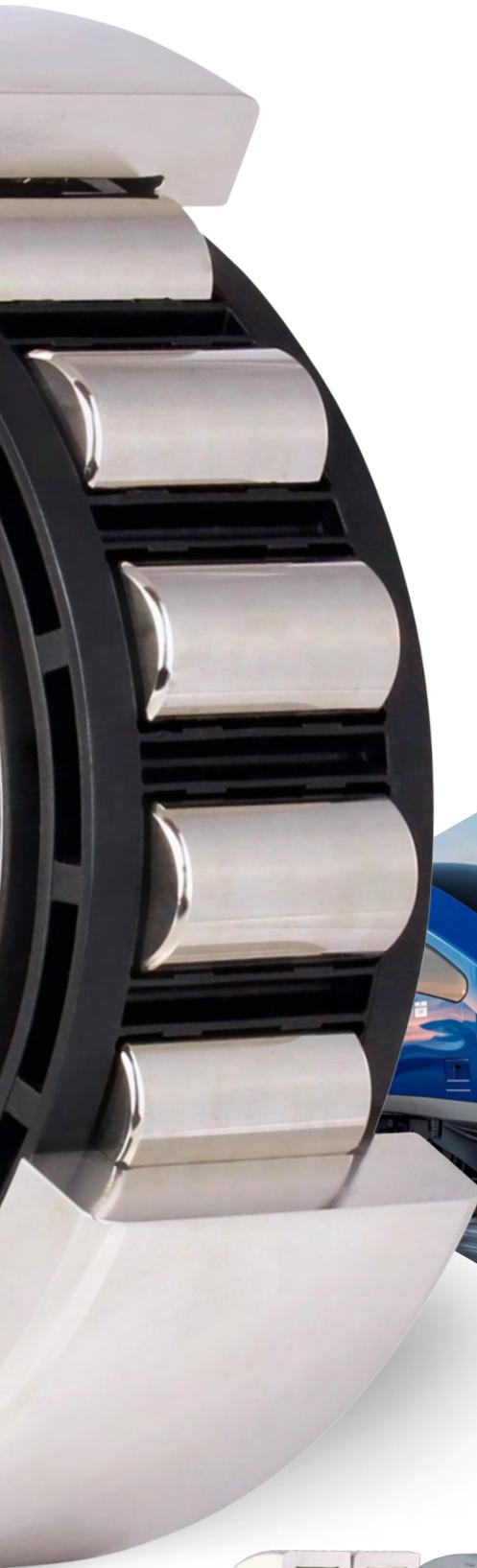


KINEX

120 anniversary



KINEX BEARINGS
Rolling Bearings for Railway Vehicles



Slovakia, Bytča (HQ)

Total land area: 86 336 m²
 Production area: 41 659 m²
 Established: 1906

References

Manufacturers

Alstom Transportation (DE), Bonatrans (CZ), Bochumer Verein Verkehrstechnik (DE), CRRC Shandong (CN), Greenbrier (PL, RO), Gredelj (HR), Inveho (DE), KLW Wheelco (UA), Kolowag (BG), Lucchini (IT), MAV Tiszavas (HU), Škoda Transportation (CZ), Taiyuan Heavy Industry Railway (CN), Talleres Alegría (ES), Tatravagónka (SK), ŽOS Trading (SK)

Slovakia, Kysucké Nové Mesto

Total land area: 97 713 m²
 Production area: 63 571 m²
 Established: 1948

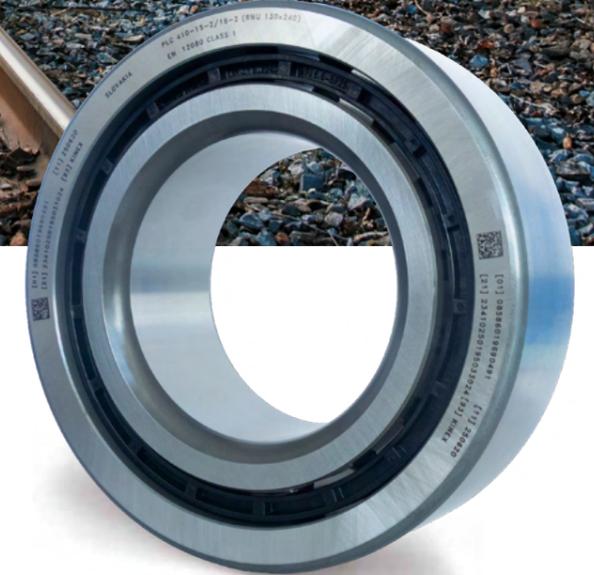
Railway companies / Operators

ČD Cargo (CZ), DB Cargo (UK), Deutsche Bahn (DB), GATX (DE), HŽ (HR), Lokaltog (DK), ÖBB (AT), PKP Cargo (PL), PKP Intercity (PL), S-Bahn (DE), SBB Cargo (CH), SJ AB (SE), SNCF (FR), SŽ (SI), Touax (FR), Transwaggon (CH), VTG (DE), ZSSK (SK), ZSSK Cargo (SK)

Company Profile

Production program of KINEX BEARINGS includes wide assortment of standard and special rolling bearings for different industrial sectors. Production plants went through complicated historical development from their establishment and presently the KINEX BEARINGS with its large scale production program belongs to global producers of the rolling bearings.

Production of the rolling bearings has a long term tradition. KINEX BEARINGS offers complex services in the field of research, development and production of the rolling bearings and rolling elements. One of the most significant industrial segments in term of volume of sold bearings is the railway industry. Beginning of production in segment of single row roller bearings for the railway vehicles dates from year 1959. A commercial corporation KINEX BEARINGS, a.s. belongs at the moment to leaders in field of the roller bearings supplies for axles of the freight wagons in Europe and disposes of validations for different products supplies needed for application of the above mentioned bearings in various territories.



Production of the single row roller bearings that are used in railway industry is assured in accordance with requirements of the European standard EN 12080 and DBS 918 004-1. KINEX BEARINGS, a.s. (Joint Stock Company) offers also deliveries of the bearing units for axles of the goods wagons with load on the axle 22.5 tons and axle load of 25 tons.

Product Portfolio for Railway Rolling Bearings

- Bearings
- Axleboxes
- Tailor made services

APPLICATION OF BEARINGS

Locomotives



- Axle Seatings of Electric and Diesel Locomotives



- Traction Motors and Generators Including Electrically Insulated Bearings



- Transmissions
- Compressor Motors, Fan Motors
- Drives of Blowers, Exciters and Charging Dynamos in Electric and Diesel Locomotives

Train Sets and Wagons

- Bearing Unit for Passenger Transportation CRU and TBU



- Axleboxes and Roller Bearings for Passenger Cars and Freight Wagons

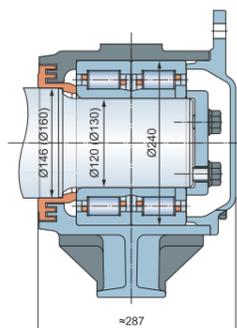
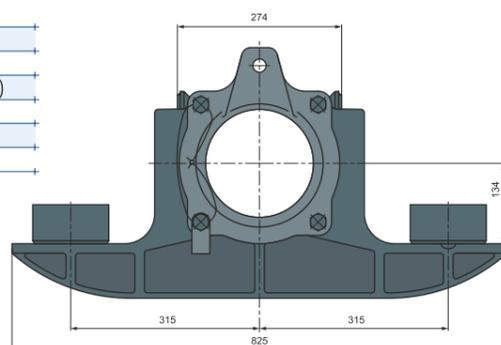


- Roller Bearings for Metro and Trams



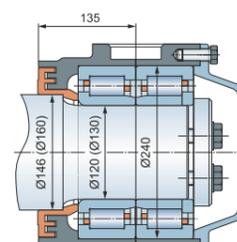
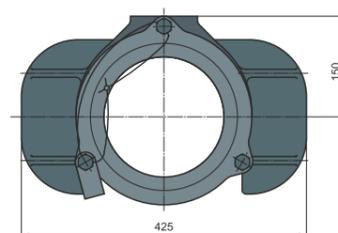
Axlebox BA 182

