NSK

# BEARINGS FOR RAILWAY ROLLING STOCK

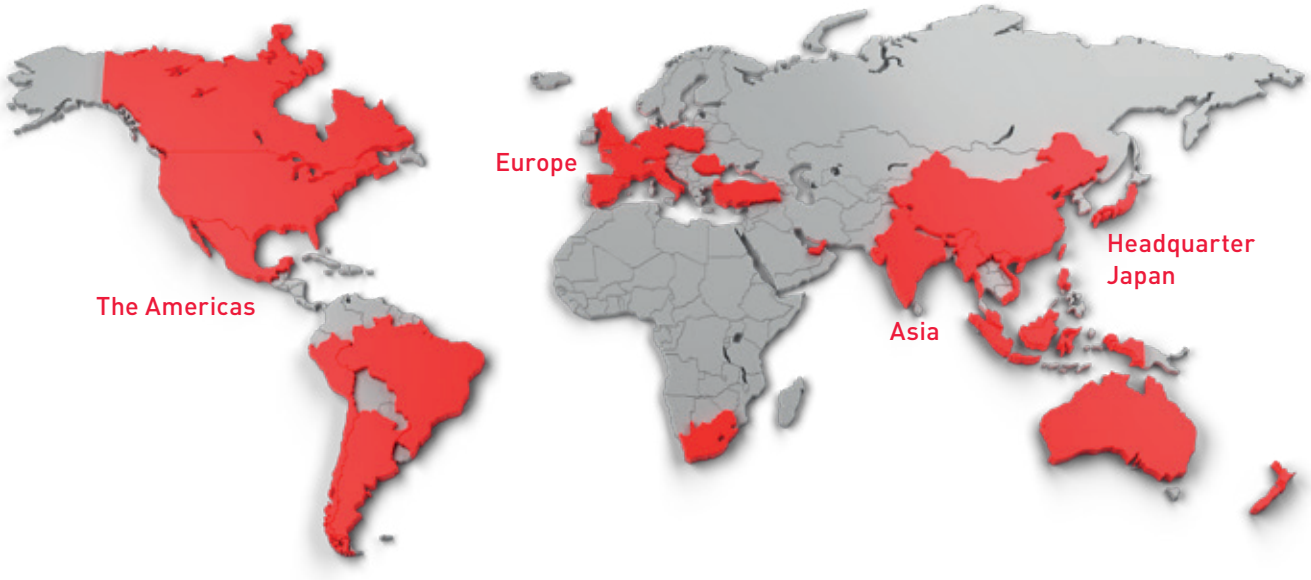


BRANDS OF **NSK EUROPE**

NSK RHP *bearings* PPL

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### The NSK company

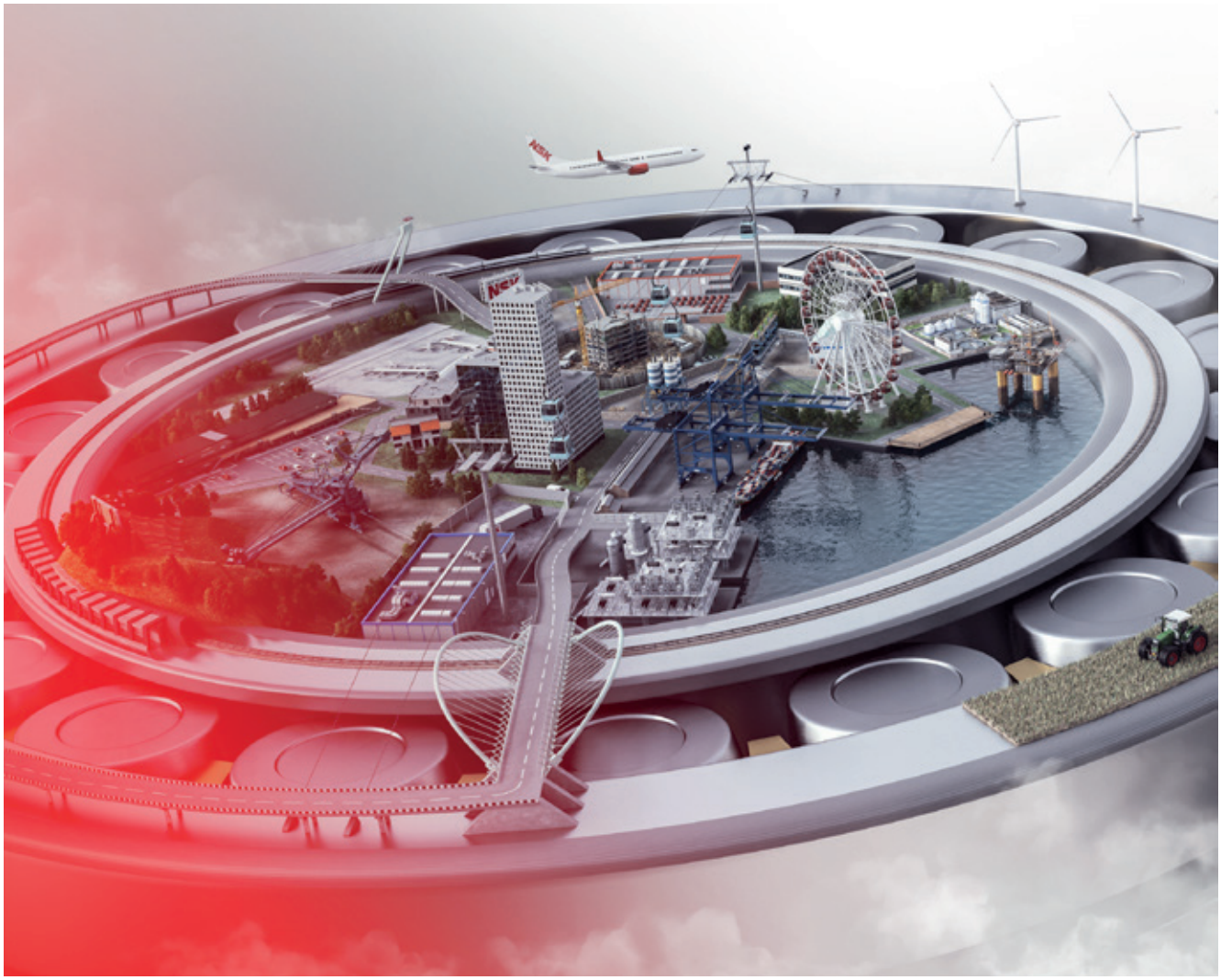
NSK commenced operations as the first Japanese manufacturer of rolling bearings back in 1916. Ever since, we have been continuously expanding and improving not only our product portfolio but also our range of services for various industrial sectors. In this context our worlwide research and production facilities are linked together in a global network. Here we concentrate not only on the development of new technologies, but also on the continuous optimisation of quality – at every process stage. Among other things, our research activities include product design, simulation applications using a variety of analytical systems and the development of different steels and lubricants for rolling bearings.

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# 1. Axle Bearings for Railway Rolling Stock






## Characteristics of Axle Bearings

Rolling stock axle bearings are subject to radial impact loads caused by rail joints, switches and sometimes wheel flats, as well as to the static and dynamic radial loads of vehicle weight. They are also liable to receive axial loads generated by lateral movement as trains run on curved rails or in a snaking motion. All of these loads together form complex combinations that act on axle bearings. Axle bearings must therefore be designed on the basis of not only dimensional requirements of the axle journal and bearing box geometry, but also these complex load conditions. Additionally, as axle bearings play a critical role in the safety of railroad operation, they are periodically disassembled for inspection. For this reason, simple and dependable procedures for disassembly, inspection and re-assembly are important design factors as well. Utilizing its vast know-how and experience, NSK has designed, manufactured and supplied a wide variety of axle bearings.

All types of radial roller bearings, including tapered roller bearings, spherical roller bearings and cylindrical roller bearings, have been used in rolling stock axles based on the particular merits of each type.

To improve operating efficiency, bearings must offer longer inspection intervals, simplified maintenance procedures and increased integration of bearing components and adjacent parts. To meet these needs, unitized bearings with advanced sealing devices have been introduced and are now widely used in modern rolling stock.

## Types of Axle Bearings and their Applications

Axle bearings currently in use are classified into the following six types based both on bearing type and sealing device:

- Sealed-Clean Rotating End Cap Tapered Roller Bearings
- Sealed-Clean Rotating End Cap Cylindrical Roller Bearings
- Spherical roller bearings
- Cylindrical roller bearings combined with ball bearings
- Cylindrical roller bearings with ribs
- Tapered roller bearings

To ensure sufficient load-carrying capacity, all of these types are usually manufactured in double-row configurations.

# 2. Sealed-Clean Rotating End Cap Tapered Roller Bearings

Preventing grease deterioration and leakage, as well as the intrusion of water and other foreign matter into the grease, are vital for eliminating bearing trouble and lengthening maintenance intervals. Clearly, bearing seals offer the best way of achieving these objectives.

Sealed-Clean Rotating End Cap Tapered Roller Bearings are highly integrated with surrounding components and incorporate advanced sealing mechanisms. They offer outstanding performance, durability and ease of handling. The NSK Sealed-Clean Rotating End Cap Tapered Roller Bearings inch series was approved by the Association of American Railroads (AAR) for use on freight car axles and has been widely used in markets all over the world. In Japan, Sealed-Clean Rotating End Cap Tapered Roller Bearings have long been used as container car axle bearings, earning a reputation among users for their excellent performance and durability. Recently, Sealed-Clean Rotating End Cap Tapered Roller Bearings are being used in a broader range of applications including Shinkansen trains and new models of conventional electric and diesel trains.

**The following outlines the features and usage of current Sealed-Clean Rotating End Cap Tapered Roller Bearings:**

**1.** Generally, Sealed-Clean Rotating End Cap Tapered Roller Bearings consist of an end cap, cap screws, a locking plate for fastening the end cap, a seal wear ring, a double-row tapered roller bearing and a backing ring. The latest variation has a backing ring that also serves as a seal wear ring.

**2.** When the axle end needs to be exposed for inspection or re-machining of the wheel, it can be exposed easily by loosening the cap screws and removing the end cap. A recent variation incorporates a smaller rubber cover designed to further ease access to the end of the axle.

**3.** Oil seals, mounted in seal cases, are press-fitted onto both ends of the outer ring and are in contact with the seal wear rings with a specified interference and pressure. The seals are spring-loaded contact seals. They are capable of preventing grease leakage and the intrusion of water and foreign matter into the bearing. The seal packing is made of nitrile or acrylic rubber in most cases, although it may be made of fluoric rubber for high-speed applications such as in Shinkansen traiç



**Fig. 2-1 Sealed-Clean Rotating End Cap Tapered Roller Bearings**

**4.** An amount of grease equivalent to approximately one-half to one-third of the bearing's internal volume, including seal lips, is prepacked in the bearing. No grease replenishment is necessary for the duration of the bearing's service life. Grease with NLGI consistency number 2 is used for axle bearings. Lithium or sodium grease is most often used, though other kinds of grease such as lithium-calcium compound grease or urea-based grease may be used depending on bearing conditions like speed, load and maintenance frequency.

**5.** The mounting and dismounting of Sealed-Clean Rotating End Cap Tapered Roller Bearings is performed by press-fitting or press-pulling using special-purpose tools. The press-fitting operation is controlled by the amount of interference between the outside diameter of the axle journal and the bore diameter of the bearing's inner ring, as well as by the load applied from the press-fitting.

**6.** For the assembly of bogies with axles supported by Sealed-Clean Rotating End Cap Tapered Roller Bearings, saddle-type adapters are used instead of the bearing boxes commonly used for ordinary bearings. The use of such adapters can reduce the weight of the bogie and make assembly work easier.

