MOTION & CONTROL™

NSK

BEARINGS FOR RAILWAY ROLLING STOCK

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As one of the world's leading manufacturers of rolling bearings, linear technology components and steering systems, we can be found on almost every continent – with production facilities, sales offices and technology centres – because our customers appreciate short decision-making channels, prompt deliveries and local service.

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, we develop technologies in the fields of rolling bearings, linear systems, components for the automotive industry and mechatronic systems. Our research and production facilities in Europe, Americas and Asia are linked together in a global technology 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.

Partnership based on trust – and trust based on quality

Total Quality by NSK: The synergies of our global network of NSK Technology Centres. Just one example of how we meet our requirements for high quality.

NSK is one of the leading companies with a long tradition in patent applications for machine parts. In our worldwide research centres, we not only concentrate on the development of new technologies, but also on the continual improvement of quality based on the integrated technology platform of tribology, material technology, analysis and mechatronics. **More about NSK at www.nskeurope.com or call us on +44 (0) 1636 605 123**

Content

Content

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.

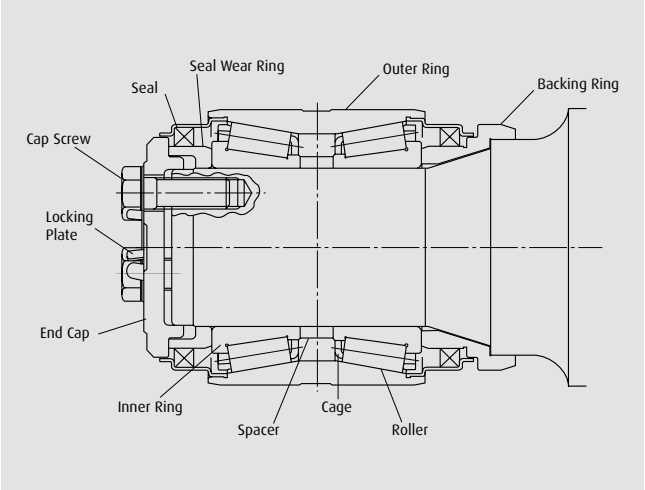
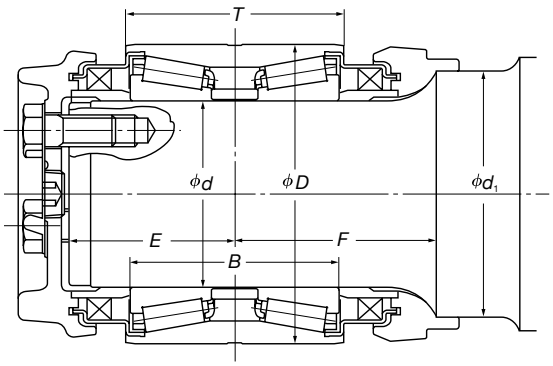


Fig. 2-2 Sealed-Clean Rotating End Cap Tapered Roller Bearings

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

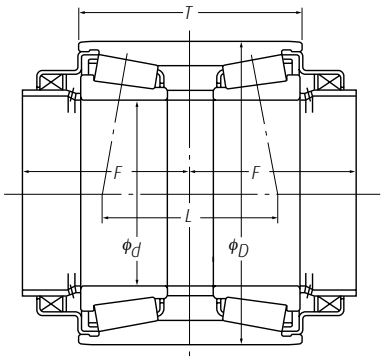


Assembly Number	Dimensions (mm)					
	d	D	T	B	d_1	
J-908	90	154	90	80	110	
J-318	110	175	130	125	155	
J-358A	110	200	150	145	139	
J-359	110	185	135	130	145	
J-910	110	188	150	145	150	
J-901	110	190	150	145	150	
J-905	110	195	150	145	150	
J-909	110	205	140	130	150	
J-902	110	220	145	144	155	
J-900	115	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)

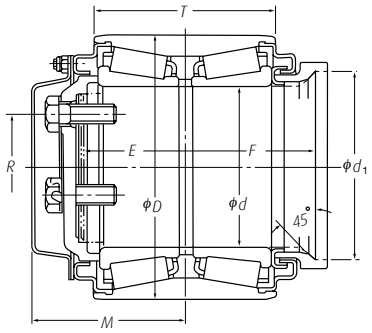
2. Sealed-Clean Rotating End Cap Tapered Roller Bearings

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

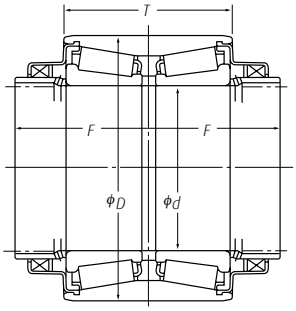


Class	Assembly Number	Dimensions (mm)				
		d	D	F	T	L
B (4¼ × 8)	J-361X	101.6000	165.1000	91	114	54.40
		4.0000	6.5000	3 19/32	4½	2.14
C (5 × 9)	J-362X	119.0620	195.2620	109	143	105.70
		4.6875	7.6875	4 9/32	5⅝	4.16
	J-362X1	119.0620	195.0000	103	132	94.10
		4.6875	7.6772	4 1/16	5 11/64	3.71
D (5½ × 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