Bogie	Y 25
Axle load	22.5 tons
Cyl. roller bearing	PLC 410-33-2/34-2 (WJ/WJP 130x240)
Maximum speed	120 kmph
Suspension	helical coil springs
Box material	spheroidal grafite cast iron



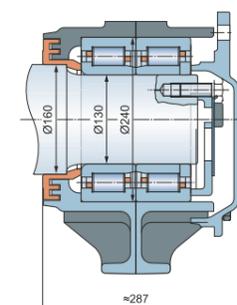
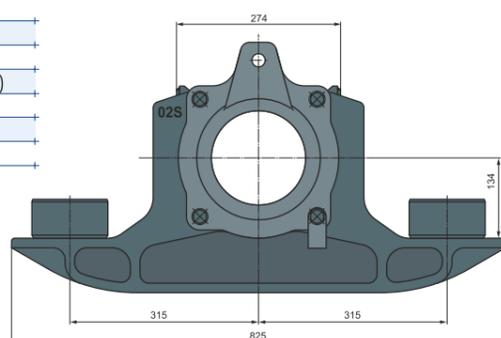
Axlebox BA 381

Bogie	2 and 4 axle goods wagon
Axle load 2	22.5 tons
Cyl. roller bearing	PLC 410-33-2/34-2 (WJ/WJP 130x240)
Maximum speed	120 kmph
Suspension	leaf spring
Box material	spheroidal grafite cast iron



Axlebox BA 386 (02S)

Bogie	Y 25
Axle load	25 tons
Cyl. roller bearing	PLC 410-33-2/34-2 (WJ/WJP 130x240)
Maximum speed	120 kmph
Suspension	helical coil springs
Box material	spheroidal grafite cast iron



Assembly Training, Disassembly and Maintenance of Cylindrical Bearings for Rail Vehicles

KINEX offers and provides professional training and practical demonstrations of assembly and disassembly of roller bearings for axleboxes of railway vehicles. The objective of these trainings is to train the staff of assembly plants in proper assembling of roller bearings which require the use of correct procedures, tools, measurement fixtures and lubrication.

For this area, KINEX has a group of experienced technicians who are ready to solve the assembling and disassembling procedure on site or demonstrate their own assembling. Based on customer requirements, we performed professional trainings for rail vehicles of cargo transport, subway, urban transport and locomotives. The subject of the training is basic information about bearings made by KINEX, assembling and disassembling of bearings and maintenance of bearings.



Rules of Mounting and Dismounting of Bearings

Warming Up of Bearings Inner Rings

Bearings of higher diameter series, used mostly in railway vehicles, require a bigger force to be pressed on at tight fitting. Therefore warming up of inner rings of bearings is used advantageously at the time of mounting them.

The bearings can be warmed up inductively or by air in electric furnace. Sufficient thermal expansion is achieved at the temperature 80–110 °C. The abutment dimensions of the axle journal and axlebox must be checked by measuring prior to bearings mounting procedure. The ring faces must be seated on their whole circumferences. Prior to mounting works it is necessary to check if the marking on the bearing is in conformity with the data on the drawing and at the list of parts.

Protection of contact surfaces and lubrication

Before fitting of the bearings it is advantageous to coat the contact surface of the axle journal and axlebox with a fine thin layer of LFAG 3 paste or with some other suitable agent in order to prevent rise of contact corrosion. At the time of mounting procedure, the bearings will be filled with a base grease, the brand and quantity of which is specified by the railway company with the consent of the bearings manufacturer.

Conditions for assembling

Mounting works must be carried out at a dry and dust-free workplace. The bearings, axleboxes and accessories must be protected from humidity and dirtiness during storage, checking and mounting procedures.

Dismounting of the bearings

If the bearings are to be reused after dismounting, this procedure must be carried out professionally with the help of suitable jigs and in accordance with the beforehand fixed procedure at a dry and dust-free workplace.

Dismounting of the bearings

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REPLACEMENT OF SPHERICAL ROLLER BEARINGS

by KINEX's Cylindrical Roller Bearings for Axles of Railway Vehicles



Technical Benefits

They mainly lie in:

- At roller bearings the ring orbits and cylindrical surface of the cylinders are loaded by radial force F_r only and the axial forces F_a , which act shortly, i.e. there are transferred between the roller heads and supporting heads of the rings when driving through rail switches and curves, so they do not affect the bearing lifetime (see Fig. 1)
- At spherical bearings, both forces load the rolling surfaces of rings and spherical bodies (see Fig. 2)
- Roller bearings can also be used at high velocities, spherical bearings cannot be used in these cases
- The construction of roller bearings allows use of easier and less demanding assembling and disassembling of imposition.

Roller bearings have been and are introduced due to their technical and service benefits as a better solution of rail vehicle axle imposition. Therefore, they are continuously deployed into operation and as a replacement of spherical bearings.

Currently, from all spherical bearings, there are only bearings with dimensions 130x220x73 mm used in railway transports.

Based on the interest of European railways, KINEX BEARINGS, a.s. has developed and integrated into production roller bearings with identical dimensions and designation PLC 410-223-2/224-2, which may be used as a replacement for spherical bearings.

Principally, the replacement of spherical bearings with roller bearings should not be taken just as a mutual replacement of bearings without an impact on their internal loading in relation with various types of bearing boxes.

The way of ensuring of the functionality of the roller bearings (for instance respecting of the axial clearance) requires a qualification of bearing boxes (with tightening of lids onto the firmly anchored or continuous screws) and supplementing of the bearings with spacing rings as at the spherical bearings for two alternatives of length of the wheelset pins (191 mm and 217 mm).

Economic Benefits

- Reduction of work intensity for service processes (assembling/disassembling)
- Significant time savings when assembling and disassembling in comparison with spherical bearings, i.e. saves up to 60% of required time!
- Cost reduction of bearing replacement by 20 %
 - For roller bearings, a replacement of individual components (bearing block – external ring, rollers, cage, inner rings, lean-ring)
 - Interchangeability of inner rings of cylindrical roller bearings
 - Replacement of whole bearing for spherical bearings
- When disassembling spherical roller bearings, the operator of repair shall comply with a specific regime, special fixture to squeeze the bearings, usage of special hydraulic device (oil pressure) => a big impact on the compliance with strict safety and health protection, environmental protection, what represents increased costs.

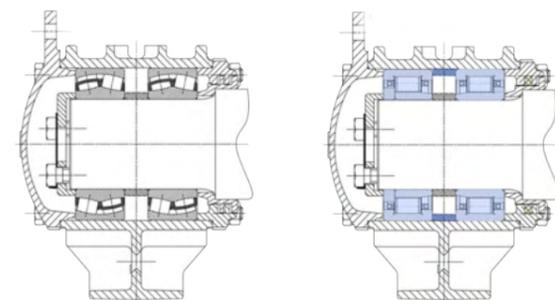


Fig. 1

Fig. 2

5
Years
Warranty

660000 km
of Guaranteed
Warranties

25 t
Maximum
Load

THE DIGITAL REVOLUTION

in Railway Bearings



KINEX BEARINGS is no longer just a bearing manufacturer. KINEX BEARINGS is changing control, traceability, and the future. We deliver bearings together with their digital DNA – data, certainty, and the future with more efficient and optimized customer processes.