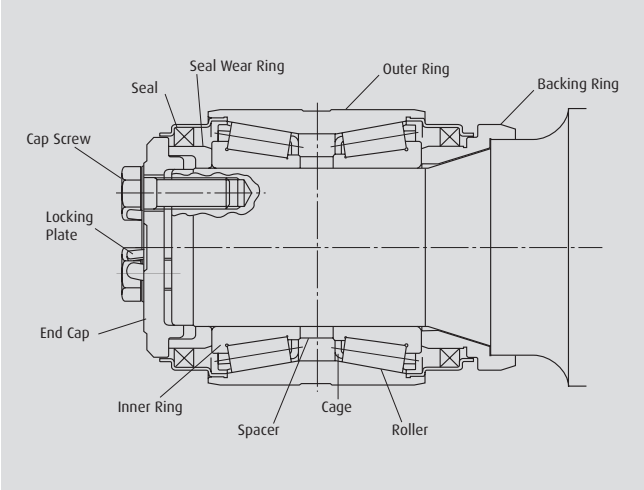


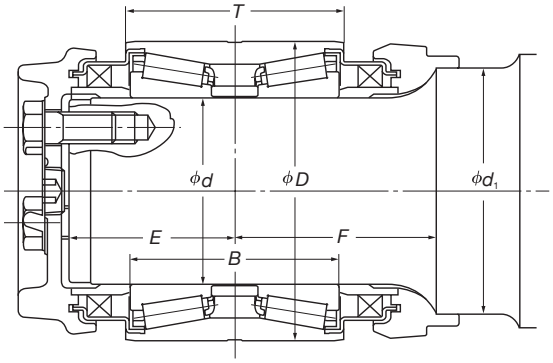

**Fig. 2-2 Sealed-Clean Rotating End Cap Tapered Roller Bearings**



**Fig. 2-3 Sealed-Clean Rotating End Cap Tapered Roller Bearings**

# 2. Sealed-Clean Rotating End Cap Tapered Roller Bearings

## Sealed-Clean Rotating End Cap Tapered Roller Bearing Unit Table

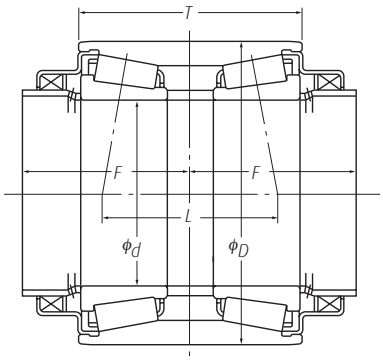



| Assembly Number | Dimensions (mm) | | | | | |
|---|---|---|---|---|---|---|
| | d | D | T | B | $d_1$ | |
| J-908 | 90 | 154 | 90 | 80 | 110 | |
| J-318 | 110 | 175 | 130 | 125 | 155 | |
| J-358A | 110 | 200 | 150 | 145 | 139 | |
| J-359 | 110 | 185 | 135 | 130 | 145 | |
| J-910 | 110 | 188 | 150 | 145 | 150 | |
| J-901 | 110 | 190 | 150 | 145 | 150 | |
| J-905 | 110 | 195 | 150 | 145 | 150 | |
| J-909 | 110 | 205 | 140 | 130 | 150 | |
| J-902 | 110 | 220 | 145 | 144 | 155 | |
| J-900 | 115 | 210 | 150 | 145 | 144 | |
| J-319 | 120 | 195 | 142 | 136 | 155 | |
| J-904 | 120 | 220 | 145 | 145 | 155 | |
| J-355 | 120 | 220 | 155 | 155 | 150 | |
| J-907A | 120 | 220 | 155 | 150 | 149 | |
| J-356 | 120 | 230 | 150 | 144 | 155 | |
| J-912 | 120 | 230 | 155 | 155 | 142 | |
| J-915 | 125 | 235 | 155 | 165 | 150 | |
| J-320 | 130 | 208 | 152 | 146 | 165 | |
| J-913 | 130 | 220 | 155 | 155 | 160 | |
| J-920 | 130 | 220 | 155 | 155 | 171 | |
| J-914 | 130 | 230 | 155 | 155 | 160 | |
| J-911 | 130 | 245 | 170 | 165 | 161 | |
| J-351 | 130 | 250 | 175 | 185 | 163 | |
| J-353 | 130 | 250 | 175 | 185 | 160 | |
| J-367 | 130 | 230 | 150 | 150 | 165 | |

| | E | F | Basic Dynamic Load Rating (N) | Basic Static Load Rating (N) | Mass (kg) approx. | Main Application |
|---|---|---|---|---|---|---|
| | 55 | 80 | 297,000 | 480,000 | 14.5 | Electric car |
| | 105 | 135 | 470,000 | 940,000 | 22.4 | Freight Car |
| | 140 | 117 | 650,000 | 1,150,000 | 25.7 | Shinkansen |
| | 80 | 113 | 550,000 | 1,060,000 | 21.8 | Electric Car |
| | 100 | 120 | 605,000 | 1,110,000 | 26.3 | Electric Car |
| | 100 | 120 | 605,000 | 1,110,000 | 25.1 | Electric Car |
| | 100 | 120 | 650,000 | 1,180,000 | 27.0 | Electric Car |
| | 85 | 105 | 745,000 | 1,270,000 | 27.0 | Diesel Car |
| | 112 | 110 | 690,000 | 1,090,000 | 35.3 | Diesel Car |
| | 98 | 117 | 710,000 | 1,250,000 | 30.9 | Shinkansen |
| | 113 | 135 | 645,000 | 1,290,000 | 26.6 | Freight Car |
| | 120 | 117 | 750,000 | 1,250,000 | 35.9 | Electric Car |
| | 125 | 100 | 845,000 | 1,530,000 | 37.6 | Electric Car |
| | 146.5 | 117 | 780,000 | 1,310,000 | 31.8 | Shinkansen |
| | 145 | 113 | 815,000 | 1,300,000 | 37.5 | Electric Car |
| | 203 | 117 | 855,000 | 1,410,000 | 38.7 | Shinkansen |
| | 181 | 117 | 800,000 | 1,290,000 | 37.8 | Shinkansen |
| | 115 | 139 | 660,000 | 1,350,000 | 31.1 | Freight Car |
| | 168 | 100 | 765,000 | 1,410,000 | 34.0 | Electric Car |
| | 115 | 140.7 | 820,000 | 1,550,000 | 37.4 | Freight Car |
| | 203 | 117 | 720,000 | 1,230,000 | 35.6 | Shinkansen |
| | 202 | 119 | 960,000 | 1,610,000 | 46.4 | Shinkansen |
| | 200 | 140 | 1,040,000 | 1,850,000 | 53.0 | Shinkansen |
| | 245 | 140 | 1,040,000 | 1,850,000 | 55.0 | Shinkansen |
| | 95 | 125 | 895,000 | 1,620,000 | 29.8 | Freight Car (China) |

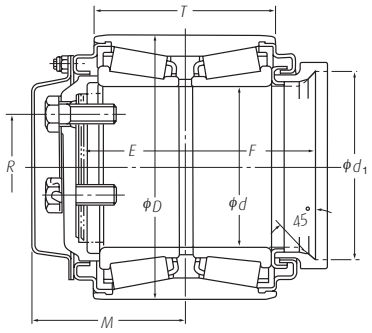
# 2. Sealed-Clean Rotating End Cap Tapered Roller Bearings

## Inch-Series Sealed-Clean Rotating End Cap Tapered Roller Bearing Unit Table

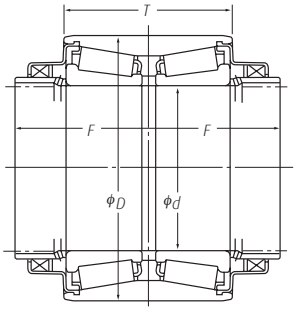



| Class | Assembly Number | Dimensions (mm) | | | | |
|---|---|---|---|---|---|---|
| | | d | D | F | T | L |
| B (4¼ × 8) | J-361X | 101.6000 | 165.1000 | 91 | 114 | 54.40 |
| | | 4.0000 | 6.5000 | 3 19/32 | 4½ | 2.14 |
| C (5 × 9) | J-362X | 119.0620 | 195.2620 | 109 | 143 | 105.70 |
| | | 4.6875 | 7.6875 | 4 9/32 | 5⅝ | 4.16 |
| | J-362X1 | 119.0620 | 195.0000 | 103 | 132 | 94.10 |
| | | 4.6875 | 7.6772 | 4 1/16 | 5 11/64 | 3.71 |
| D (5½ × 10) | J-363X1 | 131.7500 | 207.9620 | 114 | 152 | 116.80 |
| | | 5.1875 | 8.1875 | 4 15/32 | 6 | 4.60 |
| | J363X1 | 131.7500 | 210.0000 | 103 | 132 | 96.40 |
| | | 5.1875 | 8.2677 | 4 1/16 | 5 13/64 | 3.80 |
| E (6 × 11) | J-364X | 144.4500 | 220.662 | 121 | 164 | 127.50 |
| | | 5.6870 | 8.6875 | 4¾ | 6 7/16 | 5.02 |
| | J-364X1 | 144.4500 | 220.000 | 109 | 140 | 104.00 |
| | | 5.6870 | 8.6614 | 4 9/32 | 5 33/64 | 4.09 |
| F (6½ × 12) | J-365X | 157.1500 | 252.4120 | 137 | 184 | 143.30 |
| | | 6.1870 | 9.9375 | 5⅜ | 7¼ | 5.64 |
| | J-365X1 | 157.1500 | 250.0000 | 125 | 160 | 119.10 |
| | | 6.1870 | 9.8425 | 4 29/32 | 6 19/64 | 4.69 |
| G (7 × 14) | J-366X | 177.7880 | 276.2250 | 135 | 186 | 144.80 |
| | | 6.9995 | 10.8750 | 5 5/16 | 7 5/16 | 5.70 |

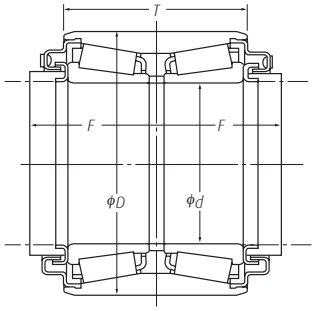
## Metric-Series Sealed-Clean Rotating End Cap Tapered Roller Bearing Unit Tables




Outboard, Labyrinth Type




Inboard, Contact Seal Type




Inboard, Labyrinth Type

### Outboard, Labyrinth Type

| Bearing Number | Dimensions (mm) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | d | D | T | M (Max) | Cap Screw | $d_1$ | R | F | E |
| JT120A | 120 | 195 | 132 | 110 | M16 × 2-6H (5/8-11UNC) | 138.162–138.122 | 80 | 90 | 75 |
| JT130A | 130 | 210 | 132 | 112 | M16 × 2-6H (5/8-11UNC) | 150.174–150.134 | 80 | 95 | 75 |
| JT140A | 140 | 220 | 140 | 118 | M16 × 2-6H (5/8-11UNC) | 160.174–160.134 | 100 | 100 | 80 |
| JT150A | 150 | 250 | 160 | 132 | M20 × 2.5-6H (3/4-10UNC) | 170.186–170.146 | 100 | 105 | 90 |

### Inboard, Contact Seal Type

| Bearing Number | Dimensions (mm) | | | |
|---|---|---|---|---|
| | d | D | T | F |
| JT120A | 120 | 195 | 132 | 103 |
| JT130A | 130 | 210 | 132 | 103 |
| JT140A | 140 | 220 | 140 | 109 |
| JT150A | 150 | 250 | 160 | 124 |

### Inboard, Labyrinth Type

| Bearing Number | Dimensions (mm) | | | |
|---|---|---|---|---|
| | d | D | T | F |
| JT120A | 120 | 195 | 132 | 90 |
| JT130A | 130 | 210 | 132 | 90 |
| JT140A | 140 | 220 | 140 | 95 |
| JT150A | 150 | 250 | 160 | 105 |

# 3. Sealed-Clean Rotating End Cap Cylindrical Roller Bearings

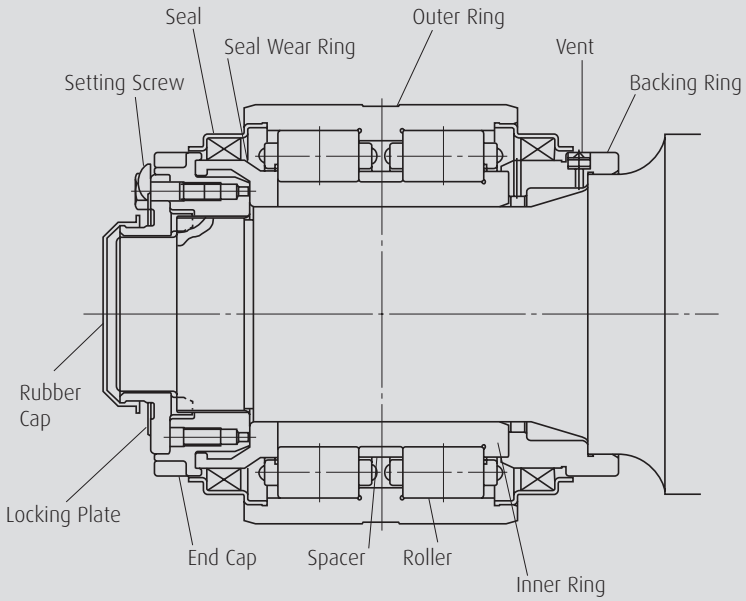
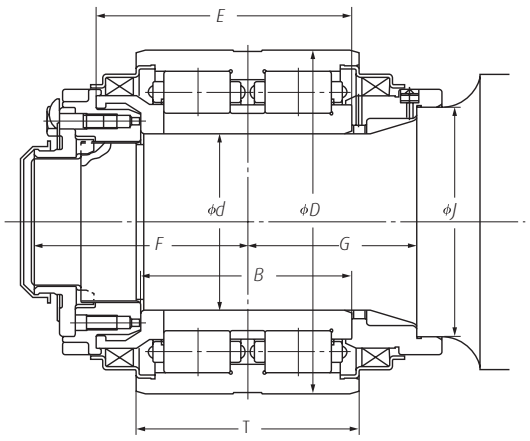