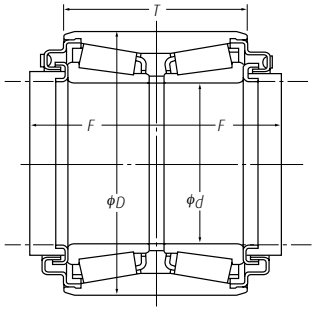
Metric-Series Sealed-Clean Rotating End Cap Tapered Roller Bearing Unit Tables



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

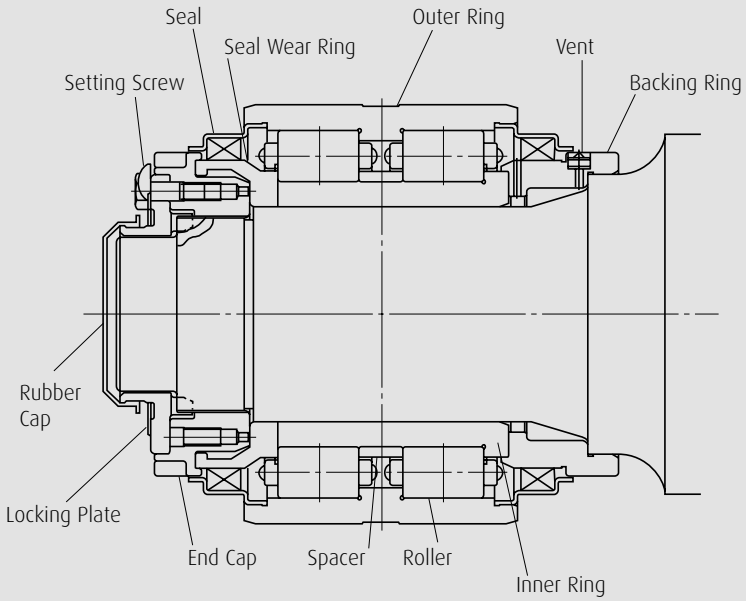
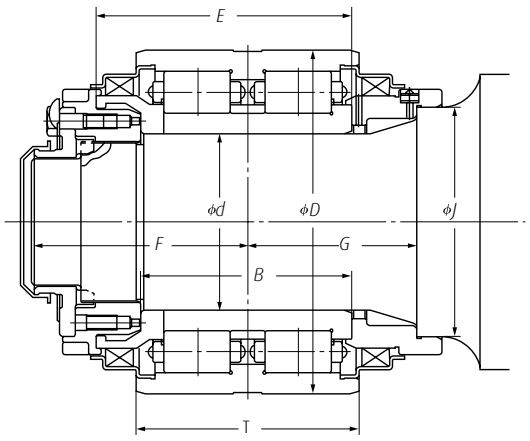


Fig. 3-1 Sealed-Clean Rotating End Cap Cylindrical Roller Bearings



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 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.

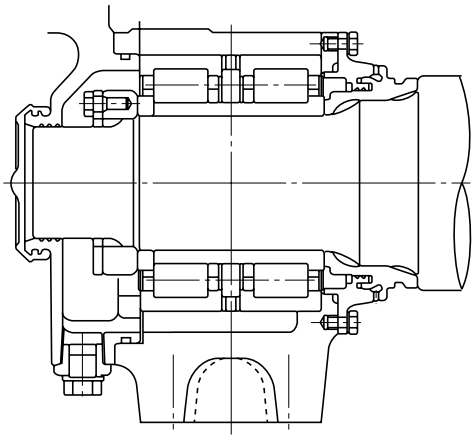
2. Cylindrical Roller Bearings combined with Ball Bearings

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.

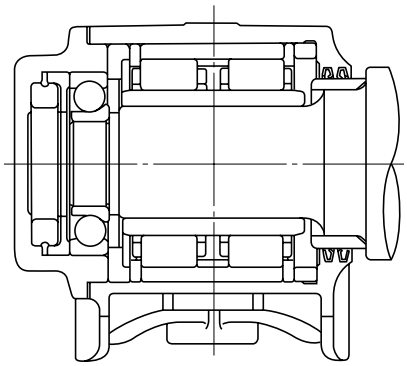
3. Cylindrical Roller Bearings with Ribs

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.

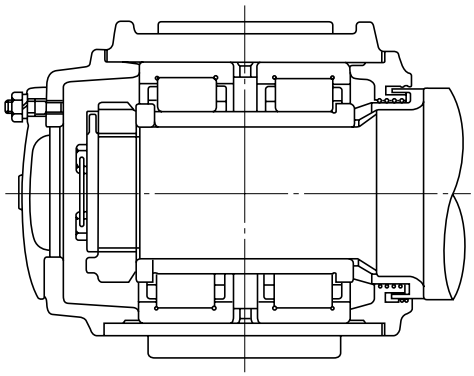
4. Cylindrical Roller Bearings



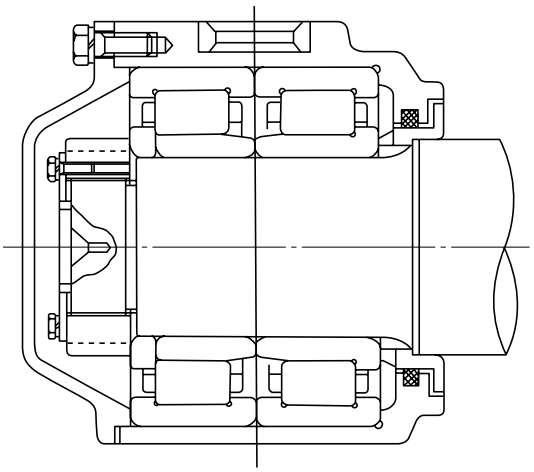
Double-Row Cylindrical Roller Bearing with Rib to Sustain Axial Load