End of Unnecessary Control

- Plug & Play: P6 accuracy (ISO 492), mounting straight out of box
- Automation: Measurements from production lines
- Savings: Control = statistical sample, time and money

30 Years in the Cloud

- EDI / ERP: DESADV / Excel → SAP
- Archiving: For 30 years digitally, without paper
- Digital Twin: Fewer errors, lower CO₂ footprint

You decide what goes into DESADV

- Standard DESADV: SULKUS, without dimensions and batch
- Extension DESADV: Dimensions, Batch, Digital DNA

DESADV (Despatch Advice)

- DESADV (Despatch Advice) is according to GS1 standard

Standard DESADV message contains

- Sender ➤ Receiver ➤ Delivery location ➤ Purchase order number ➤ Dispatch advice number ➤ Product code ➤ Quantity
- Packaging (pallets, cartons, SSCC) ➤ Logistics data (weight, dispatch date, transport)

Extension DESADV message contains

Field name:	Description:	Example value:
➤ PRODUCER	Manufacturer of the product	KINEX BEARINGS, a.s.
➤ ORDER_NO	Customer purchase order number	YYYYYY
➤ DELIVERY_NOTE_NO	Delivery note / dispatch advice number	DLXXXXXXXXXX
➤ TRADE_ITEM_DESCRIPTION	Description of the product	WJ 130x240x80 TN
➤ BUYER_ASSIGNED	Product code assigned by the buyer	XXX
➤ GTIN	Global Trade Item Number identifying the product	08586019690217
➤ PALLET_NO	Identification number of the pallet / logistic unit	990000003462
➤ CERTIFICATE_NO	Quality or material certificate number	95 / 2026
➤ PCS	Number of pieces shipped	48
➤ OUTR_SERIAL_NO	Serial number of the outer component	23410250435271020
➤ OUTR_BATCH_NO	Production batch number of the outer component	C53693
➤ OUTR_MANUFACTURE_DATE	Manufacturing date of the outer component	251208
➤ OUTR_D	Outer diameter of the component	239,989
➤ OUTR_DCS	Quality control parameter related to outer diameter	79,969
➤ CAGE_TYPE	Type of bearing cage	Monolit
➤ CAGE_MATERIAL	Material of the cage	PA6.6GF25
➤ INTR_SERIAL_NO	Serial number of the inner component	23410250434139040
➤ INTR_BATCH_NO	Production batch number of the inner component	C53693
➤ INTR_MANUFACTURE_DATE	Manufacturing date of the inner component	251208
➤ INTR_D_MALE	Inner diameter of the inner ring	129,988
➤ INTR_DBS	Quality or technical parameter related to inner diameter	79,98



Absolute safety and security

- GS1 DataMatrix: Each part has a unique S/N
- Zero Substitution: Digital Parts Matching
- 100% Traceability: Traceability up to the batch of the material

RESEARCH AND DEVELOPMENT

An important factor of quality improvement of cylindrical roller bearings is continuing design improvement that optimises lubrication, increases loading capacity and minimizes edge stresses.

KINEX BEARINGS Has Been Giving Continuous Attention to:

- > new product development
- > present product improvement

Continuing Design Improvement Increases Bearing's Life and Reliability

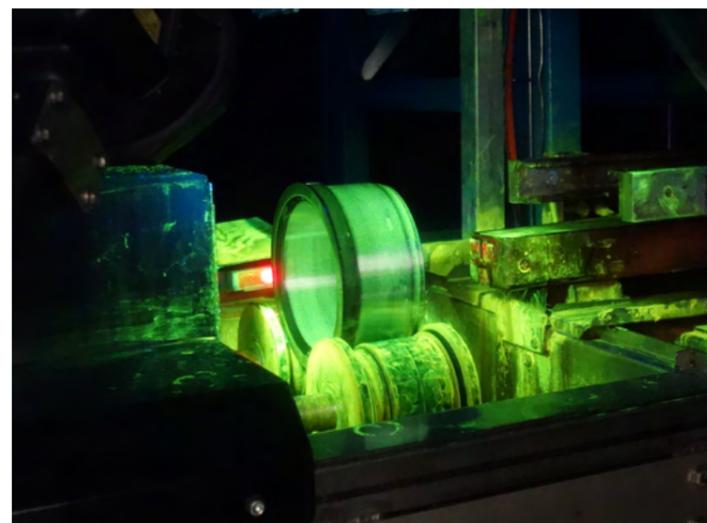
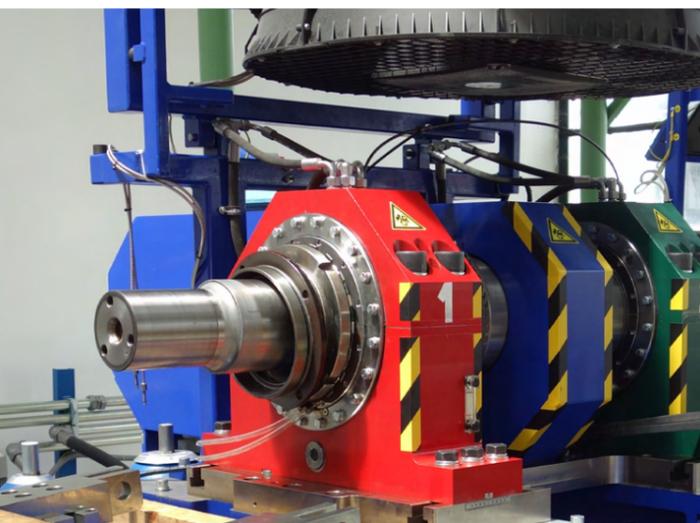
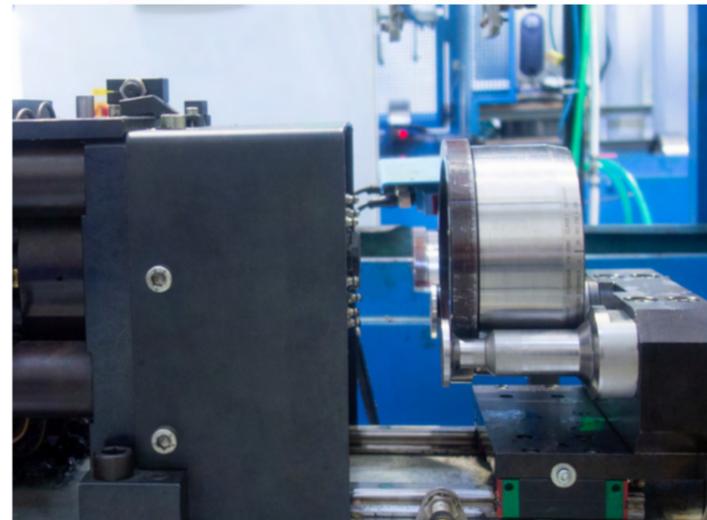


Inspection and Testing

The production of axlebox cylindrical roller bearings used in railway industry is assured in accordance with requirements of european standard EN 12 080.

Rig performance tests of axlebox cylindrical roller bearings according to EN 12082, UIC515-5

- Axle load 25 tons, speed 120 km per hour
- Axle load 22,5 tons, speed 160 km per hour
- Axle load 18 tons, speed 200 km per hour



Standard Specifications

Standards

- > STN EN 12080 Railway vehicles; Axle boxes; Rolling bearings
- > STN EN 12081 Railway vehicles; Axle boxes; Plastic lubricants
- > STN EN 12082 Railway vehicles; Axle boxes; Performance test
- > STN EN ISO 683-17: Steel intended for heat treatment; Alloyed and free cutting steel
 - Part 17: Steel for the rolling bearings
- > STN EN 1982 Copper and copper alloys. Ingots and castings
- > STN EN 12420 Copper and copper alloys. Forged pieces
- > ISO 281 Rolling bearings. Dynamic load carrying capacity and durability
- > ISO 76 Rolling bearings. Static load carrying capacity
- > DBS 918 004-1 Rolling bearings and units for rail vehicles

Quality Management

Production plants of the KINEX BEARINGS are certified in accordance with standard ISO 9001, IRIS, ISO/TS 16949, ISO 14001 and OHSAS 18001 for the field of development and production of roller and ball bearings by a certification company 3EC International.

Development and manufacturing of bearings has established and maintains a quality management system according to international railway industry standard (IRIS). Because of the amount of all certificates we work simultaneously on a complex quality management system that will allow us to join the mutual requirements of those standards with effective implementation of other requirements.

Standards

- > ISO 9001
- > ISO TS 22 163
- > ISO/TS 16949
- > ISO 14001
- > TSI
- > ISO 45001
- > ISO 50001





Rolling bearings used in production of railway vehicles are produced in standardized types ISO and also as special single row cylindrical roller bearings. The main advantages of cylindrical roller bearings usage are their simple design, easy assembly, easy maintenance and reliability in operation. Cylindrical roller bearings are characterized by low friction resistance, low temperature, low component wear and high load rating.

