

## 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 precludes 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

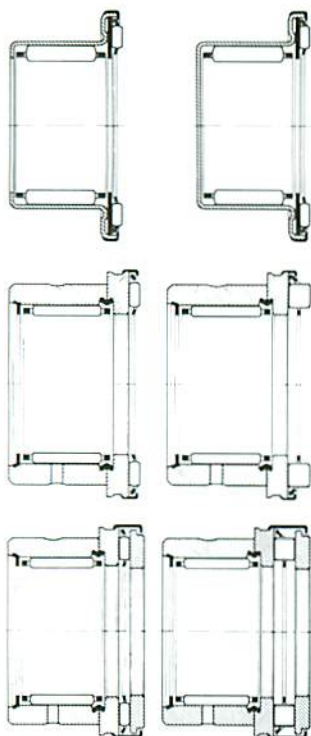
#### Standard Series

	With needle thrust bearing				With roller thrust bearing	
	Thin outer ring		Thick outer 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	CP thick or thin		CP thick or thin		CP thick or thin	
Inner rings 1)	IM		IM...P		IM...P	

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	IM 19 000 IM 20 600		IM 20 600	



### 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. Closed-end 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  $C_i$ : tolerance F6 (ISO Standard 1206).

Width  $l$ :  $-0.1/-0.2$  mm

Outer diameter  $D_1$   
Out-of-roundness  
Inner rings IM...P

Normal tolerance class according to ISO Standard 1206 (French Standard F 22 370). See table page 181.

#### ► Axial component

Thickness  $h$ :  $+0.05/-0.06$  mm

Axial run-out: 0.010 mm

#### ► Thrust plates

Tolerance	Thin thrust plates		Thick thrust plates mm
	Bore $A \leq 60$ mm	Bore $A > 60$ mm	
Thickness	$E \pm 0.030$ <sup>1)</sup>	$E \pm 0.050$ <sup>2)</sup>	$E \pm 0.050$
Axial run-out	0.020 <sup>1)</sup>	0.025 <sup>2)</sup>	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  $C_i$ : tolerance F5 (ISO Standard 1206).

Width  $l$ :  $-0.1/-0.2$  mm.

Outer diameter  $D_1$ : Normal tolerance class according to ISO Standard 1206 (French Standard E 22 370) – see table page 181.

Out-of-roundness: Precision class 5 according to ISO Recommendation 492 (DIN 620) – see table page 181.

Inner rings IM 19 000 and IM 20 600:

inner diameter  $D_i$ :  $0/-0.010$  mm

outer diameter  $C_i$ :  $0/-0.005$  mm

width  $L_1$ :  $0/-0.130$  mm up to  $D_i = 40$  mm  
 $0/-0.160$  mm for  $D_i > 40$  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  $\mu\text{m}$  up to  $C_i = 20$  mm  
 +20/+60  $\mu\text{m}$   $C_i = 25$  to 40 mm  
 +20/+65  $\mu\text{m}$   $C_i = 45$  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  $C_i$  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 $C_i$ mm	Tolerance of diameter under the needles		
	Normal F6 $\mu\text{m}$	TB $\mu\text{m}$	TC $\mu\text{m}$
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 on page 45 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 $C_i$ mm	Tolerance of diameter under the needles	
	F5 $\mu\text{m}$	
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  $C_i$  of inner ring IM 19 000 or IM 20 600.



## SHAFT AND HOUSING TOLERANCES

Combined bearings	SHAFT				HOUSING	
	Dimension Ci for bearings without inner ring		Dimension Di for bearings with inner ring		Dimension D1	
	Rotation	Oscillation	Rotation	Oscillation	Steel or cast-iron	Non-ferrous metal 1) or thin 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	M6

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.

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 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.

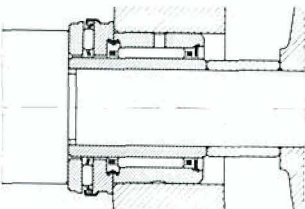
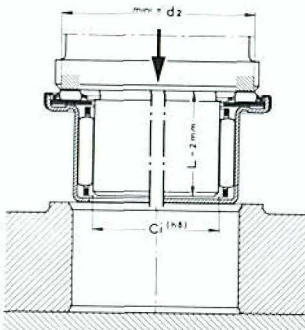
### TYPICAL ARRANGEMENTS USING COMBINED BEARINGS

RAX and RAXF 700: see page 134.

RAX 400 (or 500) and RAXPZ 400 (or RAXZ 500): see page 135.