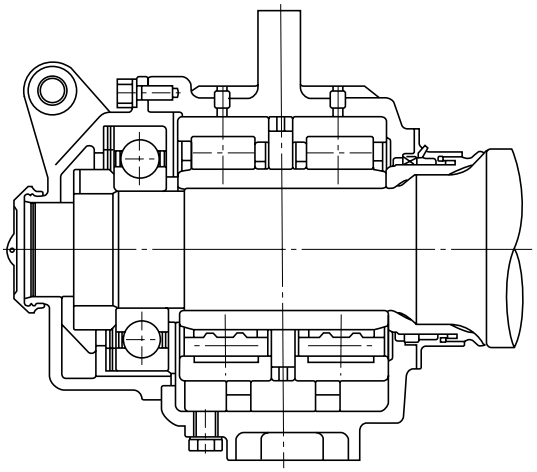
Axle Box with an Angular Contact Ball Bearing and Buffer to Sustain Axial Load



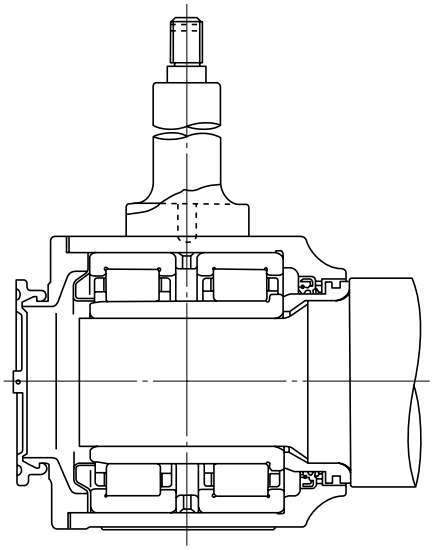
Axle Box with Roller-Guiding Ribs to Sustain Axial Loads



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

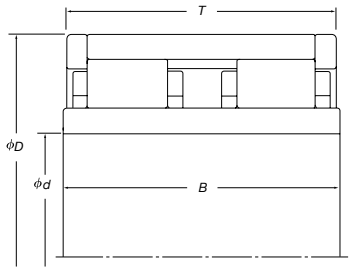


Axle Box with Single Inner Ring to Sustain Axial Load

4. Cylindrical Roller Bearings

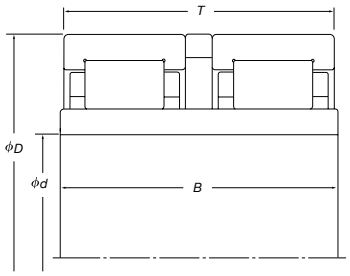
Cylindrical Roller Bearing Tables

Type A



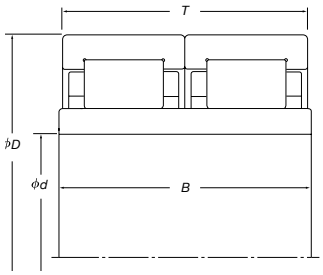
Bearing Number	Dimensions (mm)				Basic Dynamic Load Rating (N)	Basic Static Load Rating (N)	Mass (kg) approx.
	d	D	T	B			
2U85-1	85	155	105	125	400,000	605,000	9.6
2U95-1C	95	170	105	125	440,000	690,000	11.3
2U100-1	100	180	120	130	500,000	795,000	13.7
2U100-2A	100	190	130	140	690,000	1,100,000	17.2
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

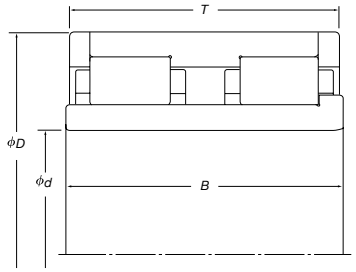


Bearing Number	Dimensions (mm)				Basic Dynamic Load Rating (N)	Basic Static Load Rating (N)	Mass (kg) approx.
	d	D	T	B			
JC2A	110	235	160	180	935,000	1,430,000	35.4

4. Cylindrical Roller Bearings

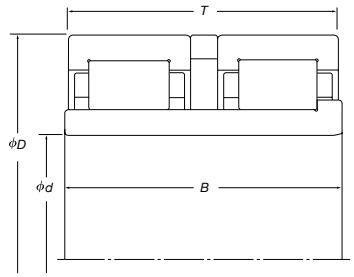
Cylindrical Roller Bearing Tables

Type D



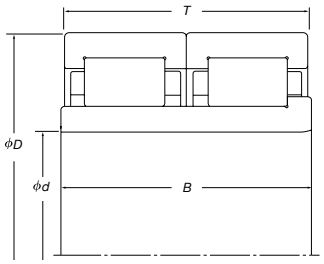
Bearing Number	Dimensions (mm)				Basic Dynamic Load Rating (N)	Basic Static Load Rating (N)	Mass (kg) approx.
	d	D	T	B			
2J100-1	100	180	130	143	560,000	915,000	15.2

