SCHNEEBERGER
LINEAR TECHNOLOGY

LINEAR BEARINGS
and Recirculating Units

SCHNEEBERGER LINEAR TECHNOLOGY

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Linear Bearings

SCHNEEBERGER linear bearings are renowned for high accuracy, reliability and excellent operating characteristics. A wide range of differing guides is available which, acording to the application, may be fitted with balls, needles or rollers. This large selection of guides and rolling elements permits the user to select the optimum guidance concept. By employing SCHNEEBERGER linear bearings the user can call on experience and technical knowledge accumulated and extended over decades. There has been ongoing development of linear bearings by a team of engineers at SCHNEEBERGER for over forty years. New findings from research and development are being constantly processed and applied to existing and new products.

In this chapter you will find SCHNEEBERGER linear bearings with cages for designs with limited strokes. Construction with an unlimited stroke can be realized using recirculating units (chapter 11 onwards).

New: Cage assist FORMULA-S

FORMULA-S was developed to survive the most difficult situations: high acceleration/ deceleration, rapid oscillation, vertical installation, etc. The cage remains perfectly centered – in all cases, in all assembly orientations.
FORMULA-S is available for the linear guideways type RN and RNG.

Types/Sizes	**Accessories**
RN 3, RN 4, RN 6	● Cage: KBS
RNG 4, RNG 6, RNG 9	

Lengths
50 to 1500 mm

Linear Bearings Type RN

The RN linear bearing represents a consistent optimization of the R linear bearing. Thanks to the enlarged contact surface of the roller with the guideway, the performance capacitiy is significantly increased, with unchanged fitting dimensions.
The features of the RN include:
– approx. 3 × higher load carrying capacity
– significantly reduced susceptibility to cage drift
– reduced danger of contamination due to narrower gap between individual guides

Sizes	**Accessories**
3, 4, 6, 9, 12	● Cage: KBN
Lengths	● Endpieces: GA and GAN
50 to 1500 mm	● Special Attaching Screws: GD
	● Cage assist FORMULA-S

Linear Bearings Type RNG

The RNG linear bearing is a modern, high-performance design and was created through the consistent optimization of the R type bearing. Highly loadable guidance systems with the smallest dimensions can be realized. Through the high performance with comparably small bearing cross-sections, an unrivalled economic efficiency results in many applications.

Sizes	**Accessories**
4, 6, 9, 12	● Cage: KBN
	● Endpieces: GBN, GCN, GCN-A
Lengths	● Special Attaching Screws: GDN
50 to 1500 mm	● Cage assist FORMULA-S
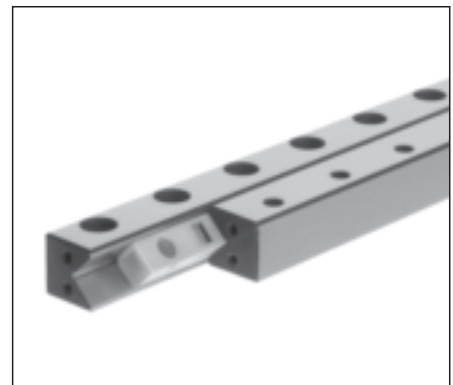
Linear Bearings Type R

With the type R, SCHNEEBERGER introduced the first standardized linear bearing in the world. Today it is recognized as an industrial standard. The bearing can be used with rollers or balls and is suitable for many applications with medium to high demands. Combined with SCHNEEBERGER recirculating units, configurations with an unlimited stroke are feasible.

Sizes
1, 2, 3, 6, 9, 12

Lengths
20 to 1500 mm

Accessories
- Cages: AC, AK, EE
- Recirculation Units: SR, SK, SKC, SKD
- Endpieces: GA, GB, GC, GC-A
- Special Attaching Screws: GD
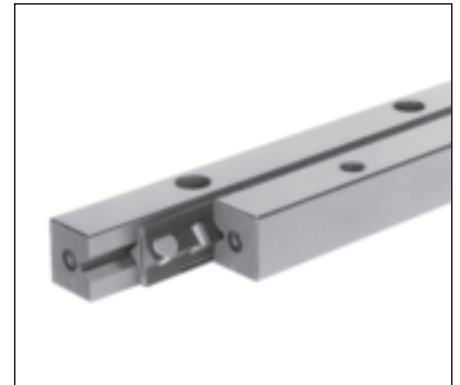
Linear Bearings Type RD

The RD linear bearing complements the R type by providing space-saving solutions. In addition, the use of R and RD linear bearings provides a substantially more economical guidance concept in the user's construction.
Combined with SCHNEEBERGER recirculating units, configurations with an unlimited stroke are feasible.

Sizes
1, 2, 3, 6, 9, 12

Lengths
100 to 2000 mm

Accessories
- Cages: AC, AK
- Recirculation Units: SR, SK, SKC, SKD

Linear Bearings Type N/O

The N/O linear bearing has been designed for use with needle cages. These anti-friction guideways are suitable for high-load applications. Together with the closely arranged needle cage the bearing has a very high rigidity. The SCHNEEBERGER plastic and steel composite cage used in these guides gives less resistance to motion than similar needle cages.

Sizes
62015, 92025, 2025, 2535, 3045, 3555

Lengths
100 to 2000 mm

Accessories
- Cages: SHW, HW
- Endpieces: GFN, GFO, GH, GH-A, GW, GW-A
- Special Attaching Screws: GD
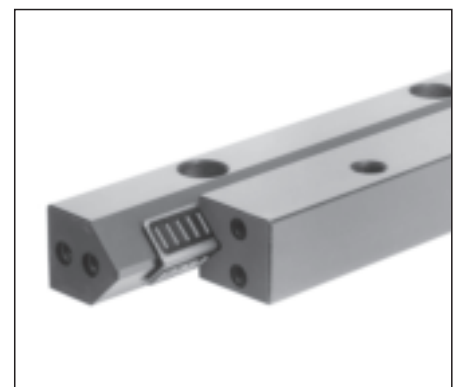
Linear Bearings Type M/V

Type M/V linear bearings are equipped with needle cages and are suitable for high load applications. The SCHNEEBERGER composite cages used with these guides ensure that there is little resistance to motion as compared to other similar needle bearing guides, while providing very great rigidity.

Sizes
3015, 4020, 5025, 6035, 7040, 8050

Lengths
100 to 1500 mm

Accessories
- Cages: SHW, HW
- Endpieces: EM, EV, EAM, EAV

Recirculating Units

SCHNEEBERGER Recirculating Units are Linear Guidance Systems for Unlimited Stroke Lengths. According to the model and loading, balls or rollers are used which are returned internally, load-free, so that continuous motion is ensured. They are characterized by:
– Low pulsation and low friction
– High load carrying capacity and rigidity
– Great precision
A restriction in the stroke is actually only given by the length of the guideways used.
SCHNEEBERGER recirculating units are used for anti-friction guideways among other things in robotics, in the construction of machinery in general and in measuring instruments i. e. everywhere where medium to high demands are placed on the accuracy of the system.

Ball Recirculating Units Type SK and SKD

The type SK recirculating unit is equipped with balls and is suitable for low to medium loading. It is used with SCHNEEBERGER type R or RD linear bearings and can be uniformly loaded in every direction. Hence, space saving designs may be realized.
Some sizes can be additionally fitted with damping elements (type designation SKD). These provide smoother operation but also have a somewhat reduced load carrying capacity.

Sizes
1, 2, 3, 6, 9, 12

Lengths
22 to 200 mm

SK

SKD

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Ball Recirculating Unit Type SKC

The recirculating unit type SKC provides unlimited stroke and equal load carrying capacity in all directions. The SKC, designed for low-to-medium loading conditions, operates dry – lubrication is not required!

These units, used with SCHNEEBERGER linear bearings type R or RD, are drop-in replacements for SCHNEEBERGER SK and SR recirculating units.

The combination of coated stainless steel, ceramic and Teflon® makes this recirculating unit suitable for **lubrication free operation in high vacuum and clean room applications.**

Sizes	**Lengths**
3, 6	SKC 3075 = 75 mm
	SKC 6100 = 100 mm

SKC

Roller Recirculating Unit Type SR

The SR recirculating unit has cross rollers and is suitable for medium to high loading. Dimensionally interchangeable with type SK, the type SR is also used with SCHNEEBERGER type R or RD linear bearings, but offers greater load carrying capacity and rigidity.

Sizes
2, 3, 6, 9, 12

Lengths
32 to 200 mm

Size 2

Sizes 3, 6, 9, 12

Flat Roller Recirculating Units Type NRT and NRV

The roller recirculating units NRT are designed for medium to heavy loads, high rigidity and high precision. Together with suitable SCHNEEBERGER linear bearings, adjusting wedge or attaching part ingenious constructions can be realized.
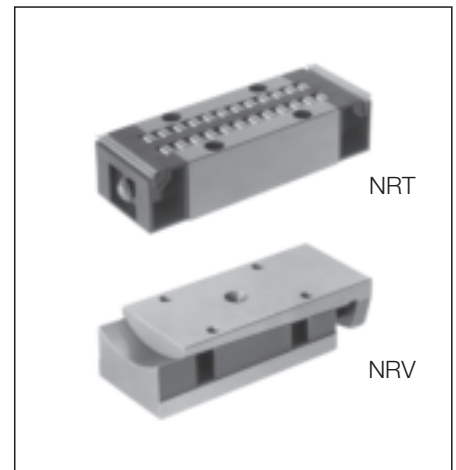
Sizes
19077, 26111, 38144

Lengths
77 to 144 mm

Accessories

Preload Wedge Type NRV

These wedges are used normally to adjust the preload. At the same time, by suitably shaping the cylindrically ground wedge bars, small angular deviations and deformations in the surrounding construction can be compensated.

The parts are made from hardened steel.

NRT

NRV

2.1 Linear Bearings for a Universal Tool Grinding Machine Table

Sensitive grinding on tool grinding machines requires a stick-slip-free and low friction antifriction guideway for the lengthwise motion of the table. Only then is it possible to achieve a uniform grinding wheel cut over the whole of the working stroke, since certain jobs are carried out without handwheel or crank. Especially on grinding machines it is also necessary to protect the linear guides because they can be damaged by the effects of dust and coolant. Covers which wipe or rub are not possible here because of the demand for low friction.

SCHNEEBERGER Products Used
«Pre-loaded» system
1 4 Linear bearings R 9 800
2 2 Roller cages AC 9×33 rollers
   8 End pieces GB 9
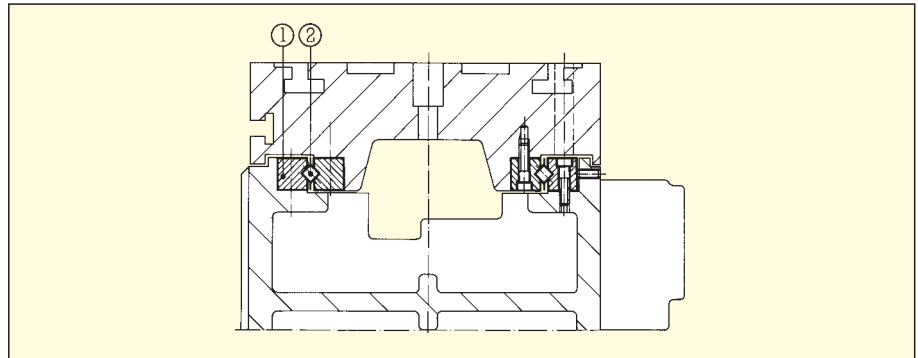
2.2 Grinding Table Mounting on an Internal Grinder

This high tech internal grinding machine required absolutely playfree, pre-loaded table guides in order to meet the high requirements of present day grinding techniques. To conform to these demands the base construction and the grinding table are box sectioned and ribbed, thus providing great torsional restistance and stability. In addition, coolant and grinding dust presented problems with regard to properly sealing the guide systems.