**Fig. 3-1 Sealed-Clean Rotating End Cap Cylindrical Roller Bearings**



## Sealed-Clean Rotating End Cap Cylindrical Roller Bearing Table

| Assembly Number | Dimensions (mm) | | | | | | | | Basic Dynamic Load Rating (N) | Basic Static Load Rating (N) | Mass (kg) approx. | Main Application |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | d | D | T | B | J | E | F | G | | | | |
| J-580A | 100 | 195 | 150 | 175.0 | 130 | — | 120 | 105 | 670,000 | 1,040,000 | 27.0 | Electric Car |
| J-447B | 110 | 220 | 160 | 154.0 | 170 | — | 135 | 140 | 875,000 | 1,370,000 | 43.9 | Electric Car |
| J-577 | 110 | 220 | 170 | 182.0 | 140 | 210.0 | 128 | 112 | 875,000 | 1,370,000 | 39.7 | Electric Car |
| J-480B | 120 | 240 | 160 | 164.0 | 150 | 197.0 | 128 | 112 | 935,000 | 1,450,000 | 55.8 | Electric Car |
| J-504 | 120 | 195 | 140 | 134.0 | 155 | 176.0 | 135 | 132 | 545,000 | 915,000 | 28.6 | Electric Car |
| J-556B | 120 | 240 | 170 | 180.0 | 168 | 218.0 | 130 | 125 | 1,020,000 | 1,580,000 | 55.3 | Diesel Car |
| J-566 | 120 | 195 | 142 | 132.0 | 155 | — | 118 | 140 | 515,000 | 855,000 | 23.8 | Freight Car |
| J-574 | 120 | 240 | 160 | 162.0 | 168 | 193.0 | 158 | 113 | 935,000 | 1,420,000 | 51.2 | Electric Car |
| J-574A | 120 | 240 | 160 | 162.0 | 168 | 196.0 | 120 | 125 | 935,000 | 1,420,000 | 52.0 | Electric Car |
| J-587 | 120 | 220 | 150 | 141.5 | 155 | 175.5 | 110 | 113 | 700,000 | 1,110,000 | 33.5 | Electric Car |
| J-590 | 120 | 230 | 150 | 142.0 | 155 | 171.0 | 134 | 113 | 830,000 | 1,290,000 | 37.8 | Electric Car |
| J-594 | 120 | 230 | 150 | 142.0 | 155 | 171.0 | 145 | 113 | 830,000 | 1,290,000 | 39.0 | Electric Car |
| J-605 | 120 | 220 | 175 | 182.0 | 140 | 210.0 | 128 | 112 | 850,000 | 1,430,000 | 35.9 | Electric Car |
| J-802 | 120 | 240 | 170 | 182.0 | 150 | 205.0 | 128 | 112 | 1,020,000 | 1,580,000 | 50.0 | Electric Car |
| J-803 | 120 | 220 | 175 | 182.0 | 150 | 210.0 | 128 | 112 | 850,000 | 1,430,000 | 35.3 | Electric Car |
| J-805 | 120 | 220 | 155 | 157.0 | 150 | 190.0 | 113 | 100 | 765,000 | 1,250,000 | 31.3 | Electric Car |
| J-806 | 120 | 220 | 160 | 172.0 | 160 | 200.0 | 128 | 112 | 765,000 | 1,250,000 | 33.0 | Electric Car |
| J-809 | 120 | 220 | 145 | 145.0 | 155 | 171.0 | 145 | 117 | 700,000 | 1,120,000 | 36.0 | Diesel Car |
| J-810A | 120 | 220 | 160 | 185.5 | 145 | — | 128 | 104 | 765,000 | 1,250,000 | 31.6 | Electric Car |
| J-811 | 120 | 220 | 160 | 204.0 | 150 | 242.0 | 128 | 112 | 815,000 | 1,320,000 | 36.1 | Electric Car |
| J-817 | 120 | 220 | 175 | 175.0 | 144 | 197.0 | 118 | 113 | 850,000 | 1,430,000 | 31.7 | Electric Car |
| J-555 | 130 | 260 | 180 | 182.0 | 160 | 215.0 | 128 | 112 | 1,030,000 | 1,610,000 | 62.0 | Electric Car |
| J-567 | 130 | 250 | 170 | 170.0 | 165 | 208.0 | 95 | 135 | 1,030,000 | 1,610,000 | 55.4 | Freight Car (China) |
| J-578 | 130 | 260 | 175 | 182.0 | 160 | 212.5 | 128 | 112 | 1,030,000 | 1,610,000 | 59.8 | Electric Car |
| J-589 | 130 | 240 | 160 | 160.0 | 170 | 188.0 | 131 | 116 | 825,000 | 1,310,000 | 42.7 | Electric Car |
| J-801 | 130 | 240 | 160 | 160.0 | 165 | 188.0 | 116 | 105 | 825,000 | 1,310,000 | 43.8 | Electric Locomotive<br>Diesel Locomotive |
| J-807 | 130 | 240 | 160 | 160.0 | 160 | 188.0 | 118 | 112 | 825,000 | 1,310,000 | 49.9 | Electric Car |
| J-816 | 130 | 240 | 160 | 160.0 | 160 | 188.0 | 100 | 112 | 825,000 | 1,310,000 | 39.9 | Electric Car |
| J-814 | 130 | 230 | 160 | 185.5 | 155 | — | 128 | 104 | 800,000 | 1,340,000 | 35.9 | Electric Car |

# 4. Cylindrical Roller Bearings






The main advantages of cylindrical roller bearings are their highspeed capability, easy maintenance, and ability to either allow or restrict axial movement.

### 1. Characteristics of Cylindrical Roller Bearings

Compared with tapered or spherical roller bearings, cylindrical roller bearings have several strong advantages as journal bearings. These are:

- The outer diameter is smaller and the weight is lower for the same load capacity.
- Assembly and disassembly are easier facilitating maintenance and inspection.
- The speed capability is higher because of the lower friction coefficient.
- They allow the free setup of their axial clearance.

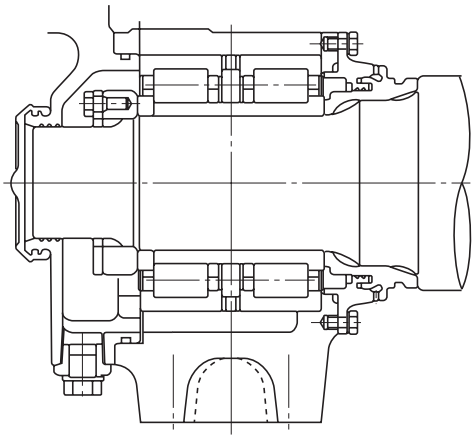
### 2. Cylindrical Roller Bearings combined with Ball Bearings

Usually, the axial loads are borne by a single-row ball bearing such as a deep groove ball bearing or an angular contact ball bearing installed between the bearing box front cover and the axle end.

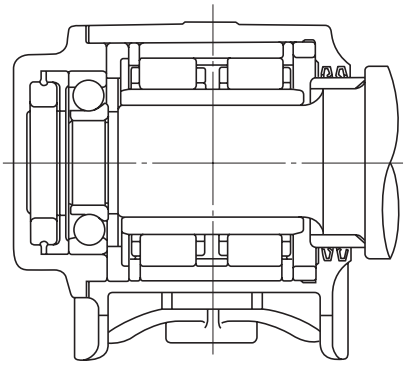
### 3. Cylindrical Roller Bearings with Ribs

With this type of bearing which is referred as the UIC type and has been standardized in Europe, axial loads are borne by ribs of the outer and inner rings and by the end of rollers. Compared with cylindrical roller bearings combined with ball bearings, this type offers more simpler and compact housing construction owing to the absence of the ball bearing.

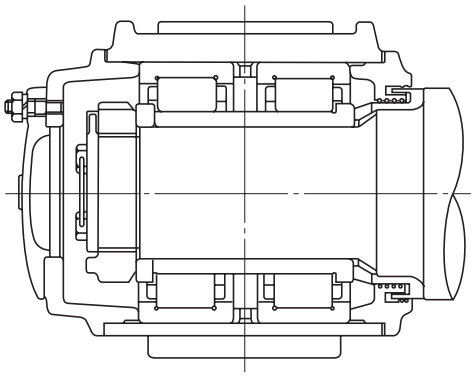
# 4. Cylindrical Roller Bearings



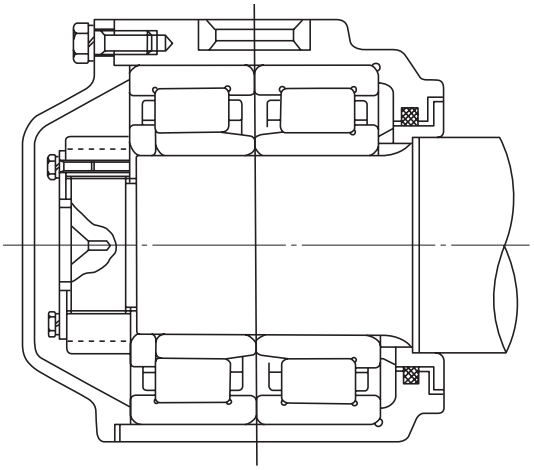
Double-Row Cylindrical Roller Bearing with Rib to Sustain Axial Load



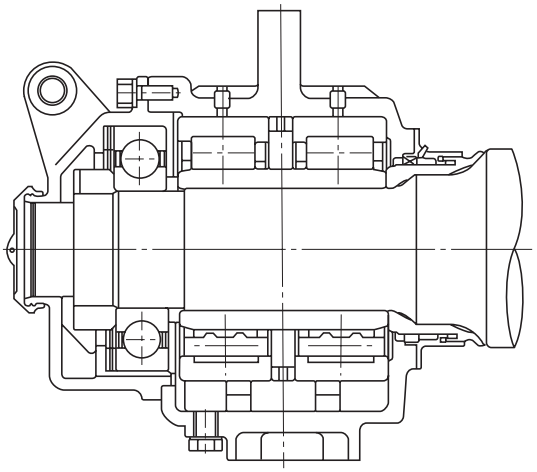
Axle Box with an Angular Contact Ball Bearing and Buffer to Sustain Axial Load



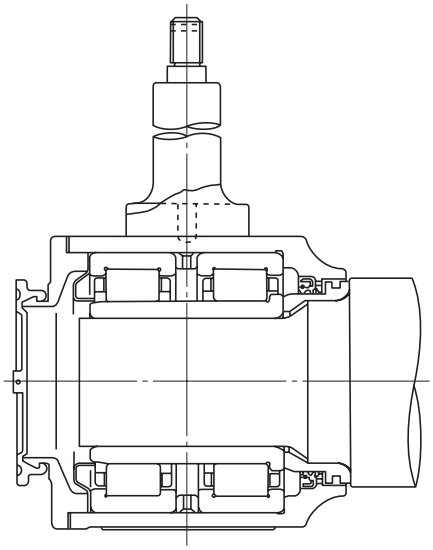
Axle Box with Roller-Guiding Ribs to Sustain Axial Loads



Axle Box with Roller-Guiding Ribs to Sustain Axial Loads (UIC Standard Type)



Axle Box with Deep Groove Ball Bearing and Conical Disc Springs to Sustain Axial Load

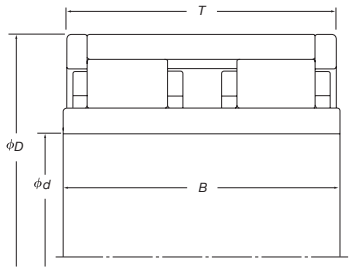


Axle Box with Single Inner Ring to Sustain Axial Load

# 4. Cylindrical Roller Bearings

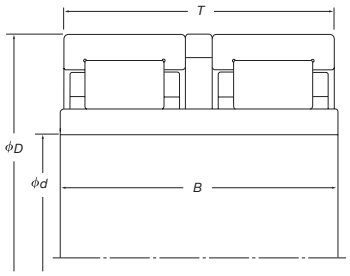
## Cylindrical Roller Bearing Tables

### Type A



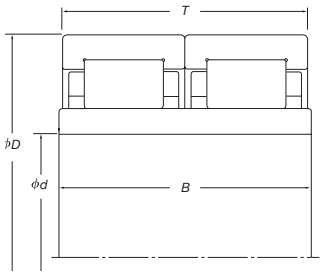

| Bearing Number | Dimensions (mm) | | | | Basic Dynamic Load Rating (N) | Basic Static Load Rating (N) | Mass (kg) approx. |
|---|---|---|---|---|---|---|---|
| | d | D | T | B | | | |
| 2U85-1 | 85 | 155 | 105 | 125 | 400,000 | 605,000 | 9.6 |
| 2U95-1C | 95 | 170 | 105 | 125 | 440,000 | 690,000 | 11.3 |
| 2U100-1 | 100 | 180 | 120 | 130 | 500,000 | 795,000 | 13.7 |
| 2U100-2A | 100 | 190 | 130 | 140 | 690,000 | 1,100,000 | 17.2 |
| JC1A | 110 | 225 | 140 | 150 | 835,000 | 1,230,000 | 28.2 |
| JC3 | 110 | 200 | 160 | 180 | 720,000 | 1,190,000 | 23.1 |
| JC10 | 110 | 225 | 140 | 180 | 935,000 | 1,430,000 | 28.4 |
| JC11 | 120 | 240 | 160 | 180 | 1,020,000 | 1,580,000 | 35.5 |
| 2U110-2 | 110 | 230 | 150 | 160 | 935,000 | 1,430,000 | 32.6 |
| 2U110-3 | 110 | 220 | 160 | 180 | 945,000 | 1,510,000 | 30.5 |
| 2U110-7A | 110 | 225 | 140 | 150 | 935,000 | 1,430,000 | 28.5 |
| 2U120-4 | 120 | 250 | 140 | 140 | 1,070,000 | 1,610,000 | 34.6 |
| 2U120-6A | 120 | 240 | 160 | 180 | 1,020,000 | 1,580,000 | 35.6 |
| 2U120-7 | 120 | 220 | 160 | 180 | 850,000 | 1,430,000 | 28.2 |
| JC5A | 130 | 260 | 160 | 180 | 1,080,000 | 1,710,000 | 43.4 |
| JC18 | 130 | 260 | 160 | 205 | 1,080,000 | 1,710,000 | 44.8 |
| 2U130-2A | 130 | 260 | 160 | 180 | 1,080,000 | 1,710,000 | 43.4 |
| 2U130-5 | 130 | 220 | 160 | 180 | 790,000 | 1,390,000 | 25.3 |
| 2U130-6 | 130 | 240 | 160 | 180 | 990,000 | 1,650,000 | 34.5 |
| 2U140-2 | 140 | 280 | 185 | 205 | 1,440,000 | 2,260,000 | 56.7 |
| 160JRX01 | 160 | 280 | 160 | 180 | 1,060,000 | 1,730,000 | 43.1 |