Material

Bearing rings according to EN 12080, EN ISO 683-17:

Chromium steel through-hardening in the whole cross section:
100 Cr6, 100 CrMnSi6-4

Bearing rollers according to EN 12080, EN ISO 683-17:

Chromium steel through-hardening in the whole cross section:
100 Cr6, 100 CrMnSi6-4

Cages according to BN 918 056:

Polyamide cage: material PA 66 GF25 HZ
Machined brass cage: material CuZn40Pb2, CuZn37Al1, uZn31MnAl, MS58Al

Structure of the steel after heat treatment:

Martensite in which the residual austenite varies in the range from 3 to 10 %. This residual austenite in axle bearings is < 2 %.

Hardness of the bearing rings after heat treatment is in the range:

58–64 HRC (dispersion of measured values between all rings of one bearing must not be more than 3 HRC). To assure dimensional stability through the whole operational period, the bearing rings for axle bearings are stabilized by means of heat treatment on 200 °C (S1).

Hardness of rollers after heat treatment is in the range:

60–65 HRC (dispersion of measured values between all rollers of one bearing must not be more than 4 HRC).

Essential Condition of Reliable Operation of Cylindrical Roller Bearings is Observance of Mounting and Dismounting Principles:

- > fitting tolerances
- > shape deviations
- > warming up of bearings (inner rings)
- > qualified mounting workplace
- > trained and qualified employees
- > using of suitable jigs
- > keeping of fixed procedures

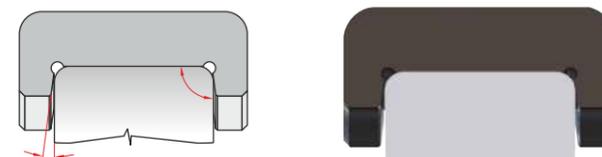
Special single row cylindrical roller bearings used in axle railway vehicle seatings are produced with machined brass cage and glass-fibre reinforced polyamide cage. Reinforced polyamide cage improves reliability and safety. Single row cylindrical roller bearings in design NU, NJ, NUP used in railway drive systems and traction motors are produced with machined brass cage version E.



Internal Design

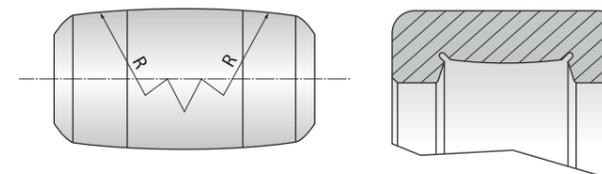
Design of Roller Face and Guide Flange

it optimizes lubrication of a contact zone in the contact area and thus it increases axial load carrying capacity of the bearing.



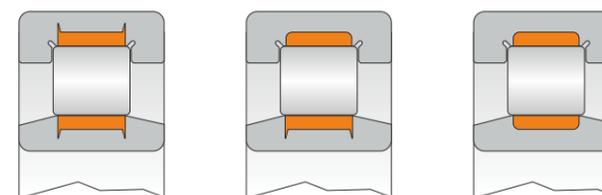
ZB Profile of the Rollers and Raceway

it takes part on minimizing of the edge stress and thus also on increasing of durability and reliability of the bearing.



Contact Effective Stress

ZB optimizes the contact effective stress created on external and internal bearing ring.



Cylindrical roller without ZB profile and non-convexed raceways of the rings

Roller ZB profile and raceway ZB profile of the outer ring. Non-convexed raceway of the inner ring

Roller ZB profile and convexed raceways of the rings (KINEX design)

Life Calculation

Single-row cylindrical roller bearings life calculation for railway vehicle axleboxes is based on the radial static load acting on the bearings of one wheel set i.e. axle load which is calculated from the equation:

$$G_1 = \frac{G}{n} - G_2$$

where:
G – weight of the vehicle (kN)
G₁ – radial static load acting on one wheel set (kN) (axle load)
G₂ – weight of a wheel set and others unsprung parts (kN)
n – number of wheel sets

Then radial static load acting on one bearing will be:

$$P_{or} = \frac{G_1}{4}$$

where:
G₁ – radial static load acting on one wheel set (kN) (axle load)
P_{or} – radial static load acting on one bearing (kN)

Radial equivalent dynamic load acting on one bearing is calculated from the equation:

$$P_r = P_{or} \cdot f_d$$

where:
P_r – radial equivalent dynamic load acting on one bearing (kN)
P_{or} – radial static load acting on one bearing (kN)
f_d – factor of additional forces (see table 1)

Factors of additional forces

Type of vehicle	f _d
Passenger carriages	1.2 to 1.3
Goods, self-discharging and ingot wagons	1.2 to 1.4
Locomotives	1.3 to 1.8

Basic bearing life can be calculated from the equation:

$$L_{10kmr} = \left(\frac{C_r}{P_r}\right)^{\frac{10}{3}} \cdot \pi \cdot D_k \cdot 10^{-3}$$

where:
L_{10km} – basic bearing life (10⁶ km)
C_r – basic radial dynamic load rating (see dimension tables) (kN)
P_r – radial equivalent dynamic load acting on one bearing (kN)
D_k – diameter of the vehicle wheel (mm)

BEARING ARRANGEMENT

Influence of Arrangement on Bearing Life

Bearing life is considerably influenced by arrangement of bearing rings on the shaft and at the housing. These parts should be manufactured with required quality and tolerances. According to specific operational conditions the rings are either push fitted (clearance fit) or force fitted (interference fit).

Essential condition for bearing arrangement is that the ring loaded on its circumference must be force fitted. Recommended values of shaft diameters and housing bore tolerances take into consideration all operational influences (type, direction and intensity of load, temperature ...) with loading during the entire operating time.

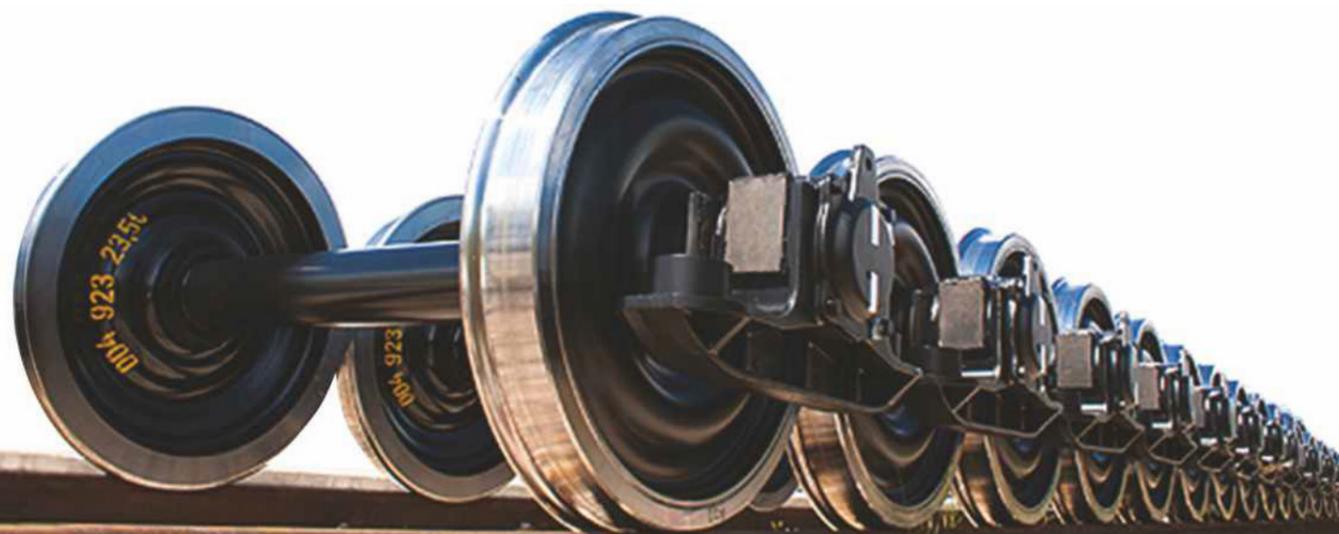
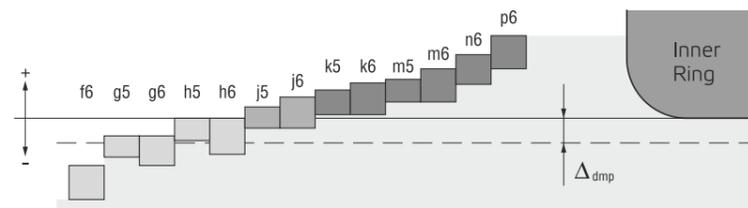
Recommended tolerances of journals diameters and housing bores

Arrangement	Journal diameter		Tolerance	Housing bore diameter	Tolerance
	Ball	Roller			
Fans	18 to 100	to 40	j6	Fans	J7
Generators	100 to 200	40 to 140	k6	Electric motors	K7
Electric motors	18 to 100	to 40	k5	Traction motors	M7
	100 to 200	40 to 140	m5		
Axlebox bearings	140 to 200	100 to 140	m6	Axlebox bearings	H7
Traction motor bearings		50 to 140	*n6, p6	Axlebox bearings	H7
		140 to 500	*n6, p6	Axlebox bearings	H7

*It is necessary to use bearings with higher radial clearance at these arrangement.