SCHNEEBERGER's Suggested Solution
The grinding table is mounted on N/O linear bearings and their V-shaped needle cages are attached to an oil pulse lubrication system. This configuration permits the high table speeds to be governed with the smallest possible amount of force. Pre-loaded attachment permitted minimum feed movements and ensured close tolerances because of playfree operation. Sealing the bearings was effected by making the drip pans at the sides of the table in the form of labyrinth seals. The table has a stroke of 550 mm and its maximum speed is 14 m/min.

SCHNEEBERGER Products Used
1 2 Linear bearings O 2535 1000
2 2 Linear bearings N 2535 1000
3 2 Needle cages HW 20×725
   4 Endpieces GH 2535 without wipers
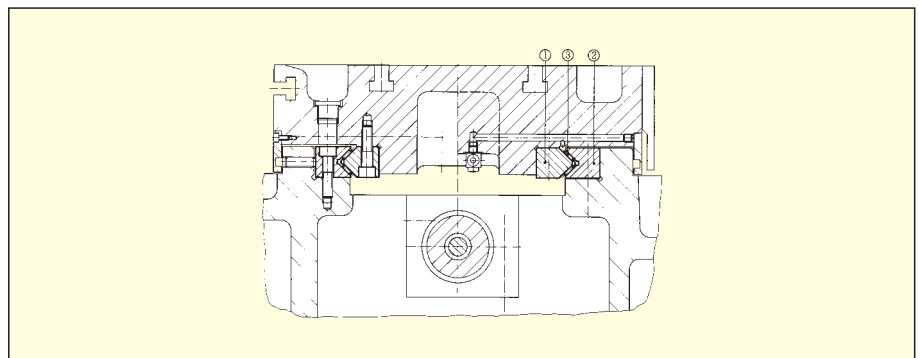
2.3 Non pre-loaded Anti-friction Guideway for Heavy Duty Flat Grinder

Gravity loaded, non pre-loaded anti-friction guideways are used in many flat grinding machines and in particular those with heavy tables and heavy workpieces. The table and workpiece weight plus the grinding pressure act vertically on the guideways; therefore, it is natural to use gravity loaded anti-friction guideways.

Economy, ease of assembly and high operational accuracy are the features of this layout. Table expansion as the result of heat effects (magnetic table; coolant) is compensated for by free expansion in two directions and, as a result, geometric errors cannot occur. The guideways are lubricated with grease. The wipers, not visible in the drawing, keep the bearings free from foreign matter and the lubricant loss to a minimum.

SCHNEEBERGER's Suggested Solution

The first solution is simple and economical. The V-Type guideways provide the table with lateral guidance. The special guideways are aligned at the height of the Type N/O V-bearings. The customer could thereby interchange the systems according to whether the grinding spindle was attached on the l.h. or r.h. side.

Machining the attaching surfaces was easier because they were at the same height and had the same drilling pattern. This type of guidance system requires no further pre-loading.
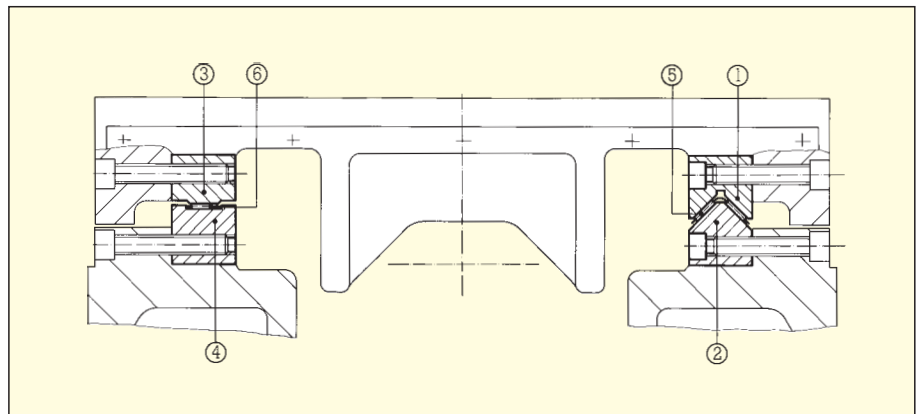
SCHNEEBERGER Products Used
1 1 Linear bearing N 3555-600 EG
2 1 Linear bearing O 3555-1000
3 1 Linear bearing Spec. 45×35×600 EG
4 1 Linear bearing Spec. 45×42.5×1000
5 1 Cage SHW 30×810
6 1 Cage H 25×810
   2 Endpieces GW 3555
   2 Endpieces special

2.4 Closed V-Guides for Flat Grinding Machine

In addition to high accuracy and rigidity, the design layout of linear bearings for flat grinding machines is governed by economical aspects. The V-shaped rolling element layout provides a closed guide which can accept forces and moments from all directions. A low resistance to motion and low maintenance requirements are a matter of course. Drive units can be mounted under the center of the table. The few components permit quick and simple assembly as there are only a few screws to be tightened to set the pre-load. The stroke in this case is 340 mm.

SCHNEEBERGER's Suggested Solution

The stroke/table length relationship is optimal for the use of anti-friction guideways.
The base surfaces of the inverted V linear bearings can be easily and accurately machined, since they lie in the same plane. These surfaces also enable high operating accuracy. Flange bars are not needed. Possible changes in pre-load can be effected easily with the freely accessible adjustment and attachment screws.
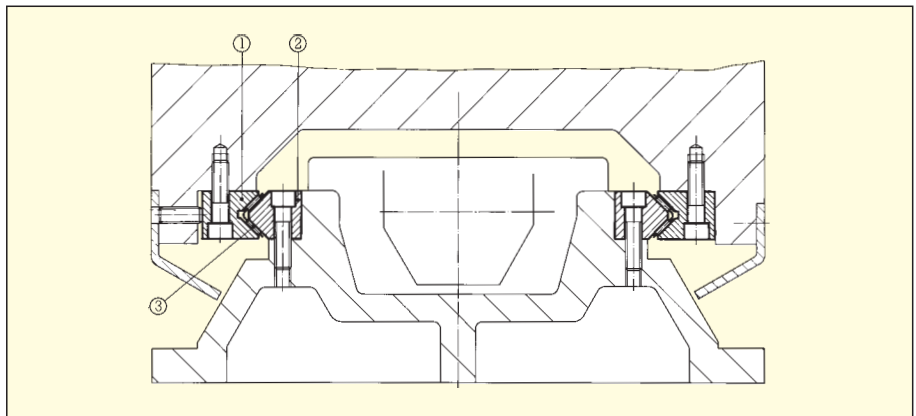
SCHNEEBERGER Products Used

1 2 Linear bearings N 3045-900
2 2 Linear bearings O 3045-900
3 2 Needle cages SHW 25 × 730
   8 Endpieces GF 3045

2.5 V-Guide for Heavy Duty Tool Grinding Machines

Tool grinding machines place great demands on the anti-friction guideway systems in the machine table. High operating accuracy, low friction, absence of stick-slip effect and protected guideways are the main requirements. With present day deep grinding techniques and with the big sweep which is a feature of these machines, large moments are produced. They require a stiff stress-strain characteristic from the guidance system. Sliding wipers cannot be used because of the free running characteristic demanded.

SCHNEEBERGER's Suggested Solution

Because of their high load carrying capacity the RNG linear bearings used here are tailor-made for the job. The table design permits the location of the drive mechanisms and also easy mounting of the table top. Initial and subsequent pre-loading is a simple operation. The holes for tool access can be closed with screwed plugs. The anti-friction guideways are permanently lubricated and, therefore, need no maintenance.
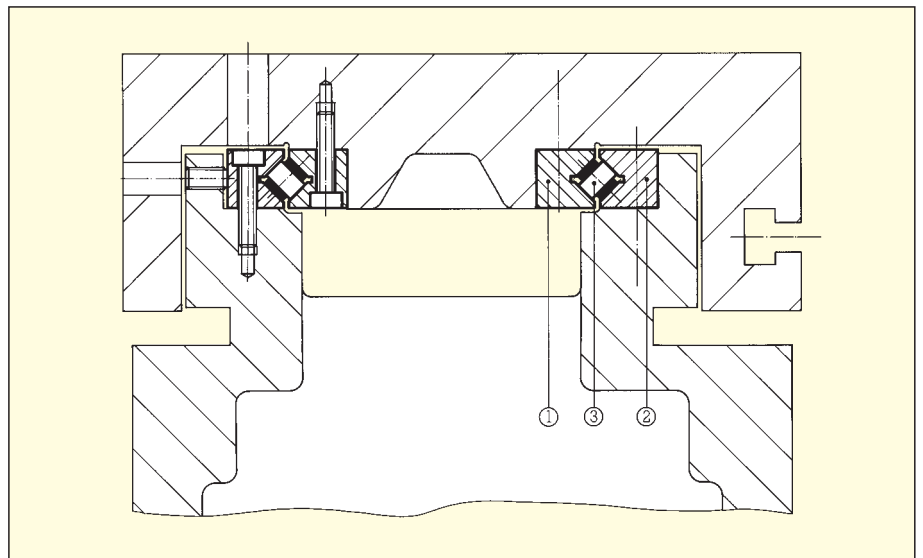
SCHNEEBERGER Products Used
1 2 Linear bearings RNG 9-700
2 2 Linear bearings RNG 9-450-EG
3 2 Roller cages KBN 9×43 rollers
   4 Endpieces GCN 9

2.6 Delivery Unit in Nuclear Industry

The delivery unit, operating in a vacuum, places great demands on the guidance system. A U-shaped beam forms the main carrier which is, at the same time, the base for the linear bearings. The whole system is made of rustproof materials, operates vertically and has a stroke of 2700 mm. The operating speed is 3 m/min.

SCHNEEBERGER's Suggested Solution
Two Type R linear bearings mounted on the U-shaped base and 4 Type SK recirculating units compose the actual guideway system. Two of the four recirculating units can be regulated externally and, therefore, provide the best possible pre-load adjustment. All parts of the recirculating units are made of stainless steel, including the balls, or aluminium. The fact that the whole system has to run dry and that materials have to be rustfree means a reduction in load carrying capacity of approximately 50%.
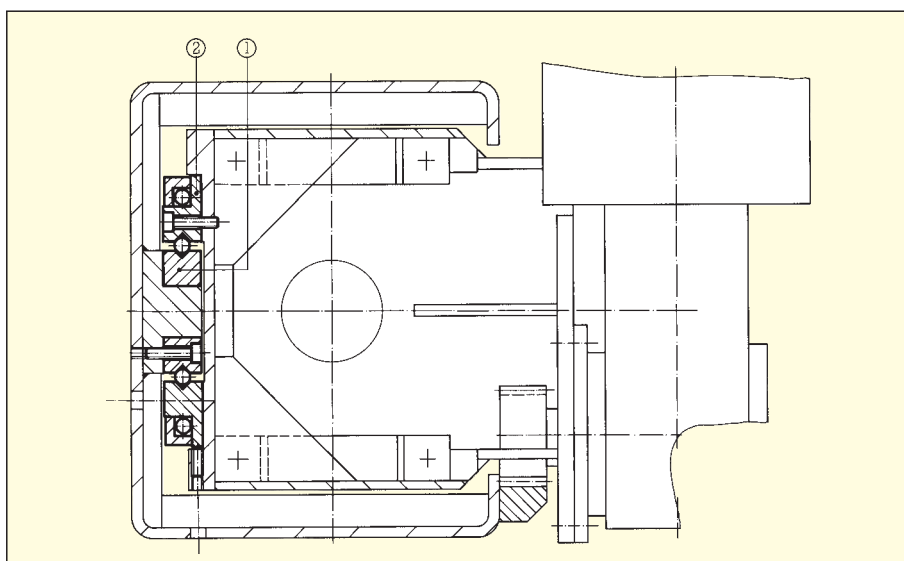
SCHNEEBERGER Products Used
1 16 Linear bearings R 9-400-RF-ZG (rustproof, ground together) to 3200 mm length
2   4 Recirculating units SK 9-150-RF (rustproof)

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3.1 Linear Bearings Type RN

The RN linear bearing represents a consistent optimization of the R linear bearing. Thanks to the enlarged contact surface of the roller with the guideway, the performance capacity is significantly increased, with unchanged fitting dimensions.
The features of the RN include:
– approx. 3 × higher load carrying capacity
– significantly reduced susceptibility to cage drift
– reduced danger of contamination due to the narrower gap between the individual guides

3.2 Material

SCHNEEBERGER **linear bearings** are normally manufactured from tool steel No. 1.2510 or 1.2842. The hardness is between 58 and 62 HRC, or min. 54 HRC for certain corrosion resistant models (material No. 1.4125).
The whole SCHNEEBERGER **rolling element range** is made generally from bearing steel No. 1.3505. The hardness is between 58 and 64 HRC, or min. 56 HRC for corrosion-resistant models.