Type E



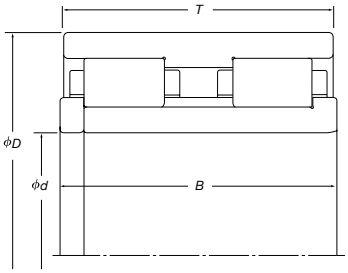
Bearing Number	Dimensions (mm)				Basic Dynamic Load Rating (N)	Basic Static Load Rating (N)	Mass (kg) approx.
	d	D	T	B			
85JRJ02	85	150	120.0	125	365,000	585,000	8.7
90JRJ01	90	160	118.5	130	355,000	530,000	9.3
110JRJ01	110	200	150.0	160	625,000	995,000	19.9
2J110-2	110	220	180.0 (80x2)	190	875,000	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

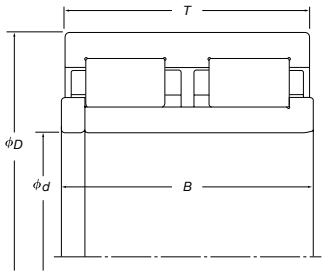


Bearing Number	Dimensions (mm)				Basic Dynamic Load Rating (N)	Basic Static Load Rating (N)	Mass (kg) approx.
	d	D	T	B			
2M110-3A	110	220	160	154	875,000	1,370,000	28.9
2M120-9	120	240	180	185	935,000	1,450,000	38.7
120JRF02	120	220	160	165	850,000	1,430,000	28.0
2M130-1	130	270	153	135	820,000	1,140,000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

4. Cylindrical Roller Bearings

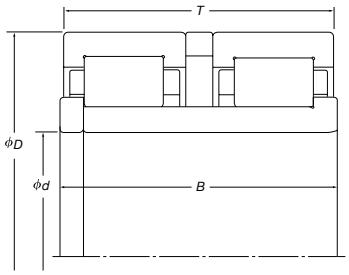
Cylindrical Roller Bearing Tables

Type H



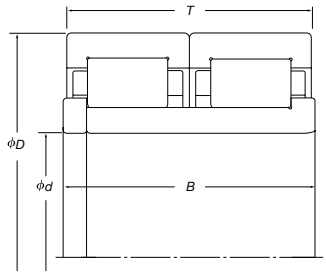
Bearing Number	Dimensions (mm)				Basic Dynamic Load Rating (N)	Basic Static Load Rating (N)	Mass (kg) approx.
	d	D	T	B			
JC14	130	260	160	160	1,140,000	1,840,000	46.6

Type I



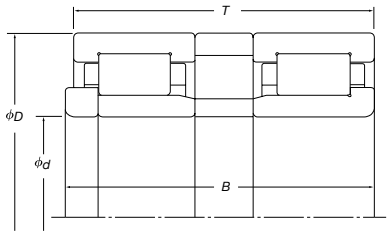
Bearing Number	Dimensions (mm)				Basic Dynamic Load Rating (N)	Basic Static Load Rating (N)	Mass (kg) approx.
	d	D	T	B			
95JRT01	95	190	125	130	800,000	1,340,000	15.7
95JRT02	95	170	115	125	440,000	685,000	11.4
20100-1	100	200	170	170	650,000	1,030,000	24.8
JC6K	110	220	172	180	790,000	1,190,000	30.5
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

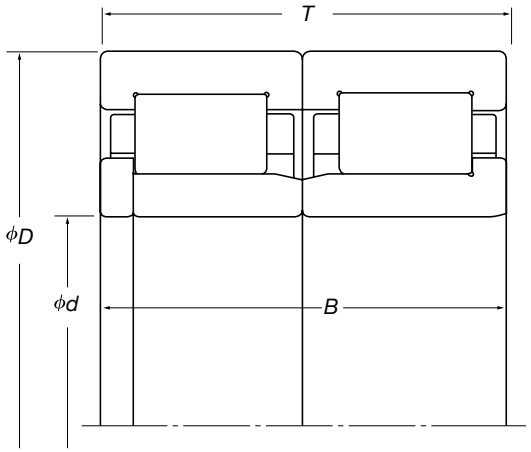
Type K



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

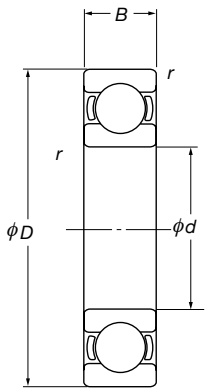
4. Cylindrical Roller Bearings

Type L

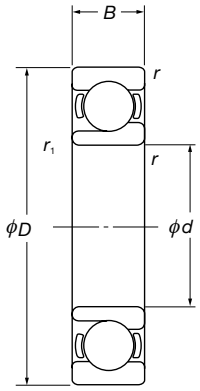


Bearing Number	Dimensions (mm)				Basic Dynamic Load Rating (N)	Basic Static Load Rating (N)	Mass (kg) approx.
	d	D	T	B			
J110-2/U110-4DB	110	215	73 × 2	73 × 2	800,000	1,240,000	25.4
J120-1C/U120-2C	120	240	80 × 2	80 × 2	960,000	1,500,000	35.1
J120-1D/U120-2D	120	240	80 × 2	80 × 2	960,000	1,500,000	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

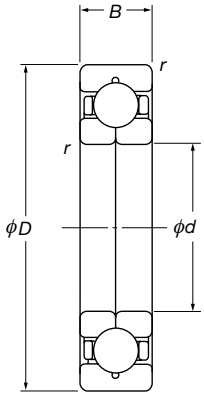
Table of Ball Bearings for Axial Loads



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.