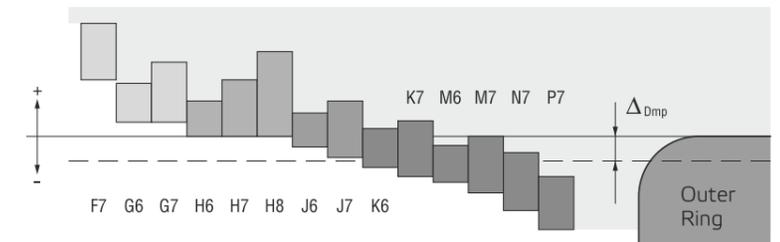
Journal diameter tolerance limiting deviations

Journal nominal diameter mm		k5		m5		j6		k6		m6		n6		p6	
over	to	upper	lower												
30	50	+13	+2	+20	+9	+11	-5	+18	+2	+25	+9	+33	+17	+42	+26
50	80	+15	+2	+24	+11	+12	-7	+21	+2	+30	+11	+39	+20	+51	+32
80	120	+18	+3	+28	+13	+13	-9	+25	+3	+35	+13	+45	+23	+59	+37
120	180	+21	+3	+33	+15	+14	-11	+28	+3	+40	+15	+52	+27	+68	+43
180	250	+24	+4	+37	+17	+16	-13	+33	+4	+46	+17	+60	+31	+79	+50



Bore diameter tolerance limiting deviations

Nominal bore diameter mm		H7		J7		K7		M7	
over	to	upper	lower	upper	lower	upper	lower	upper	lower
50	80	+30	0	+18	-12	+9	-21	0	-30
80	120	+35	0	+22	-13	+10	-25	0	-35
120	180	+40	0	+26	-14	+12	-28	0	-40
180	250	+46	0	+30	-16	+13	-33	0	-46
250	315	+52	0	+36	-16	+16	-36	0	-52
315	400	+57	0	+39	-18	+17	-40	0	-57



Shape Deviations

The further conditions to achieve high bearing life in arrangements is to keep prescribed shape deviations of supporting areas and their surface quality. The shape deviations of supporting surfaces i.e. permissible deviation from roundness and cylindrical shape and permissible run-out of bearing surfaces with regard to the axle must be smaller than range of diameter tolerances.

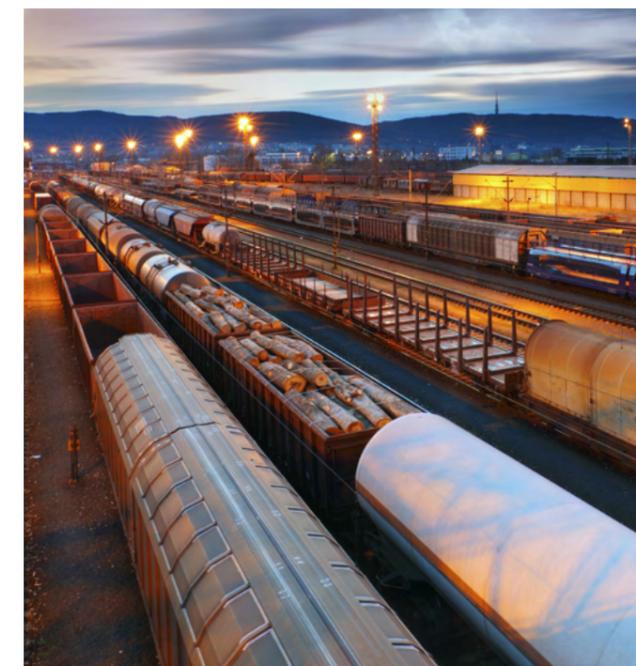
Tolerance class	Place of arrangement from cylindrical shape	Permissible deviation	Permissible run-out of bearing surfaces with regard to the axle
P0, P6	shaft	IT 5/2	IT 3
P0, P6	shape	IT 6/2	IT 4

Values of standard tolerances IT

Nominal diameter mm		Tolerance class μm				
over	to	IT 2	IT 3	IT 4	IT 5	IT 6
18	30	2.5	4	6	9	13
30	50	2.5	4	7	11	16
50	80	3	5	8	13	19
80	120	4	6	10	15	22
120	180	5	8	12	18	25

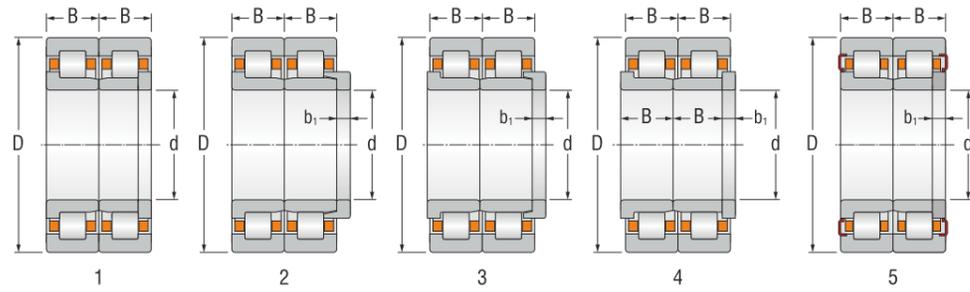
Arrangement quality is influenced also by roughness of bearing supporting surfaces. These surfaces are smoothed at mounting procedures. Interference in the arrangement is more reduced if the surfaces are enough roughness.

Supporting surface	Nominal diameter of the bearing	
	from 10 to 80	over 80
Shaft	Ra _{max} μm	
Housing's bore	0.63	1.25
Face of journal shaft or housing	1.25	1.25



