5. CYLINDRICAL ROLLER BEARINGS

ROLLING BEARINGS

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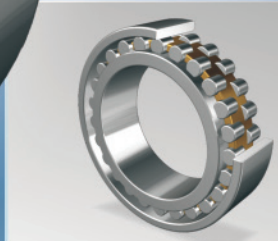
SCINETTI



TABLES:

INTRODUCTION:

5. Cylindrical roller bearings

5.1. Single-row cylindrical roller bearings

5.1.1. Dimension series

- **N** – open-end outer ring
- **NF** – one-sided open-end outer ring
- **NP** – closed-end outer ring and retaining ring **P**
- **NU** – open-end inner ring
- **NUB** – extended open-end inner ring
- **NUC** – open-end inner ring (as NU, but different make of the inner ring)
- **NUJ** – NU bearing and **HJ** angular ring
- **NJ** – one-sided open-end inner ring
- **NH** – NJ bearing and **HJ** angular ring
- **NJP** – NJ bearing with a separate lip in the form of the **P** retaining ring
- **NUP** –- one-sided open-end inner ring and additionally the **P** retaining ring

The dimension series listed below are characteristic for various solutions described above:

- **18.. 38.. 48.. 19.. 29.. 39.. 49.. 69.. 10.. 20.. 30.. 40.. 50.. 31.. 51.. 2.. 12.. 22.. 32.. 52.. 3.. 23.. 33.. 4..**

Cylindrical roller bearings are dismountable and after removing the free ring we always get the following types of bearings:

- **RNU** – without the inner ring or
- **RN** – without the outer ring.

5.1.2. Structure

Because of the wide variety of construction types it is very difficult to describe in detail the structure of cylindrical roller bearings.

On the whole, though, cylindrical roller bearings consist of the cage with rollers, which is fixed to one of the rings (to the inner ring in the N, NP and NF makes and to the outer ring in the NU, NJ, NUP and NH makes), and the second, free ring of diversified structure. And precisely this diversified structure of the free ring contributed to such great number of construction types. Individual construction types have been listed above in the form of dimension series. The key feature of all cylindrical roller bearings is their dismountability, of course, besides bearings that lack free rings.

