 2000 and 3000 series.	149
BIP		Wide cylindrical inner ring without lubrication hole for full complement needle bearings type RNA 1000 series.	149
вк	BIR BP BR	Full complement needle bearing type NA with special convex inner ring. Caged needle bush, closed-end, according to ISO tolerances. Needle roller with flat ends. Needle roller with round ends.	52 25 63 63
CN, CNS CP CPN CPR CPT	C2, C3, C4, C5	Radial play groups for complete bearings with inner rings. Needle bush closed-end with full complement grease retained needles. Plate for needle thrust bearing, roller thrust bearing (light series) and combined bearing. Plate, machine-tool quality. Plate for roller thrust bearing (heavy series) and 812 series. Overthick thrust plate.	38 25 - - -
		D	
DB DBF DBFH DBH		Caged needle bush, open. Caged needle bush, closed-end. Needle bush DBF with lubrication hole. Needle bush DB with lubrication hole.	25 25 25 25
DG, DGX®	DELTA DER	High precision needle roller bearing with adjustable play. Needle roller bearing with convex outer ring. Deltaflex bearing for steering column.	- 51 -
DL DLF DLFH DLH		Full complement needle bush, open. Full complement needle bush, closed-end. Needle bush DLF with lubrication hole. Needle bush DL with lubrication hole.	25 25 25 25
		E	
	E EE EEM	Seal incorporated one side. Seals incorporated on two sides Metal seals incorporated on two sides	25 71 71
ET		Sealing ring.	143



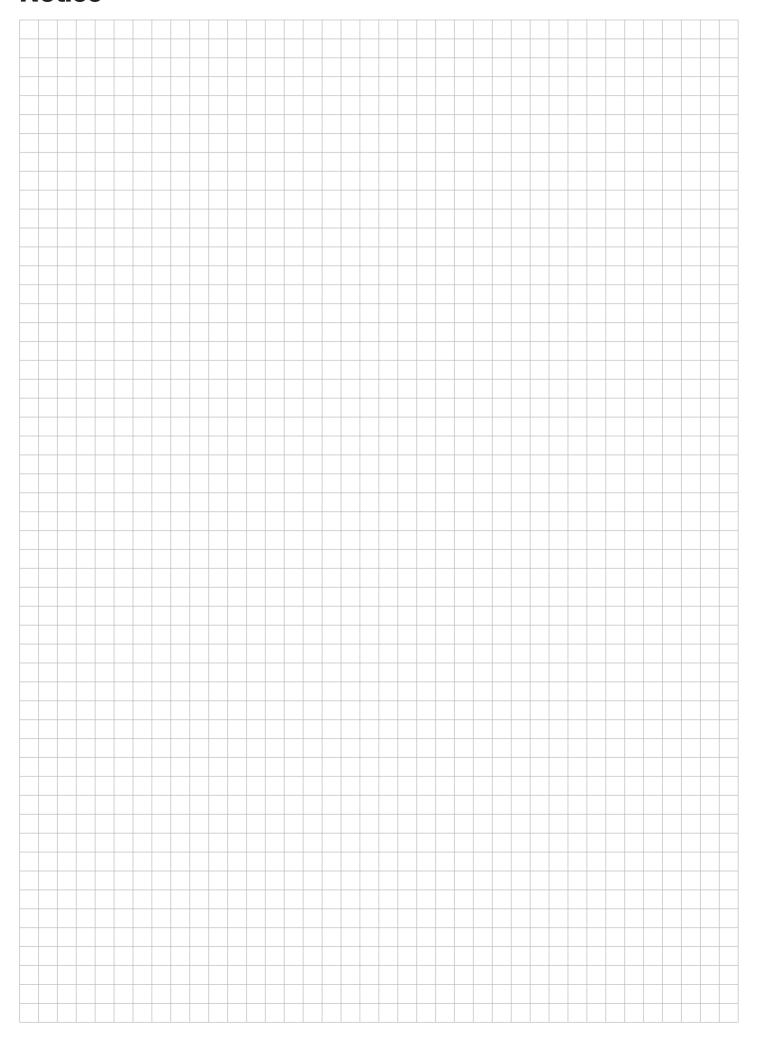
		F	Page
FGL FGUFGUL		Cam follower with non-separable outer and inner rings. Convex outer ring. Cam follower with non-separable outer and inner rings. Cylindrical outer ring. Roller cam follower.	71 71 71
		G	
GC GCL GCR		Cam follower with stud. Convex outer ring. Cam follower with stud. Cylindrical outer ring. Eccentric cam follower with stud. Convex outer ring.	71 71 71
GCRL GCU-GCUL GCUR GCURL		Eccentric cam follower with stud. Cylindrical outer ring. Roller cam follower. Eccentric roller cam follower with stud. Convex Outer Ring Eccentric roller cam follower with stud. Cylindrical Outer Ring	71 71 71 71
GN		Grease nipple for cam follower with stud.	74
		н	
HK Hm	HT 1, 2, 3, 4	Caged needle bush, open, according to ISO tolerances. Nut for cam follower with stud. Stabilisation heat treatment for high temperature.	25 74 12
		I	
IM IMC		Cylindrical inner ring. Cylindrical inner ring with lubrication hole.	145 145
JL JLF JLFH JLH		J Full complement needle bushes, open, inch dimensions. Full complement needle bush, closed-end, inch dimensions. Needle bush JLF with lubrication hole. Needle bush FL with lubrication hole.	25 25 25 25
MB MBB		M Needle cage two-piece with one row of needles. Needle cage two-piece with two rows of needles.	-
IVIDD			_
NA NAR NAW NB NBI		R Full complement or caged needle bearing with inner ring. Full complement self-aligning needle roller bearing, with inner ring. Full complement inverted bearing. Caged needle bearing without inner ring. Caged needle bearing with inner ring.	51 - - 37 37
NE NG NH		Special product, deep drawn raceway. Special product, tooled race~ay. Special product, both types raceway.	- - -
ОВ		O Plug for cam follower with stud.	74
		P	
	P P6, P5, P4	Needle bush DB, DL and derivatives, or inner rings 1M and IMC, according to ISO tolerances. Precision tolerance codes for inner and outer rings.	25 38
PM PMH	10, 10, 14	Intermediate plate for needle or roller thrust bearing, light series. Intermediate plate with lubrication hole for needle or roller thrust bearing, light series.	-



