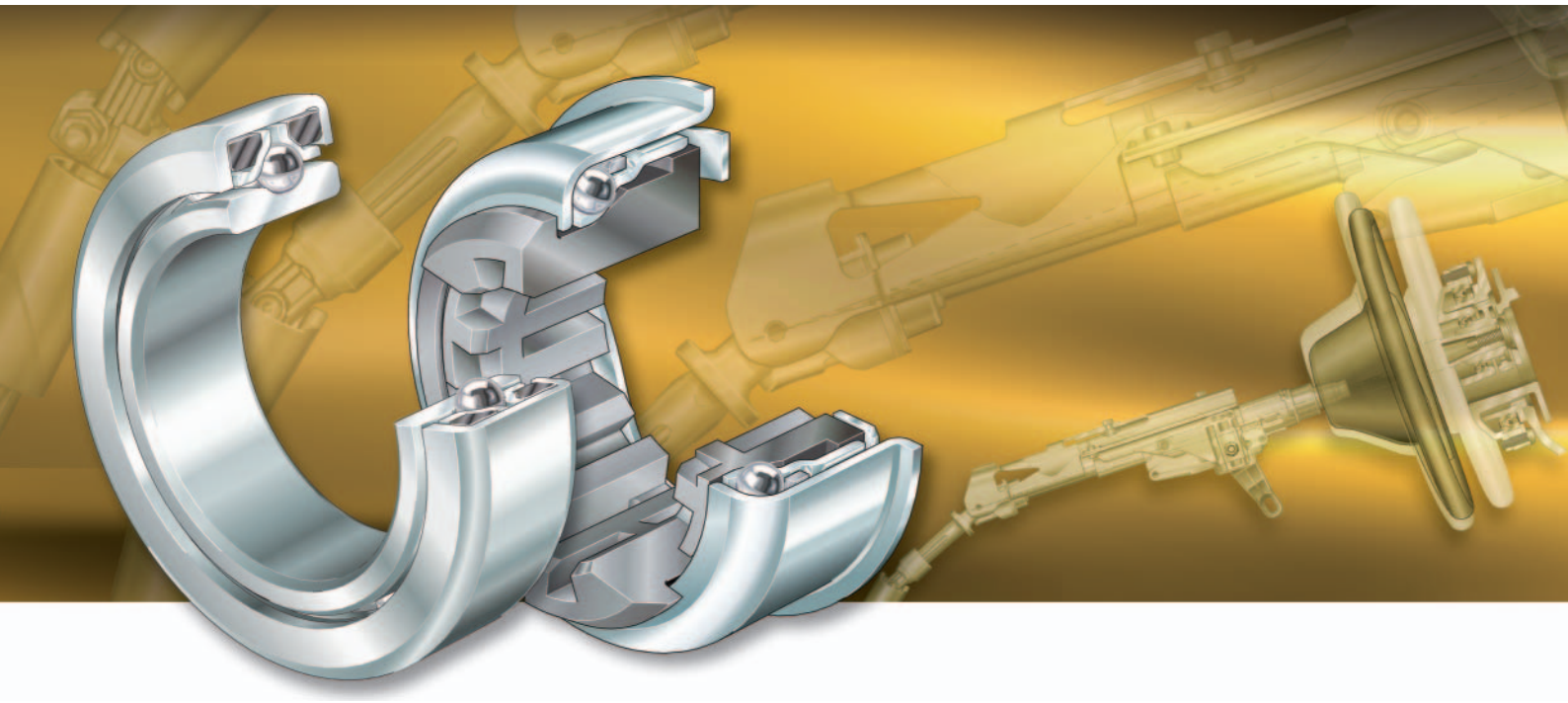


Steering column bearings

Technical Product Information

SCHAEFFLER GROUP
AUTOMOTIVE

Steering column bearings

Steering column bearings are part of the steering column and contribute to easy, precise steering of the vehicle. Very high travel safety and optimum comfort are to be achieved.

Steering column manufacturers and bearing manufacturers must work together closely in order to ensure that all components are optimally matched to each other.

The Schaeffler Group has expertise and experience in the design, calculation and production of steering column bearings and offers solutions for the widest variety of technical requirements.

In partnership with our customers, we have developed steering column bearings with characteristics including the following:

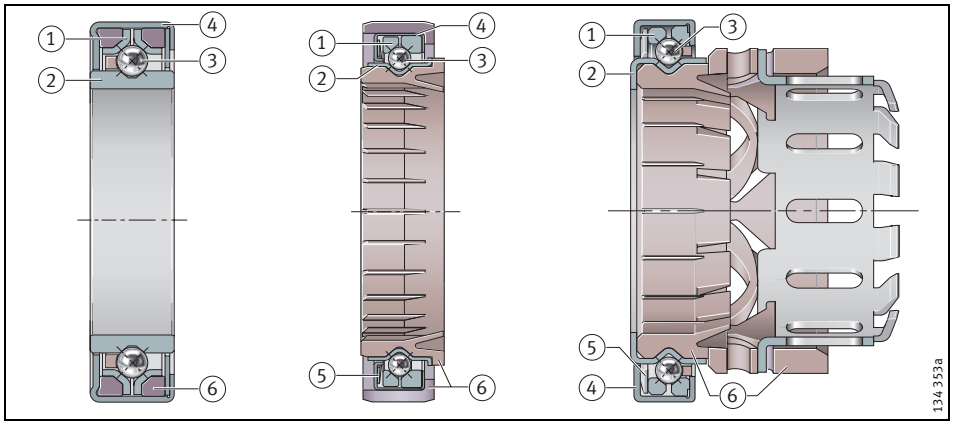
- they support the steering shaft without clearance
- they support radial and axial forces
- they contribute to the insulation of noise
- they have low friction and high rigidity
- they are optimised for design space and sealed
- they are maintenance-free and easy to fit.

We work to very high quality standards – our engineers carry out comprehensive tests using defined test methods on specially developed test rigs. Furthermore, we apply stringent process and functional controls to ensure that all customer specifications are fulfilled.

With the special bearings and precision components for steering columns described in this publication, we are making a significant contribution to the comfort, safety, reliability and cost-effectiveness of passenger vehicles – worldwide.

Further information on this subject is given in the Automotive Product Information Steering Column Bearings (API 04).

Four point contact ball bearings



Four point contact ball bearings KLXAK, KLXB, KLXBK

Four point contact ball bearings KLX

Bearings of this series can support radial and axial forces in both directions.

They generally comprise:

- an outer ring – one-piece or two-piece ①
- an inner ring – one-piece or two-piece ②
- a ball set – with or without cage ③
- a sleeve ④
- a spring element ⑤
- one or more tolerance rings ⑥.

Four point contact ball bearings KLX are adapted to match the customer requirements of the specific application. They are greased as standard and can be used at operating temperatures between –40 °C and +80 °C.