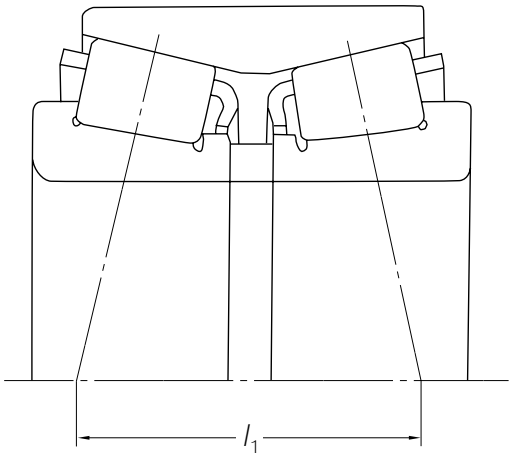


Fig. 5-1 Back-to-Back Arrangement

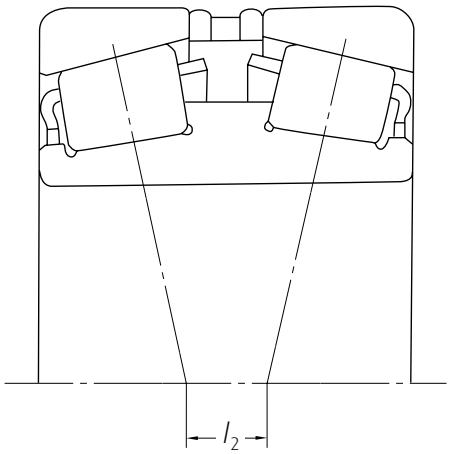
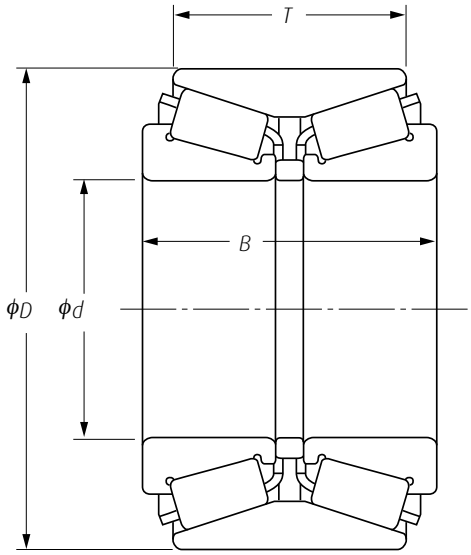


Fig. 5-2 Face-to-Face Arrangement

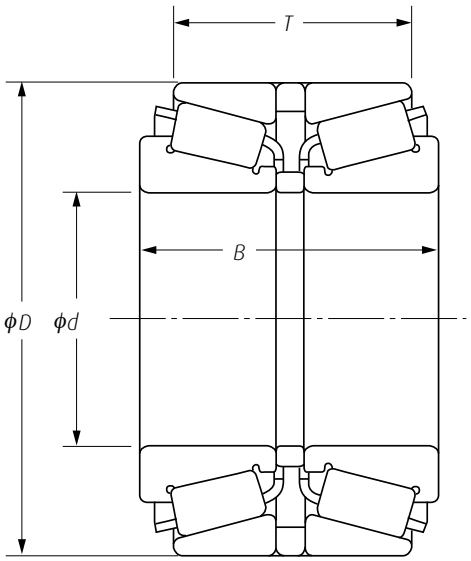
Tapered roller bearings are used either in sets of two, or in a double-row configuration in which there is one outer ring or one inner ring for the two rows of rollers. There are two types of duplex arrangements: back-to-back and face-to-face, as shown in Figs. 5-1 and 5-2, respectively. For rolling 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

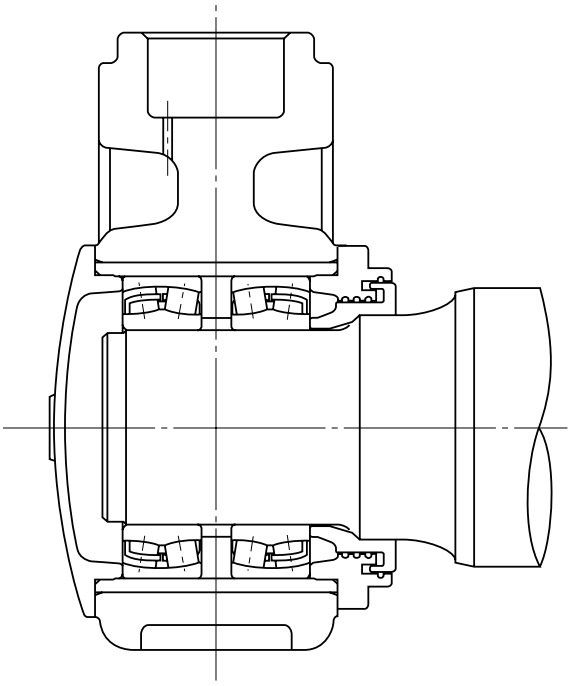


Type B

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



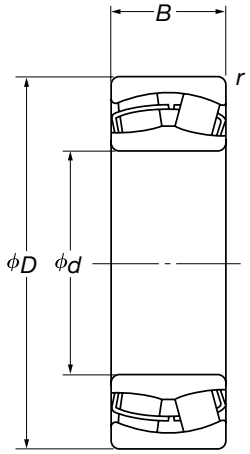
Spherical roller bearings can sustain, not only heavy radial loads, but also some axial loads in either direction. They have excellent radial load carrying capacity and are suitable for use where there are heavy or impact loads.