SINGLE-ROW CYLINDRICAL ROLLER BEARINGS

For Axleboxes



Dimensions				Basic load rating		Max. speed of railway vehicle	Weight of a pair of bearings	Bearings designation	Fig.	Cage	
d	D	B	b ₁	dyn. cr	static cor						
mm				kN		km/hour	kg				
100	180	60.3	-	333.5	444.4	160	12	PLC 49-200-2-1 (WJ100x180)	PLC 49-201-2 (WJP 100x180) ⁽¹⁾⁽³⁾⁽⁴⁾	1	TNG
	180	120.6	-	333.5	444.4	160	12	WJ/WJP 100x180x120,6 P TN C4		1	TNG
118	215	80	-	519.8	740.9	160	25.7	PLC 410-213-3	PLC 410-214-3 ⁽¹⁾⁽⁴⁾⁽⁵⁾	1	M
	240	80	-	553.8	742.5	160	32.3	WJ 118x240x80 TN (PLC 410-13-2-3)	WJP 118x240x80 P TN (PLC 410-14-2-3) ⁽¹⁾⁽³⁾⁽⁴⁾	1	TNG
	240	80	-	553.8	742.5	160	34.2	PLC 410-23	PLC 410-24 ⁽¹⁾⁽²⁾⁽⁴⁾	1	TNG
119	240	80	-	553.8	742.5	160	32.1	WJ 119x240x80 TN (PLC 410-13-2-4)	WJP 119x240x80 P TN (PLC 410-14-2-4) ⁽¹⁾⁽³⁾⁽⁴⁾	1	TNG
119.3	240	80	-	553.8	742.5	160	31.7	WJ 119,3x240x80 TN (PLC 410-13-2-5)	WJP 119,3x240x80 P TN (PLC 410-14-2-5) ⁽¹⁾⁽³⁾⁽⁴⁾	1	TNG
120	200	62	-	372.8	549.1	120	16	PLC 49-202	PLC 49-203 ⁽¹⁾⁽⁴⁾⁽⁵⁾	1	M
	215	73	-	518.5	717.5	160	21	PLC 410-231-2 (WJ 120x215x73)	PLC 410-232-2 (WJP 120x215x73) ⁽¹⁾⁽³⁾⁽⁴⁾	1	TNG
	215	80	-	519.8	740.9	160	25.2	PLC 410-213	PLC 410-214 ⁽¹⁾⁽²⁾⁽⁴⁾	1	M
	240	80	-	553.8	742.5	160	33.7	PLC 410-13	PLC 410-14 ⁽¹⁾⁽²⁾⁽⁴⁾	1	M
	240	80	-	553.8	742.5	160	33.7	PLC 410-13-1	PLC 410-14-1 ⁽¹⁾⁽⁴⁾⁽⁵⁾	1	M
	240	80	-	553.8	742.5	160	31.7	WJ 120x240x80 TN (PLC 410-13-2)	WJP 120x240x80 P TN (PLC 410-14-2) ⁽¹⁾⁽³⁾⁽⁴⁾	1	TNG
129	240	80	-	539.6	775.4	160	30.2	WJ 129x240x80 TN (PLC 410-33-2-4)	WJP 129x240x80 P TN (PLC 410-34-2-4) ⁽¹⁾⁽³⁾⁽⁴⁾	1	TNG
129.3	240	80	-	539.6	775.4	160	30.18	WJ 129,3x240x80 TN (PLC 410-33-2-9)	WJP 129,3x240x80 P TN (PLC 410-34-2-9) ⁽¹⁾⁽³⁾⁽⁴⁾	1	TNG
130	220	73	-	505.0	761.7	160	21.08	PLC 410-223-2	PLC 410-224-2 ⁽¹⁾⁽³⁾⁽⁴⁾	1	TNG
	240	80	-	516.3	752.1	160	32.6	PLC 410-15	PLC 410-16 ⁽¹⁾⁽²⁾⁽⁴⁾	1	M
	240	80	-	516.3	752.1	160	30.5	PLC 410-15-2 (WJ 130x240)	PLC 410-16-2 (WJP 130x240) ⁽¹⁾⁽³⁾⁽⁴⁾	1	TNG
	240	80	-	539.6	775.4	160	32.7	PLC 410-33-1	PLC 410-34-1 ⁽¹⁾⁽²⁾⁽⁴⁾	1	M
	240	80	-	539.6	775.4	160	30.2	WJ 130x240x80 TN (PLC 410-33-2)	WJP 130x240x80 P TN (PLC 410-34-2) ⁽¹⁾⁽³⁾⁽⁴⁾	1	TNG
	240	86	21.55	539.6	775.4	160	30.7	WJ 130x240x80 TN (PLC 410-33-2)	WJP 130x240x86 P TN (PLC 410-34-2-6) ⁽¹⁾⁽³⁾⁽⁴⁾		TNG
	240	160	-	539.6	775.4	200	30.6	PLC 410-215/216		5	TNG
	250	80	-	580.0	800.3	160	36.6	PLC 410-17	PLC 410-18 ⁽¹⁾⁽²⁾⁽⁴⁾	1	M
	250	80	-	580.0	800.3	160	34.2	PLC 410-17-2	PLC 410-18-2 ⁽¹⁾⁽³⁾⁽⁴⁾	1	TNG
158	300	84	15	869.5	1214.3	160	58.3	PLC 411-200	PLC 411-201 ⁽¹⁾⁽²⁾⁽⁴⁾	2	M
159	300	84	15	869.5	1214.3	160	57.9	PLC 411-20	PLC 411-21 ⁽¹⁾⁽²⁾⁽⁴⁾	2	M
160	300	84	15	869.5	1214.3	160	57.5	PLC 411-10	PLC 411-12 ⁽¹⁾⁽²⁾⁽⁴⁾	2	M
180	320	86	12	713.5	1082.8	160	64.6	NJ2236 M C 4A450-900	NUC2236 M C4 + HJ2236 X 16.33 ⁽²⁾⁽⁴⁾	2	M
	320	86	15	713.5	1082.8	160	64.9	NJ2236 XM C4	NUC2236 M C4 + PLC 810-1	3	M
	320	86	15	713.5	1082.8	160	64.9	NJ2236 XMAS C4	NUC2236 MAS C4 + PLC 810-1	3	MAS
	320	86	17	713.5	1082.8	160	64.8	NJ2236 XM C4	NUC2236 M C4+prilozný kružok NUP2236	4	M

¹⁾ Pair of bearings is marked shortly e.g. PLC 410-13/14

²⁾ Machined brass cage (steel riveted) or -1 (cross piece riveted)

³⁾ Glass-fiber reinforced polyamide cage, roller centred

⁴⁾ Inner ring interchangeable

⁵⁾ Two-piece machined brass pronged cage

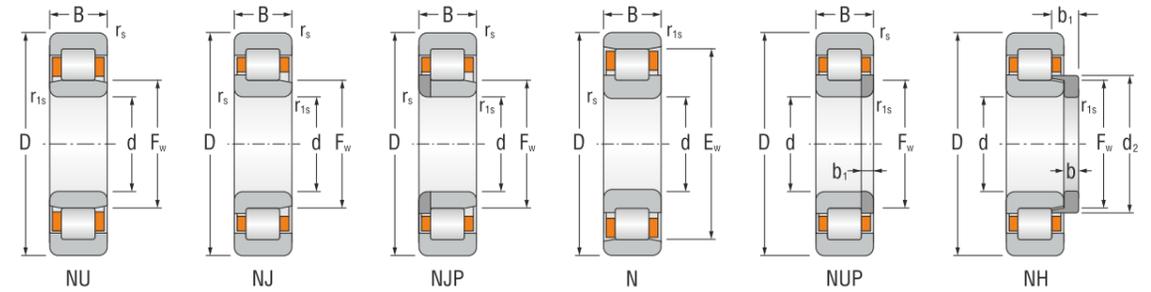
M - two-piece machined brass cage, roller centred