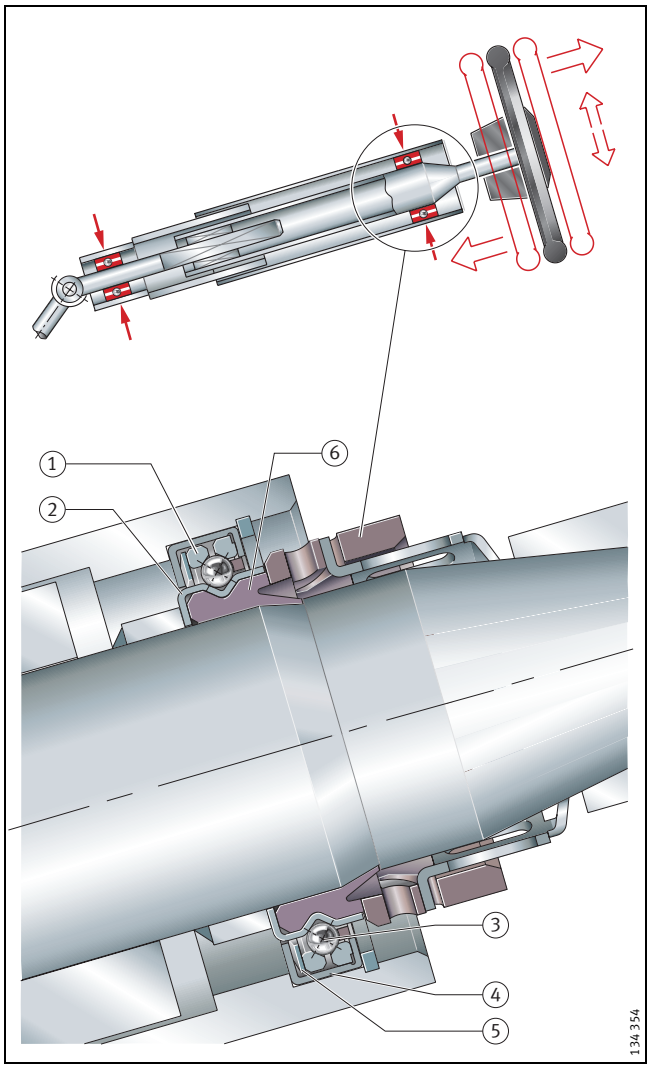
Essential variants of four point contact ball bearings

The Schaeffler Group manufactures our point contact ball bearings KLX:

- clearance-free with rubber elements – designation KLXA
- clearance-free with ondular washer – designation KLXB (for new designs we recommend series KLXA)
- with clearance – designation KLXC (for new designs we recommend series KLXA)
- with cage – additionally with suffix K; for example KLXAK.

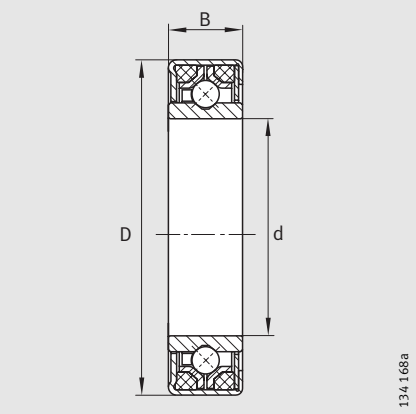
The clearance-free, spring preloaded bearings have – due to the manufacturing process – a defined rigidity and friction. These values are specified by means of test specifications.

Please consult Application Engineering on the selection of bearings.



Design of the bearing seating surfaces – press fit of the bearing on the shaft and in the housing

Four point contact ball bearings



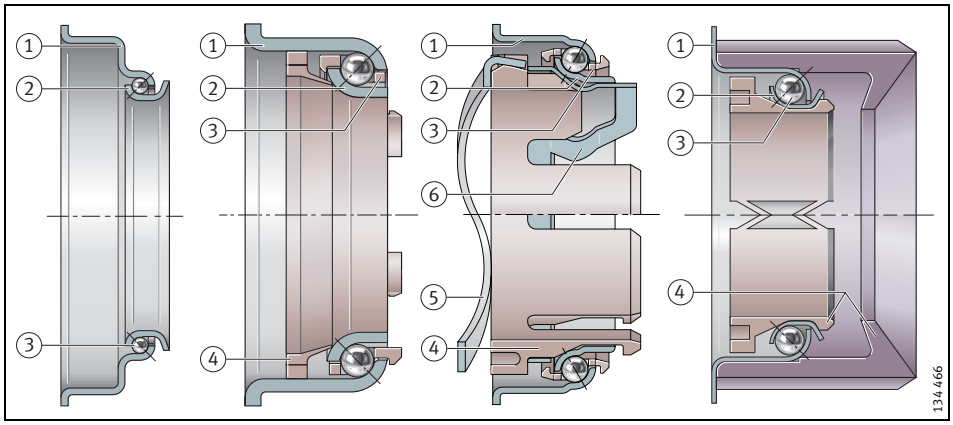
Four point contact ball bearing KLX

Dimension table · Dimensions in mm

Shaft diameter	Series	F- no.	Dimensions		
			d	D	B
18,1	**KLXCK**	**F-94098**	18,1	33,5	14,4
	KLXCK	**F-94098.5**	18,1	33,5	14,4
19	**KLXB**[1)]	**F-203501.1**	19	32	7
	KLXB[1)]	**F-217217**	18,88	32	11
	KLXAK[1)]	**F-208940.2**	18,88	36,15	11
19,3	**KLXA**[1)]	**F-230434.09**	19,25	37,5	15
	KLXBK[1)]	**F-234805**	19,25	37,85	15
	KLXBK[1)]	**F-234805.01**	19,25	37,85	15
	KLXC	**F-230434.3**	19,25	37,9	15
	KLXAK	**F-234832.8**	19,25	39,65	15,95
	KLXA	**F-550850**	19,25	39,65	15,95
20	**KLXBK**	**F-210163.8**	19,75	32,1	11
22	**KLXC**	**F-580801.1**	21,65	40	9,2
	KL	**F-237960.1**	21,98	40,13	15,5
24	**KLXB**[1)]	**F-216217**	22,4	44,3	13
	KLXA	**F-551533**	23,88	38,13	10,15
	KLXBK[1)]	**F-228237.3**	23,88	40,06	8
	KLXAK[1)]	**F-213781.1**	23,88	40,15	10,6
25	**KLXAX**[1)]	**F-234647**	23,1	45,6	15,5
	KLXAK	**F-227411.2**	24,8	45,6	15,5
	KLXAK	**F-234494.3**	24,89	42,1	19
	KLX	**F-238684**	24,92	42,08	19
	KLX	**F-239889**	24,92	46,75	19
	KLXAK	**F-552317**	24,92	46,75	19
	KLXAK	**F-552317.01**	24,92	46,8	13,7
	KLXAK[1)]	**F-554257.02**	24,89	45,6	15,5
	KLXAX[1)]	**F-552280.02**	24,99	39,17	10,13
	KLXB[1)]	**F-204040.1**	25	45,5	13
27	**KLXCK**	**F-222950.7**	26,6	53,25	13,5
30	**KLXAK**	**F-230572**	29,9	43,22	8
31,5	**KLXBK**[1)]	**F-216218.3**	29,8	50	35,1

[1)] Preferred types.

Angular contact ball bearings



Angular contact ball bearings SKLA, SKLAK, SKLBK, SKLC

Angular contact ball bearings SKL

Bearings of this series can support axial forces in one direction. In order to support radial forces, they must be preloaded.

The angular contact ball bearings comprise:

- an outer ring ①
- an inner ring ②
- a ball set – with or without cage ③
- one or more tolerance rings ④
- an ondular washer (optional) ⑤
- a contact ring – for transmitting current to the horn ⑥.