3.3 Special version

Also available in a special corrosion resistant material. The comprehensive standardized program is complemented as the situation requires with special models so that every desired, technically optimal design can be realized. We can supply complete solutions specific to the application conditions.

3.4   Dimension Table Type RN

s*: Cage assist FORMULA-S
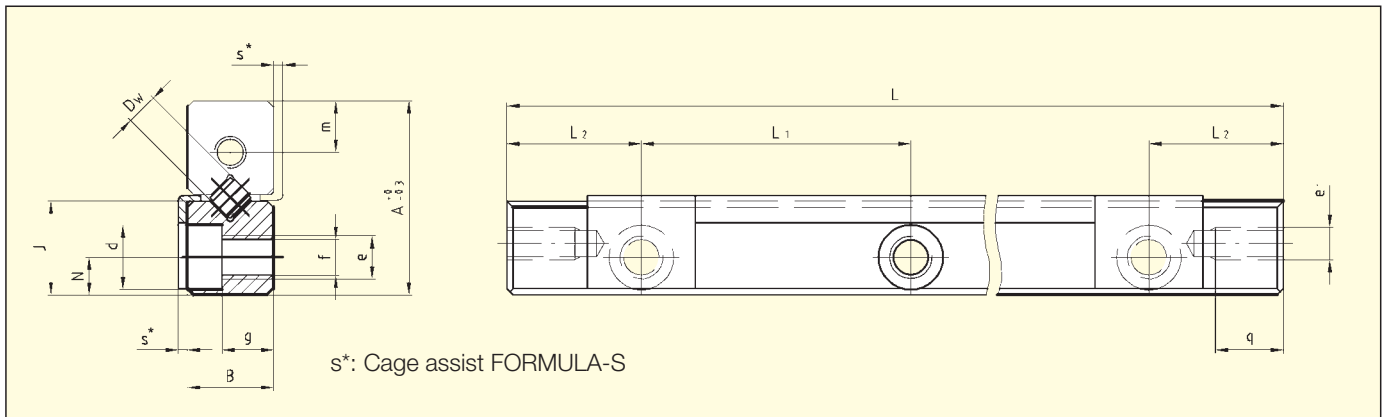
Type	Size	A	B	Dw	J	L₁	L₂	N	d	e	e₁	f	g	m	q	s
RN	3	18	8	3	8.7	25	12.5	3.5	6	M4	M3	3.3	4.8	4.8	7	0.85
RN	4	22	11	4.5	10.5	40	20	4.5	8	M5	M3	4.3	6.9	5.5	7	0.85
RN	6	31	15	6.5	14.8	50	25	6	9.5	M6	M5	5.2	9.8	7.5	9	0.85
RN	9	44	22	9	21.1	100	50	9	10.5	M8	M6	6.8	15.8	11.5	9	–
RN	12	58	28	12	27.6	100	50	12	13.5	M10	M8	8.5	19.8	15	12	–
RN 15, RN 18, RN 24 on request																

Type	Size	Length L											Max L
RN	3	050	075	100	125	150	175	200	225	250	275	300	700
RN	4	080	120	160	200	240	280	320	360	400			700
RN	6	100	150	200	250	300	350	400	450	500			1500
RN	9	200	300	400	500	600	700	800					1500
RN	12	200	300	400	500	600	700	800	900	1000			1500
Other lengths on request													

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Cage KBN   Cage KBS*

* for cage assist FORMULA-S
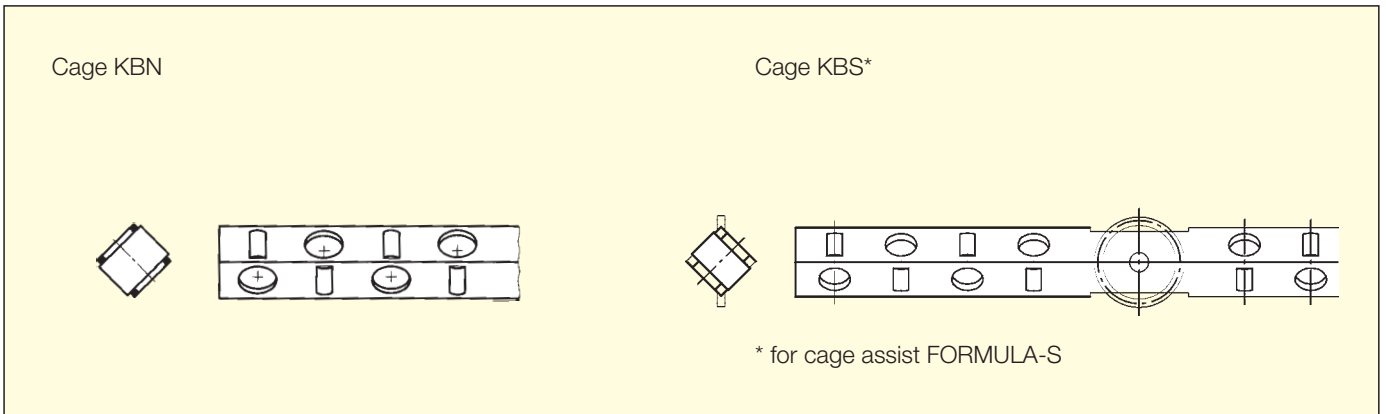
Type	Size	Accessories (see also chapter 7) Cages KBN	*KBS	Spec. Attaching Endscrews GAN or GA	Options screws GD	SQ	SSQ	RF	EG	ZG	HA	DU	DR	KS
RN	3	•	•	•	•	(•)	(•)	(•)	•	•	•	•	•	•
RN	4	•	•	•	•	(•)	(•)	(•)	•	•	•	•	•	•
RN	6	•	•	•	•	(•)	(•)	(•)	•	•	•	•	•	•
RN	9	•		•	•	(•)	(•)	(•)	•	•	•	•		
RN	12	•		•	•	(•)	(•)	(•)	•	•	•	•		

(•) Maximum length 600 mm in corrosion resistant, otherwise 1200 mm

Corrosion resistant rolling elements on request

Ordering information Linear Bearings

Standard

| Type | Size | – | Length | – | Additional ordering information |

RN   9   –   800   –

Options

SQ Special quality, high requirements[1]
SSQ Super special quality, most stringent requirements[1]
RF Corrosion resistant[2]
EG Inlets rounded[3]
ZG Linear Bearings ground together[1]
HA Of Height Matched Linear Bearings in pairs[1]
DU Coating type Duralloy®[2]
DR Coating type DryRunner[2]
KS Integrated cages with assisted movement

Order information

4 Linear Bearings Type RN 9-800-SQ
2 Roller Cages KBN 9 x 30 rollers
8 Endpieces GA

[1] see chapter 15.1
[2] see chapter 15.2
[3] see chapter 16.7

• 17

Linear Bearings Type RNG

4.1 Linear Bearings Type RNG
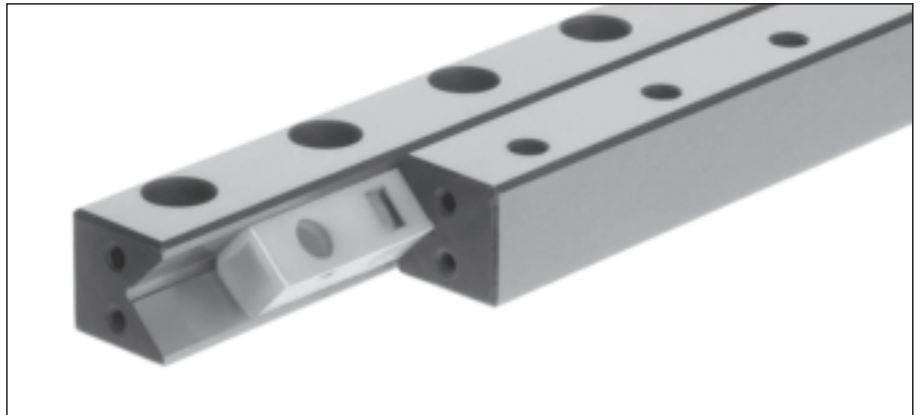
Type RNG linear bearings were created through the optimization of the R type. As a result of their new shape, they are more accurate, have greater load carrying capacity and rigidity and a longer operational life. This high performance linear bearing with its relatively small guidance cross-section yields matchless economy in many applications.

4.2 Material

SCHNEEBERGER **linear bearings** are normally manufactured from tool steel No. 1.2510 or 1.2842. The hardness is between 58 and 62 HRC, or min. 54 HRC for certain corrosion resistant models (material No. 1.4125).
The whole SCHNEEBERGER **rolling element range** is made generally from bearing steel No. 1.3505. The hardness is between 58 and 64 HRC, or min. 56 HRC for corrosion-resistant models.

4.3 Special version

The comprehensive standardized program is complemented as the situation requires with special models so that every desired, technically optimal design can be realized. We can supply complete solutions specific to the application conditions.

4.4 Dimension Table Type RNG

RNG 4+6   RNG 9–12

*s: Cage assist FORMULA-S
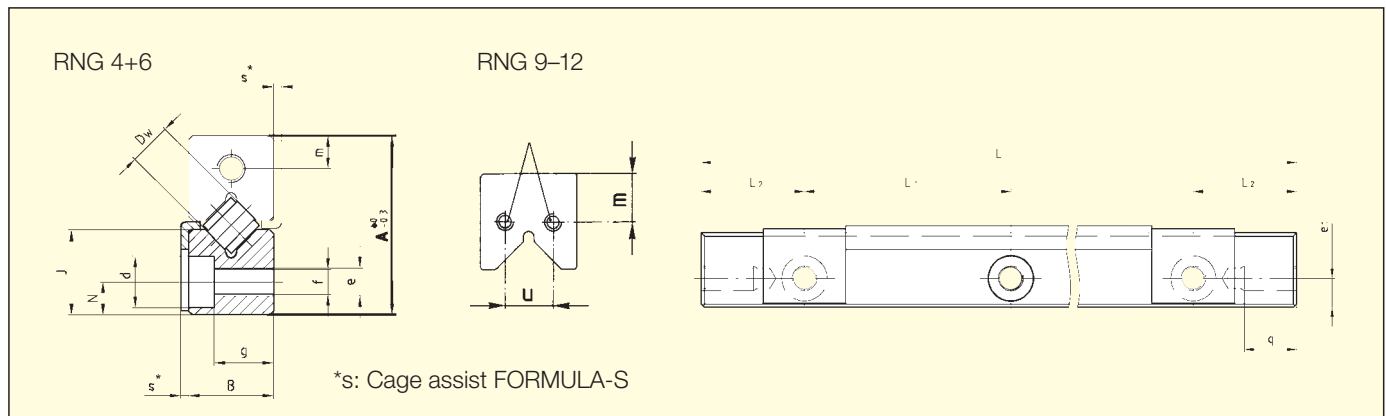
Type	Size	A	B	Dw	J	L_1	L_2	N	d	e	e_1	f	g	m	q	u	s
RNG	4	19	9	4.5	9	25	12.5	3.5	5.5	M3	M3	2.65	6.3	3.5	6	–	0.85
RNG	6	25	12	6.5	12	25	12.5	5	7	M4	M3	3.3	8.8	5	6	–	0.85
RNG	9	33	16	9	16	25	12.5	6	8.5	M5	M3	4.4	11.8	8	6	8	–
RNG	12	45	22	12	22	50	25	8	12	M8	M5	6.8	15.8	11	7.5	10	–