## Type B




| Bearing Number | Dimensions (mm) | | | | Basic Dynamic Load Rating (N) | Basic Static Load Rating (N) | Mass (kg) approx. |
|---|---|---|---|---|---|---|---|
| | d | D | T | B | | | |
| 2P85-1 | 85 | 150 | 120 | 130 | 365,000 | 585,000 | 8.8 |
| 90JRU01 | 90 | 160 | 120 | 130 | 355,000 | 530,000 | 8.6 |
| 2P110-4MA | 110 | 225 | 140 | 150 | 935,000 | 1,430,000 | 27.4 |
| 2P120-6MA | 120 | 240 | 160 | 180 | 935,000 | 1,450,000 | 35.0 |
| JC9 | 130 | 280 | 210 | 215 | 1,440,000 | 2,250,000 | 61.5 |
| JC29 | 130 | 270 | 210 | 215 | 1,280,000 | 2,000,000 | 56.0 |
| JC9-2 | 133 | 280 | 210 | 215 | 1,440,000 | 2,250,000 | 60.4 |
| 160JRU01 | 160 | 260 | 140 | 140 | 820,000 | 1,460,000 | 29.0 |
| 170JRU01 | 170 | 340 | 230 | 230 | 1,660,000 | 2,760,000 | 97.9 |

## Type C

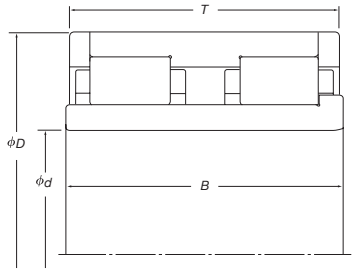



| Bearing Number | Dimensions (mm) | | | | Basic Dynamic Load Rating (N) | Basic Static Load Rating (N) | Mass (kg) approx. |
|---|---|---|---|---|---|---|---|
| | d | D | T | B | | | |
| JC2A | 110 | 235 | 160 | 180 | 935,000 | 1,430,000 | 35.4 |

# 4. Cylindrical Roller Bearings

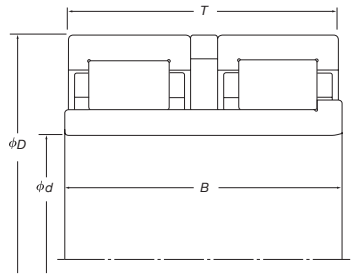
## Cylindrical Roller Bearing Tables

### Type D



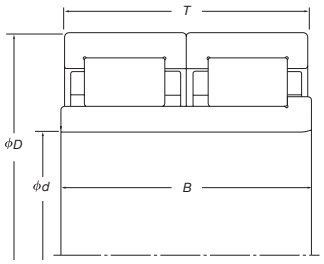

| Bearing Number | Dimensions (mm) | | | | Basic Dynamic Load Rating (N) | Basic Static Load Rating (N) | Mass (kg) approx. |
|---|---|---|---|---|---|---|---|
| | d | D | T | B | | | |
| 2J100-1 | 100 | 180 | 130 | 143 | 560,000 | 915,000 | 15.2 |

### Type E



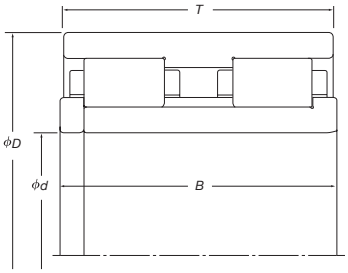

| Bearing Number | Dimensions (mm) | | | | Basic Dynamic Load Rating (N) | Basic Static Load Rating (N) | Mass (kg) approx. |
|---|---|---|---|---|---|---|---|
| | d | D | T | B | | | |
| 85JRJ02 | 85 | 150 | 120.0 | 125 | 365,000 | 585,000 | 8.7 |
| 90JRJ01 | 90 | 160 | 118.5 | 130 | 355,000 | 530,000 | 9.3 |
| 110JRJ01 | 110 | 200 | 150.0 | 160 | 625,000 | 995,000 | 19.9 |
| 2J110-2 | 110 | 220 | 180.0 (80x2) | 190 | 875,000 | 1,370,000 | 31.6 |
| 120JRJ01 | 120 | 220 | 180.0 | 183 | 850,000 | 1,430,000 | 29.5 |
| 2J120-1 | 120 | 240 | 180.0 (80x2) | 190 | 935,000 | 1,450,000 | 38.1 |
| 2J120-3M | 120 | 240 | 180.0 (80x2) | 180 | 935,000 | 1,450,000 | 37.2 |

## Type F




| Bearing Number | Dimensions (mm) | | | | Basic Dynamic Load Rating (N) | Basic Static Load Rating (N) | Mass (kg) approx. |
|---|---|---|---|---|---|---|---|
| | d | D | T | B | | | |
| 2J110-1 | 110 | 225 | 70×2 | 150 | 935,000 | 1,430,000 | 28.4 |
| 120JRJ02A | 120 | 240 | 160 | 180 | 935,000 | 1,450,000 | 36.0 |

## Type G

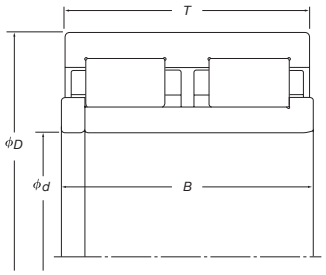



| Bearing Number | Dimensions (mm) | | | | Basic Dynamic Load Rating (N) | Basic Static Load Rating (N) | Mass (kg) approx. |
|---|---|---|---|---|---|---|---|
| | d | D | T | B | | | |
| 2M110-3A | 110 | 220 | 160 | 154 | 875,000 | 1,370,000 | 28.9 |
| 2M120-9 | 120 | 240 | 180 | 185 | 935,000 | 1,450,000 | 38.7 |
| 120JRF02 | 120 | 220 | 160 | 165 | 850,000 | 1,430,000 | 28.0 |
| 2M130-1 | 130 | 270 | 153 | 135 | 820,000 | 1,140,000 | 39.2 |
| 2M150-3 | 150 | 270 | 153 | 135 | 790,000 | 1,220,000 | 35.3 |

# 4. Cylindrical Roller Bearings

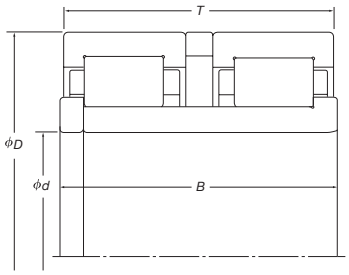
## Cylindrical Roller Bearing Tables

### Type H



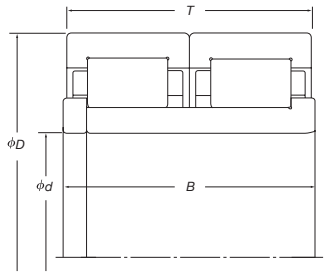

| Bearing Number | Dimensions (mm) | | | | Basic Dynamic Load Rating (N) | Basic Static Load Rating (N) | Mass (kg) approx. |
|---|---|---|---|---|---|---|---|
| | d | D | T | B | | | |
| JC14 | 130 | 260 | 160 | 160 | 1,140,000 | 1,840,000 | 46.6 |

### Type I



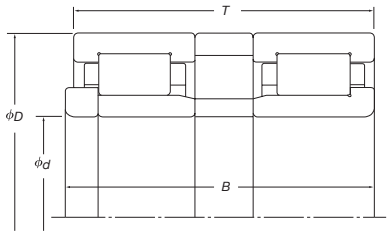

| Bearing Number | Dimensions (mm) | | | | Basic Dynamic Load Rating (N) | Basic Static Load Rating (N) | Mass (kg) approx. |
|---|---|---|---|---|---|---|---|
| | d | D | T | B | | | |
| 95JRT01 | 95 | 190 | 125 | 130 | 800,000 | 1,340,000 | 15.7 |
| 95JRT02 | 95 | 170 | 115 | 125 | 440,000 | 685,000 | 11.4 |
| 20100-1 | 100 | 200 | 170 | 170 | 650,000 | 1,030,000 | 24.8 |
| JC6K | 110 | 220 | 172 | 180 | 790,000 | 1,190,000 | 30.5 |
| 20110-1 | 110 | 220 | 180 | 185 | 875,000 | 1,370,000 | 31.8 |
| JC12 | 120 | 240 | 176 | 180 | 1,020,000 | 1,580,000 | 38.1 |
| JC34 | 120 | 230 | 165 | 170 | 945,000 | 1,460,000 | 31 |
| JC35 | 120 | 225 | 165 | 170 | 875,000 | 1,380,000 | 30 |
| 120JRT01 | 120 | 240 | 180 | 185 | 935,000 | 1,450,000 | 37.8 |
| 120JRT04 | 120 | 220 | 160 | 165 | 810,000 | 1,340,000 | 28.3 |
| 20120-4 | 120 | 240 | 180 | 185 | 935,000 | 1,450,000 | 38.1 |
| 20120-11 | 120 | 220 | 180 | 183 | 850,000 | 1,430,000 | 29.8 |
| 20120-12 | 120 | 220 | 180 | 185 | 850,000 | 1,430,000 | 29.9 |
| JC38 | 125 | 235 | 165 | 170 | 945,000 | 1,470,000 | 32.1 |
| JC21 | 130 | 260 | 180 | 205.5 | 1,030,000 | 1,610,000 | 46 |
| JC37 | 130 | 265 | 166 | 166 | 1,140,000 | 1,700,000 | 43.4 |
| 130JRT01 | 130 | 260 | 180 | 185 | 1,030,000 | 1,610,000 | 45.6 |
| 130JRT08 | 130 | 235 | 165 | 170 | 895,000 | 1,520,000 | 32.1 |
| 20130-6 | 130 | 260 | 180 | 185 | 1,030,000 | 1,610,000 | 45.7 |
| 20130-7 | 130 | 240 | 180 | 185 | 915,000 | 1,490,000 | 35.3 |
| 20140-1 | 140 | 250 | 155 | 160 | 865,000 | 1,480,000 | 33.5 |
| 170JRT01 | 170 | 340 | 230 | 230 | 1,660,000 | 2,760,000 | 99.4 |

## Type J




| Bearing Number | Dimensions (mm) | | | | Basic Dynamic Load Rating (N) | Basic Static Load Rating (N) | Mass (kg) approx. |
|---|---|---|---|---|---|---|---|
| | d | D | T | B | | | |
| JC27X | 120 | 230 | 150 | 177 | 935,000 | 1,440,000 | 30.3 |
| JC400K | 120 | 230 | 150 | 177 | 885,000 | 1,340,000 | 30.6 |

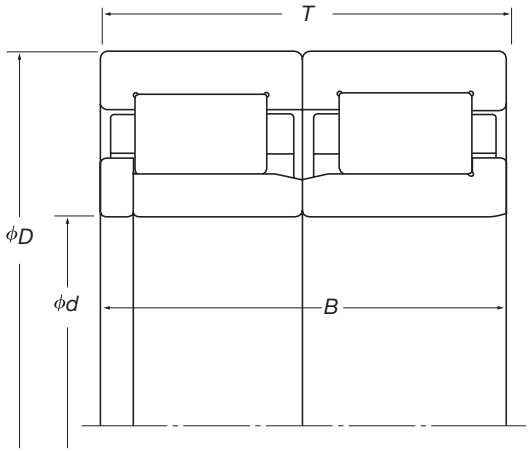
## Type K




| Bearing Number | Dimensions (mm) | | | | Basic Dynamic Load Rating (N) | Basic Static Load Rating (N) | Mass (kg) approx. |
|---|---|---|---|---|---|---|---|
| | d | D | T | B | | | |
| J130-5/U130-5DB+KL38 | 130 | 240 | 198 (80 × 2) | 204 | 880,000 | 1,450,000 | 38.3 |