MAS - two-piece machined brass cage with lubrication grooves, outer ring centred

TNG - polyamide cage

SINGLE-ROW CYLINDRICAL ROLLER BEARINGS

For Locomotives



Dimensions			Bearings designation	Angle ring	Basic load rating		Limiting speed for lubrication		Mass of		Dimensions							
d	D	B			HJ	dyn. C _r	static C _w	grease	oil	Bearing	Angle ring	r _{s min}	r _{1s min}	F _w	E _w	d ₂	b	b ₁
mm					kN		min ⁻¹		kg		mm							
70	150	51	NU2314EMAP		273.8	322.9	2 730	3 250	4.507									4.1
	150	51	NUP2314EMAP R110-13ONASO		273.8	322.9	2 730	3 250	4.680		2.1	2.1	89					8.5
75	160	55	NU2314EMAP R170-19ONASO		329.4	394.5	2 470	2 925	5.468		2.1	2.1	95					4.5
	160	55	NU2315EMAP R170-19ONASO		329.4	394.5	2 470	2 925	6.661		2.1	2.1	95					8.5
85	210	52	NUP417AM P6R155-172NAA260-491		355	381.8	3 000	3 500	10.000		4	4	113					10
90	190	43	NJ318EM	HJ318E	310.8	346.9	3 000	3 500	6.230	0.641	4	4	113.5	124	12	18.5	2	
	190	43	NU318EM	HJ318E	310.8	346.9	3 000	3 500	6.229	0.641	4	4	113.5	124	12	18.5	2	
	190	43	NJ318M	HJ318	234.9	258.4	3 200	3 800	6.070	0.667	4	4	115	125	12	21	2	
	190	43	N318		234.9	258.4	3 200	3 800	5.250		4	4	165				2	
	190	43	NU318M	HJ318	234.9	258.4	3 200	3 800	5.910	0.667	4	4	115	125	12	21	2	
	190	43	NU318MA	HJ318	234.9	258.4	3 200	3 800	5.910	0.667	4	4	115	125	12	21	2	
	190	43	NJ318	HJ318	234.9	258.4	3 200	3 800	5.520	0.667	4	4	115	125	12	21	2	
	190	43	NU318	HJ318	234.9	258.4	3 200	3 800	5.360	0.667	4	4	115	125	12	21	2	
	190	43	NU318EMAP R120-150SO		310.8	346.9	1 950	2 275	5.955		3	3	113.5				2	
95	200	45	NJ319EM		328.9	378.5	2 800	3 300	7.170		4	4	121.5				1.9	
	240	55	NJ419M		415.2	465.0	2 500	3 000	13.860		4	4	133.5				2.5	
	240	55	NU419M		415.2	465.0	2 500	3 000	13.570		4	4	133.5				2.5	
100	180	34	NJ220EX6M P64SO		191.3	230.8	3 500	4 200	3.935		2.1	2.1	119				2	
	180	34	NJP220EX6M P64SO		191.3	230.8	3 500	4 200	3.931		2.1	2.1	119					
	215	47	NU320EMA		379.1	424.3	2 700	3 200	8.840		4	4	127.5				2	
	215	47	NJ320EAM C4 SP1B F1	HJ320EA F1	379.2	424.3	2 800	3 300	8.700	0.900	4	4	127.5	215	13	20.5	2	
105	260	60	NJ421M	HJ421	515.1	585.1	2 200	2 700	17.620	1.740	4	4	144.5	159.7	16	27	2.5	
	260	60	NU421M	HJ421	515.1	585.1	2 200	2 700	17.250	1.740	4	4	144.5	159.7	16	27	2.5	
110	200	38	NJ222EX6M P64SO		240.1	289.7	3 200	3 800	5.508		2.1	2.1	132.5				2.5	
	200	38	NJP222EX6M P64SO		240.1	289.7	3 200	3 800	5.511		2.1	2.1	132.5					
	240	50	NJ322EM		439.6	507.6	2 400	2 800	12.006		4	4	143				2.9	
	240	50	NU322EM		439.6	507.6	2 400	2 800	11.806		4	4	143				2.9	
	240	50	NJ322M	HJ322	401.0	467.1	2 500	3 000	11.830	1.020	4	4	143	147.5	13	22.5	2.7	
	240	50	NJ322MA	HJ322	401.0	467.1	2 500	3 000	11.830	1.020	4	4	143	147.5	13	22.5	2.7	
	240	50	N322M		401.0	467.1	2 500	3 000	11.420		4	4	207				2.7	
	240	50	NU322M	HJ322	401.0	467.1	2 500	3 000	11.580	1.020	4	4	143	147.5	13	22.5	2.7	
	280	65	NJ422M		569.5	654.7	2 100	2 500	22.350		4	4	155				2.7	
	280	65	NU422M		569.5	654.7	2 100	2 500	21.880		4	4	155				2.7	

¹⁾ Permissible axial displacement out of central position

E - bearings with higher load rating

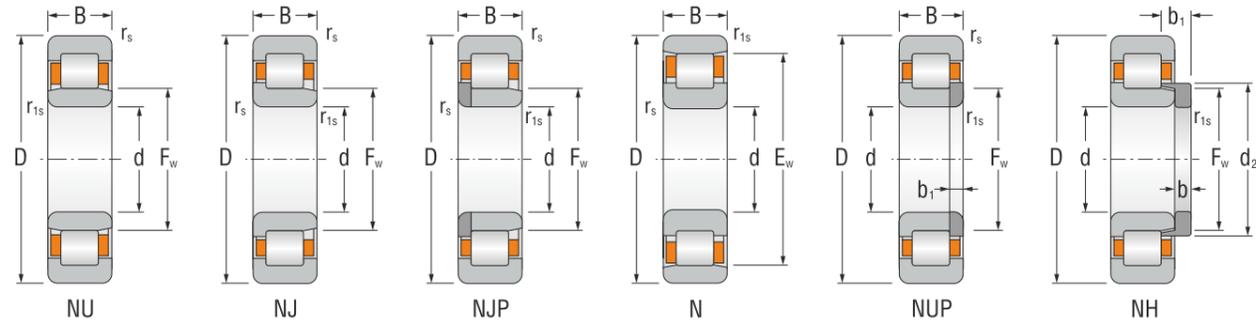
M - two piece machined brass cage, roller centred

MA - two piece machined brass cage, outer ring centred

MAP - machined brass cage

SINGLE-ROW CYLINDRICAL ROLLER BEARINGS

For Axleboxes

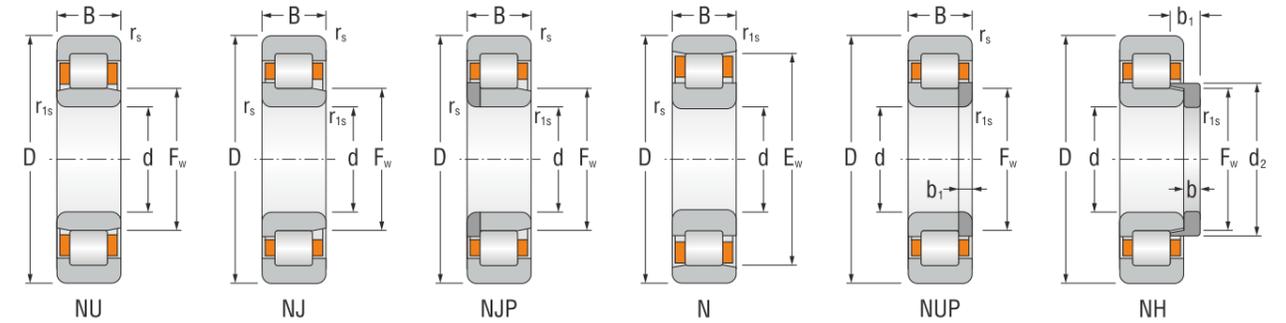


Dimensions	Bearings designation	Angle ring	Basic load rating		Limiting speed for lubrication		Mass of		Dimensions								
			dynamic	static	grease	oil	Bearing	Angle ring	r _s	r _{1s}	F _w	E _w	d ₂	b	b ₁	s ¹⁾	
d D B		HJ	C _r	C _r	min ⁻¹	min ⁻¹	kg	kg	mm								
mm			kN	kN													
120 215 58	NU2224EMAP R150-180SO		446.4	609.2	1 950	2 275	9.279		2.1	2.1	143.5						4.6
215 58	NUP2224EMAP R150-180 A 180-300SO		446.4	609.2	1 950	2 275	9.604		2.1	2.1	144.5						9
260 55	NU324M		465.1	534.1	2 400	2 800	14.700		4	4	154						
260 55	NJ324M		465.1	534.1	2 400	2 800	14.700		4	4	154						
260 55	NUP324M		465.1	534.1	2 400	2 800	14.700		4	4	154						
260 55	NH324M	HJ324	465.1	534.1	2 400	2 800	14.700	1.400	4	4	154	164	14	22.5			
260 55	NU324EM		516.2	592.8	2 200	2 700	15.200		4	4	154						
310 72	NU424M		714.4	834.5	1 900	2 200	30.590		5	5	170						
310 72	NJ424M		714.4	834.5	1 900	2 200	30.590		5	5	170						
130 280 58	NU326EM	HJ326E	603.2	715.6	2 000	2 400	18.600	1.700	4	4	167	182	14	23	2.9		
280 58	NJ326EM	HJ326E	603.2	715.6	2 000	2 400	19.000	1.700	4	4	167	182	14	23	2.9		
280 58	NJ326EMP C4S0	HJ326E SO	603.2	715.6	2 000	2 400	18.361	1.666	4	4	167	182	14	23	2.9		
140 250 42	NJP228EMA		385.1	502.0	2 300	2 800	9.650		4	4	169						1.6
250 42	NU228EMA		385.1	502.0	2 300	2 800	9.440		4	4	169						1.6
250 42	N228M		318.3	410.5	2 500	3 000	8.897		4	4	221						2.5
250 42	NUP228M		318.3	410.5	2 500	3 000	9.870		4	4	169						
250 42	NJ228M		318.3	410.5	2 500	3 000	9.330		4	4	169						2.5
250 42	NU228M		318.3	410.5	2 500	3 000	9.110		4	4	169						2.5
250 68	NU2228EMAP R170-200SO		615.3	903.6	2 000	2 500	14.991		3	3	169						6.6
250 68	NUP222 8EMAP		615.3	903.6	2 000	2 500	15.513		3	3	169						12
300 62	NU328M		603.4	725.8	2 000	2 400	22.100		4	4	180						2.7
300 62	NJ328M		603.4	725.8	2 000	2 400	22.840		4	4	180						2.7
300 102	NJ2328EM		1 018.8	1 384.5	1 900	2 200	37.600		4	4	180						7.9
300 102	NJP2328M		909.3	1 229.8	2 000	2 400	36.760		4	4	180						9.2
300 102	NU2328EM		1 018.8	1 384.5	1 900	2 200	37.600		4	4	180						7.9
300 102	NJ2328M	HJ2328	909.3	1 229.8	2 000	2 400	36.100	2.380	4	4	180	197.6	15	33.5	9.2		
300 102	NU2328M	HJ2328	909.3	1 229.8	2 000	2 400	35.300	2.380	4	4	180	197.6	15	33.5	9.2		
360 82	NJ428X5M		952.8	1 117.7	1 600	1 900	47.160		5	5	196						