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 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 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 5.0	575,000 (129,000)	960,000 (216,000)
228285C	139.734	218	80.0	1.5 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 5.0	725,000 (163,000)	1,180,000 (266,000)
228708C	152.434	250	100.0	2.7 5.0	860,000 (193,000)	1,450,000 (325,000)
231481C	157.174	270	86.0	2.0 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 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.

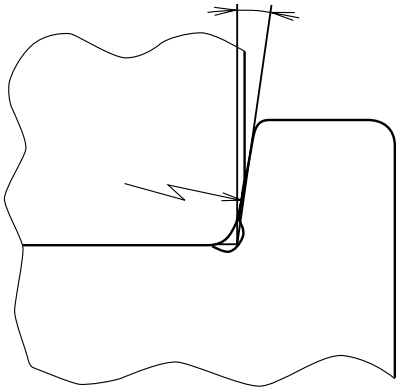


Fig. 7-1 The design of rib and roller end

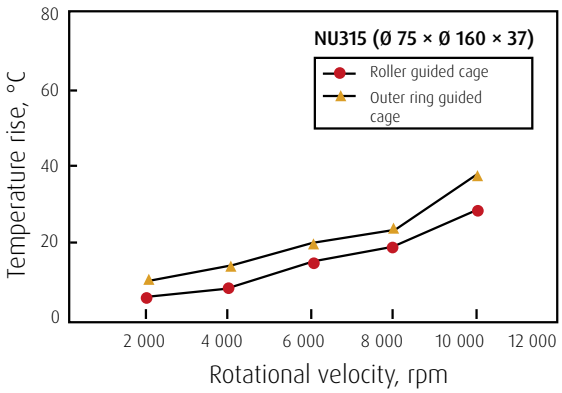


Fig. 7-2 Comparison of temperature rise

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).

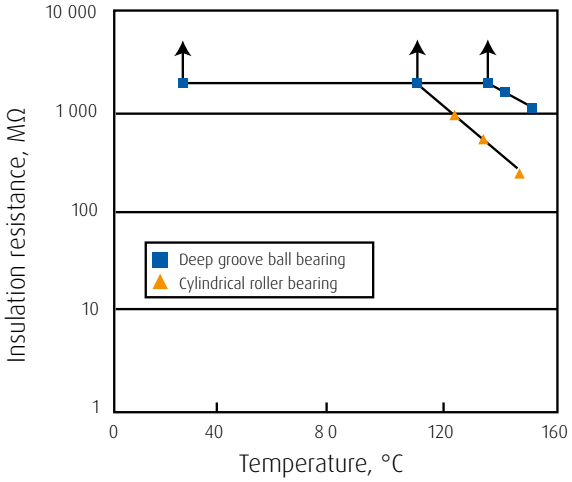
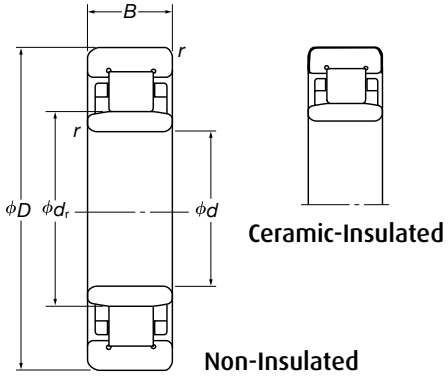


Fig. 7-3 Temperature vs. Insulation resistance

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

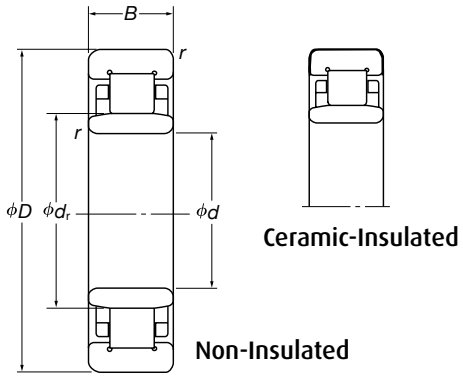
Note (1) E: High-Capacity

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)

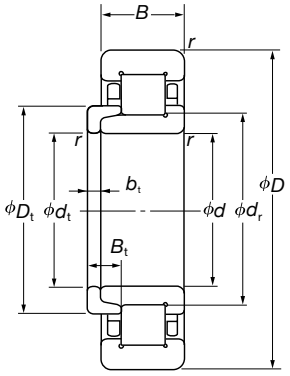
4xx Series (Free End-Bearings)

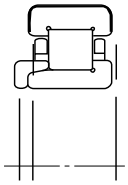
Boundary Dimensions (mm)					Basic Numbers	Internal Design(1)	Basic Dynamic Load Rating (N)	Basic Static Load Rating (N)	Mass (kg) approx.
d	D	B	d_r	r (min)					
90	225	54	123.5	4	NU418	-	375,000	400,000	11.5
105	260	60	144.5	4	NU421	-	495,000	555,000	17.3
160	400	88	226.0	5	NU432	-	1,000,000	1,220,000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