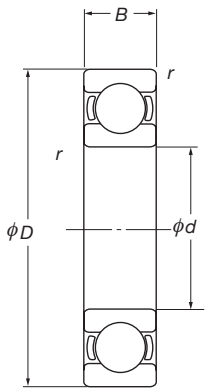
# 4. Cylindrical Roller Bearings

**Type L**

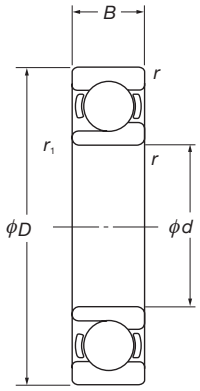



| Bearing Number | Dimensions (mm) | | | | Basic Dynamic Load Rating (N) | Basic Static Load Rating (N) | Mass (kg) approx. |
|---|---|---|---|---|---|---|---|
| | d | D | T | B | | | |
| J110-2/U110-4DB | 110 | 215 | 73 × 2 | 73 × 2 | 800,000 | 1,240,000 | 25.4 |
| J120-1C/U120-2C | 120 | 240 | 80 × 2 | 80 × 2 | 960,000 | 1,500,000 | 35.1 |
| J120-1D/U120-2D | 120 | 240 | 80 × 2 | 80 × 2 | 960,000 | 1,500,000 | 35.4 |
| 42724T/152724T | 120 | 240 | 80 × 2 | 80 × 2 | 910,000 | 1,400,000 | 35.1 |
| JC130M | 130 | 250 | 160 | 160 | 1,030,000 | 1,610,000 | 38.0 |
| 42726T/152726T | 130 | 250 | 80 × 2 | 80 × 2 | 1,030,000 | 1,610,000 | 36.9 |
| J130-3/U130-4 | 130 | 250 | 80 × 2 | 80 × 2 | 1,030,000 | 1,610,000 | 37.1 |
| J150-5/U150-2 | 150 | 270 | 160 (80 × 2) | 160 (80 × 2) | 1,020,000 | 1,700,000 | 41.0 |

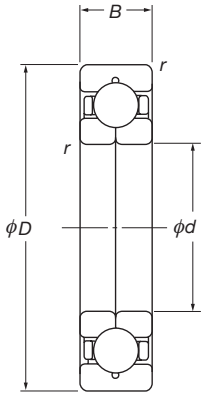
## Table of Ball Bearings for Axial Loads




Deep Groove




Angular Contact




Four-point Contact

| Bearing Number | | Dimensions (mm) | | | | | Basic Dynamic Load Rating (N) | Basic Static Load Rating (N) | Mass (kg) approx. | Examples of Matching Radial Roller Bearings |
|---|---|---|---|---|---|---|---|---|---|---|
| Deep Groove | Angular Contact | d | D | B | r | $r_1$ | | | | |
| JB8 | — | 70 | 150 | 35 | 3.5 | — | 99,500 | 68,000 | 2.56 | JC2, JC3, JC10 |
| JB8A | — | 70 | 150 | 35 | 3.5 | — | 99,500 | 68,000 | 2.56 | JC2, 2U95-1 |
| 6314 | — | 70 | 150 | 35 | 3.5 | — | 104,000 | 68,000 | 2.56 | JC11 |
| 6315 | — | 75 | 160 | 37 | 3.5 | — | 113,000 | 77,000 | 3.05 | 2U100, JC1 |
| — | JB1D | 85 | 180 | 41 | 4.0 | 2.0 | 121,000 | 93,000 | 4.30 | JC2, JC11 |
| — | JB1E | 85 | 180 | 41 | 4.0 | 2.0 | 141,000 | 116,000 | 4.80 | JC2, JC11 |
| 6220 | — | 100 | 180 | 34 | 3.5 | — | 122,000 | 93,000 | 3.15 | 2U110, 2U130, JC1 |
| — | JB2 | 100 | 215 | 47 | 4.0 | 2.0 | 170,000 | 138,000 | 6.60 | 2U140 |
| 6320 | — | 100 | 215 | 47 | 4.0 | — | 173,000 | 141,000 | 7.00 | JC5 |
| — | JB3 | 110 | 215 | 47 | 4.0 | 2.0 | 165,000 | 142,000 | 6.40 | JC5 |
| — | JB5* | 110 | 215 | 47 | 4.0 | — | 179,000 | 167,000 | 6.80 | JC5 |
| JB4 | — | 125 | 260 | 55 | 4.0 | — | 207,000 | 185,000 | 13.00 | JC9 |
| JB9 | — | 125 | 250 | 55 | 4.0 | — | 186,000 | 162,000 | 11.90 | JC29 |

* Four-point contact ball bearing

# 5. Tapered Roller Bearings

Tapered roller bearings can carry radial and axial loads simultaneously and therefore permit compact design of the bearing and its adjacent parts. This type of bearing, however, requires precise internal clearance adjustment in order to perform properly.

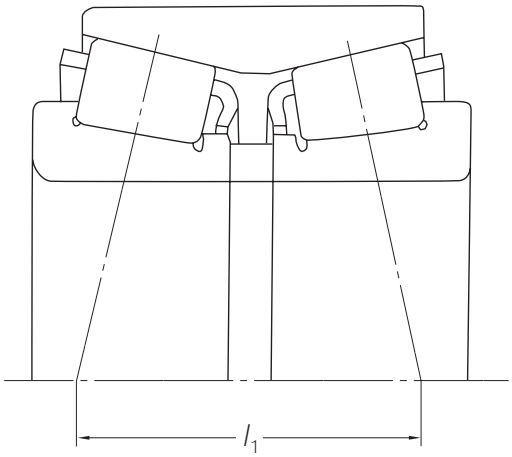



**Fig. 5-1 Back-to-Back Arrangement**

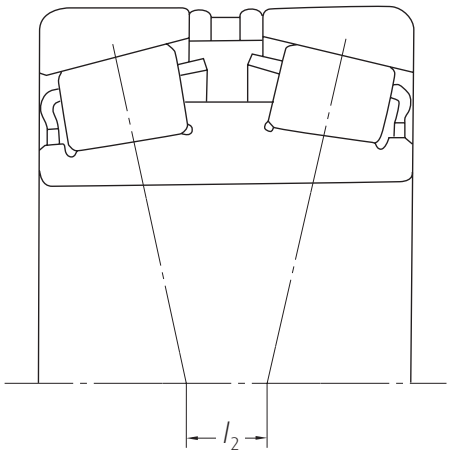


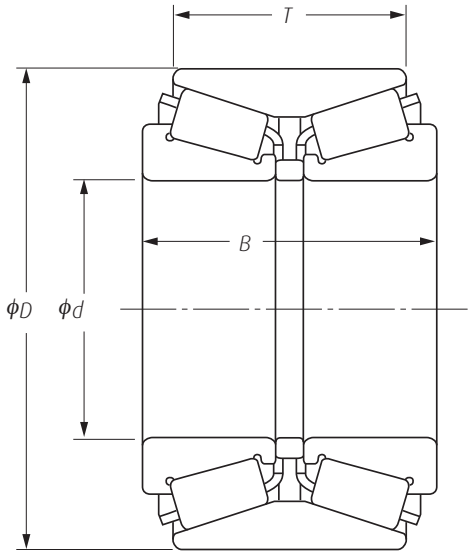

**Fig. 5-2 Face-to-Face Arrangement**

Tapered roller bearings are used either in sets of two, or in a double-row configuration in which there is one outer ring or one inner ring for the two rows of rollers. There are two types of duplex arrangements: back-to-back and face-to-face, as shown in Figs. 5-1 and 5-2, respectively. For rolling stock axle applications where heavy moment loads are expected, the back-to-back arrangement, which provides a greater distance between load centers (l1>l2), is preferable.

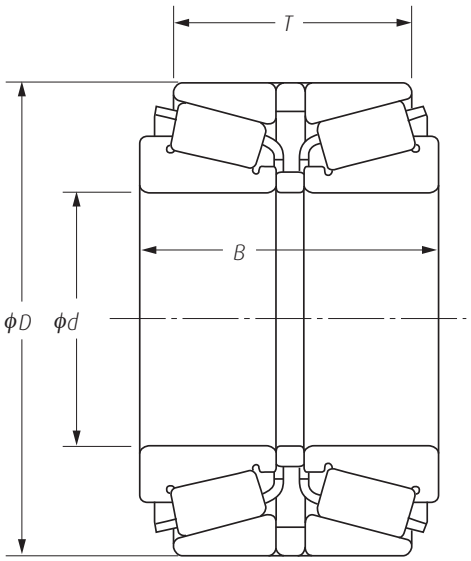
When the rollers are rolling under load, part of their load is transferred to the large rib of the inner ring. The rollers maintain sliding contact with and are guided by the rib. This results in the friction coefficient of these bearings being higher than that of cylindrical bearings. Recently, however, improvements in surface roughness and contact geometry have virtually eliminated the friction problems associated with tapered roller bearings for axles.

This type of axle bearing can be designed with a sealed arrangement between the rear cover and the bearing box or, as described in the section on Sealed-Clean Rotating End Cap Tapered Roller Bearings, they can have an internally sealed construction.




Type A



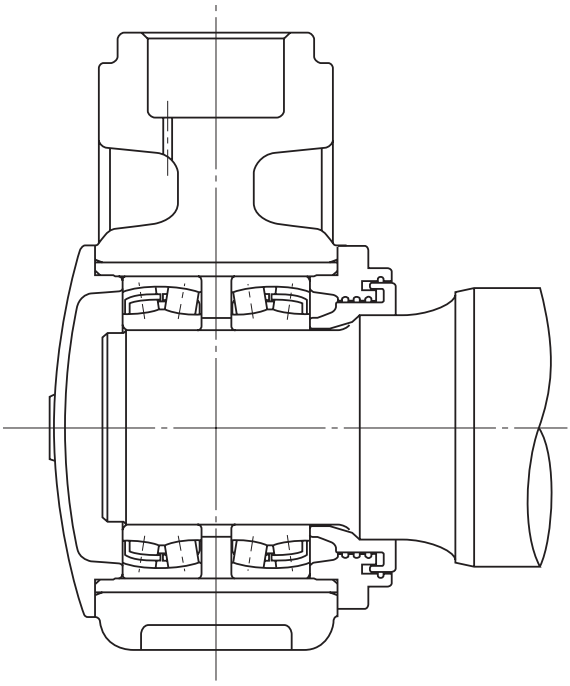

Type B

## Tapered Roller Bearing Table

| Class | Bearing Number | Bearing Type | Boundary Dimensions (mm) | | | | Basic Dynamic Load Rating (N) | Basic Static Load Rating (N) | Mass (kg) approx. | Main Application |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | d | D | T | B | | | | |
| 110 | 110KBE2201+L | A | 110 | 220 | 115 | 145 | 820,000 | 1,350,000 | 23.6 | Rolling Stock for Steel Plants |
| 120 | 120KBE2001+L | A | 120 | 200 | 84 | 100 | 515,000 | 885,000 | 11.3 | Rolling Stock for Steel Plants |
| 120 | 120KBE52X+L | A | 120 | 215 | 109 | 132 | 720,000 | 1,170,000 | 18.3 | Rolling Stock for Steel Plants |
| 120 | JT21 | A | 120 | 220 | 130 | 155 | 860,000 | 1,480,000 | 23.5 | Shinkansen |
| 130 | 130KBE2302+L | A | 130 | 230 | 115 | 145 | 850,000 | 1,480,000 | 23.4 | Rolling Stock for Steel Plants |
| 140 | 140KBE2302+L | A | 140 | 230 | 110 | 140 | 820,000 | 1,550,000 | 20.5 | Rolling Stock for Steel Plants |
| 140 | 140KBE2701A+L | A | 140 | 270 | 95 | 120 | 870,000 | 1,440,000 | 29.3 | Rolling Stock for Steel Plants |
| 140 | JT8 | B | 140 | 280 | 170 | 210 | 1,170,000 | 1,920,000 | 50.0 | Electric Locomotive |
| 150 | 150KBE2502+L | A | 150 | 250 | 95 | 115 | 745,000 | 1,320,000 | 20.2 | Rolling Stock for Steel Plants |
| 160 | 160KBE2701A+L | A | 160 | 270 | 120 | 140 | 990,000 | 1,880,000 | 31.0 | Rolling Stock for Steel Plants |
| 170 | 170KBE2802A+L | A | 170 | 280 | 130 | 150 | 1,110,000 | 2,160,000 | 33.3 | Rolling Stock for Steel Plants |
| 180 | 180KBE3401+L | A | 180 | 340 | 140 | 180 | 1,410,000 | 2,510,000 | 68.1 | Rolling Stock for Steel Plants |

# 6. Spherical Roller Bearings





Spherical roller bearings can sustain, not only heavy radial loads, but also some axial loads in either direction. They have excellent radial load carrying capacity and are suitable for use where there are heavy or impact loads.

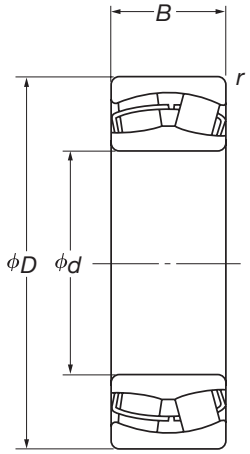
### 1. Single spherical roller bearing

The bearing box is allowed to move freely in relation to the axle center because of the self-aligning property of the bearing. When a single spherical roller bearing is used, the use of a wing-type bearing box is recommended.

### 2. Two spherical roller bearing

When two spherical roller bearings are used in a double-row configuration, the self-aligning capability of the bearing is lost, but they will provide higher load carrying capacity. This type of bearing is used worldwide because of standardization by the International Union of Railways (UIC) in Europe.