The bearings are greased as standard and can be used at operating temperatures between –40 °C and +80 °C.

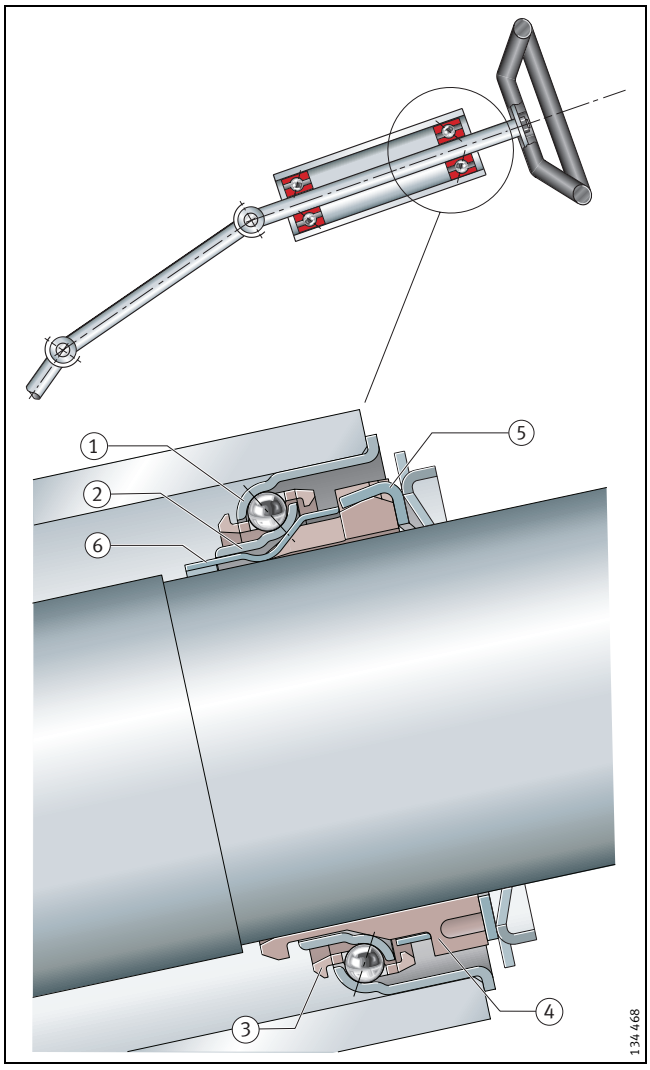
Main variants of angular contact ball bearings

The Schaeffler Group manufactures angular contact ball bearings:

- without tolerance ring – designation SKLA
- with one tolerance ring – designation SKLB
- with two tolerance rings – designation SKLC
- with cage – additionally with suffix K; for example SKLAK.

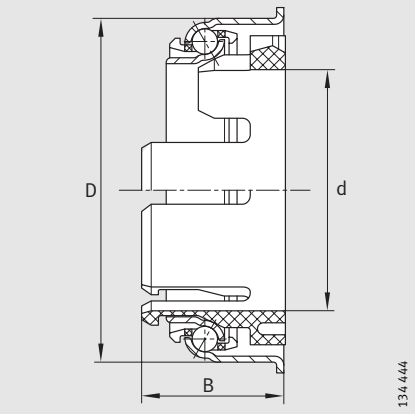
Angular contact ball bearings are centred on the shaft by means of integral tolerance rings or separate clamping rings. These rings permit less precise shaft tolerances. The clamping rings are indicated – where applicable – in the dimension table.

Optionally, an ondular washer can be integrated in order to preload the system. Please consult Application Engineering in relation to defining the spring force and spring rate.



Design of the bearing seating surfaces

Angular contact ball bearings



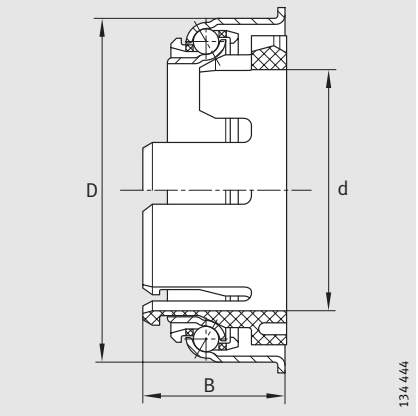
Angular contact ball bearing SKLBK

Dimension table · Dimensions in mm

Shaft diameter	Series	F- no.	Clamping ring	Combination	Dimensions		
					d	D	B
18	**SKLCK**	**F-209405**	–	–	18	34,5	15
19	**SKLA**	**F-89834.1**	F-81023	–	18,9	26,6	8,3
	SKLA	**F-90306.1**	F-81023	F-89834.1	19,3	26,6	8,3
20	**SKLBK**	**F-95843**	–	–	19,7	32,1	14
	SKLBK	**F-550267**	–	–	19,7	32,1	14
	SKLBK	**F-209400**	–	–	19,7	32,1	14
	SKLAK[1)]	**F-83737**	–	–	20,1	32,1	12
22	**SKLC**	**F-205879.3**	–	–	22	38	21,5
	SKLB	**F-215539.1**	F-215539-151	–	22	43,75	12,5
	SKLAK[1)]	**F-203016.2**	F-203017	–	22,7	36,09	16,6
	SKLBK[1)]	**F-230539.1**	–	–	22,35	36,02	12,8
	SKLBK[1)]	**F-230539**	–	–	22,35	36,02	12,8
22,225	**SKLA**	**F-95023**	F-81022	–	22,225	35,71	20,6

[1)] Preferred types.

Angular contact ball bearings



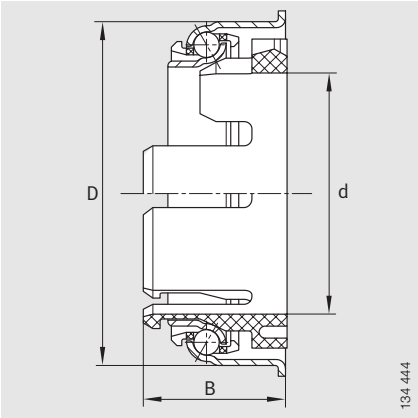
Angular contact ball bearing SKLBK

Dimension table (continued) · Dimensions in mm

Shaft diameter	Series	F- no.	Clamping ring	Combination	Dimensions		
					d	D	B
23	**SKLA**	**F-58894**	–	–	23,1	32	12,5
	SKLA	**F-203482**	F-81024	–	23,1	32	12,5
	SKLBK[1)]	**F-227331.3**	–	–	23	43,05	17,5
25	**SKLBK**[1)]	**F-213334.6**	–	–	25	38,5	17
	SKLCK[1)]	**F-213334.5**	–	–	25	42,05	17
	SKLAK[1)]	**F-86895.3**	–	–	25,2	38	16,5
	SKLAK[1)]	**F-93233.1**	F-92752	F-87201.3	25,2	38	16,5
	SKLAK[1)]	**F-92846.4**	–	–	25,3	38	16,8
	SKLAK[1)]	**F-92846.2**	–	–	25,3	38	16,8
	SKLAK[1)]	**F-92846.07**	–	–	25,3	46,7	18,2
	SKLAK	**F-220532.4**	F-219482	–	25,3	36	20
	SKLA	**F-220532.3**	F-219482	–	25,3	36	15
	SKLA	**F-220533.2**	F-219482	–	25,3	36	15
	SKLBK[1)]	**F-234495.5**	–	–	25,2	39,5	16,5
	SKLAK	**F-220532.8**	–	–	25,4	35,95	16,5
	SKLAK[1)]	**F-231121**	–	–	25,3	35,95	16,8

[1)] Preferred types.