Type	Size	Length L											Max L
RNG	4	050	075	100	125	150	175	200	225	250	275	300	700
RNG	6	100	150	200	250	300	350	400					1500
RNG	9	100	150	200	250	300	350	400	450	500			1500
RNG	12	200	300	400	500	600	700	800	900	1000			1500
RNG 15, RNG 20 and other lengths on request												

Cage KBN

Cage KBS*

* for cage assist FORMULA-S

Type	Size	Accessories (see also chapter 7)						Spec. Attaching Screws	Options								
		Cages		Endpieces													
		KBN	*KBS	GBN	GCN	GCN-A	GDN	SQ	SSQ	RF	EG	ZG	HA	DU	DR	KS
RNG	4	•	•	•	•	•	•	(•)	(•)	(•)	•	•	•	•	•	•
RNG	6	•	•	•	•	•	•	(•)	(•)	(•)	•	•	•	•	•	•
RNG	9	•	•	•	•	•	•	(•)	(•)	(•)	•	•	•	•	•	•
RNG	12	•		•	•	•	•	(•)	(•)	(•)	•	•	•	•		

(•) Maximum length 600 mm by RF otherwise 1200 mm

Corrosion resistant rolling elements on request

Ordering information Linear Bearings

Standard

Type		Size	–	Length	–	Additional ordering information

RNG   9   –   400   –

Options

SQ	Special quality, high requirements [1]
SSQ	Super special quality, most stringent requirements [1]
RF	Corrosion resistant [2]
EG	Inlets rounded [3]
ZG	Linear Bearings ground together [1]
HA	Of Height Matched Linear Bearings in pairs [1]
DU	Coating type Duralloy® [2]
DR	Coating type DryRunner [2]
KS	Integrated cages with assisted movement

Order information

4 Linear Bearings Type RNG 9-400
2 Roller Cages KBN 9 x 25 rollers
8 Endpieces GBN 9

[1] see chapter 15.1
[2] see chapter 15.2
[3] see chapter 16.7

5.1 Linear Bearings Type R

Type R linear bearings can be equipped with ball or roller cages and are suitable for applications involving medium to high demands. Further combinations are possible with type RD linear bearings and type SK, SKD, SR and SKC recirculating units.

5.2 Material

SCHNEEBERGER **linear bearings** are normally manufactured from tool steel No. 1.2510 or 1.2842. The hardness is between 58 and 62 HRC, or min. 54 HRC for certain corrosion resistant models (material No. 1.4125).
The whole SCHNEEBERGER **rolling element range** is made generally from bearing steel No. 1.3505. The hardness is between 58 and 64 HRC, or min. 56 HRC for corrosion-resistant models.

5.3 Special version

Also available in a special corrosion resistant material. The comprehensive standardized program is complemented as the situation requires with special models so that every desired, technically optimal design can be realized. We can supply complete solutions specific to the application conditions.

5.4 Dimension Table Type R
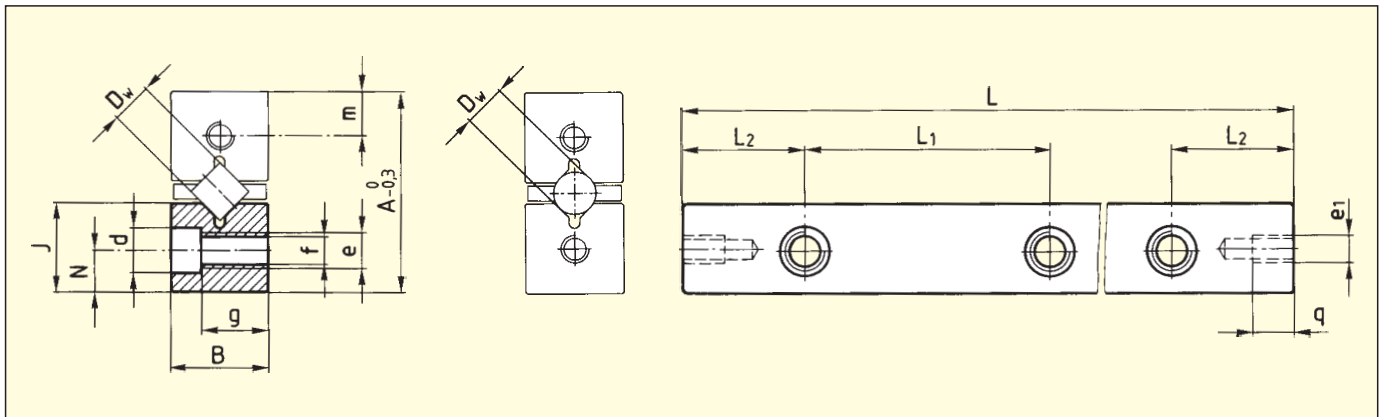
Type	Size	A	B	Dw	J	L_1	L_2	N	d	e	e_1	f	g	m	q
R	1	8.5	4	1.5	3.9	10	5	1.8	3	M2	M1.7	1.65	2.6	1.9	2.5
R	2	12	6	2	5.5	15	7.5	2.5	4.4	M3	M2.5	2.55	4	2.7	3.5
R	3	18	8	3	8.3	25	12.5	3.5	6	M4	M3	3.3	4.8	4.1	7
R	6	31	15	6	13.9	50	25	6	9.5	M6	M5	5.2	9.8	6.9	9
R	9	44	22	9	19.7	100	50	9	10.5	M8	M6	6.8	15.8	9.8	9
R	12	58	28	12	25.9	100	50	12	13.5	M10	M8	8.5	19.8	12.9	12

Type	Size	Length L														Max L
R	1	020	030	040	050	060	070	080	100	120						200
R	2	030	045	060	075	090	105	120	150	180						300
R	3	050	075	100	125	150	175	200	225	250	275	300	350	400	500	600	700
R	6	100	150	200	250	300	350	400	450	500	600	700	800	1000			1500
R	9	200	300	400	500	600	700	800	900	1000	1100	1200	1400				1500
R	12	200	300	400	500	600	700	800	900	1000	1100	1200					1500
R 15, R 18, R 24 and other lengths on request																1500
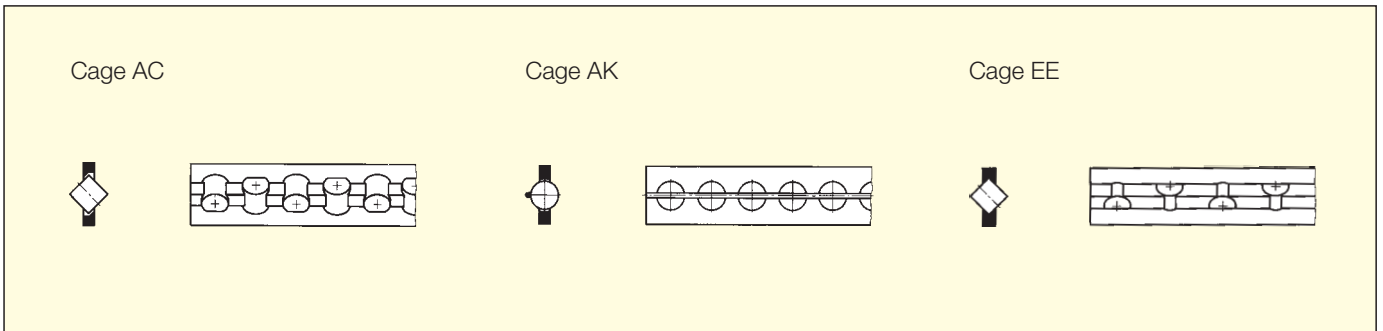
Cage AC   Cage AK   Cage EE

| Type | Size | Accessories (see also chapter 7) | | | | | | Spec. Attaching screws | Options | | | | | | | |
| | | Cages | | Endpieces | | | | | | | | | | | | |
		AC	AK	GA	GB	GC	GC-A	GD	SQ	SSQ	RF	EG	EE	ZG	HA	DU
R	1	•	•		•				•	•	•	•		•	•	•
R	2	•	•		•				•	•	•	•		•	•	•
R	3	•	•	•	•	•	•	•	(•)	(•)	(•)	•		•	•	•
R	6	•	•	•	•	•	•	•	(•)	(•)	(•)	•	•	•	•	•
R	9	•	•	•	•	•	•	•	(•)	(•)	(•)	•	•	•	•	•
R	12	•	•	•	•	•	•	•	(•)	(•)	(•)	•		•	•	•
(•) Maximum length 600 mm by RF otherwise 1200 mm																

Corrosion resistant, brass or aluminium cages on request

Ordering information Linear Bearings

Standard   Options

| Type | | Size | – | Length | – | Additional ordering information |

| R | | 9 | – | 800 | – | |

SQ   Special quality, high requirements [1]
SSQ   Super special quality, most stringent requirements [1]
RF   Corrosion resistant [2]
EG   Inlets rounded [3]
EE   For Cages EE [4]
ZG   Linear Bearings ground together [1]
HA   Of Height Matched Linear Bearings in pairs [1]
DU   Coating type Duralloy® [2]

Order information

4 Linear Bearings Type R 9-800-SQ
2 Roller cages AC 9 x 33 rollers
8 Endpieces GB 9

[1] see chapter 15.1
[2] see chapter 15.2
[3] see chapter 16.7
[4] see chapter 7.1

Linear Bearings Type RD

6.1   Linear Bearings Type RD

The RD linear bearing complements the R type linear bearing by providing for space saving solutions. In addition, the many applications open to the R and RD linear bearings result in substantially more economical guidance systems for the users' constructions.
In combination with SCHNEEBERGER type SR or SK recirculating units, unlimited stroke solutions can be realized.

6.2   Material

SCHNEEBERGER **linear bearings** are normally manufactured from tool steel No. 1.2510 or 1.2842. The hardness is between 58 and 62 HRC, or min. 54 HRC for certain corrosion resistant models (material No. 1.4125).
The whole SCHNEEBERGER **rolling element range** is made generally from bearing steel No. 1.3505. The hardness is between 58 and 64 HRC, or min. 56 HRC for corrosion-resistant models.

6.3   Special version

The comprehensive standardized program is complemented as the situation requires with special models so that every desired, technically optimal design can be realized. We can supply complete solutions specific to the application conditions.
The prism for cages KBN and KBS (FORMULA-S) is also available on request.