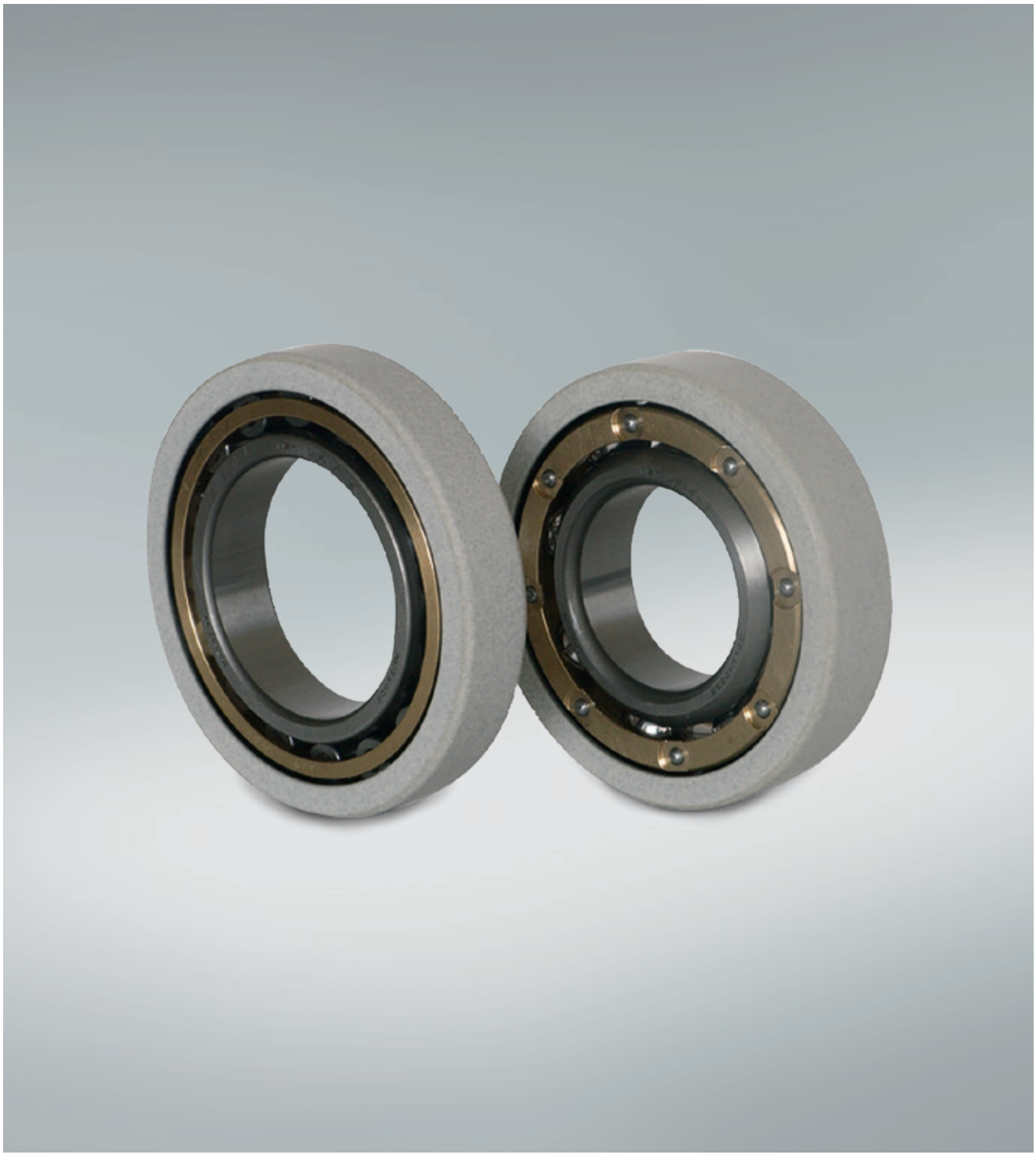

Cylindrical Bore

## Spherical Roller Bearing Table

| Bearing Number | Dimensions (mm) | | | | Basic Dynamic Load Rating N (lbf) | Basic Static Load Rating N (lbf) |
|---|---|---|---|---|---|---|
| | d | D | B | r(1) | | |
| 230092C | 99.746 | 180 | 60.3 | 3.5 | 420,000 (94,000) | 605,000 (135,000) |
| 23220C | 100.000 | 180 | 60.3 | 2.1 | 420,000 (94,000) | 605,000 (135,000) |
| 23122C | 110.000 | 180 | 56.0 | 2.0 | 385,000 (86,500) | 630,000 (141,000) |
| 231255C | 119.105 | 200 | 62.0 | 2.0<br>5.0 | 465,000 (105,000) | 720,000 (162,000) |
| 23124C | 120.000 | 200 | 62.0 | 2.0 | 465,000 (105,000) | 720,000 (162,000) |
| 23224C | 120.000 | 215 | 76.0 | 2.1 | 630,000 (142,000) | 970,000 (218,000) |
| 22324C | 120.000 | 260 | 86.0 | 3.0 | 845,000 (190,000) | 1,130,000 (253,000) |
| 23126C | 130.000 | 210 | 64.0 | 2.0 | 505,000 (113,000) | 825,000 (186,000) |
| 229750C | 130.000 | 220 | 73.0 | 2.7<br>5.0 | 575,000 (129,000) | 960,000 (216,000) |
| 23226C | 130.000 | 230 | 80.0 | 3.0 | 700,000 (158,000) | 1,080,000 (243,000) |
| 22326C | 130.000 | 280 | 93.0 | 4.0 | 995,000 (223,000) | 1,350,000 (305,000) |
| 230906C | 131.796 | 220 | 73.0 | 2.7<br>5.0 | 575,000 (129,000) | 960,000 (216,000) |
| 228285C | 139.734 | 218 | 80.0 | 1.5<br>5.0 | 605,000 (136,000) | 1,040,000 (235,000) |
| 23128C | 140.000 | 225 | 68.0 | 2.1 | 580,000 (130,000) | 945,000 (212,000) |
| 23228C | 140.000 | 250 | 88.0 | 3.0 | 835,000 (187,000) | 1,300,000 (292,000) |
| 231019C | 144.475 | 250 | 80.0 | 2.7<br>5.0 | 725,000 (163,000) | 1,180,000 (266,000) |
| 228708C | 152.434 | 250 | 100.0 | 2.7<br>5.0 | 860,000 (193,000) | 1,450,000 (325,000) |
| 231481C | 157.174 | 270 | 86.0 | 2.0<br>5.0 | 855,000 (192,000) | 1,400,000 (315,000) |
| 22228M | 140.000 | 250 | 68.0 | 3.0 | 655,000 (147,000) | 910,000 (205,000) |
| 23026Ca3 | 130.000 | 200 | 52.0 | 2.0<br>5.0 | 400,000 (90,000) | 655,000 (148,000) |
| 22328 | 140.000 | 300 | 102.0 | 4.0 | 1,160,000 (260,000) | 1,590,000 (360,000) |
| 23120C | 100.000 | 165 | 52.0 | 2.0 | 345,000 (78,000) | 530,000 (119,000) |

Note (1) The upper and lower numbers in "r" column refer to radial and axial directions, respectively.

# 7. Bearings for Traction Motors






Roller bearings are used in all traction motors for electric locomotives and electric cars. Usually, cylindrical roller bearings are utilized due to their high-speed and heavy-load capabilities, as well as their ease of assembly and disassembly. In the case of small motors, deep groove ball bearings may also be used.

## Specification for Traction Motor Bearings

**1. Special consideration must be given to the economical operation of railway vehicles as well as their reliability and safety.**

**2. Traction motor bearings operate under severe conditions such as:**

› high radial and axial loads
› high impact loads
› high speed
› extended periods of operation without maintenance

**3. NSK uses the following bearing specifications to satisfy the above-noted severe requirements.**

› Bearing materials are vacuum degassed for high purity.
› Inner and outer rings are treated for heat dimensional stabilization.
› Raceway surfaces are always super-finished and the rolling surfaces of rollers are either super-finished or barrel-finished.
› High load-capacity design is applied for electric locomotives.
› Tapered ribs and roller end crowning are applied for cylindrical roller bearings to increase the axial load capacity (Fig. 7-1).
› Roller-guided cages is applied for superior lubrication, temperature rise (Fig. 7-2), etc.
› High-strength cages are applied, particularly with means to prevent loosening of rivets due to vibration and impacts.
› Outside surface and both end faces of outer ring are coated with ceramic or heat-resistant resin for prevention of electric pitting.

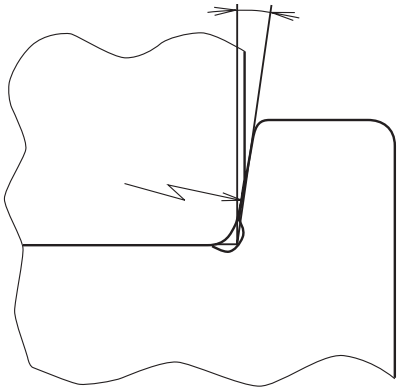


**Fig. 7-1 The design of rib and roller end**

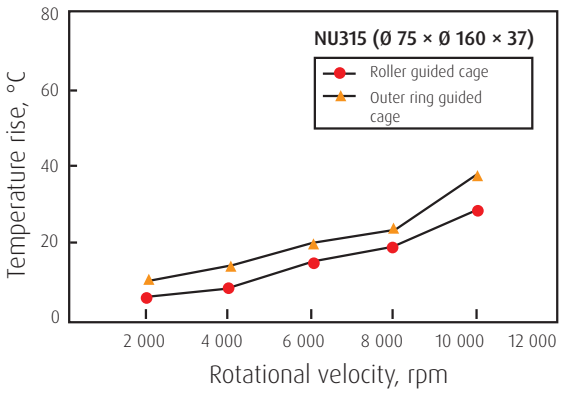



**Fig. 7-2 Comparison of temperature rise**

# 7. Bearings for Traction Motors

**Insulated Bearings**

The most important factor hindering maintenance-free running of traction motor bearings is an occurrence of electric pitting of the bearings. To prevent electric pitting, NSK developed ceramic coating insulated bearings and PPS-resin coating insulated bearings.

Relationship between bearing temperature and insulation resistance of ceramic-insulated bearings was assessed. As a result, no deterioration of insulation resistance up to 110°C was observed. And even above 110°C, 100MΩ of resistance was maintained (Fig. 7-3).

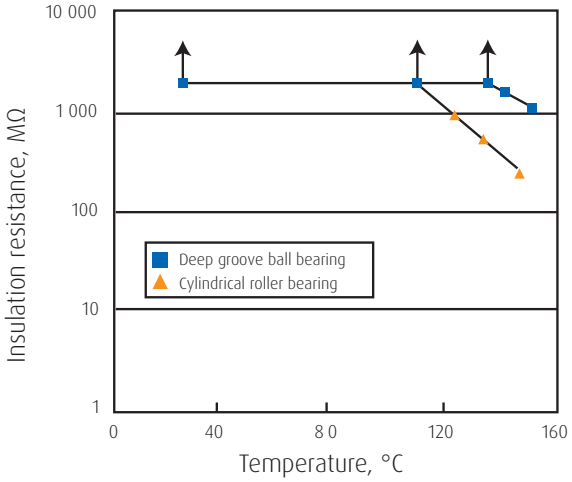
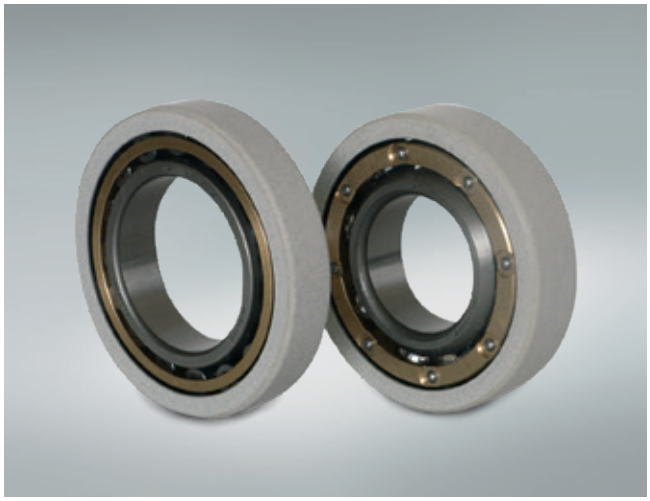
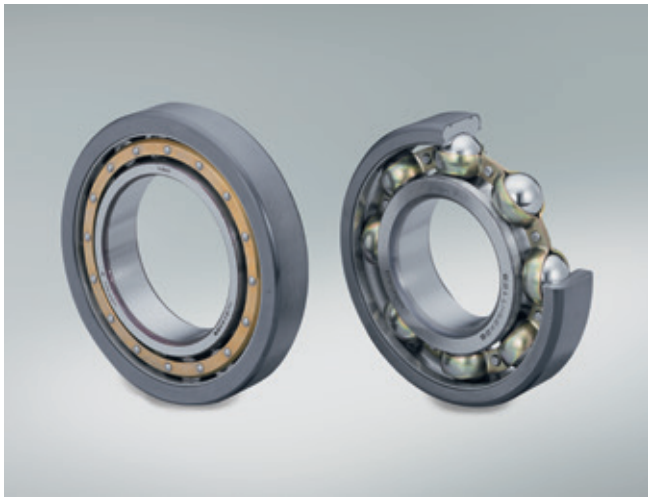