Angular contact ball bearings



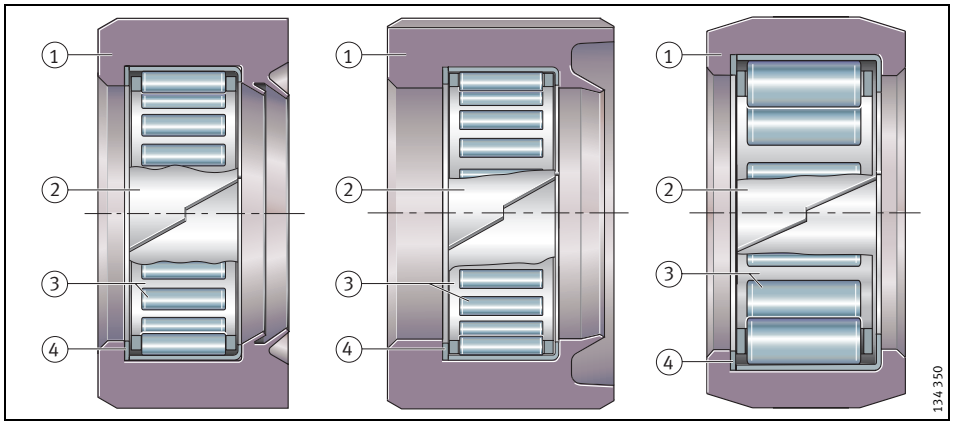
Angular contact ball bearing SKLBK

Dimension table (continued) · Dimensions in mm

Shaft diameter	Series	F- no.	Clamping ring	Combination	Dimensions		
					d	D	B
26	**SKLAK**[1)]	**F-224590.3**	F-223522	–	26	42,5	23,2
	SKLAK[1)]	**F-223586**	–	–	26	43	17,3
	SKLA	**F-81819**	F-82828	–	26,1	42,1	24
	SKLA	**F-81819.2**	F-82828	–	26,1	42,1	24
	SKLAK	**F-219379.4**	–		26,3	36,09	8,5
	SKLAK	**F-213647.4**	F-81025	–	26,3	36,09	21
28	**SKLA**	**F-96065**	F-96065-51	–	28	43,75	12,5
	SKLA	**F-96056-10**	F-95065-51	F-95065	28,3	43,75	12,5
30	**SKLBK**[1)]	**F-227330.5**	–	–	30,2	43,05	22,6
	SKLBK[1)]	**F-230972.7**	–	–	30,2	43,05	22,6
	SKLAK	**F-221588**	F-213356	–	30,35	43	11,5
	SKLBK[1)]	**F-227330**	–	–	30,2	43,05	17,5

[1)] Preferred types.

Needle roller bearings



Needle roller bearings LEN – variants

Needle roller bearings LEN

Bearings of this series can only support radial forces.

They comprise:

- a rubber tolerance ring ①
- a split outer ring ②
- a cage with needle rollers ③
- a thrust washer ④.

The bearings are greased as standard and can be used at operating temperatures between –40 °C and +80 °C.

The hardness of the rubber tolerance rings is 65 to 80 Shore A – it is matched to the required rigidity. The exact specification for the rubber mixture and the resulting technical delivery conditions ensure that the NBR quality remains constant throughout the operating life of the bearing. The steering comfort level is therefore maintained over the whole operating life.

The split outer ring and rolling element set are matched to each other. The raceways are thus protected against deformation and damage whilst under load. The split is set at an angle to the rolling element axis and is staggered. The rolling elements can therefore roll across the split without any detriment to their function.

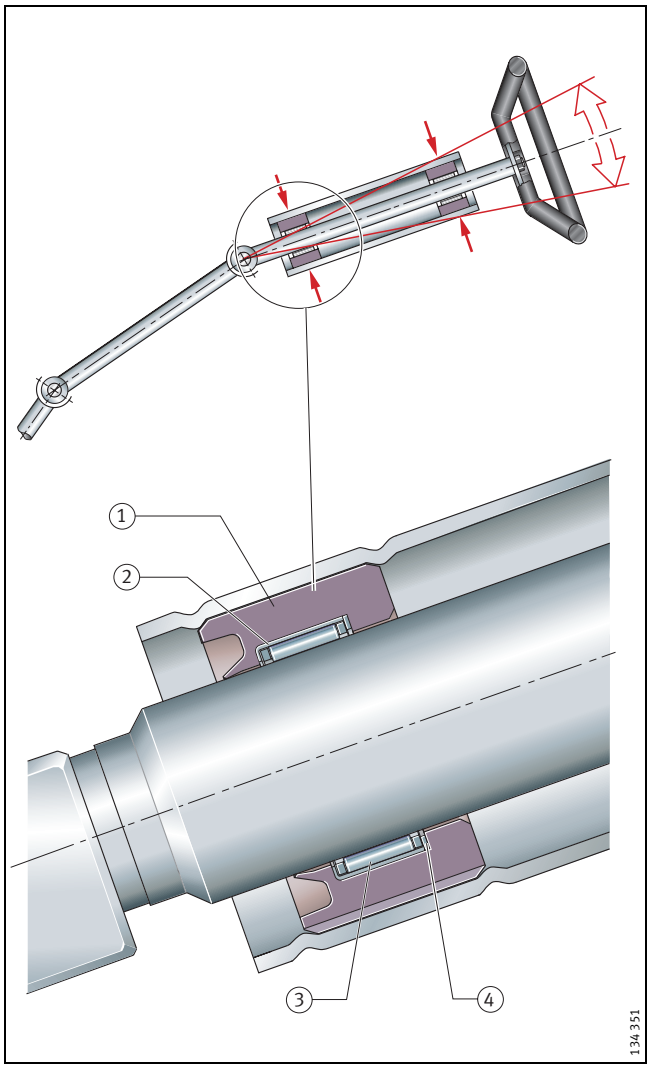
The rolling elements roll directly on a work-hardened, unhardened shaft. The minimum hardness of the rolling element raceway must be 200 HV.

The bearings are generally located in the housing by means of beads.

Variants of needle roller bearings

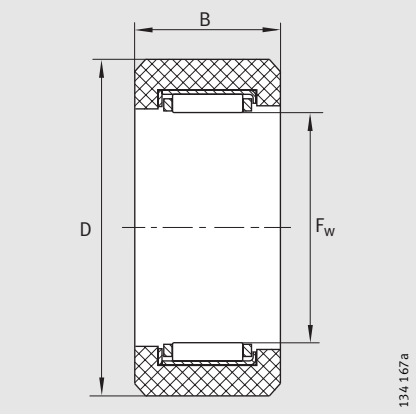
The Schaeffler Group manufactures needle roller bearings LEN:

- with a single or double lip seal to protect the bearings against contamination
- with a smooth or serrated tolerance ring.