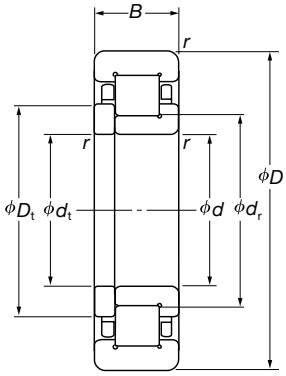


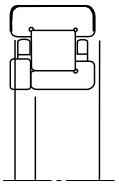


Ceramic-Insulated

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	115.0 113.5	125.0 124.2	21.0 18.5	12.0	3.0	NH318	— E	240,000 315,000	265,000 355,000	6.8 6.8
90	190	43	115.0 113.5	125.0 124.2	—	—	3.0	NUP318	B E	240,000 315,000	265,000 355,000	6.3 6.3
100	215	47	129.5 129.5 127.5	140.5 140.5 139.0	22.5 22.5 20.5	13.0	3.0	NH320	A B E	310,000 310,000 380,000	355,000 355,000 425,000	9.5 9.5 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	182.0 181.0	24.0	14.0	4.0	NH326	— E	560,000 615,000	665,000 735,000	20.2 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

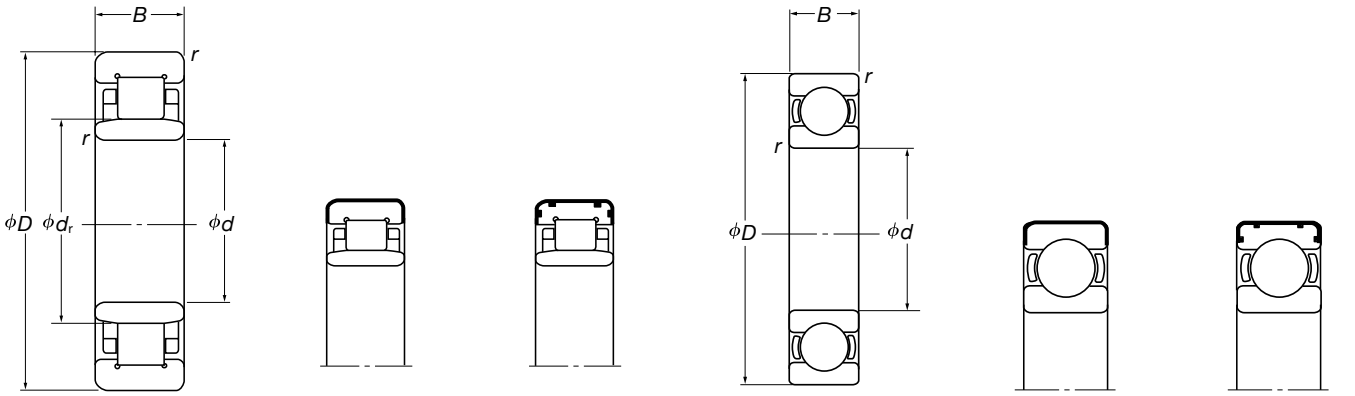
Example: NU 3 30 E TM 0 1 0 1

- 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

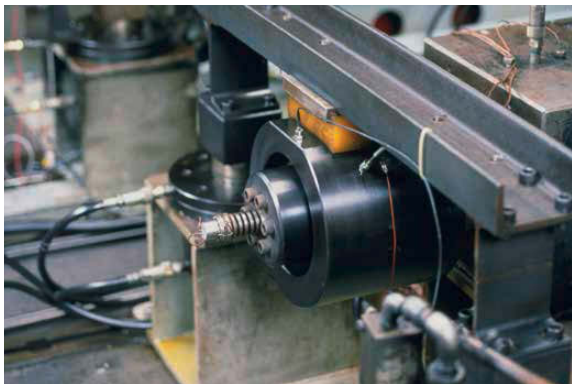
Interchangeability of Traction Motor Bearings

	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

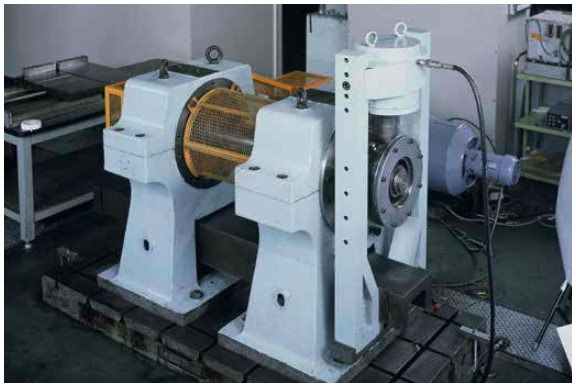
Notes (1) E: High-Capacity Type B, J: Specific Types, respectively
(2) Ceramic-Insulated Type

8. Bearing Test Facilities for Rolling Stock

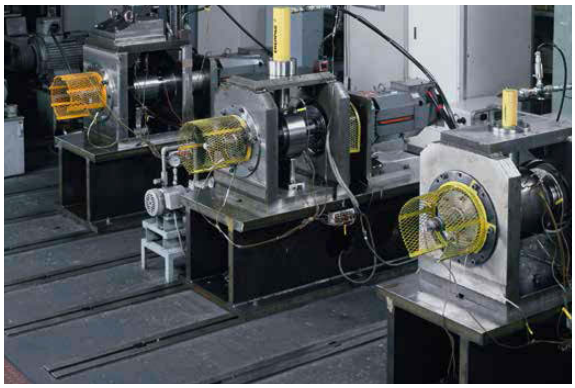
UIC-compliant rotation test equipment for railway axlebox bearings
This equipment can test railway axle box bearings based on UIC515-50 standards. It can test two bearings simultaneously under identical conditions and programmed operation including forward and reverse rotation. The loading mechanism 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.

