

1. Types, design features, and characteristics

Since the rolling elements in cylindrical roller bearings make line contact with raceways, these bearings can accommodate heavy radial loads. The rollers are guided by ribs on either the inner or outer ring, therefore these bearings are also suitable for high speed applications. Furthermore, cylindrical roller bearings are separable, and relatively easy to install and disassemble even when interference fits are required.

Among the various types of cylindrical roller bearings, Type E has a high load capacity and its boundary dimensions are identical to standard type. HT type has a

large axial load capacity, and HL type provides extended wear life in conditions where the development of a lubricating film inside the bearing is difficult.

Double and multiple row bearing arrangements are also available.

For extremely heavy load applications, the non-separable full complement SL type bearing offers special advantages.

Table 1 shows the various types and characteristics of single row cylindrical roller bearings. **Table 2** shows the characteristics of non-standard type cylindrical roller bearings.

Table 1 Cylindrical roller bearing types and characteristics

Type code	Design	Characteristics
NU type N type	 NU type	<ul style="list-style-type: none"> • NU type outer rings have double ribs; outer ring and roller as well as cage can be separated from inner ring. N type inner ring have double ribs; inner ring and roller as well as cage can be separated from outer ring. • Unable to accommodate even the lightest axial loads. • This type is extremely suitable for, and widely used as, the floating side bearing.
	 N type	
NJ type NF type	 NJ type	<ul style="list-style-type: none"> • NJ type has double ribs on outer ring, single rib on inner ring; NF type has single rib on outer ring, and double rib on inner ring. • Can receive single direction axial loads. • When there is no distinction between the fixed side and floating side bearing, can be used as a pair in close proximity.
	 NF type	
NUP type NH type (NJ + HJ)	 NUP type	<ul style="list-style-type: none"> • NUP type has a collar ring attached to the ribless side of the inner ring; NH type is NJ type with an L type collar ring attached. All of these collar rings are separable, and therefore it is necessary to fix the inner ring axially. • Can accommodate axial loads in either direction. • Widely used as the shaft's fixed-side bearing.
	 NH type	

Table 2 Non-standard type cylindrical roller bearing characteristics

Bearing type	Characteristics
<p>E Type cylindrical roller bearing</p> <p>E type Standard type</p> <p> NU2220E $C_r=335kN$ E type bearing NU320 $C_r=299kN$ Standard type bearing NU224E $C_r=335kN$ E type bearing </p> <p>Remarks: In the dimension tables, both E type and standard type are listed, but in the future JIS will change to E type.</p>	<ul style="list-style-type: none"> Boundary dimensions are the same as the standard type, but the diameter, length and number of the rollers have been increased, as well as load capacity. Identified by addition of "E" to end of basic roller number. Enables compact design due to its high load rating. Rollers' inscribed circle diameter differs from standard type rollers and therefore cannot be interchanged.
<p>Large axial load use cylindrical roller bearings (HT type)</p>	<ul style="list-style-type: none"> Can accommodate larger axial loads than standard type thanks to improved geometry of the rib roller end surface. Please consult NTN Engineering concerning the many factors which require consideration, such as load, lubricant, and installation conditions.
<p>Double row cylindrical roller bearings</p>	<ul style="list-style-type: none"> NN type and NNU type available. Widely used for applications requiring thin-walled bearings, such the main shafts of machine tools, rolling machine rollers, and in printing equipment. Internal radial clearance is adjusted for the spindle of machine tools by pressing the tapered bore of the inner ring on a tapered shaft.
<p>Four row cylindrical roller bearings</p>	<ul style="list-style-type: none"> Used mainly in the necks of rolling machine rollers; designed for maximum rated load to accommodate the severely limited space in the roller neck section of such equipment. Many varieties exist, including sealed types, which have been specially designed for high speed use, to prevent creeping, provide dust and water proofing properties, etc. Contact NTN Engineering.
<p>SL type cylindrical roller bearings</p>	<ul style="list-style-type: none"> Full complement roller bearing capable of handling heavy loads. Consult NTN Engineering regarding special application designs for SL type cylindrical roller bearings.

2. Standard cage types

Table 3 shows the standard varieties for cylindrical roller bearings.

Table 3 Standard cage types

Bearing series	Molded resin cage	Pressed cage	Machined cage
NU10	—	—	1005~10/500
NU 2 NU2E	— 204E~218E	208~230 —	232~264 219E~240E
NU22 NU22E	— 2204E~2218E	2208~2230 —	2232~2264 2219E~2240E
NU3 NU3E	— 304E~314E	308~324 —	326~356 315E~332E
NU23 NU23E	— 2304E~2311E	2308~2320 —	2322~2356 2312E~2332E
NU4	—	405~416	—

The basic load ratings listed in the dimension charts correspond to values achieved with the standard cages listed in Table 3. Furthermore, please note that even for the identical bearing, in cases where the number of rolling elements or the cage type differs, the basic rated load will also differ from the values listed in the dimension charts.