Fig.16 Single-row cylindrical roller bearing with an open-end outer ring

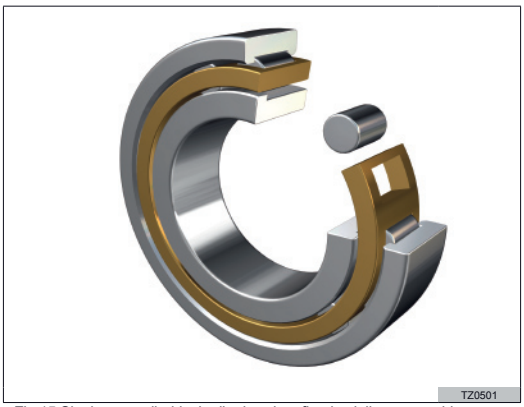


Fig.15 Single-row cylindrical roller bearing, fixed axially on one side

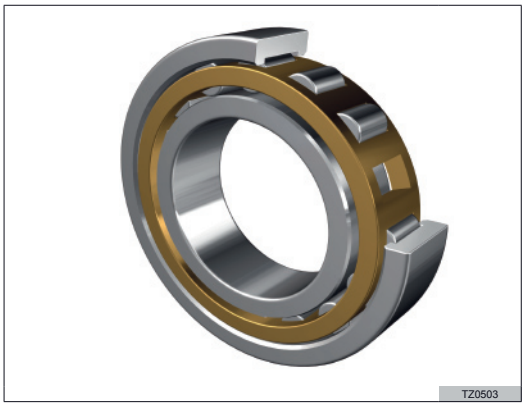


Fig.17 Single-row cylindrical roller bearing, with an open-end inner ring

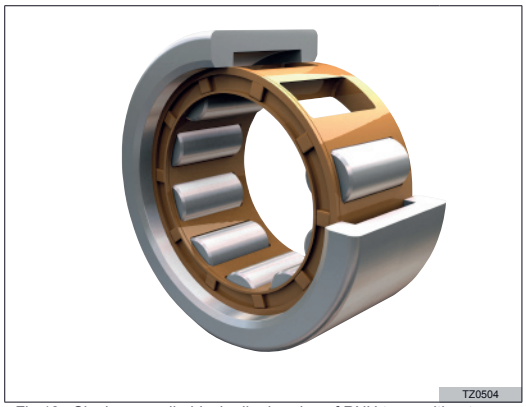


Fig.18a Single-row cylindrical roller bearing of RNU type, without an inner ring

5.1.3. Features

Cylindrical roller bearings feature a very high load capacity and rigidity when compared to other bearings with similar dimensions. The variants without cage (with full complement of rolling elements) are characterized by even higher rigidity and load capacity, though, their limiting rotational speed is considerably lower. Single-row cylindrical roller bearings are by and large intended for accommodating radial loads, but bearings of NJ (NF) type allow to fix the shaft axially in one direction, and NUP (NP) bearings as well as NJ bearings together with the HJ angular ring (marked as NH) allow to fix the shaft in two directions. These bearings are able to support some axial load, especially periodical loads or load in form of shock pulses, however to a limited extent.

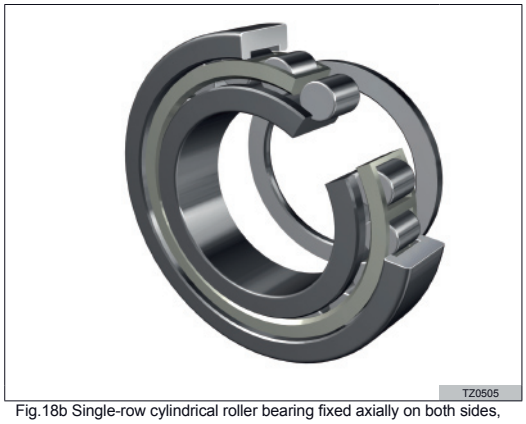


Fig.18b Single-row cylindrical roller bearing fixed axially on both sides, NUP-type

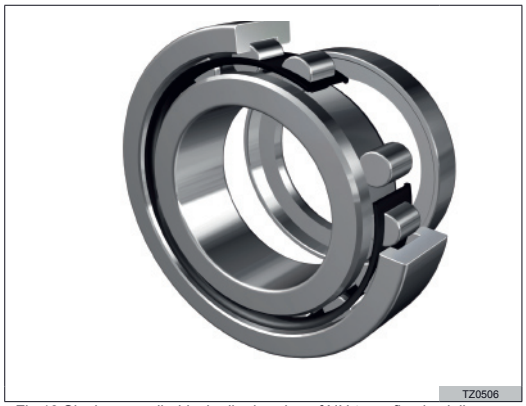


Fig.19 Single-row cylindrical roller bearing of NH-type, fixed axially on both sides

5.1.4. Cages

Cages of single-row cylindrical roller bearings are usually made of steel or brass.
One can also encounter designs with cages made of thermoplastic material – polyamide strengthened with glass fiber.

5.1.5. Misalignment

Single-row cylindrical roller bearings are rated among extremely sensitive to errors of alignment, which cause end stresses. The longevity of cylindrical roller bearings is very short under such conditions.

5.1.6. Clearance

The clearance of cylindrical roller bearings is always reached through the processing of the free ring.
The "**NA**" designation behind the cylindrical roller bearing symbol gives information that free rings: the outer or the inner one (depending on the type) have been individually matched with rollers and are not replaceable.