Design of the bearing seating surfaces – location of the bearing by beads in the housing

Needle roller bearings



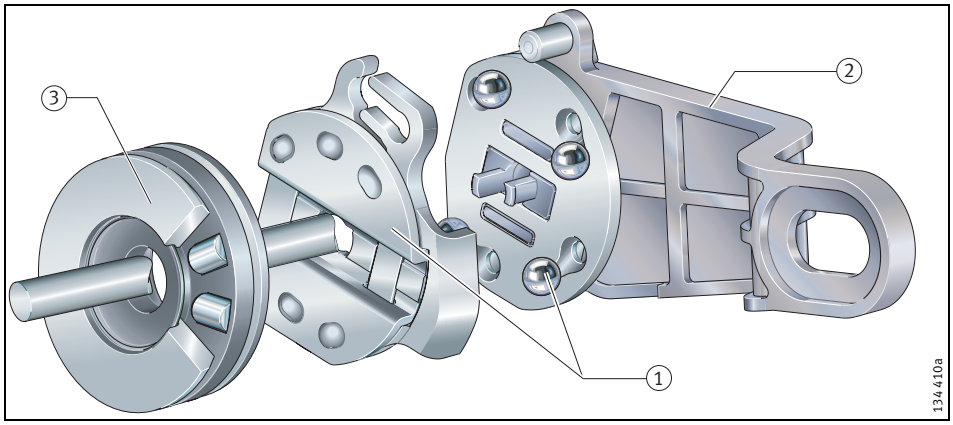
Needle roller bearing LEN

Dimension table · Dimensions in mm

Shaft diameter	Series	F- no.	Dimensions			Mounting dimensions	
			F_w	D	B	Shaft diameter	Bore diameter
19	**LEN**[1)]	**F-223309.1**	19	36	19	$18{,}93_{\pm 0{,}03}$	$36^{+0{,}02}_{-0{,}15}$
	LEN	**F-210151.1**	19	37	18	$19_{-0{,}052}$	$36_{\pm 0{,}15}$
	LEN	**F-94361.2**	19	37,1	18	$19_{-0{,}052}$	$36^{+0{,}16}$
	LEN[1)]	**F-206475.4**	19	38	18	$19_{-0{,}052}$	$37_{\pm 0{,}15}$
	LEN	**F-110573.6**	19	38	18	$19_{-0{,}052}$	$37_{\pm 0{,}15}$
	LEN	**F-113528**	19	38	18	$19{,}02_{-0{,}1}$	$27_{\pm 0{,}15}$
19,02	**LEN**	**FC69424.3**	19,02	32,23	20	$19{,}02_{-0{,}050}$	$31{,}6_{\pm 0{,}45}$
	LEN	**FC90300.2**	19	37	18	$19_{-0{,}050}$	$36^{+0{,}25}$
22	**LEN**	**F-96770**	22	36,85	18	$22_{-0{,}084}$	$36_{\pm 0{,}1}$
	LEN	**F-215819**	22	38	18	$22_{-0{,}052}$	$37_{\pm 0{,}15}$
24,3	**LEN**	**FC69184**	24,3	36,5	24	$24{,}3_{-0{,}050}$	$36^{+0{,}062}$
25	**LEN**	**F-239187.01**	25	36	20	$25_{\pm 0{,}08}$	$36_{\pm 0{,}15}$
25,4	**LEN**	**F-216642.1**	25,4	36,4	20	$25{,}4_{\pm 0{,}025}$	$36^{+0{,}05}_{-0{,}2}$
	LEN	**F-216642.6**	25,4	36,4	20	$25{,}4_{\pm 0{,}025}$	$36^{+0{,}25}$
	LEN	**F-216642**	25,4	36,6	20	$25{,}4_{\pm 0{,}025}$	$36^{+0{,}25}$
	LEN	**F-390697**	25,4	43,74	20	$25{,}4_{\pm 0{,}025}$	$43{,}07^{+0{,}53}$
26	**LEN**	**F-223821**	26	41,4	24	$26_{-0{,}06}$	$40{,}4_{\pm 0{,}1}$
	LEN	**F-201939**	26	42	28	$26{,}021_{-0{,}013}$	$42_{\pm 0{,}35}$
	LEN	**F-211765**	26	42,5	18	$26{,}021_{-0{,}013}$	$41{,}9_{\pm 0{,}1}$
	LEN	**F-230317**	26	42,5	18	$26{,}021_{-0{,}013}$	$42_{\pm 0{,}15}$
	LEN	**F-208336**	26	43,4	20	$25{,}980_{\pm 0{,}1}$	$42_{\pm 0{,}12}$
28	**LEN**	**FC66901.3**	28	33,82	18,8	$28_{-0{,}084}$	–
	LEN	**F-228712.4**	28	38,4	20	$28_{-0{,}084}$	$38^{+0{,}2}$
28,2	**LEN**	**FC68337**	28,2	39,8	22	$28{,}2_{-0{,}052}$	–
30	**LEN**	**F-391951**	30	38,55	22	$30_{\pm 0{,}025}$	–
32,5	**LEN**	**FC69887**	32,5	49	22	$32{,}5_{-0{,}062}$	$48{,}5^{+0{,}04}$
33,25	**LEN**	**FC69601.1**	33,25	43,95	20	$33{,}25_{\pm 0{,}025}$	$43{,}07_{\pm 0{,}63}$
35	**LEN**[1)]	**F-227410**	35	47,6	20	$36_{\pm 0{,}05}$	$47_{\pm 0{,}25}$

[1)] Preferred types.

Clamping device



Clamping device – KLV

Clamping device KLV

Clamping devices are used for steering wheels with rake and/or reach adjustment. A clamping device essentially consists of:

- a base unit with rolling element guidance ①
- an integral lever ②
- an axial bearing unit ③ as the bearing against which the clamping force acts.

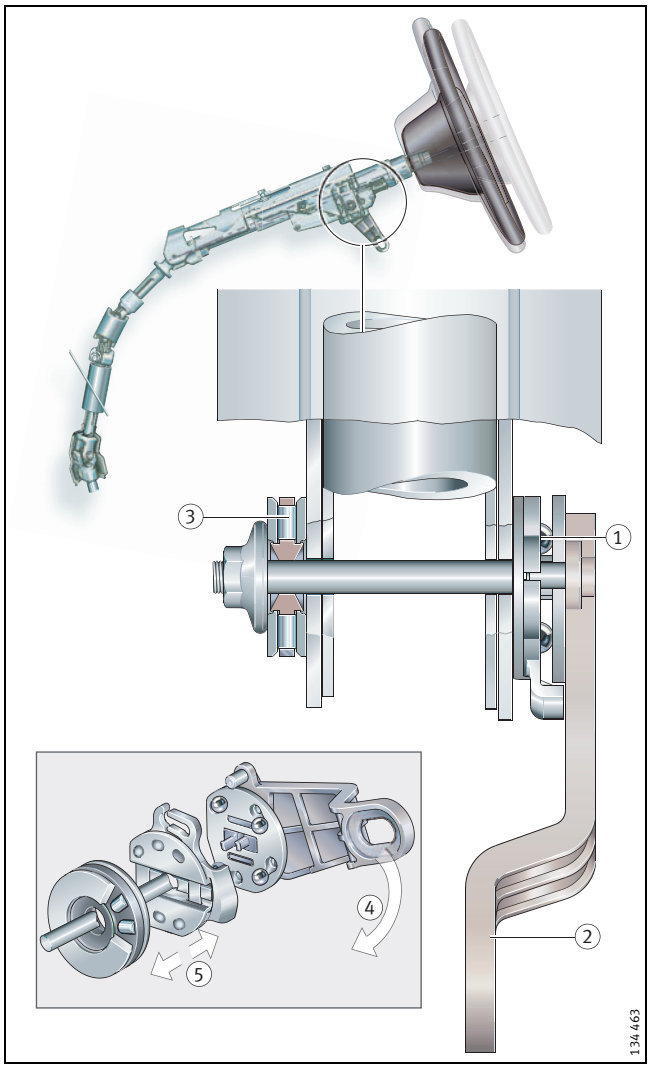
The base unit converts the swivel movement of the lever ④ into an axial stroke movement ⑤. The axial stroke movement opens the clamping device, allowing the steering wheel to be easily adjusted. Once the driver has adjusted the steering wheel, he moves the lever back to its original position. The steering column is then clamped against the mounting module. The steering wheel is thus securely fixed in the required position. The clamping force is then transmitted exclusively via steel elements. This ensures a constant clamping force throughout the operating life.