**Fig. 7-3 Temperature vs. Insulation resistance**

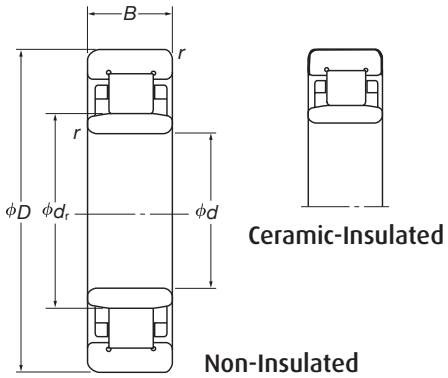


**Ceramic Insulated Bearing**



**PPS Insulated Bearing**

## Tables on Bearings for Electric Locomotive Traction Motors




Cylindrical Roller Bearing (NU Type)

### 2xx Series (Free End-Bearings)

| Boundary Dimensions (mm) | | | | | Basic Numbers | Internal Design(1) | Basic Dynamic Load Rating (N) | Basic Static Load Rating (N) | Mass (kg) approx. |
|---|---|---|---|---|---|---|---|---|---|
| d | D | B | $d_r$ | r (min) | | | | | |
| 120 | 215 | 40 | 143.5 | 2.1 | NU224 | E | 320,000 | 395,000 | 6.3 |
| 130 | 230 | 40 | 153.5 | 3.0 | NU226 | E | 345,000 | 425,000 | 7.9 |

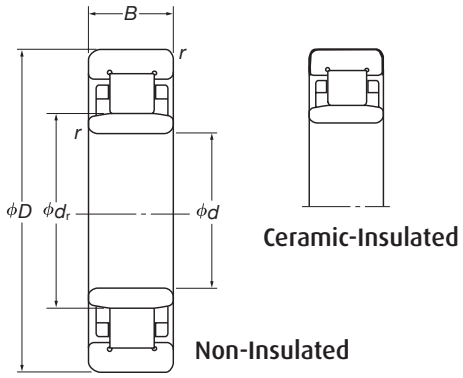
Note (1) E: High-Capacity

### 3xx Series (Free End-Bearings)

| Boundary Dimensions (mm) | | | | | Basic Numbers | Internal Design(1) | Basic Dynamic Load Rating (N) | Basic Static Load Rating (N) | Mass (kg) approx. |
|---|---|---|---|---|---|---|---|---|---|
| d | D | B | $d_r$ | r (min) | | | | | |
| 90 | 190 | 43 | 113.5 | 3 | NU318 | E | 315,000 | 355,000 | 6.1 |
| 100 | 215 | 47 | 127.5 | 3 | NU320 | E | 380,000 | 425,000 | 8.6 |
| 110 | 240 | 50 | 143.0 | 3 | NU322 | E | 425,000 | 485,000 | 11.5 |
| 120 | 260 | 55 | 154.0 | 3 | NU324 | E | 530,000 | 610,000 | 15.0 |
| 130 | 280 | 58 | 165.0 | 4 | NU326 | B | 655,000 | 795,000 | 18.8 |
| | | | 167.0 | | | E | 615,000 | 735 000 | 18.2 |
| 140 | 300 | 62 | 180.0 | 4 | NU328 | E | 665,000 | 795,000 | 22.3 |
| | | | 178.0 | | | F | 705,000 | 860,000 | 22.9 |
| 150 | 320 | 65 | 193.0 | 4 | NU330 | E | 760,000 | 920,000 | 27.1 |
| | | | 193.0 | | | EA | 715,000 | 855,000 | 26.8 |
| | | | 190.5 | | | J | 800,000 | 985,000 | 27.3 |
| | | | 190.0 | | | L | 790,000 | 970,000 | 27.5 |
| 160 | 340 | 68 | 204.0 | 4 | NU332 | E | 860,000 | 1,050,000 | 31.5 |
| 180 | 380 | 75 | 231.0 | 4 | NU336 | E | 985,000 | 1,230,000 | 43.5 |

Note (1) E, EA: High-Capacity Type B, F, J, L: Specific Types,respectively

# 7. Bearings for Traction Motors




Cylindrical Roller Bearing (NU Type)

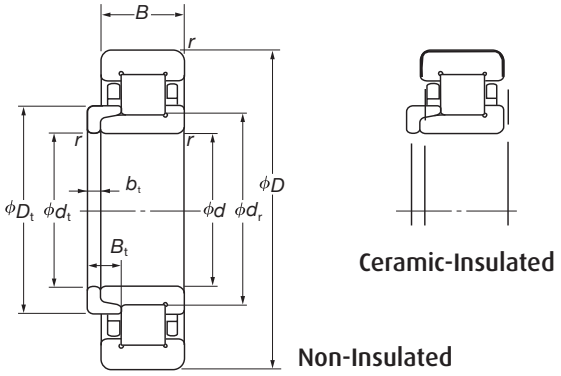
## 4xx Series (Free End-Bearings)

| Boundary Dimensions (mm) | | | | | Basic Numbers | Internal Design(1) | Basic Dynamic Load Rating (N) | Basic Static Load Rating (N) | Mass (kg) approx. |
|---|---|---|---|---|---|---|---|---|---|
| d | D | B | $d_r$ | r (min) | | | | | |
| 90 | 225 | 54 | 123.5 | 4 | NU418 | - | 375,000 | 400,000 | 11.5 |
| 105 | 260 | 60 | 144.5 | 4 | NU421 | - | 495,000 | 555,000 | 17.3 |
| 160 | 400 | 88 | 226.0 | 5 | NU432 | - | 1,000,000 | 1,220,000 | 61.3 |

## 22xx Series (Free End-Bearings)

| Boundary Dimensions (mm) | | | | | Basic Numbers | Internal Design(1) | Basic Dynamic Load Rating (N) | Basic Static Load Rating (N) | Mass (kg) approx. |
|---|---|---|---|---|---|---|---|---|---|
| d | D | B | $d_r$ | r (min) | | | | | |
| 100 | 180 | 46 | 119 | 2.1 | NU2220 | EA | 320,000 | 425,000 | 5.3 |

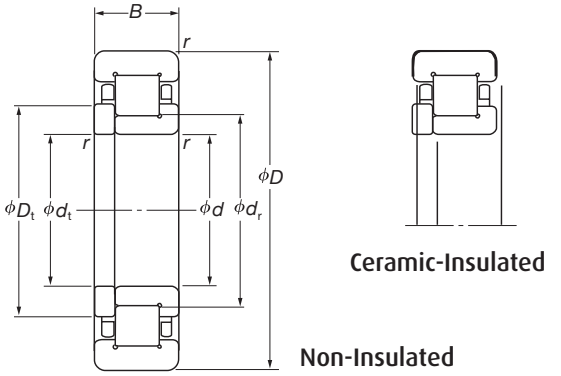
Note (1) EA: High-Capacity Type




Ceramic-Insulated

Non-Insulated

Cylindrical Roller Bearing (NH Type)




Ceramic-Insulated

Non-Insulated

Cylindrical Roller Bearing (NUP Type)

| Boundary Dimensions (mm) | | | | | | | | Basic Numbers | Internal Design(1) | Basic Dynamic Load Rating (N) | Basic Static Load Rating (N) | Mass (kg) approx. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $d, d_t$ | D | B | $d_r$ | $D_t$ | $B_t$ | $b_t$ | r (min) | | | | | |
| 60 | 130 | 31 | 77.0 | 84.2 | 15.5 | 9.0 | 2.1 | NH312 | — | 124,000 | 126,000 | 2.3 |
| 65 | 140 | 33 | 83.5 | 91.0 | 17.0 | 10.0 | 2.1 | NH313 | — | 143,000 | 151,000 | 2.9 |
| 70 | 150 | 35 | 90.0 | 98.0 | 17.5 | 10.0 | 2.1 | NH314 | — | 158,000 | 168,000 | 3.4 |
| 75 | 160 | 37 | 95.5 | 104.2 | 16.5 | 11.0 | 2.1 | NH315 | E | 240,000 | 263,000 | 4.2 |
| 75 | 160 | 37 | 95.0 | 104.2 | — | — | 2.1 | NUP315 | E | 240,000 | 263,000 | 3.9 |
| 80 | 170 | 39 | 101.0 | 111.8 | 17.0 | 11.0 | 2.1 | NH316 | E | 256,000 | 282,000 | 5.0 |
| 90 | 190 | 43 | 115.0<br>113.5 | 125.0<br>124.2 | 21.0<br>18.5 | 12.0 | 3.0 | NH318 | —<br>E | 240,000<br>315,000 | 265,000<br>355,000 | 6.8<br>6.8 |
| 90 | 190 | 43 | 115.0<br>113.5 | 125.0<br>124.2 | — | — | 3.0 | NUP318 | B<br>E | 240,000<br>315,000 | 265,000<br>355,000 | 6.3<br>6.3 |
| 100 | 215 | 47 | 129.5<br>129.5<br>127.5 | 140.5<br>140.5<br>139.0 | 22.5<br>22.5<br>20.5 | 13.0 | 3.0 | NH320 | A<br>B<br>E | 310,000<br>310,000<br>380,000 | 355,000<br>355,000<br>425,000 | 9.5<br>9.5<br>9.6 |
| 110 | 240 | 50 | 143.0 | 155.0 | 22.0 | 14.0 | 3.0 | NH322 | E | 425,000 | 485,000 | 12.9 |
| 120 | 260 | 55 | 154.0 | 168.5 | 23.5 | 14.0 | 3.0 | NH324 | — | 475,000 | 550,000 | 16.6 |
| 130 | 280 | 58 | 167.0 | 182.0<br>181.0 | 24.0 | 14.0 | 4.0 | NH326 | —<br>E | 560,000<br>615,000 | 665,000<br>735,000 | 20.2<br>20.1 |
| 140 | 300 | 62 | 180.0 | 196.0 | 26.0 | 15.0 | 4.0 | NH328 | — | 615,000 | 745,000 | 24.7 |

Note (1) E: High-Capacity Type A, B: Specific Types, respectively

## Standard Number of Cylindrical Roller Bearings

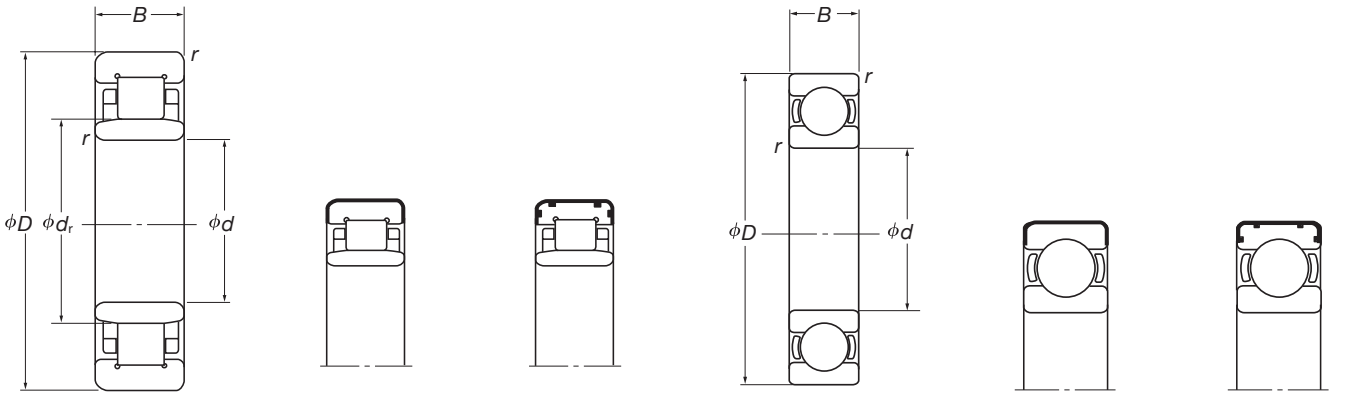
**Example:** NU 3 30 E TM 0 1 0 1

- NU — Type Symbol
- 3 — Diameter Series 3
- 30 — Bore Diameter 150 mm
- E — Internal Design (E: High Capacity)
- TM — Traction Motor
- 0 — Standard Internal Design
- 1 — Dimension Stabilizing Heat Treatment
- 0 — C4 Clearance & ISO Class 6
- 1 — Machine Brass Cage (Rolling Element guided)

Remarks : For cylindrical roller bearings for traction motors not listed above, please contact NSK.