5.1.7. "E" – Bearings in the strengthened design

In no other case the E-design is more important than in that of cylindrical roller bearings. Similar to other types of bearings the E-letter means also in case of cylindrical roller bearings that the internal construction of the bearing has been changed, through the change of the number and size of the rolling elements, of the cage structure and the like. Strengthened-design bearings feature considerably better parameters both with regard to their load capacity and to their rotational speed. From the point of view of designers it is possible to substitute standard-make bearings for strengthened variants. One can await an improvement in the quality and longevity of the bearing-closed pair. The problem arises when we take a bearing that lacks a free ring – the bearing of RNU and RN type. The main dimensions of the strengthened version are kept unchanged of course, whereas some of additional dimensions are slightly modified. One of such dimensions is the diameter of the F_w circle, which is inscribed about the cage with rollers (in case of RNU bearings) or circumscribed about the cage with rollers (in case of RN bearings). So it is logically that in case of using bearings without free rings the former, "additional", dimension becomes the main dimension. One shall pay special attention to this fact when replacing bearings that lack free rings (mounted directly on the shaft or in the housings).

5.1.8. Application of cylindrical roller bearings

Because the cylindrical roller bearings are intended for accommodating substantial radial load, they should be applied wherever such loads prevail. Besides the fact that they are able to carry considerable radial loads, they guarantee substantial bearing mounting rigidity, too, compared with other types of bearings. Actually it is nearly impossible to point out the field in which cylindrical roller bearings are not applied.
Because of their high sensitivity to errors of alignment, cylindrical roller bearings are often used together with other types of bearings (e.g. in tool machines' spindles).

5.2. Multi-row cylindrical roller bearings

5.2.1. Dimension series

- **NN 30.. NN31.. NN48.. NN49.. NN40..**
- **NN 30..K NN31..K NN48..K NN49..K NN40..K**
- **NNU 49.. NNU60.. NNU41..**
- **NNU 49..K NNU60..K NNU41..K**

5.2.2. Main features

Multi-row cylindrical roller bearings are characterized by substantial load capacity (the more rows of rollers the higher the load capacity) but also by rigidity when mounted on the shaft. There are also versions without a free ring **(RNNU.. and RNN..)**. Most often they are produced in higher accuracy classes. Cylindrical roller bearings with full number of rolling elements (without cage) feature exceptionally high load carrying capacity and rigidity.

5.2.3. Misalignments

Multi-row cylindrical roller bearings are rated among extremely sensitive to errors of alignment and angular displacement, which cause end stresses. The longevity of cylindrical roller bearings is very short under such conditions.

5.2.4. Cages

Most often solid brass cages are used but steel and polyamide cages are also available.
It is often the case that bearings are manufactured without cage – with full number of rolling elements.
The data in the table below regard production of the most common makes. Individual types may often differ with small details, which may have no relevance from the point of view of the housing of the bearing. The differences encountered most often result from the ways of axial placement of rings. As seen in the table, dimension series represent different types of lips, sometimes additional expanding rings, etc.

