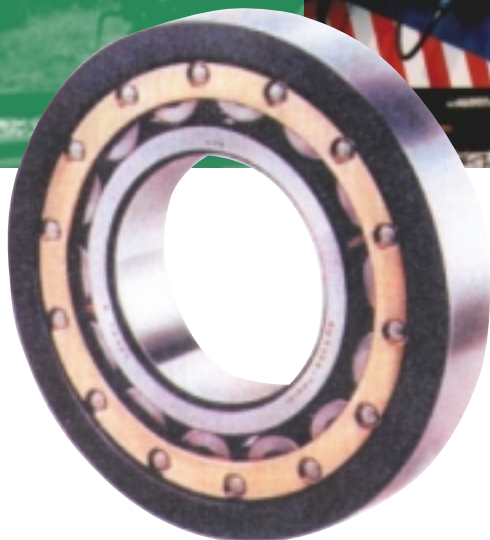


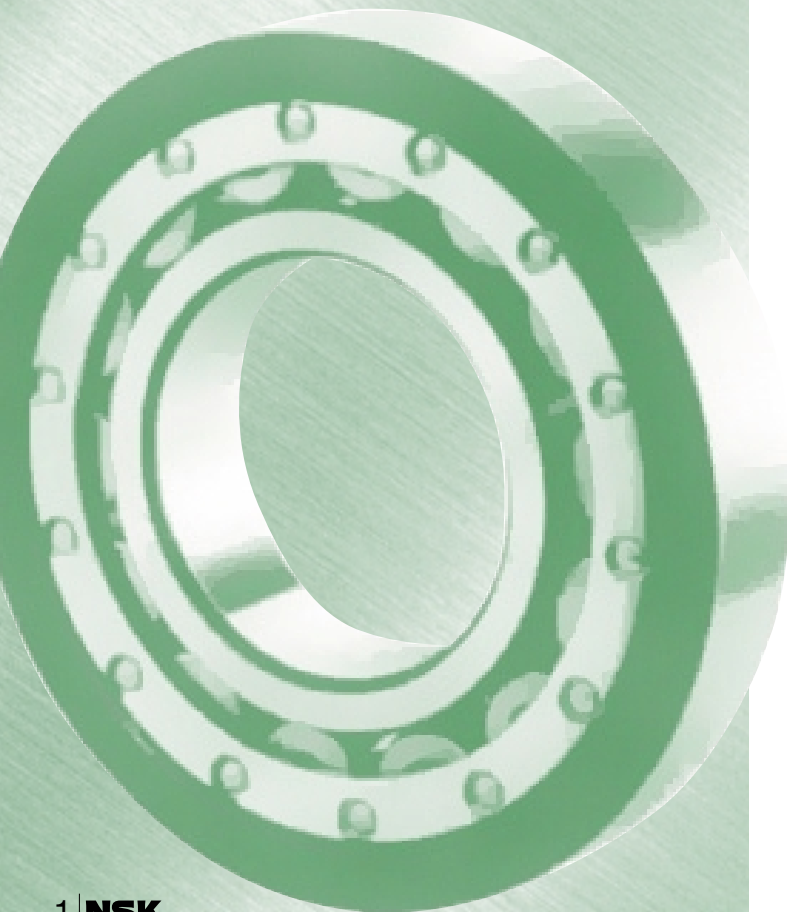
Bearings for Traction Motors

Cylindrical Roller Bearings and Ball Bearings

In all traction motors for electric locomotives and electric cars are used roller bearings, and they are usually cylindrical ones because of their high-speed and heavy-load capabilities as well as easy assembly and disassembly. In the case of small motors, deep groove ball bearings may also be used.



Cylindrical Roller Bearings and Ball Bearings



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:
 - 1) high radial and axial loads
 - 2) high impact loads
 - 3) high speed
 - 4) extended periods of operation without maintenance
3. NSK uses the following bearing specifications to satisfy the above-noted severe requirements.
 - 1) Bearing materials are vacuum degassed for high purity.
 - 2) Inner and outer rings are treated for heat dimensional stabilization.
 - 3) Raceway surfaces are always super-finished and the rolling surfaces of rollers are either super-finished or barrel-finished.
 - 4) High load-capacity design is applied for electric locomotives.
 - 5) Tapered ribs and roller end crowning are applied for cylindrical roller bearings to increase the axial load capacity (Fig. 1).