		R	Page
RAX 400 RAX 500 RAX 700° RAX 700°	R6	Convex inner ring raceway. Combined bearing with needle thrust cage. Combined bearing with roller thrust cage. Combined bearing with thin outer ring, open. Combined bearing with thin outer ring, closed- end.	52 111 111 111 111
RAXN 400, 500 RAXNPZ 400, 500 RAXNTZ 400 RAXPZ 400 RAXTZ 400 RAXZ 500		Combined bearing, machine-tool quality. Combined bearing RAXN 400 or RAXN 500 with retained thrust plate. Combined bearing RAXN 400 with retained thrust plate. Combined bearing RAX 400 with retained thrust plate. Combined bearing RAX 400 with retained thrust plate. Combined bearing RAX 500 with retained thrust plate.	112 112 112 112 123 111
RNA RNAB RNAL RNAR RT		Full complement or cages needle bearing without inner ring. Cam follower 11 000 series, outer diameter crowned greater than86. Cam follower 11 000 series, cylindrical outer ring. Full complement self-aligning needle roller bearing, without inner ring. Adjustment spring for Delta bearing.	51 71 71 -
SL	(s/Bi) SGT	S Old symbol for full complement bearing without inner ring. Replaced by RNA. Needle bearing without lubrication groove and hole in outer ring. Full complement needle bush, grease retained needles, open.	51 51 25
	TA TB TC	T Radial play, precision applications. Radial play, selected from lower half of standard tolerance. Radial play, selected from upper half of standard tolerance TS Special radial play for conditions of expansion.	38–53 38–53 38–53
	Z S	Z Reduced radial play for special conditions.	38



Notice



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