6.4　Dimension Table Type RD

*with Linear Bearings Type R
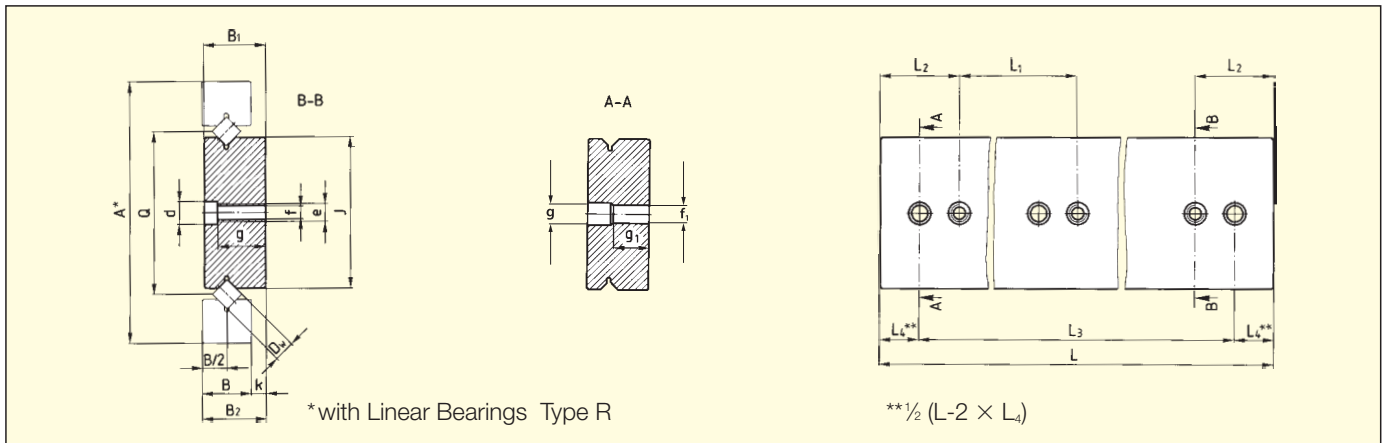
**½ (L-2 × L₄)

Type	Size	A	B	B_1	B_2	Dw	J	L_1	L_2	L_4	Q	d	e	f	f_1	g	g_1	k
RD	1	22	4	5.5	6	1.5	12.8	25	12.5	5	13.5	4.4	M3	2.55	3	3.5	–	–
RD	2	30	6	8.5	9	2	17	50	25	12.5	18	6	M4	3.35	3	5.4	–	–
RD	3	46	8	11.5	12	3	26.6	50	25	12.5	28	7.5	M5	4.2	3	7.3	6.5	4
RD	6	76	15	19	20	6	41.8	100	50	25	45	9.5	M6	5.2	6	13.8	12	5
RD	9	116	22	27	28	9	67.4	100	50	25	72	10.5	M8	6.8	8	20.8	16	6
RD	12	135	28	34	35	12	70.8	100	50	25	77	13.5	M10	8.5	10	25.8	20	7

Type	Size	Length L					Max L
RD	1	100	150	200			200
RD	2	200	300	400			400
RD	3	300	400	500	600	800	800
RD 6, RD 9, RD 12 and other lengths on request							2000

Cage AC	Cage AK	Cage EE
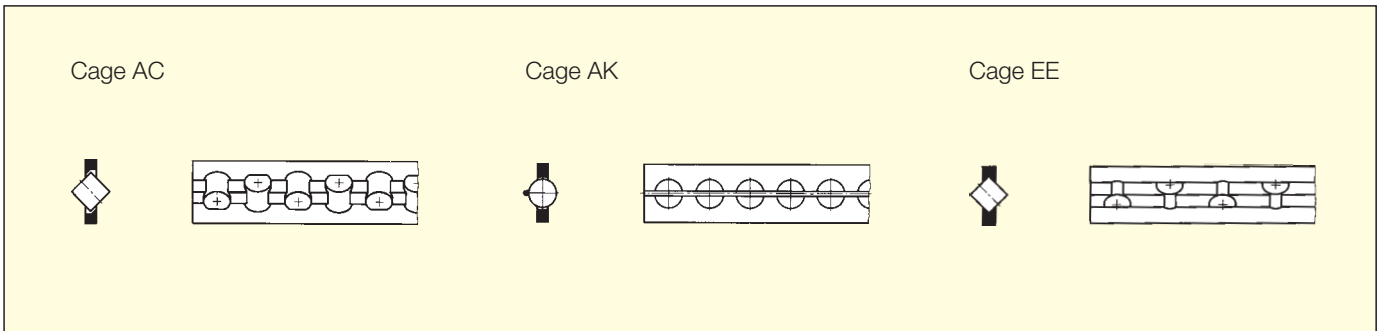
Type	Size	Accessories (see also chapter 7)			Options						
		Cages									
		AC	AK	EE	SQ	SSQ	RF	EG	EE	ZG	DU
RD	1	•	•		•	•	•	•		•	•
RD	2	•	•		•	•	•	•		•	•
RD	3	•	•		(•)	(•)	(•)	•		•	•
RD	6	•	•	•	(•)	(•)	(•)	•	•	•	•
RD	9	•	•	•	(•)	(•)	(•)	•	•	•	•
RD	12	•	•		(•)	(•)	(•)	•		•	•

(•) Maximum length 600 mm by RF otherwise 1200 mm

Corrosion resistant, brass or aluminium cages on request

Ordering information Linear Bearings

Standard

Type		Size	–	Length	–	Additional ordering information

RD   9   –   800   –

Options

SQ	Special quality, high requirements [1]
SSQ	Super special quality, most stringent requirements [1]
RF	Corrosion resistant [2]
EG	Inlets rounded [3]
EE	For Cages EE [4]
ZG	Linear Bearings ground together [1]
DU	Coating type Duralloy® [2]

Order information

1 Linear Bearing Type RD 9-800-SQ

[1] see chapter 15.1
[2] see chapter 15.2
[3] see chapter 16.7
[4] see chapter 7.1

7.1   Cages

Roller Cages Type KBS, Sizes 3–6 for FORMULA-S
– Suitable for all types of fitting
– Captive rollers
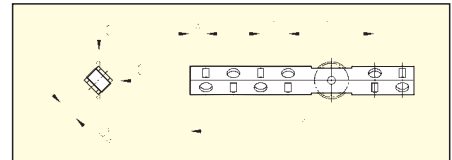
Type	Size	D_w	t	t_z	w	C/Roller in N
KBS	**3**	3	5	18	3.5	410
KBS	**4**	4.5	6.5	23	4	850
KBS	**6**	6.5	8.5	27	5	1800
KBS	**9**	9	12	40	7.5	3900

Ordering example: 2 Roller Cages KBS 4 × 15 rollers for RN 4

Roller cages Type KBN, for RN and RNG, Sizes 3–12
– Suitable for all types of fitting
– Captive rollers
– POM
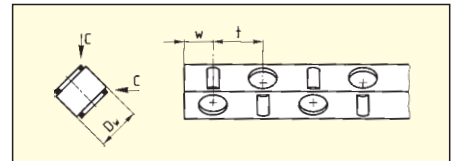
Type	Size	D_w	t	w	C/Roller in N
KBN	**3**	3	5	3.5	410
KBN	**4**	4.5	6.5	4	850
KBN	**6**	6.5	8.5	5	1800
KBN	**9**	9	12	7.5	3900
KBN	**12**	12	15	9	6500

Ordering example: 2 Roller Cages KBN 4 × 15 rollers

Roller Cages Type AC, Sizes 1–12 for R and RD
– Suitable for all types of fitting
– Captive rollers
– Material: Sizes 1 and 2 POM from size 3 PA 12 GF 30% Steel wire
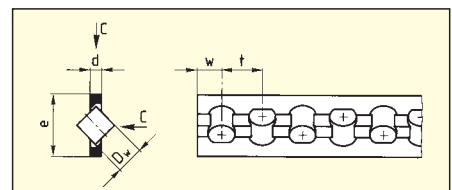
Type	Size	D_w	d	e	t	w	C/ Roller in N	Max. Length
AC	**1**	1.5	0.45	3.5	3	1.5	50	70
AC	**2**	2	0.75	5	4	2	85	85
AC	**3**	3	1	7	5	2.5	130	1200
AC	**6**	6	2.5	14	9	6	530	1500
AC	**9**	9	3.5	20	14	9	1300	1500
AC	**12**	12	4.5	25	18	11	2500	1500

Ordering example: 2 Roller cages AC 3 × 20 rollers

Ball cages Type AK, Sizes 1–12 for R and RD
– Suitable for all types of fitting
– Captive balls
– Material: Sizes 1 to 3 POM
  from size 6 PA 12 GF 30%
  Steel wire composite
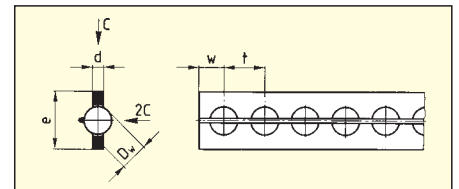
Type	Size	D_w	d	e	t	w	C/ Ball in N	Max. Length
AK	1	1.5	0.45	3.5	2.2	1.5	9	80
AK	2	2	0.75	5	4	2	15	100
AK	3	3	1	7	4.2	2.5	25	180
AK	6	6	2.5	14	9	6	65	1500
AK	9	9	3.5	20	14	9	150	1500
AK	12	12	4.5	25	18	11	260	1500

Ordering example: 2 Ball cages AK 1 $\times$ 5 balls

Roller Cages Type EE, Sizes 6 and 9 for R 6, R 9, RD 6 and RD 9 (Special Accessories)
– Use only with specially designated Linear bearings (suffix EE) and Type GB or GC endpieces
– For horizontal and vertical fitting
– Captive rollers
– Acts as a dirt wiper, thus running friction is somewhat higher
– When ordering, it is essential that the overall cage length K is quoted
– Material PE plastic
– Not suitable for protruding cages and gravity loaded bearings
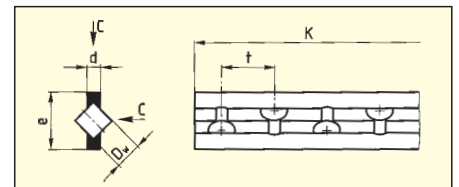
Type	Size	D_w	d	e	t	C/Roller in N
EE	6	6	3.2	13.5	12	530
EE	9	9	4.6	19	18	1300

Ordering example: 2 Roller cages EE 6 $\times$ 150 mm length

Other materials for cages/rolling elements on request

7.2   Endpieces

Endpieces Type GB
– For horizontal or vertical fitting
– For R 1 and R 2

Size 1

Size 2
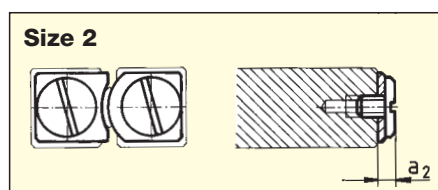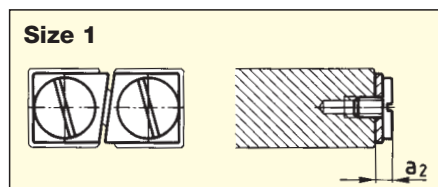
– For horizontal or vertical fitting
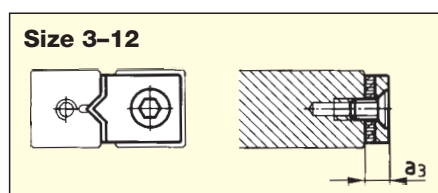– For Type EE roller cages
– For R 3 to R 12

Size 3–12
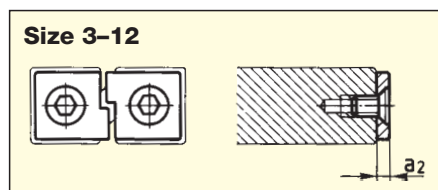
Endpieces Type GC
– For protruding cages
– For R 3 to R 12

Size 3–12
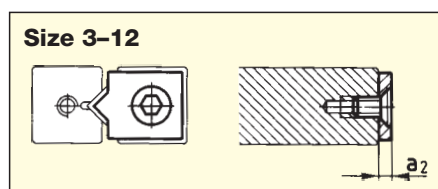
Endpieces Type GC–A with Wipers
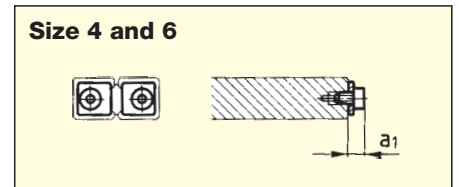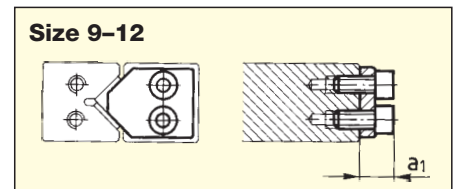– For horizontal or vertical fitting
– Felt Wiper
– For R 3 to R 12

Size 3–12

Size	1	2	3	6	9	12
a_1	–	–	2	3	3	3
a_2	1.7	2	2	3	4	5
a_3	–	–	5	6	7	8

Ordering example: 8 Endscrews GA 6 or 4 Endpieces GC–A 9

Endpieces delivered with attaching screws

Endpieces Type GBN
– For horizontal and vertical fitting
– For RNG 4 and 6

Size 4 and 6

– For RNG 9 to 12

Size 9–12
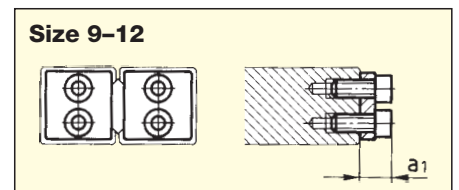
Endpieces Type GCN
– For protruding cages
– For RNG 4 and 6