Clamping devices are greased as standard and can be used at operating temperatures between –40 °C and +80 °C.

The grip for actuating the clamping device can be:

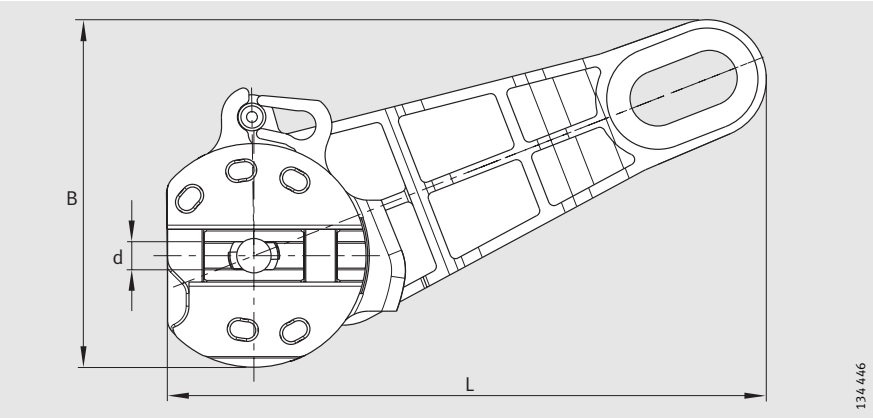
- connected by means of a so-called drawer system or
- attached directly to the lever ②.

The base unit of the INA clamping device can be carried over unchanged in most cases, so it is only necessary to adapt the lever to the specific mounting situation.



Construction of the clamping device

Clamping device



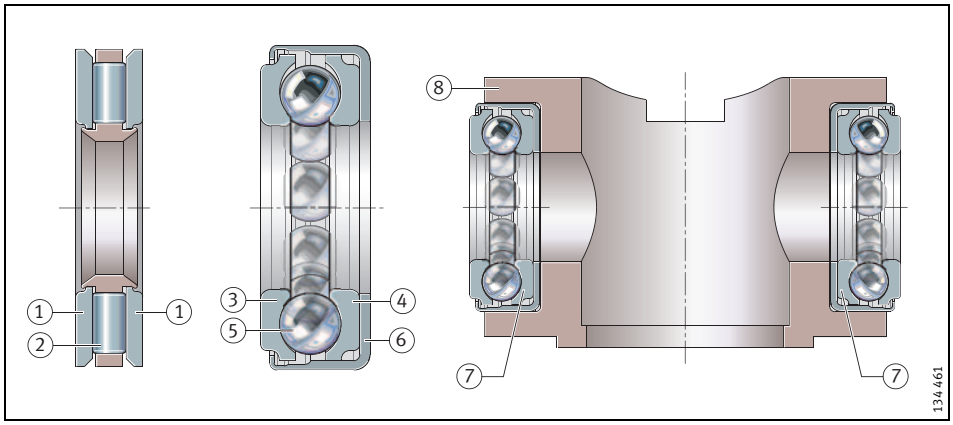
Clamping device

Dimension table · Dimensions in mm

Shaft diameter	Series	F- no.	Dimensions		
			d	L	B
6	**KLV**	**F-237904.12**	6,2	107,9	62,6
	KLV[1)]	**F-237904.11**	6,2	108,1	62,6
8	**KLV**	**F-237402.2**	8,1	37,2	92,1
	KLV	**F-227396.14**	8,03	128,5	27
	KLV	**F-228312.7**	8,03	135	99

1) With decoupling function.

Axial bearings



Axial bearings – AX, FBLR and complete unit AKL

Axial bearings

Bearings of this series are used in mechanically or electrically adjustable steering systems.

Axial bearings are greased as standard and can be used at operating temperatures between –40 °C and +80 °C.

Under purely axial load, axial needle roller bearings are used.

AX bearings generally comprise:

- two axial washers ①
- an axial needle roller and cage assembly ② with a plastic cage.

If radial forces also occur in the bearing position, axial ball bearings are used:

FBLR bearings generally comprise:

- a shaft locating washer ③
- a housing locating washer ④
- a ball set ⑤
- a sleeve ⑥.

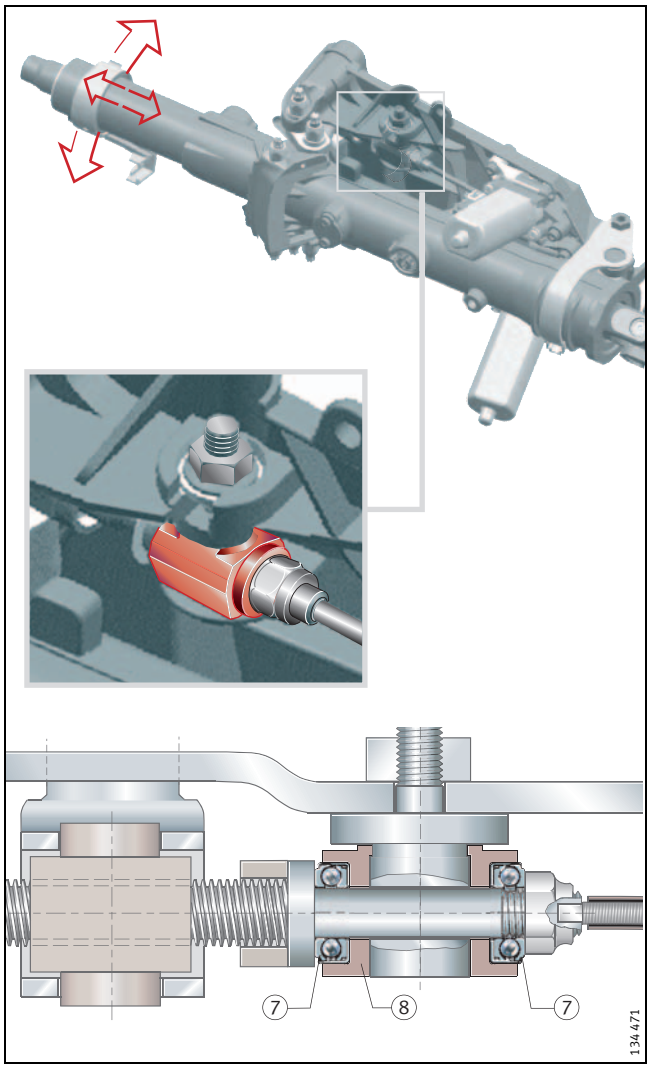
In order to optimise assembly and support axial forces from both directions, a unit comprising two axial ball bearings can be used.