- Note: 1) Within the same bearing series, cage type is identical even if the type code (NJ, NUP, N, NF) differs.
- 2) For high speed and other special applications, machined cages can be manufactured when necessary. Consult NTN Engineering.
- 3) Among E type bearings (those using molded resin cages), certain varieties may also use pressed cages. Consult NTN Engineering.
- 4) Although machined cages are standard for two row and four row cylindrical roller bearings, molded resin cages may also be used in some of these bearings for machine tool applications.
- 5) **Due to their material properties, molded resin cages cannot be used in applications where temperatures exceed 120°C. #04 - #07 however use resin material with superior ability to withstand heat and high temperatures, which are capable of withstanding temperatures up to 150°C.**
- 6) Formed resin cages capable of withstanding temperatures up to 150°C can be manufactured by request for type E (formed resin cage) of #08 or greater. For information, please contact NTN Engineering.

3. Allowable misalignment

Although values vary somewhat depending on bearing type and internal specifications, under general load conditions, to avoid the occurrence of edge loading, allowable misalignments have been set as follows:

Bearing width series 0 or 1:	0.001 rad (3.5')
Bearing width series 2:	0.0005 rad (1.5')
Double row cylindrical roller bearings ①:	0.0005 rad (1.5')

① Does not include high precision bearings for machine tool main shaft applications.

4. Allowable axial load for cylindrical roller bearings

Cylindrical roller bearings with ribs on the inner and outer rings are capable of simultaneously bearing a radial load and an axial load of a certain degree. Unlike basic load ratings based on rolling fatigue, allowable axial load is determined by heat produced on the sliding surface between the ends of the rollers and rib, seizure and wear. Allowable axial load when center axial load is applied is approximately determined by formula (1), which is based upon experience and testing.

$$P_t = k \cdot d^2 \cdot P_z \dots\dots\dots(1)$$

Where:

- P_t : Allowable axial load when rotating N {kgf}
- k : Factor determined by internal design of bearing (see **Table 4**)
- d : Bearing bore mm
- P_z : Allowable surface pressure of rib MPa {kgf/mm²} (see **Diagram 1**)

If axial load is greater than radial load, the rollers will not rotate properly. The allowable axial load therefore must not exceed the value for $F_{a \max}$ given in **Table 4**.

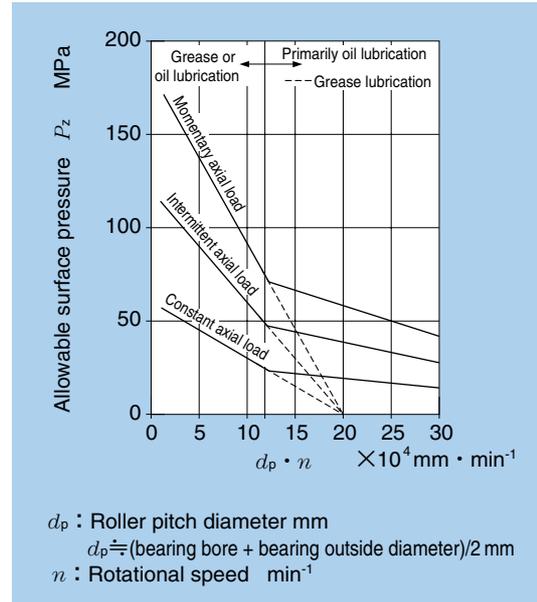
The following are also important to operate the bearing smoothly under axial load:

- (1) Do not make the internal radial clearance any larger than necessary.
- (2) Use lubricant with extreme pressure additive.
- (3) Make the shoulder of the housing and shaft high enough for the rib of the bearing.
- (4) If the bearing is to support an extreme axial load, mounting precision should be improved and the bearing should rotate slowly before actual use.

If large cylindrical roller bearings (bore of 300 mm or more)

are to support an axial load or moment load simultaneously, please contact NTN Engineering.

NTN Engineering also offers cylindrical roller bearings for high axial loads (HT type). For details, please contact NTN Engineering.



d_p : Roller pitch diameter mm
 $d_p \doteq (\text{bearing bore} + \text{bearing outside diameter})/2$ mm
 n : Rotational speed min⁻¹

Diagram 1 Allowable surface pressure of rib

Table 4 Factor k values and allowable axial load ($F_{a \max}$)

Bearing series	k	$F_{a \max}$
NJ, NUP10	0.040	$0.4F_r$
NJ, NUP, NF, NH2,		
NJ, NUP, NH22		
NJ, NUP, NF, NH3,	0.065	$0.4F_r$
NJ, NUP, NH23		
NJ, NUP, NH2E,	0.050	$0.4F_r$
NJ, NUP, NH22E		
NJ, NUP, NH3E,	0.080	$0.4F_r$
NJ, NUP, NH23E		
NJ, NUP, NH4,	0.100	$0.4F_r$
SL01-48	0.022	$0.2F_r$
SL01-49	0.034	$0.2F_r$
SL04-50	0.044	$0.2F_r$