Size 4 and 6

– For RNG 9 to 12

Size 9–12
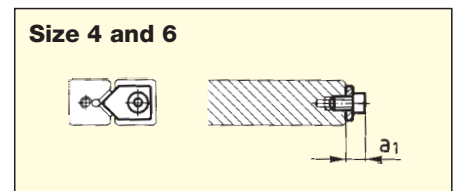
Endpieces Type GCN-A with Wipers
– For horizontal and vertical fitting
– Plastic wiper
– For RNG 4 and 6

Size 4 and 6
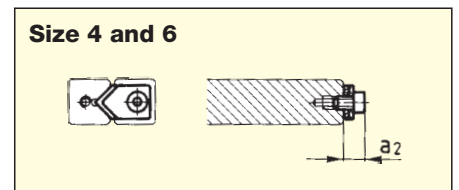
– For RNG 9 to 12

Size 9–12
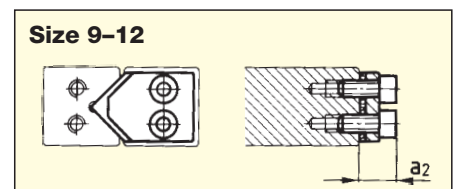
Size	4	6	9	12
a_1	4	4	4	8.5
a_2	5.5	5.5	5.5	10

Ordering example: 40 Endpieces GBN 9

Endpieces delivered with attaching screws

7.3 Attaching Screws

**Special Attaching Screws
for R and RN
Type GD, Sizes 3–12**
– To compensate for difference in hole pitch
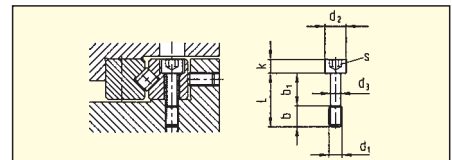
Type	Size	L	b	b_1	d_1	d_2	d_3	k	s
GD	3	12	5	7	M3	5	2.3	3	2.5
GD	4	16	7	9	M4	6.5	3	4	3
GD	6	20	8	12	M5	8	3.9	5	4
GD	9	30	12	18	M6	8.5	4.6	6	5
GD	12	40	17	23	M8	11.3	6.25	8	6

**Special Attaching Screws
for RNG
Type GDN, Sizes 4–12**
– To compensate for difference in hole pitch
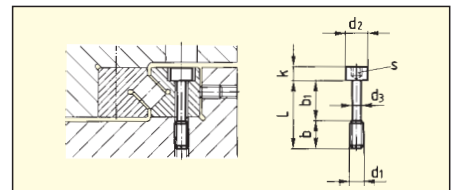
Type	Size	L	b	b_1	d_1	d_2	d_3	k	s
GDN	4	12	5	7	M2.5	4.5	1.85	2.5	2
GDN	6	16	5	11	M3	5.5	2.3	3	2.5
GDN	9	25	11	14	M4	7	3	4	3
GDN	12	30	12	18	M6	10	4.6	6	5

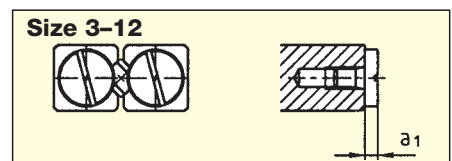Ordering example: 50 Special Attaching Screws GDN 9

7.4 Endscrews

Endscrews Type GAN
– $a_1 = 2$
– For RN 3–RN 4
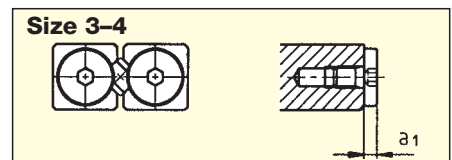
Endscrews Type GA
– For horizontal fitting
– For R 3–R 12
– From RN 6–RN 12

Order numbers in bold face are standard articles

Linear Bearings Type N and O

8.1   Linear Bearings Type N and O

Type N/O linear bearings are equipped with needle cages and are suitable for high load applications. The SCHNEEBERGER composite cages used with these guides ensure that there is little resistance to motion as compared to other similar needle bearing guides, while providing very great rigidity.

8.2   Material

SCHNEEBERGER **linear bearings** are normally manufactured from tool steel No. 1.2510 or 1.2842. The hardness is between 58 and 62 HRC, or min. 54 HRC for certain corrosion resistant models (material No. 1.4125).
The whole SCHNEEBERGER **rolling element range** is made generally from bearing steel No. 1.3505. The hardness is between 58 and 64 HRC, or min. 56 HRC for corrosion-resistant models.

8.3   Special version

The comprehensive standardized program is complemented as the situation requires with special models so that every desired, technically optimal design can be realized. We can supply complete solutions specific to the application conditions.

8.4   Dimension Table Type N/O
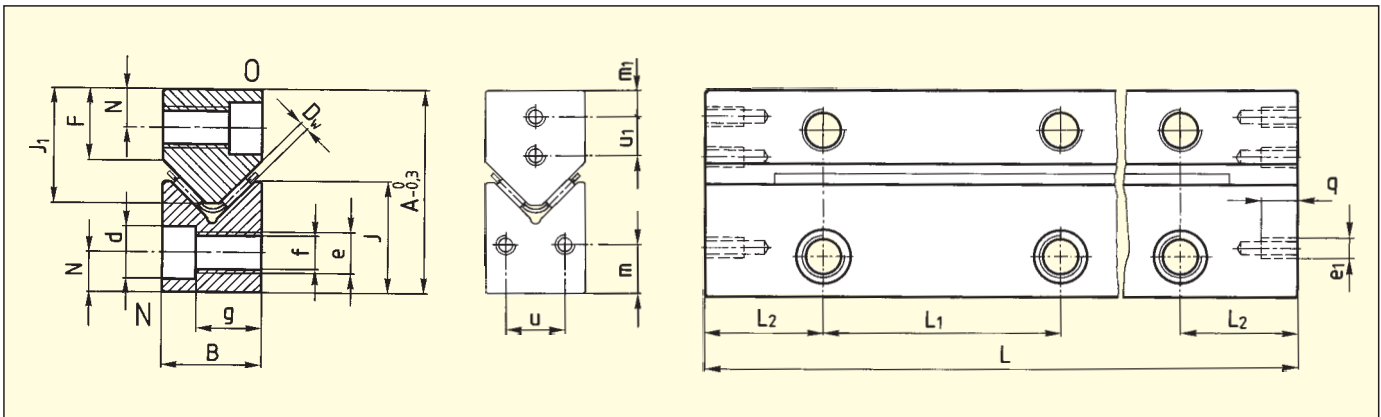
Type	Size	A	B	Dw	F	J	J$_1$	L$_1$	L$_2$	N	d	e	e$_1$	f	g	m	m$_1$	q	u	u$_1$
N/O	62015	31	15	2	11	16	18	50	25	6	9.5	M6	M3	5.2	9.8	7.5	4.5	7	7	7
N/O	92025	44	22	2	15	24	24.5	100	50	9	10.5	M8	M4	6.8	15.8	11	6	11	10	10
N/O	2025	52	25	2	18	28	29	100	50	10	13.5	M10	M6	8.5	16.8	12	7	11	14	11
N/O	2535	62	30	2.5	22	34	35	100	50	12	16.5	M12	M6	10.5	19.8	15	8	11	18	12
N/O	3045	74	35	3	25	42.5	40	100	50	14	18.5	M14	M6	12.5	22.8	18	10	11	19	16
N/O	3555	78	45	3.5	25	45	45	100	50	14	18.5	M14	M6	12.5	32.8	18	12	11	29	20

Type	Size	Length L									Max L
N/O	62015	100	150	200	250	300	350	400	450	500	1200
N/O	92025	200	300	400	500	600	700	800			2000
N/O	2025	200	300	400	500	600	700	800	900	1000	2000
N/O	2535	300	400	500	600	700	800	900	1000		2000
N/O 3045, N/O 3555 and other lengths on request											

Cage SHW

Cage HW
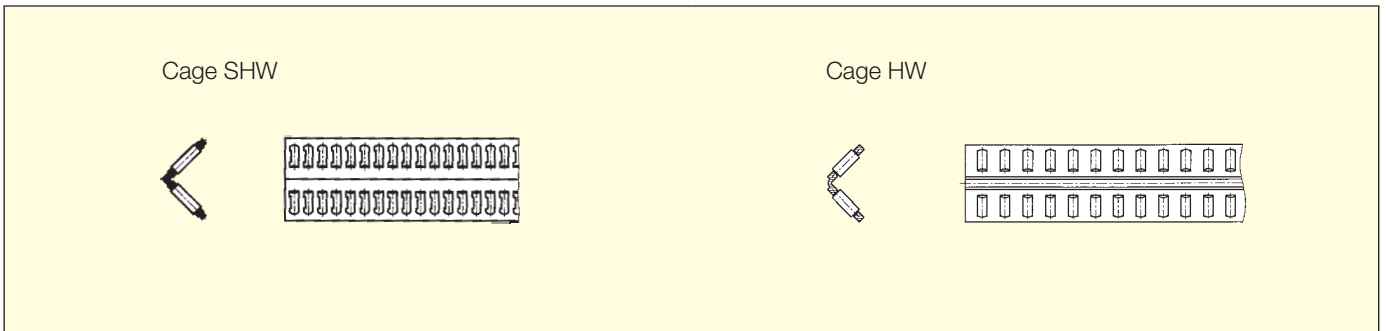
Type	Size	Accessories (see also chapter 10)								Spec. Attaching Screws	Options							
		Cages		Endpieces														
		SHW	HW	GFN	GFO	GH	GH-A	GW	GW-A	GD	SQ	SSQ	RF	EG	ZG	HA	DU	KS
N/O	62015		•	•	•	•	•	•	•	•	(•)	(•)	(•)	•	•	•	•	
N/O	92025	•	•	•	•	•	•	•	•	•	(•)	(•)	(•)	•	•	•	•	•
N/O	2025	•	•	•	•	•	•	•	•	•	(•)	(•)	(•)	•	•	•	•	•
N/O	2535	•	•	•	•	•	•	•	•	•	(•)	(•)	(•)	•	•	•	•	•
N/O	3045	•	•	•	•	•	•	•	•	•	(•)	(•)	(•)	•	•	•	•	•
N/O	3555	•	•	•	•	•	•	•	•	•	(•)	(•)	(•)	•	•	•	•	•

(•) Maximum length 600 mm by RF otherwise 1200 mm

Ordering information Linear Bearings

Standard

Options

Type		Size	–	Length	–	Additional ordering information

| N | 2025 | – | 800 | – |
| O | 2025 | – | 400 | – |

SQ	Special quality, high requirements [1]
SSQ	Super special quality, most stringent requirements [1]
RF	Corrosion resistant [2]
EG	Inlets rounded [3]
ZG	Linear Bearings ground together [1]
HA	Of Height Matched Linear Bearings in pairs [1]
DU	Coating type Duralloy® [2]
KS	Integrated cage assist

Order information

2 Linear Bearings Type N 2025-800
2 Linear Bearings Type O 2025-400-EG
2 Needle Cages SHW 15 x 600 mm
4 Endpieces GH 2025