AKL units comprise:

- two axial bearings FBLR ⑦
- a plastic carrier element ⑧.

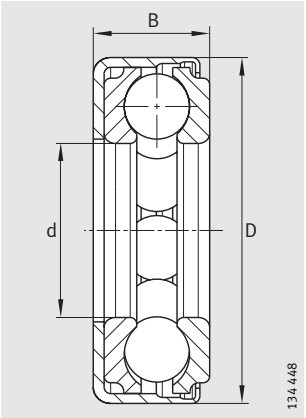
The plastic carrier element is matched to the specific steering system and performs further functions such as:

- angular compensation ±3°
- absorption of shocks.

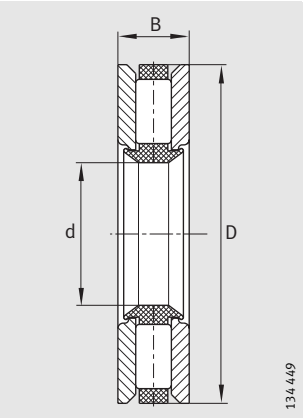


Axial ball bearing –
unit comprising two bearings and plastic carrier element

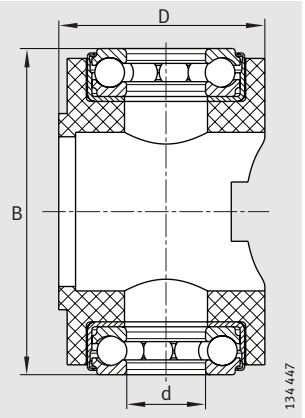
Axial bearings



Axial bearing FBLR



Axial bearing AX



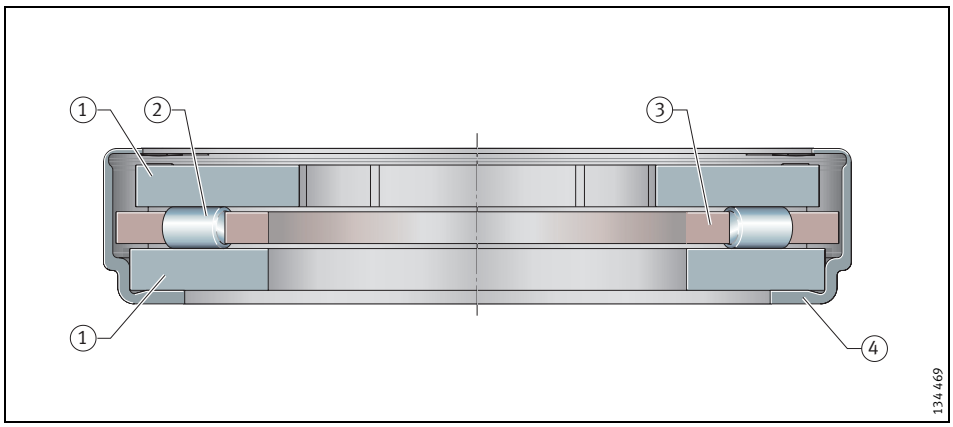
Unit AKL

Dimension table · Dimensions in mm

Shaft diameter	Series	F- no.	Dimensions		
			d	D	B
6	**AX**[1]	**F-228656.2**	6	17	4
	FBLR[2]	**F-230809**	6	12,8	4,7
8	**AX**[1]	**F-228656**	8	19	4
	FBLR[2]	**F-222307**	8	16	5,5
	FBLR[2]	**F-227843**	8	16	5,5
	FBLR[2]	**F-227843.1**	8	16	5,5
	FBLR[2]	**F-228634**	8	18	27,5
	AKL[3]	**F-234734**	8	19,8	29,35
	AKL[3]	**F-234735**	8	19,8	29,35
	AKL[3]	**F-238612**	8	20	33
14	**FBLR**[2]	**F-234405.2**	14,1	24,25	5,35
18	**FBLR**[2]	**F-550381**	18,1	24	4

1) Needle roller bearing.
2) Ball bearing.
3) Base unit.

Friction bearings



Friction bearing – AX

Friction bearing AX

Bearings of this series are used to damp steering wheel shake and thus improve the directional stability of the vehicle.

Friction bearings are greased as standard and can be used at operating temperatures between –40 °C and +80 °C.

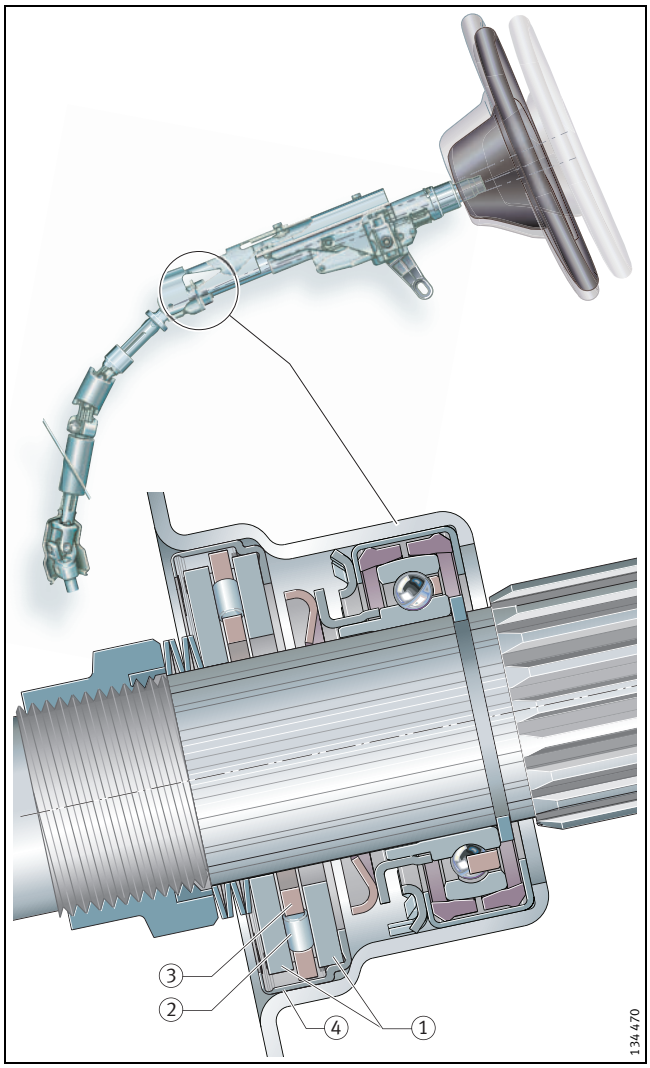
The bearings comprise:

- two axial washers (1)
- a rolling element set (2)
- a plastic cage (3)
- a sleeve (4).

Due to their defined axial preload, these bearings generate sufficient frictional torque in the steering column to achieve the required damping.