¹⁾ Permissible axial displacement out of central position
 E – bearings with higher load rating
 M – two piece machined brass cage, roller centred
 MA – two piece machined brass cage, outer ring centred
 MAP – machined brass cage

SINGLE-ROW CYLINDRICAL ROLLER BEARINGS

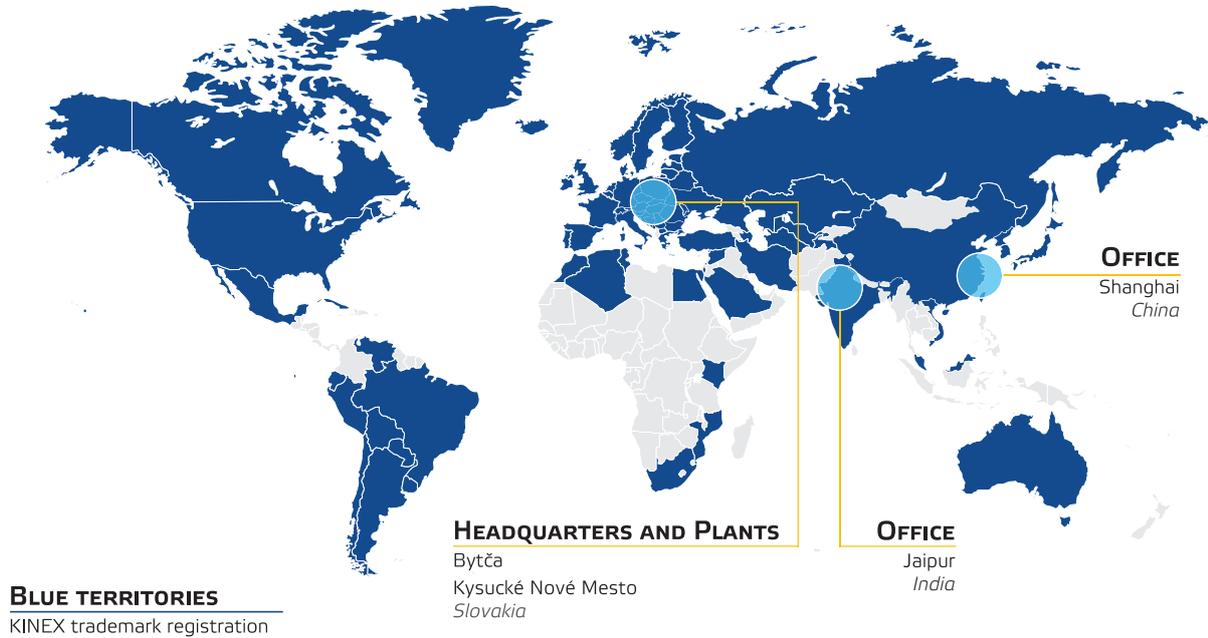
For Locomotives



Dimensions	Bearings designation	Angle ring	Basic load rating		Limiting speed for lubrication		Mass of		Dimensions								
			dynamic	static	grease	oil	Bearing	Angle ring	r _s	r _{1s}	F _w	E _w	d ₂	b	b ₁	s ¹⁾	
d D B		HJ	C _r	C _r	min ⁻¹	min ⁻¹	kg	kg	mm								
mm			kN	kN													
150 270 45	NJP230EMA		440.2	581.3	2 200	2 700	12.520		4	4	182						2.4
270 45	NJ230EMA		440.2	581.3	2 200	2 700	12.520		4	4	182						2.4
270 45	NU230EMA		440.2	581.3	2 200	2 700	12.160		4	4	182						2.4
270 45	NJ230EM		440.2	581.3	2 200	2 700	12.520		4	4	182						2.4
270 45	NU230EM		440.2	581.3	2 200	2 700	12.000		4	4	182						2.4
270 45	NUP230M		367.7	480.5	2 200	2 700	12.050		4	4	182						
270 45	NJ230M		367.7	480.5	2 200	2 700	11.800		4	4	182						2.4
270 45	NU230M		367.7	480.5	2 200	2 700	11.800		4	4	182						2.4
320 65	NJ330EM		757.6	921.6	1 800	2 100	27.100		4	4	193						1.8
320 65	NJ330M	HJ330	663.1	807.4	1 900	2 200	26.840	2.420	4	4	193	210	15	26.5	2.7		
320 65	NU330M	HJ330	663.1	807.4	1 900	2 200	26.280	2.420	4	4	193	210	15	26.5	2.7		
320 65	NU330AH1M P6R185-210NA		663.1	807.4	1 900	2 200	26.200		4	4	193						2.7
160 290 48	NJ232EM	HJ232E	498.6	666.4	2 000	2 400	14.700	1.520	4	4	195	206.2	12	20	2.5		
340 67	NJ332EM		857.8	1 053.2	1 700	2 000	32.200		4	4	195						2.5
340 68	NJ332EAM P6R190-215NA		857.8	1 053.2	1 700	2 000	31.700		4	4	204						2.4
170 310 52	NJ234EM	HJ234E	589.0	777.2	1 900	2 200	18.400	1.740	4	4	207	221.4	12	20	2.9		
310 52	NU234EM	HJ234E	589.0	777.2	1 900	2 200	16.600	1.740	4	4	207	221.4	12	20	2.9		
180 280 46	NU1036M		334.6	474.5	2 100	2 500	9.858		2.1	2.1	205						3.6
320 52	NJ236EM	HJ236E	611.3	826.0	1 800	2 100	19.500	1.820	4	4	217	230.5	12	20	2.9		
320 52	NU236EM	HJ236E	611.3	826.0	1 800	2 100	19.200	1.820	4	4	217	230.5	12	20	2.9		
320 86	NU2236EAM C4 F1		992.4	1 483.4	1 870	2 720	30.900		4	4	215						6.9
190 290 46	NJP1038EMA		411.2	612.0	1 970	2 360	12.100		2.1	2.1	214						2.5
290 46	NU1038M		354.8	520.3	1 900	2 200	9.510		2.1	2.1	215						3.5
340 55	NU238EMAP C4S0		678.3	927	1 300	1 950	22.228		4	4	230						2.1
200 310 51	NUP1040M		381.9	567.1	1 900	2 200	14.750		2.1	2.1	229						
310 51	NJ1040M		381.9	567.1	1 900	2 200	14.000		2.1	2.1	229						4.2
310 51	NU1040M		381.9	567.1	1 900	2 200	13.804		2.1	2.1	229						4.2
360 58	NJ240EM	HJ240E	749.9	1 033.7	1 500	1 800	27.900	2.710	4	4	243	257.8	14	23	2.9		
360 58	NU240EM	HJ240E	749.9	1 033.7	1 500	1 800	27.300	2.710	4	4	243	257.8	14	23	2.9		

¹⁾ Permissible axial displacement out of central position
 E – bearings with higher load rating
 M – two piece machined brass cage, roller centred
 MA – two piece machined brass cage, outer ring centred
 MAP – machined brass cage

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