[1] see chapter 15.1
[2] see chapter 15.2
[3] see chapter 16.7

9.1   Linear Bearings Type M and V

Type M/V linear bearings are equipped with needle cages and are suitable for high load applications. The SCHNEEBERGER composite cages used with these guides ensure that there is little resistance to motion as compared to other similar needle bearing guides, while providing very great rigidity.
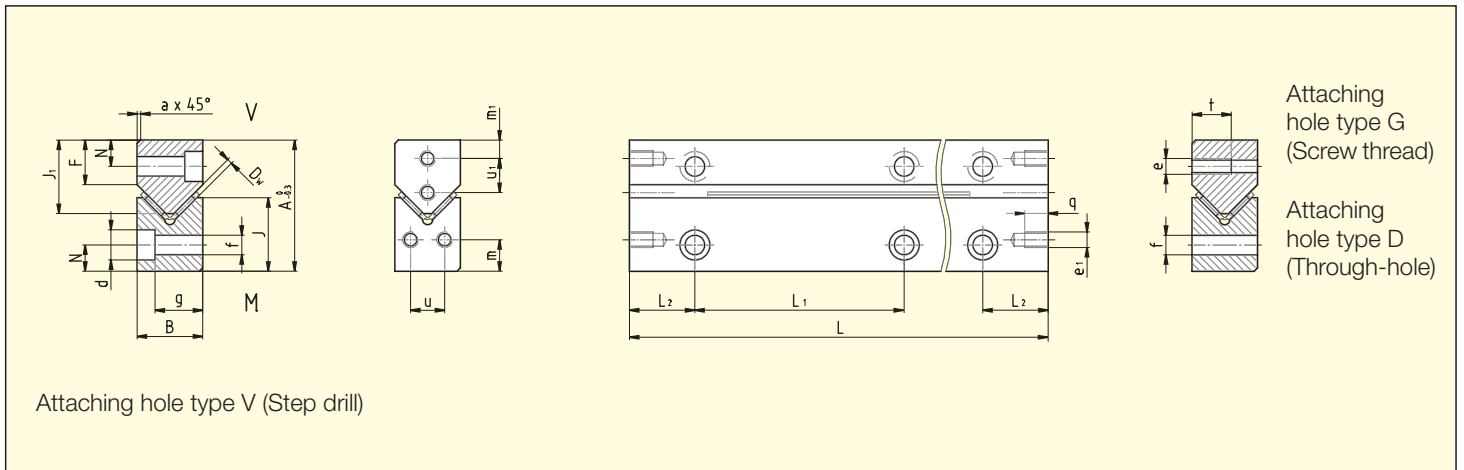
9.2   Material

SCHNEEBERGER **linear bearings** are normally manufactured from tool steel No. 1.2510 or 1.2842. The hardness is between 58 and 62 HRC, or min. 54 HRC for certain corrosion resistant models (material No. 1.4125).
The whole SCHNEEBERGER **rolling element range** is made generally from bearing steel No. 1.3505. The hardness is between 58 and 64 HRC or min. 56 HRC for corrosion-resistant models.

9.3   Special version

The comprehensive standardized program is complemented as the situation requires with special models so that every desired, technically optimal design can be realized. We can supply complete solutions specific to the application conditions.

9.4 Dimension Table Type M/V

Attaching hole type V (Step drill)

Attaching hole type G (Screw thread)

Attaching hole type D (Through-hole)

Type	Size	A	B	Dw	F	J	J_1	L_1	L_2	N	a	d	e	e_1	f	g	m	m_1	q	t	u	u_1
M/V	3015	30	15	2	10.5	15.5	17.4	[1]40	[3]	5.5	0.7	8.5	M4	M3	5.25	10.5	8	5.5	7	15	7	7
M/V	4020	40	20	2	13.5	22.5	22	[2]80	[4]	7.5	1.3	11.5	M6	M5	7.5	13.2	10	5.5	8	20	11	10.5
M/V	5025	50	25	2	17	28	28	[2]80	[4]	10	1.3	11.5	M6	M6	7.5	18.2	12	7	9	15	13	13
M/V	6035	60	35	2.5	20	35	35.5	100	50	11	1.3	15	M8	M6	10	26	14	8	9	20	20	18
M/V	7040	70	40	3	24	40	41.5	100	50	13	1.3	18.5	M10	M6	12.5	29	16	10	9	25	20	20
M/V	8050	80	50	3.5	26	45	48	100	50	14	1.3	20	M12	M6	14	37	20	10	9	30	30	25

[1] For length 100 : L_1 = 35 (2×)   [3] min. 15
[2] For length 100 : L_1 = 50   [4] min. 20

Type	Size	Length L										Max L
M/V	3015	100	150	200	300	400	500	600				1200
M/V	4020	100	150	200	300	400	500	600				1500
M/V	5025	100	200	300	400	500	600	700	800	900	1000	1500
M/V	6035	200	300	400	500	600	700	800	900	1000		1500
M/V	7040	200	300	400	500	600	700	800	900	1000		1500
M/V	8050	300	400	500	600	700	800	900	1000			1500
Other Lengths on request												

Cage SHW

Cage HW
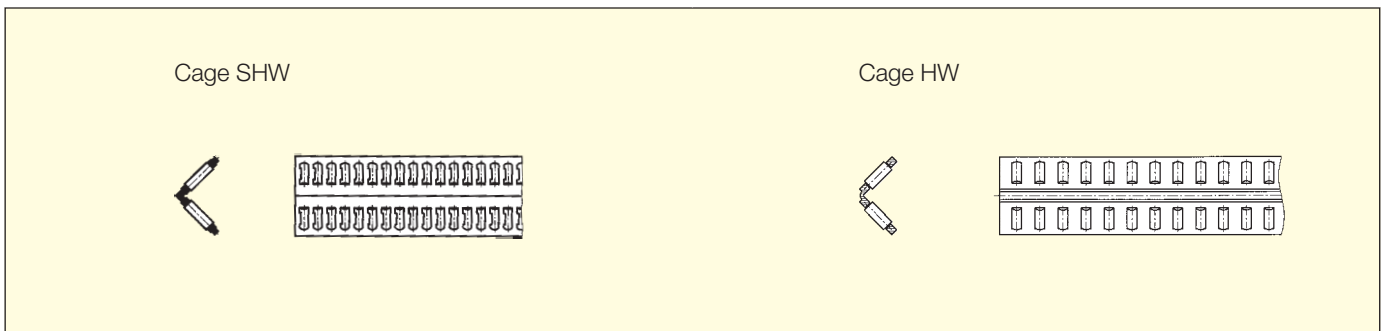
Type	Size	Accessories (see also chapter 10)						Options						
		Cages		Endpieces										
		SHW	HW	EM	EV	EAM	EAV	SQ	SSQ	RF	EG	ZG	HA	KS
M/V	3015		•	•	•	•	•	(•)	(•)	(•)	•	•	•	
M/V	4020	•	•	•	•	•	•	(•)	(•)	(•)	•	•	•	•
M/V	5025	•	•	•	•	•	•	(•)	(•)	(•)	•	•	•	•
M/V	6035	•	•	•	•	•	•	(•)	(•)	(•)	•	•	•	•
M/V	7040	•	•	•	•	•	•	(•)	(•)	(•)	•	•	•	•
M/V	8050	•	•	•	•	•	•	(•)	(•)	(•)	•	•	•	•
(•) Maximum length 600 mm by RF otherwise 1200 mm														

Ordering information Linear Bearings

Standard

Options

Type		Size	–	Length	–	Additional ordering information

| M | 5025 | – | 600 | – |
| V | 5025 | – | 600 | – |

SQ   Special quality, high requirements [1]
SSQ Super special quality, most stringent requirements [1]
RF   Corrosion resistant [2]
EG   Inlets rounded [3]
ZG   Linear Bearings ground together [1]
HA   Of Height Matched Linear Bearings in pairs [1]
KS   Integrated cage assist

Order information

2 Linear Bearings Type M 5025-600
2 Linear Bearings Type V 5025-600
2 Needle Cages SHW 15 x 500 mm
4 Endpieces Type EAM 5025
4 Endpieces Type EAV 5025

[1] see chapter 15.1
[2] see chapter 15.2
[3] see chapter 16.7

10.1 Cages

Needle Cage Type SHW, Sizes 15–30
– For all types of fitting
– Captive needles
– Material plastic PA 12 GF 30%/Stainless steel composite

The needle cages are supplied in one piece in the customer specified length K.
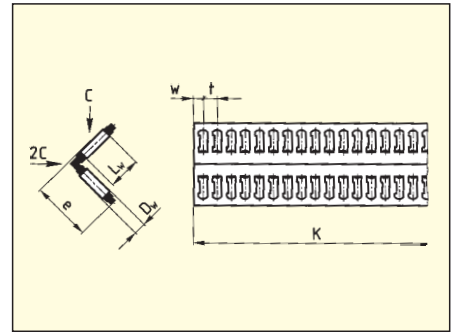
Type	Size	D_w	L_w	e	t	w	C/Needle in N	Suitable for Linear Bearings Type		Max. Length
SHW	15	2	6.8	14	4	2.9	750	N/O 92025 and 2025	M/V 4025 and 5025	1500
SHW	20	2.5	9.8	19	4.75	3.4	1375	N/O 2535	M/V 6035	1500
SHW	25	3	13.8	25	5.2	3.6	2350	N/O 3045	M/V 7040	1500
SHW	30	3.5	17.8	30	6.1	4.3	3600	N/O 3555	M/V 8050	1500

Ordering example: 2 Needle cages SHW 20 × 402 mm length

Needle Cage Type HW, Sizes 10–30
– For all types of fitting
– Captive needles
– Material: Light metal; HW 10: steel
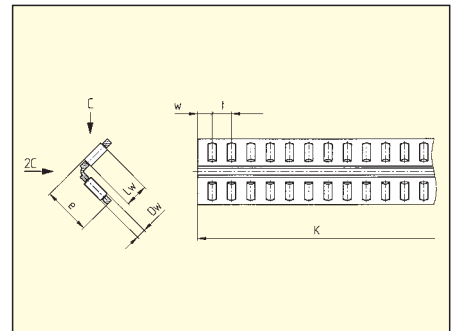
Type	Size	D_w	L_w	e	t	w	C/Needle in N	Suitable for Linear Bearings Type		Max. Length
HW	10	2	4.8	10	4	3	530	N/O 62015	M/V 3015	2000
HW	15	2	6.8	14	4.5	3.5	750	N/O 92025	M/V 4020 and 5025	2000
HW	16	2	8.8	16	3.8	2.8	970		M/V 5025	2000
HW	20	2.5	9.8	20	5.5	4	1375	N/O 2535	M/V 6035	2000
HW	25	3	13.8	25	6	4.5	2350	N/O 3045	M/V 7040	2000
HW	30	3.5	17.8	30	7	5	3600	N/O 3555	M/V 8050	2000

10.2 Endpieces for N/O

**Endpieces Type GFN and GFO,
Sizes 62015–3555**
– For horizontal and vertical fitting
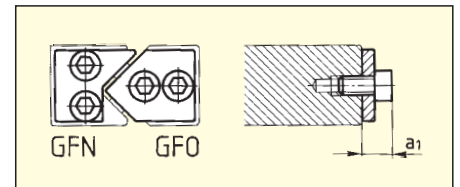
**Endpieces Type GH,
Sizes 62015–3555**
– For protruding cages
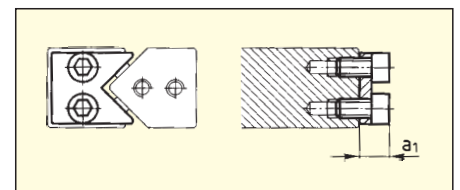
**Endpieces Type GH-A with Wipers,
Sizes 62015–3555**
– For horizontal and vertical fitting
– Felt wiper
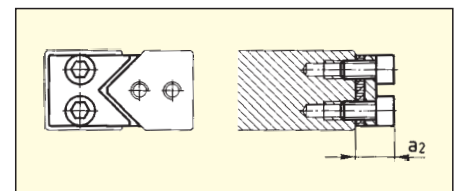
**Endpieces Type GW,
Sizes 62015–3555**
– For protruding cages
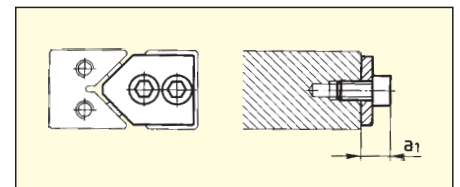
**Endpieces Type GW-A with Wipers,
Sizes 62015–3555**
– For horizontal and vertical fitting
– Felt wiper
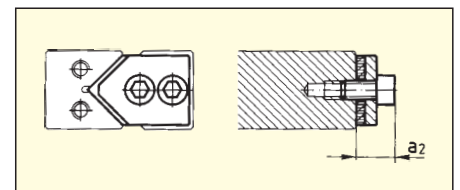
Size	62015	92025	2025	2535	3045	3555
a_1	6	7	10	10	10	11
a_2	9	10	13	13	13	14