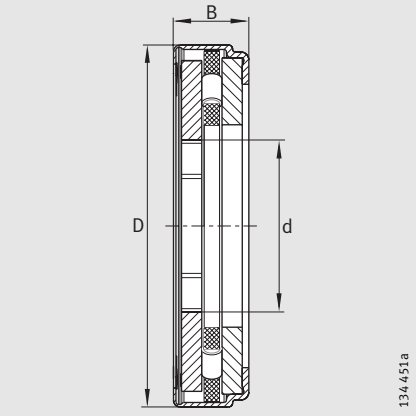
The frictional torque in the bearing is induced by skewed rolling elements. As a result, a greater frictional torque can be achieved under the same axial preload in comparison with a standard axial needle roller bearing.

The preload can, for example, by applied by means of an ondular washer (which can be optionally integrated).



Friction bearing – axially preloaded

Friction bearings

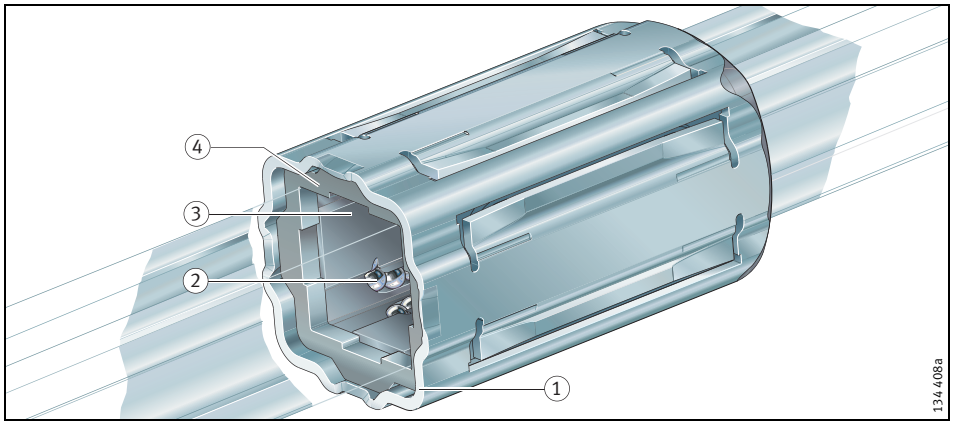


Friction bearing AX

Dimension table · Dimensions in mm

Shaft diameter	Series	F- no.	Dimensions			Mounting dimensions	
			d	D	B	Shaft diameter	Bore diameter
21	**AX**	**F-237302.2**	21,3	44,85	9,2	$21_{-0,05}$	$45 \pm 0,12$

Displacement bearings



Displacement bearing – KMS

Displacement bearings KMS

Bearings of this series transmit the torque from the intermediate steering shaft without clearance into the steering gear and at the same time allow axial movement free of stick-slip between the shaft and steering gear (housing).

Displacement bearings are greased as standard and can be used at operating temperatures between –40 °C and +120 °C.

The bearings comprise:

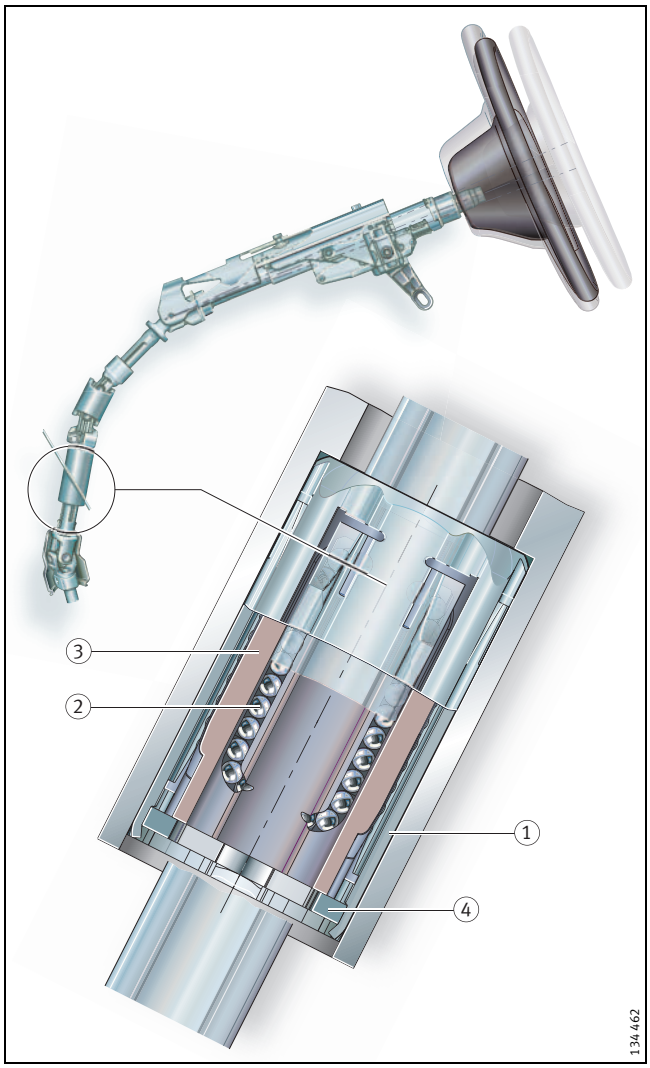
- a sleeve ①
- recirculating rolling elements ②
- a plastic cage ③
- a washer ④.

When displacement bearings KMS are used, this gives easier assembly of the intermediate steering shaft on the steering gear.

This requires a hardened shaft that can act as a raceway for the rolling elements.

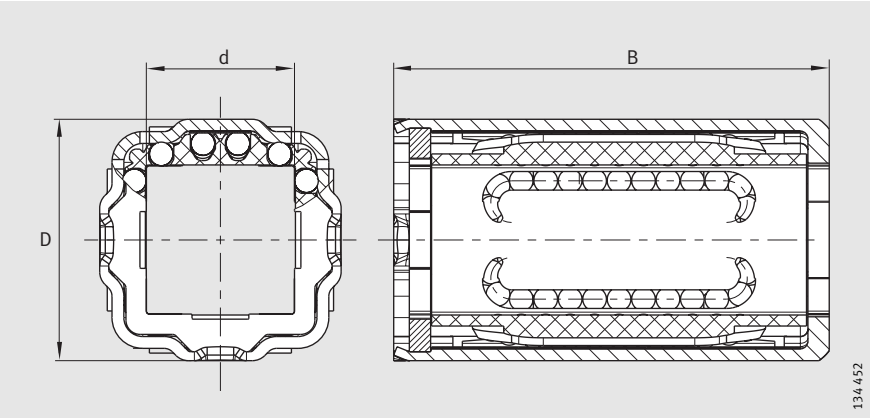
Advantages compared to conventional plain bearing solutions include:

- “infinite” shaft displacement by means of eight recirculating ball units arranged in series
- high torsional rigidity due to spring elements integrated in the outer sleeve
- freedom from radial clearance under low displacement force due to rolling elements with defined preload
- wear-free bearing arrangement due to rolling element contact between the shaft and housing
- capacity for transmitting high levels of excessive torque under overload in the system.



Displacement bearing KMS –
linkage of intermediate steering shaft to steering gear

Displacement bearings



Displacement bearings

Dimension table · Dimensions in mm

Shaft diameter	Series	F- no.	Dimensions			Mounting dimensions	
			d	D	B	Shaft diameter	Bore diameter
15,54	**KMS**	**F-236160.05**	15,4	25,5	46	$15,54_{-0,04}$	$25,5_{-0,05}$

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