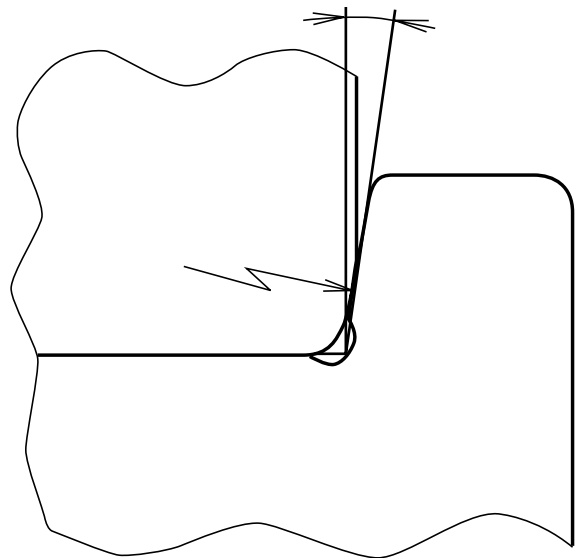


Fig. 1 The design of rib and roller end

- 6) Roller-guided cages is applied for superior lubrication, temperature rise (Fig. 2), etc.
- 7) High-strength cages are applied, particularly with means to prevent loosening of rivets due to vibration and impacts.
- 8) Outside surface and both end faces of outer ring are coated with ceramic or heat-resistant resin for prevention of electric pitting.

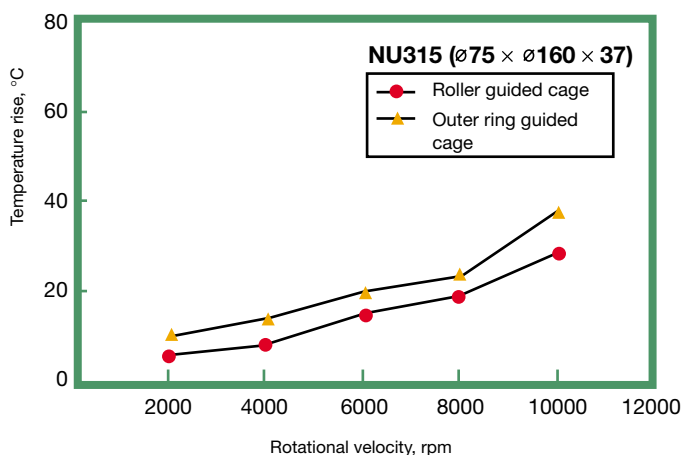


Fig. 2 Comparison of temperature rise



Ceramic-Insulated Bearing



PPS-Insulated Bearing

Photo 1 Insulated bearings

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 (Photo 1).

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. 3).

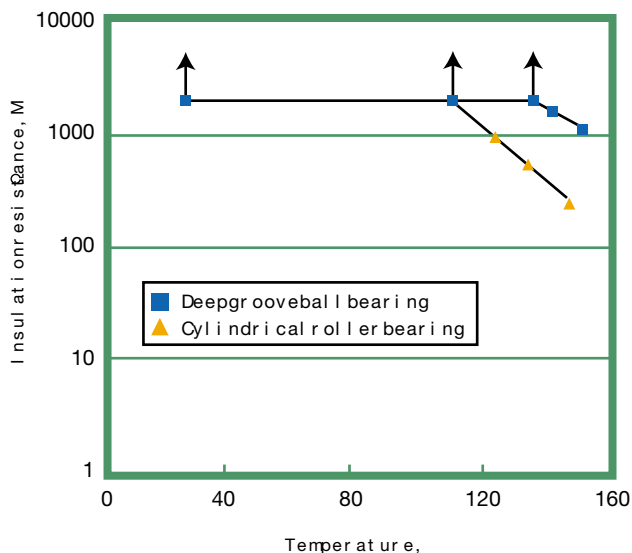
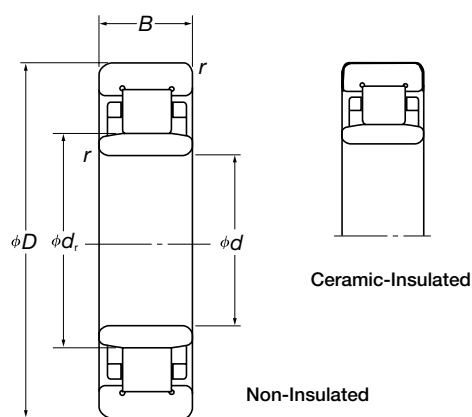


Fig. 3 Temperature vs. Insulation resistance

Tables on Bearings for Electric Locomotive Traction Motors



Cylindrical Roller Bearing (NU Type)

2□□ 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	NU226	E	345 000	425 000	7.9