# 7. Bearings for Traction Motors

## Table on Bearings for Electric Car Traction Motors




Non-Insulated | Ceramic-Insulated | PPS-Insulated — Cylindrical Roller Bearing

Non-Insulated | Ceramic-Insulated | PPS-Insulated — Ball Bearing

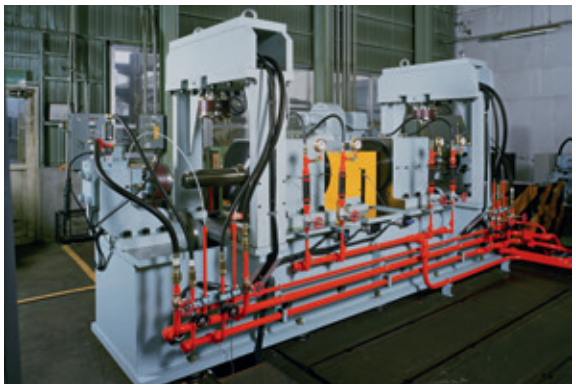
| Loaded Side, Cylindrical Roller Bearings | Boundary Dimensions (mm) | | | | | Non-Loaded Side, Ball Bearings | Boundary Dimensions (mm) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | d | D | B | $d_r$ | r (min) | | d | D | B | r (min) |
| NU212 | 60 | 110 | 22 | 73.5 | 1.5 | 6310 | 50 | 110 | 27 | 2 |
| NU312 | 60 | 130 | 31 | 77.0 | 2.1 | 6310 | 50 | 110 | 27 | 2 |
| NU213 | 65 | 120 | 23 | 79.6 | 1.5 | 6310 | 50 | 110 | 27 | 2 |
| NU313 | 65 | 140 | 33 | 83.5 | 2.1 | 6311 | 55 | 120 | 29 | 2 |
| NU214 | 70 | 125 | 24 | 84.5 | 1.5 | 6310 | 50 | 110 | 27 | 2 |
| | | | | | | 6311 | 55 | 120 | 29 | |
| NU314 | 70 | 150 | 35 | 90.0 | 2.1 | 6311 | 55 | 120 | 29 | 2 |
| NU215 | 75 | 130 | 25 | 88.5 | 1.5 | 6311 | 55 | 120 | 29 | 2 |
| | | | | | | 6312 | 60 | 130 | 31 | 2.1 |
| NU315 | 75 | 160 | 37 | 95.5 | 2.1 | 6311 | 55 | 120 | 29 | 2 |
| | | | | | | 6312 | 60 | 130 | 31 | 2.1 |
| | | | | | | 6314 | 70 | 150 | 35 | 2.1 |
| NU415 | 75 | 190 | 45 | 104.5 | 3.0 | 6313 | 65 | 140 | 33 | 2.1 |
| NU216 | 80 | 140 | 26 | 95.3 | 2.0 | 6312 | 60 | 130 | 31 | 2.1 |
| NU316 | 80 | 170 | 39 | 103.0 | 2.1 | 6312 | 60 | 130 | 31 | 2.1 |
| NU416 | 80 | 200 | 48 | 110.0 | 3.0 | 6313 | 65 | 140 | 33 | 2.1 |
| NU217 | 85 | 150 | 28 | 101.8 | 2.0 | 6217 | 85 | 150 | 28 | 2 |
| NU218 | 90 | 160 | 30 | 107.0 | 2.0 | 6218 | 90 | 160 | 30 | 2 |
| NU219 | 95 | 170 | 32 | 113.5 | 2.1 | 6219 | 95 | 170 | 32 | 2.1 |

## Interchangeability of Traction Motor Bearings

| | NSK Bearing Numbers(1) | Internal Clearance | Tolerance Class | Other Maker's Numbers (SKF) |
|---|---|---|---|---|
| Loaded-Side Bearings (Free End-Bearings) NU3xx Series | NU315E-TM0102 | C4 | P6 | NU315ECMC4VA301 |
| | NU316E-TM0101 | C4 | P6 | NU316ECMC4VA301 |
| | NU317E-TM0101 | C4 | P6 | NU317ECMC4VA301 |
| | NU318E-TM0101 | C4 | P6 | NU318ECMC4VA301 |
| | NU320E-TM0102 | C4 | P6 | NU320ECMC4VA301 |
| | NU322E-TM0101 | C4 | P6 | NU322ECMC4VA301 |
| | NU324E-TM0102 | C4 | P6 | NU324ECMC4VA301 |
| | NU326B-TM0113 | CG185 | P6A | 468540VAS |
| | NU326E-TM0101 | C4 | P6 | NU326ECMC4VA301 |
| | NU328E-TM0102 | C4 | P6 | NU328ECMC4VA301 |
| | NU330E-TM0101 | C4 | P6 | NU330ECMC4VA301 |
| | NU330E-TM1105 | C4 | P6 | NU330ECMRDC4VA301 |
| | NU330J-TM0111 | CG205 | P6 | 466830M/W23 |
| | NU332E-TM0101 | C4 | P6 | NU332ECMC4VA301 |
| | NU332EH2(2)-TM0101 | C4 | P6 | NU332ECMC4VA309 |
| Non-Loaded Side-Bearings (Fixed End-Bearings) NH3xx Series | NH312E-TM0101 | C4 | P6 | NH312ECMC4VA301 |
| | NH313E-TM0101 | C4 | P6 | NH313ECMC4VA301 |
| | NH314E-TM0101 | C4 | P6 | NH314ECMC4VA301 |
| | NH315E-TM0102 | C4 | P6 | NH315ECMC4VA301 |
| | NH316E-TM0101 | C4 | P6 | NH316ECMC4VA301 |
| | NH317E-TM0101 | C4 | P6 | NH317ECMC4VA301 |
| | NH318E-TM0101 | C4 | P6 | NH318ECMC4VA301 |
| | NH320E-TM0102 | C4 | P6 | NH320ECMC4VA301 |
| | NH320B-TM0312 | CG153 | P6A | NH320M2/W23B/W83 |
| | NH320EH2(2)-TM0102 | C4 | P6 | NH320ECMC4VA309 |
| | NH322E-TM0101 | C4 | P6 | NH322ECMC4VA301 |
| | NH324E-TM0102 | C4 | P6 | NH324ECMC4VA301 |
| | NH324E-TM0105 | C4 | P6 | NH324ECMRDC4VA301 |
| | NH326E-TM0101 | C4 | P6 | NH326ECMC4VA301 |
| | NH328E-TM0102 | C4 | P6 | NH328ECMC4VA301 |

Notes (1) E: High-Capacity Type B, J: Specific Types, respectively
(2) Ceramic-Insulated Type

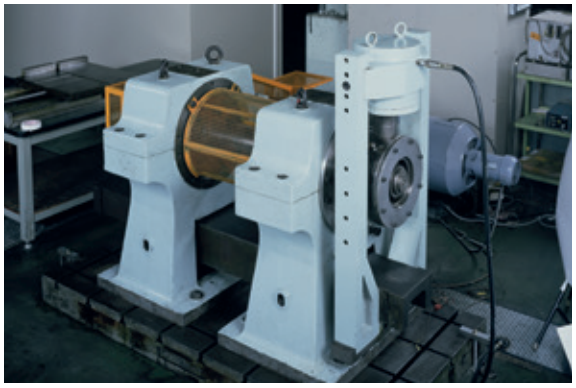
# 8. Bearing Test Facilities for Rolling Stock



**UIC-compliant rotation test equipment for railway axlebox bearings**
This equipment can test railway axle box bearings based on UIC515-50 standards. It can test two bearings simultaneously under identical conditions and programmed operation including forward and reverse rotation. The loading mechanism utilizes a servo-pulsar and can apply various fluctuating radial and axial loads. Additionally, bearing rotational tests can be conducted by inputting the load data of an actual vehicle. The test equipment can simulate Shinkansen conditions and is equipped with a cooling device.

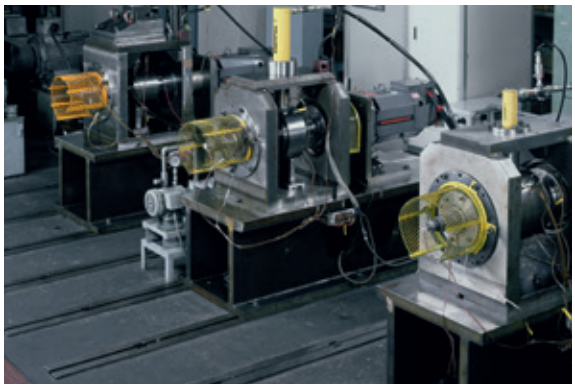


**Rotation test equipment for railway axle box bearings**
This equipment can test performance and durability for railway axle box bearings using actual axle boxes for bullet trains and conventional trains. It can test programmed operation including forward and reverse rotation and stopping. To create the load conditions of bearings in actual vehicles, radial load can be applied by hydraulic pistons and axial loads can be applied in turn to both rows of a doublerow bearing by moving the axle box back and forth with a hydraulic piston. Additionally, replicating cooling conditions during actual running, an air cooling device is included

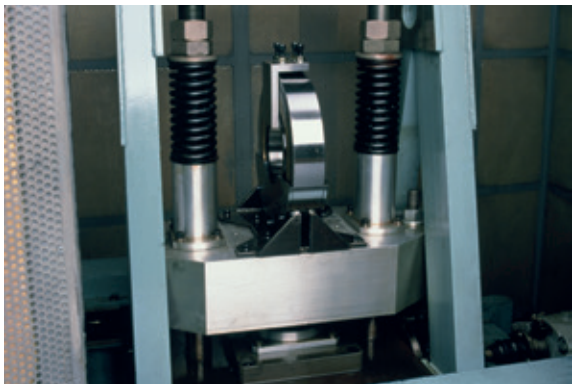


**Rotation test equipment for bearings for large traction motors**
This equipment can test the performance and durability of traction motor bearings for electric locomotives with bores of ø150 mm and over. To simulate actual running conditions, programmed operation can be conducted with rapid acceleration to the maximum speed of actual trains under load conditions equivalent to actual vehicles. Additionally, to replicate heat generated by the rotor, high temperature tests can be conducted.

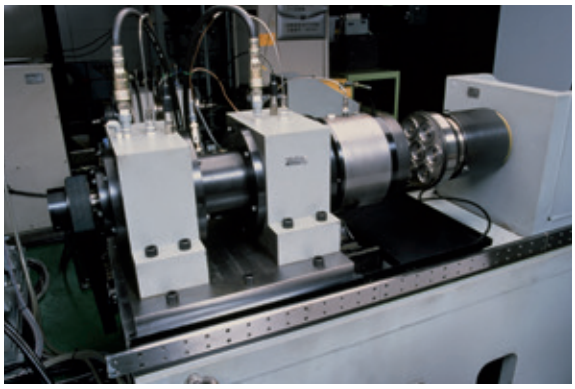


**Rotation test equipment for bearings for small traction motors**
This equipment can test the performance and durability of electric car traction motor bearings whose bores are ø100 mm or less. Simulating actual running conditions of motors and providing the required conditions for pre-delivery motor inspections, programmed operation can be conducted including rapid acceleration to the maximum speed of actual trains under load conditions equivalent to actual vehicles. Additionally, to replicate heat generated by the rotor, high temperature tests can be conducted. The equipment is used primarily to evaluate bearings under radial load only, but it can also be used to test bearings with a fluctuating axial load. The bearings are usually tested with grease but sometimes with oil.



**Drop impact test equipment**
This equipment can apply impact loads to a bearing. Applying repeated drop impacts to a bearing is an effective means of evaluating the fatigue strength of the cage. The vibrating acceleration applied to the bearing with each impact can be set by changing the height from which the bearing is dropped.



**PV test equipment**
This equipment is for testing the performance and durability of gear unit bearings. Bearing starting torque and dynamic torque can be measured during testing. Radial and axial loads are applied to the bearing using hydrostatic bearings. Additionally, accelerated testing on the seizure resistance between the rib and end faces of rollers in tapered or cylindrical roller bearings can be evaluated by creating lubricant-starved conditions

# Increasing efficiency – with AIP, the value-added programme from NSK

Incorrectly applied or selected bearings can lead to anything from a reduction in machine performance to failure of an entire system. We support you in solving these technical problems. The value-added programme AIP incorporates a comprehensive service package which enables you to design both productive operation and maintenance processes with increased efficiently and consequently better profitability. With AIP, you reduce your costs at every value-added stage.

### Concentrated knowledge, many years of experience

Thanks to their in-depth technical knowledge and industry know-how, the experienced NSK application engineers are able to identify profitability potential and recommend appropriate measures. Our experts work according to a procedure which has been tested in practice and standardised – the value cycle. The ideally coordinated solution for your application is developed in close cooperation with them.

### AIP services made to measure

The comprehensive range of AIP services is purposely designed to enhance efficiency and competitiveness. Your NSK expert will advise you about which measures can be derived from the examination results and will support you in implementing them. An app developed specially by NSK helps to collect data quickly on site and to perform calculations. Another app presents success stories from various branches of industry.




### AIP NSK Solutions

Example success stories show how profitability and reliability can be increased using tried and tested practices.

### Cost Saver App

The cost savings calculator app enables potential cost savings to be calculated rapidly.







- Stores Survey
- Workshop Survey
- Process Map
- Bearing Cross Referencing




- Application Reviews
- Machine Design Support
- OEM Part Conversion
- Diagnostics




- Product Training
- Application of NSK Bearings
- AIP Training
- Industry Specific Training




- Bearing Condition Analysis
- Failed Bearing Analysis
- Lubrication Analysis
- Material & Dimensional Analysis

Discover how you can increase your profitability with the help of our value-added AIP programme and our high-quality products. **We will be pleased to send you our complete AIP brochure or contact you personally. Please email your enquiry to us at:** aip@nsk.com

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