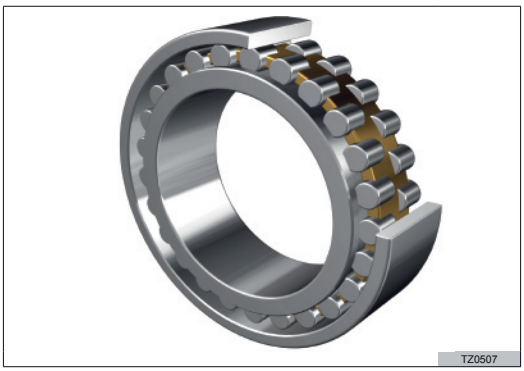


Fig.20 Double-row cylindrical roller bearing with an open-end outer ring

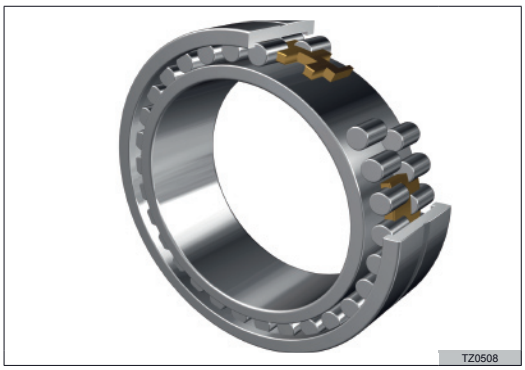


Fig.21 Double-row cylindrical roller bearing with an open-end inner ring

5.3. Cylindrical roller bearings with full complement of rolling elements

5.3.1. Dimension series

CX	Number or rows	Lips on the inner ring	Lips on the outer ring	Notes
NCF..	**1**	two fixed lips	one fixed lip	snap ring on the inside of the outer ring without a fixed lip
NJF..	**1**	one fixed lip	two fixed lips	inner ring the same as used in the NJ bearings
NNCF..	**2**	two fixed lips	one fixed lip	snap ring on the inside of the outer ring without a fixed lip
NNC..	**2**	two fixed lips	one fixed lip	side ring adjacent to the outer ring from the side without the fixed lip
	2	two fixed lips	two fixed lips	
NNCL..	**2**	two fixed lips	none	
NNF..	**2**	four fixed lips	one inner lip between the rows of rollers	snap grooves on the outer ring, two-piece inner ring

5.3.2. Characterization

Cylindrical roller bearings with full number of rolling elements are equipped with as many rollers as possible and are characterized by a small cross-section height in relation to the bearing's width. It allows to achieve a very high load carrying capacity, and extremely compact constructions. These bearings are absolutely suitable for applications where very heavy radial loads occur, however because of changed kinematic conditions they are not able to operate with so high rotational speed as cylindrical roller bearings with cage.

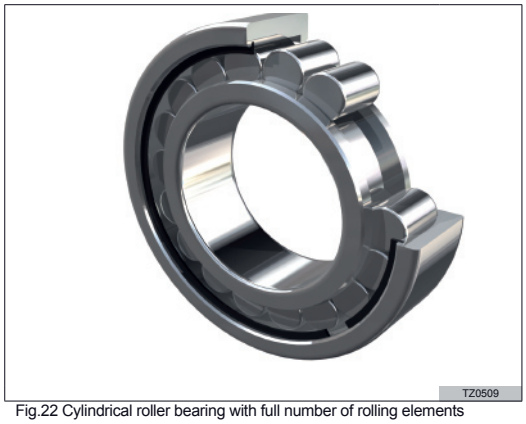


Fig.22 Cylindrical roller bearing with full number of rolling elements

5.3.3. Construction variants

Because of the continually increasing interest into this type of bearings along with ever higher requirements as of operating parameters, cylindrical roller bearings with full number of rolling elements are made in a great number of construction variants. The Table 5.9. shows designations of individual series produced by several manufacturers. Additionally some drawings and pictorial diagrams have been attached.

5.3.4. Special processing of rolling elements

Kinematic conditions of cylindrical roller bearings with full number of rolling elements are adverse in relation to conditions of cylindrical roller bearings with cage, because pitch-surface generators (generating lines) of the adjacent rollers are in contact with each other and slide in different directions to each other. Because of this, surfaces of rolling elements are subjected to special treatment, which aims at minimizing the adverse occurrences. The processing consists in modifying the surface profile of rollers contact surfaces.

5.3.5. Axial load carrying capacity

Cylindrical roller bearings with full number of rollers having lips on the inner and outer ring can accommodate axial loads in addition to radial load. However in that case axial load carrying capacity does not depend on material durability but on the strength and operating parameters of the friction pair: roller/lip.

5.3.6. Misalignment

The ability of the cylindrical roller bearing without cage to compensate misalignments of the inner ring in relation to the outer ring is limited in the same way as in case of cylindrical roller bearings with cage, and comprises in just a few minutes (of arc).

5.3.7. Heat treatment

Cylindrical roller bearings with full number of rolling elements can be operated in the working temperature of up to 150°C, and bearings of over 120 mm in internal diameter keep their dimension up to 200°C.

5.3.8. Application

Cylindrical roller bearings with full number of rolling elements without seal are mainly used for manufacturing gears, while double-row sealed cylindrical roller bearings are most often applied in crane constructions.