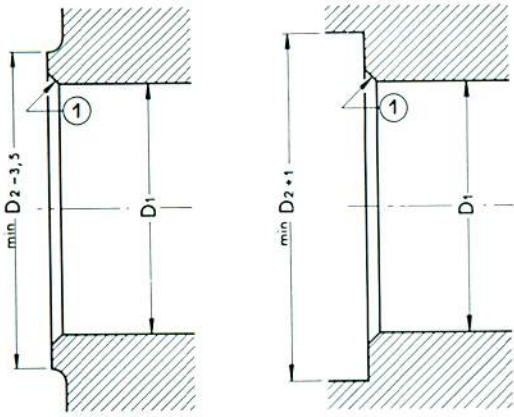
RAXN 400 (or 500) and RAXNPZ 400 (or RAXNZ 500): the typical applications for these machine-tool quality combined bearings used without inner ring and with or without thick thrust plate are identical to those for the corresponding standard combined bearings (see page 135).

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).

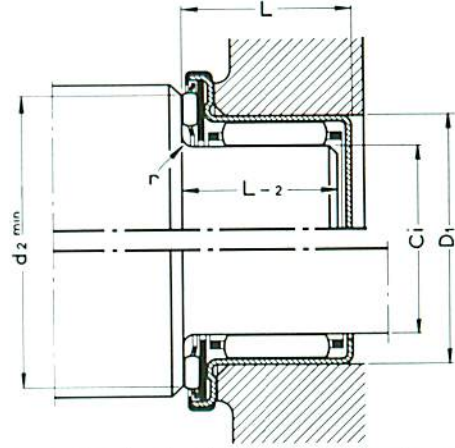




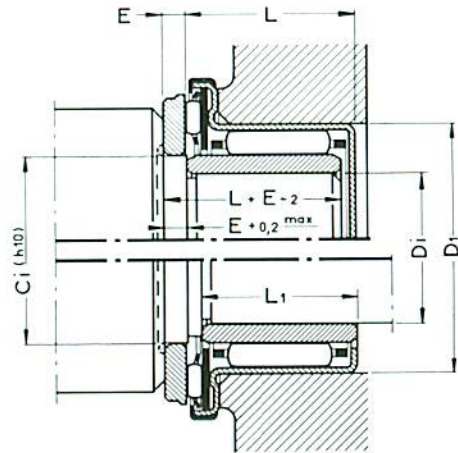
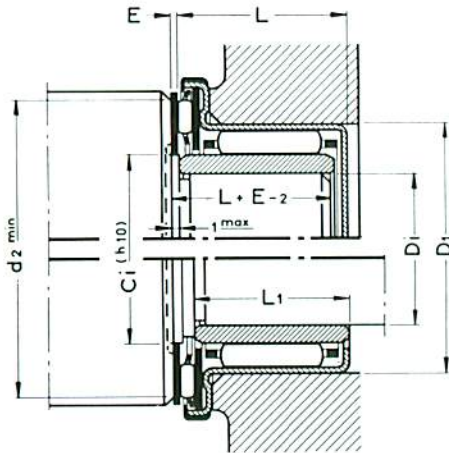
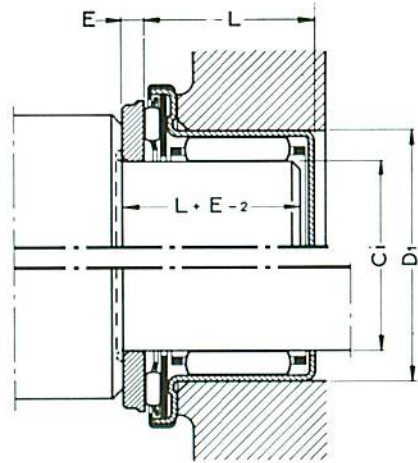
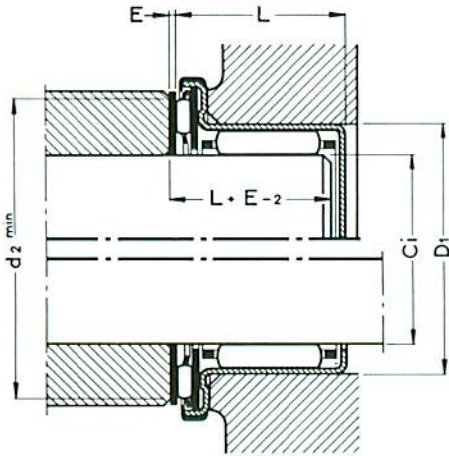
MOUNTING FACES OF HOUSING



(1) Chamfer: 0,5 to 1 mm up to RAX (or RAXF) 720  
0,7 to 1,5 mm from RAX (or RAXF) 725



RAX RAXF	712	714	715	718	720	725	730	735	740	745
r max mm	0,75	1	1,8	1	0,5	1,8	1,8	1,8	0,5	0,5



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