Note (1) E: High-Capacity Type

3□□ 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	3	NU322	E	425 000	485 000	11.5
120	260	55	154	3	NU324	E	530 000	610 000	15.0
130	280	58	165	4	NU326	B	655 000	795 000	18.8
			167			E	615 000	735 000	18.2
140	300	62	180	4	NU328	E	665 000	795 000	22.3
			178			F	705 000	860 000	22.9
150	320	65	193	4	NU330	E	760 000	920 000	27.1
			193			EA	715 000	855 000	26.8
			190.5			J	800 000	985 000	27.3
			190			L	790 000	970 000	27.5
160	340	68	204	4	NU332	E	860 000	1 050 000	31.5
180	380	75	231	4	NU336	E	985 000	1 230 000	43.5

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

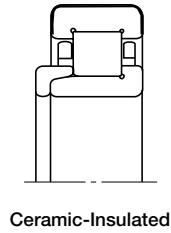
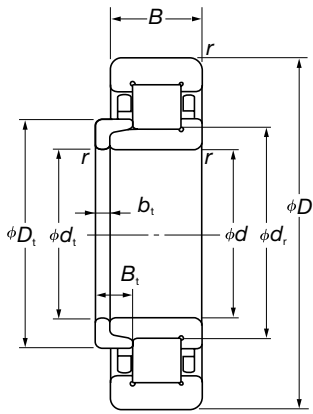
4□□ Series (Free End-Bearings)

Boundary Dimensions (mm)					Basic Numbers	Internal Design	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	5	NU432	-	1 000 000	1 220 000	61.3

22□□ 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

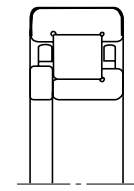
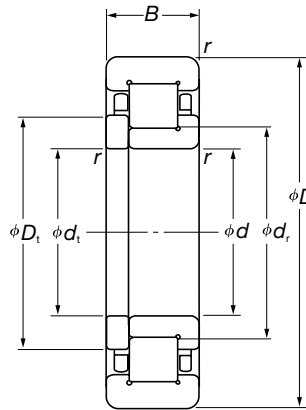
Note (1) EA: High-Capacity Type



Ceramic-Insulated

Non-Insulated

Cylindrical Roller Bearing (NH Type)



Ceramic-Insulated

Non-Insulated

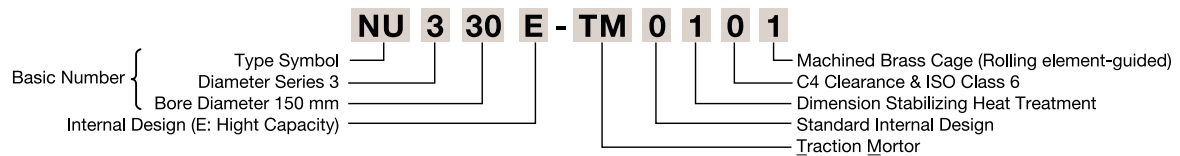
Cylindrical Roller Bearing (NUP Type)

3□□ Series (Fixed 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_t	D	B	d_r	D_t	B_t	b_t	r (min)					
60	130	40	77	84.2	15.5	9	2.1	NH312	—	124 000	126 000	2.3
65	140	43	83.5	91	17	10	2.1	NH313	—	143 000	151 000	2.9
70	150	45	90	98	17.5	10	2.1	NH314	—	158 000	168 000	3.4
75	160	37	95.5	104.2	16.5	11	2.1	NH315	E	240 000	263 000	4.2
75	160	37	95	104.2	—	—	2.1	NUP315	E	240 000	263 000	3.9
80	170	50	101	111.8	17	11	2.1	NH316	E	256 000	282 000	5.0
90	190	55	115	125	21	12	3	NH318	—	240 000	265 000	6.8
			113.5	124.2	18.5				E	315 000	355 000	6.8
90	190	43	115	125	—	—	3	NUP318	B	240 000	265 000	6.3
			113.5	124.2	—				E	315 000	355 000	6.3
100	215	60	129.5	140.5	22.5	13	3	NH320	A	310 000	355 000	9.5
			129.5	140.5	22.5				B	310 000	355 000	9.5
			127.5	139	20.5				E	380 000	425 000	9.6
110	240	64	143	155	22	14	3	NH322	E	425 000	485 000	12.9
120	260	69	154	168.5	23.5	14	3	NH324	—	475 000	550 000	16.6
130	280	72	167	182	24	14	4	NH326	—	560 000	665 000	20.2
			181	181					E	615 000	735 000	20.1
140	300	77	180	196	26	15	4	NH328	—	615 000	745 000	24.7