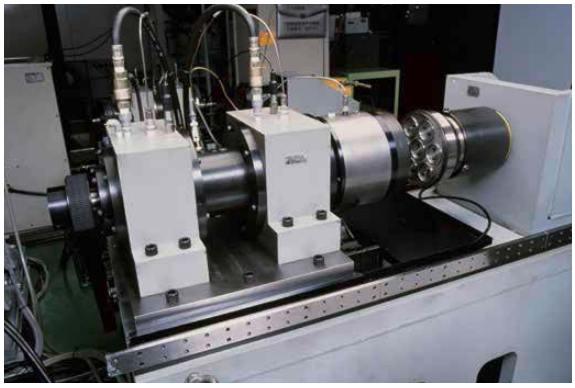


Rotation test equipment for bearings for small traction motors

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

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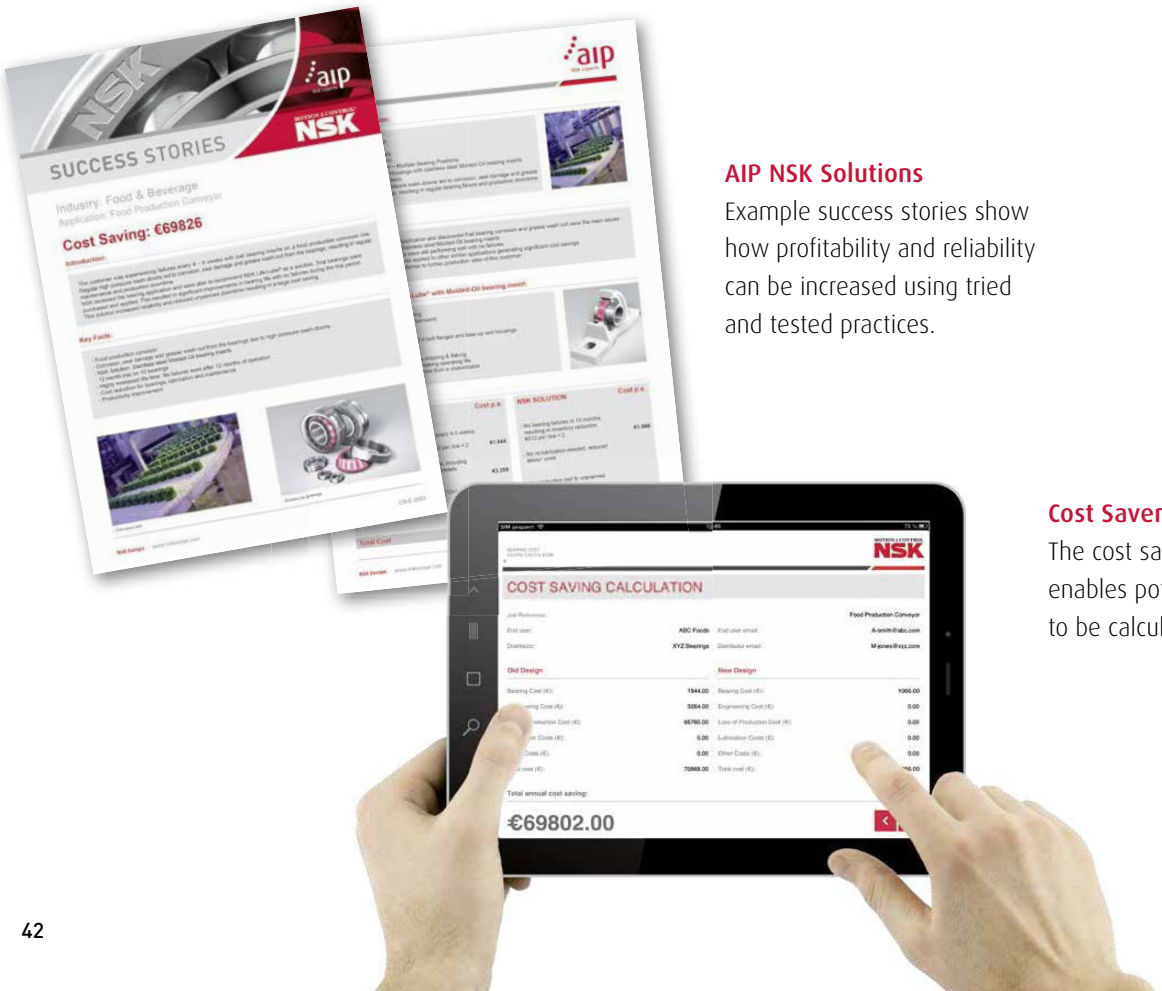

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