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

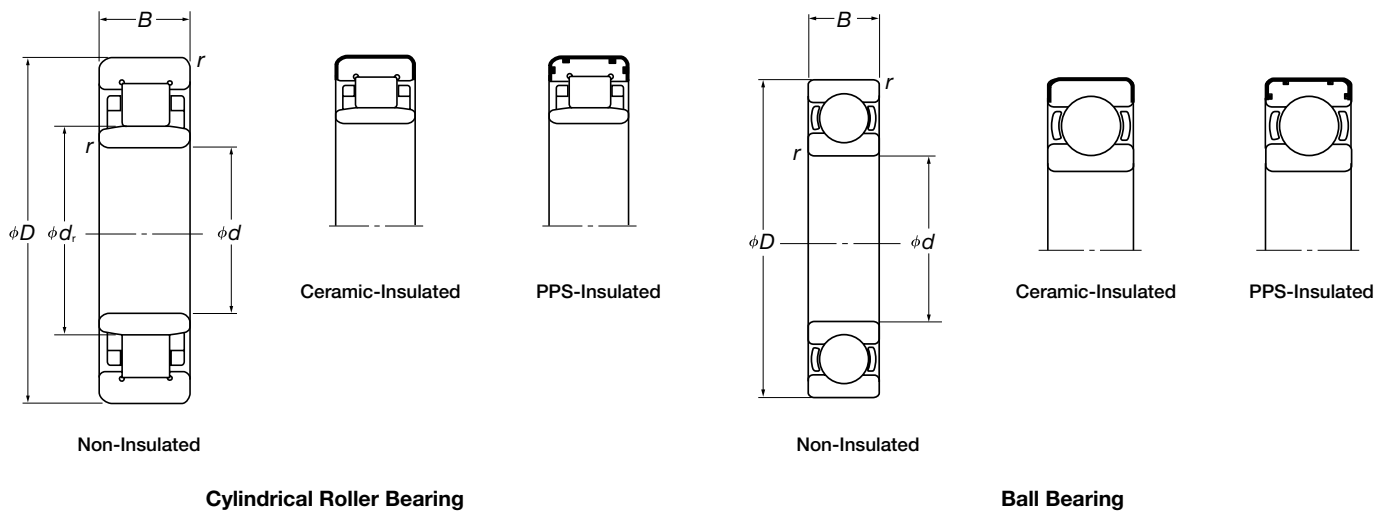
Standard Number of Cylindrical Roller Bearings



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

Cylindrical Roller Bearings and Ball Bearings

Table on Bearings for Electric Car Traction Motors



Cylindrical Roller Bearing

Ball Bearing

Loaded Side, Cylindrical Roller Bearings	Boundary Dimensions (mm)					Non-Loaded Side, Ball Bearings	Boundary Dimensions (mm)			
	d	D	B	d_i	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	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 6311	50 55	110 120	27 29	2
NU314	70	150	35	90	2.1	6311	55	120	29	2
NU215	75	130	25	88.5	1.5	6311 6312	55 60	120 130	29 31	2 2.1
NU315	75	160	37	95.5	2.1	6311 6312 6314	55 60 70	120 130 150	29 31 35	2 2.1
NU415	75	190	45	104.5	3	6313	65	140	33	2.1
NU216	80	140	26	95.3	2	6312	60	130	31	2.1
NU316	80	170	39	103	2.1	6312	60	130	31	2.1
NU416	80	200	48	110	3	6313	65	140	33	2.1
NU217	85	150	28	101.8	2	6217	85	150	28	2
NU218	90	160	30	107	2	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) NU3□□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 ⁽²⁾	CG185	P6A	468540VAS
	NU326E-TM0101	C4	P6	NU326ECMC4VA301
	NU328E-TM0102	C4	P6	NU328ECMC4VA301
	NU330E-TM0101	C4	P6	NU330ECMC4VA301
	NU330E-TM1105 ⁽³⁾	C4	P6	NU330ECMRDC4VA301
	NU330J-TM0111	CG205	P6	466830M/W23
	NU332E-TM0101	C4	P6	NU332ECMC4VA301
	NU332EH2 ⁽⁴⁾ -TM0101	C4	P6	NU332ECMC4VA309
Non-Loaded Side-Bearings (Fixed End-Bearings) NH3□□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 ⁽²⁾	CG153	P6A	NH320M2/W23B/W83
	NH320EH2 ⁽⁴⁾ -TM0102	C4	P6	NH320ECMC4VA309
	NH322E-TM0101	C4	P6	NH322ECMC4VA301
	NH324E-TM0102	C4	P6	NH324ECMC4VA301
	NH324E-TM0105 ⁽³⁾	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) Two-Piece Roller Drop Type

(3) One-Piece Roller Drop Type

(4) Ceramic-Insulated Type