Ordering example: 4 Endpieces GFN 3045, 4 Endpieces GFO 3045 or 4 Endpieces GW 3045

Endpieces delivered with attaching screws

Accessories Type N/O and M/V

Screws for N/O

**Special Attaching Screws
Type GD, Size 6–3555**
– To compensate for differences in hole
pitches
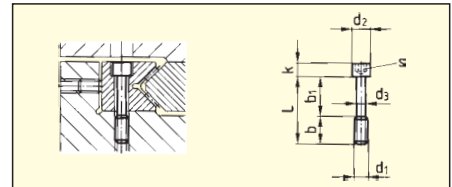
Type	Size	L	b	b_1	d_1	d_2	d_3	k	s	Suitable for Linear Bearings Type
GD	6	20	8	12	M5	8	3.9	5	4	N/O 62015
GD	9	30	12	18	M6	8.5	4.6	6	5	N/O 92025
GD	2025	35	16	19	M8	11.3	6.25	8	6	N/O 2025
GD	2535	40	18	22	M10	13.9	7.9	10	8	N/O 2535
GD	3045	50	25	25	M12	15.8	9.6	12	10	N/O 3045
GD	3555	60	25	35	M12	15.8	9.6	12	12	N/O 3555

Ordering example: 40 Special Attaching Screws GD 2025

10.3 Endpieces for M/V

**Endpieces Type EM / EV,
Sizes 3015–8050**
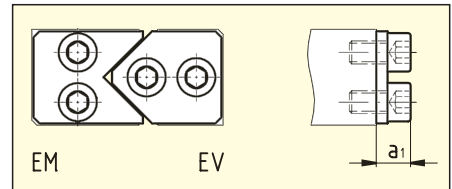
**Endpieces Type EAM,
Sizes 3015–8050**
– Wiper
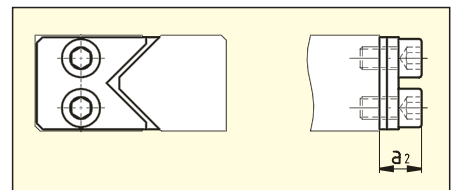
**Endpieces Type EAV,
Sizes 3015–8050**
– Wiper
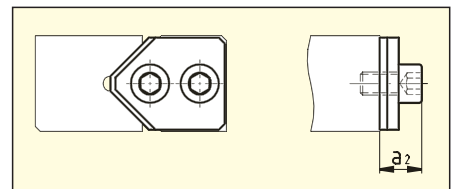
Dimension Table Type EM to EAV

Size	3015	4020	5025	6035	7040	8050
a_1	5	8	9	9	9	9
a_2	7	10	11	11	11	11

Endpieces delivered with attaching screws

11.1 Recirculating Type SK and SKD
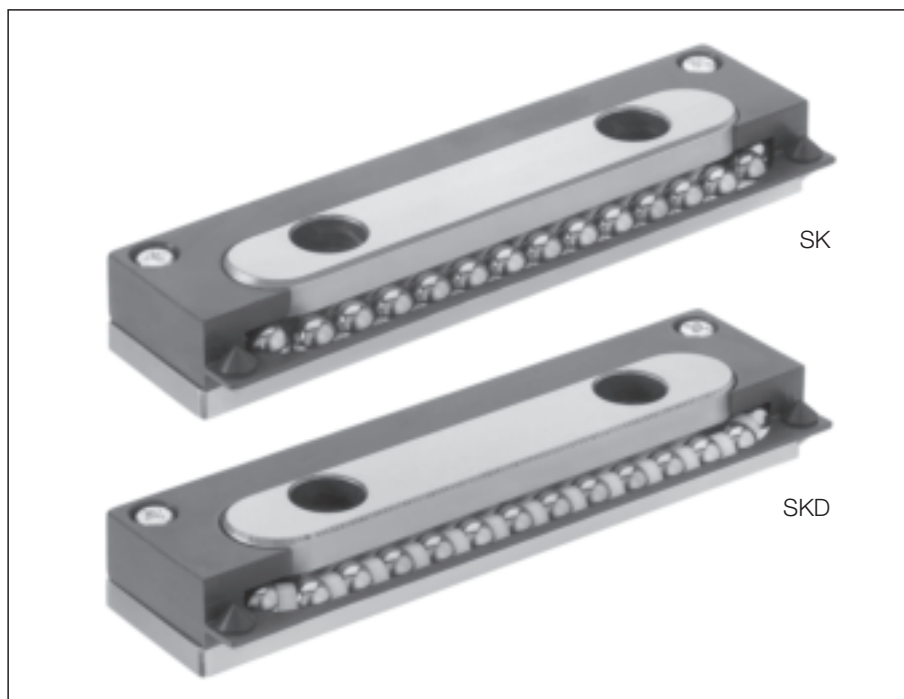
SK

SKD

The type SK recirculating unit is equipped with balls and is suitable for low to medium loading. It is used with SCHNEEBERGER type R or RD linear bearings and can be uniformly loaded in every direction. Hence, space saving designs may be realized. Some sizes can be additionally fitted with damping elements (type designation SKD). These provide smoother operation but also have a somewhat reduced load carrying capacity.

11.2 Material

Steel carrier: hardened and very precisely ground.
All recirculating parts, with their integrated ball retainers: protectively coated aluminium or plastic.
From size 3 and larger, replaceable plastic track wipers are included as standard.
With type SKD, available from size 6, the balls are spaced with plastic damping elements which give them even better running qualities.

11.3 Dimension Table SK and SKD
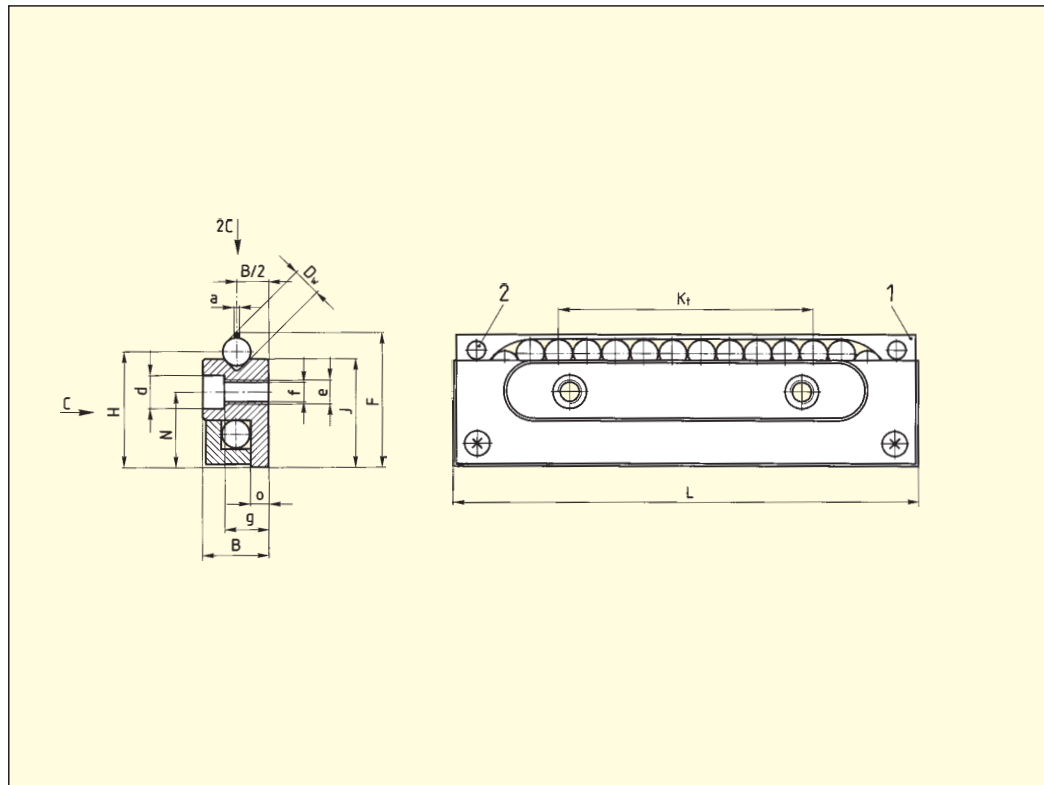
1: Retaining shoulder; may not be used as a stop
2: Wipers, from size SK 3-075 and larger

Type	Size			Weight in g	B	D_w	F	H	J	K_t
SK	**1-022**		**–**	5	4	1.5	8.4	7.25	6.9	9
SK	**2-032**		**–**	10	6	2	11	9.5	9	16
SK	**3-075**		**–**	45	8	3	16.9	14.5	13.8	48
SK	**6-100**	**SKD**	**6-100**	200	15	6	28.9	24.5	22.9	60
SK	**6-150**	**SKD**	**6-150**	300	15	6	28.9	24.5	22.9	102
SK	**9-150**	**SKD**	**9-150**	670	22	9	45.1	39	36.7	90
SK	**9-200**	**SKD**	**9-200**	940	22	9	45.1	39	36.7	144
SK	12-200	SKD	12-200	1470	28	12	57.1	49	45.9	120

Ordering example: 4 Recirculating units SK 6-100 or
8 Recirculating units SK 6-100-GP, matched in sets of 4
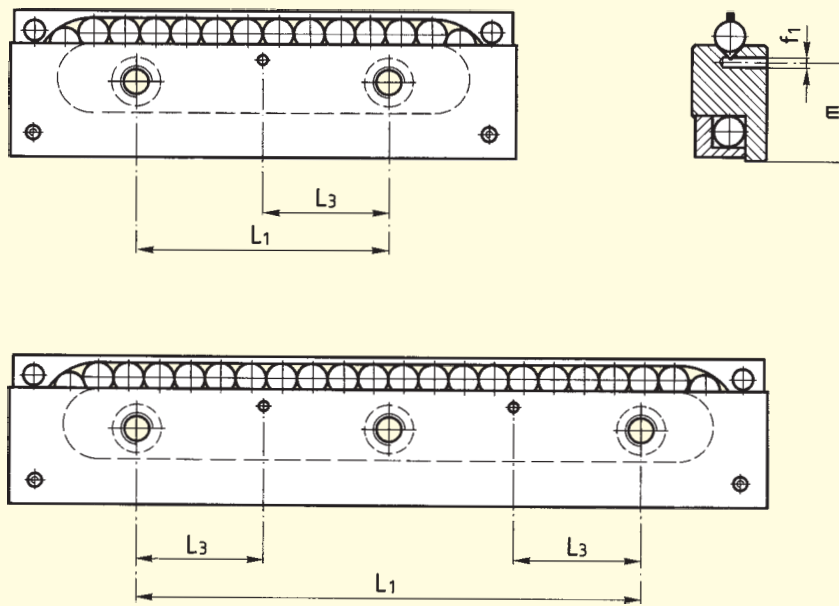
L	L$_1$	L$_3$	N	Q	a	d	e	f	f$_1$	g	m	o	C in N	
													SK	SKD
22	1×10	–	4.8	13.5	0.3	3	M2	1.65	–	2.6	–	1.2	63	–
32	1×15	–	6	18	0.3	4.4	M3	2.55	–	4	–	1.9	135	–
75	1×25	12.5	9	28	0.5	6	M4	3.3	1.5	4.9	11.5	2.4	425	–
100	1×50	25	15	45	1	9.5	M6	5.2	2	9.8	19.7	4.4	715	650
150	2×50	25	15	45	1	9.5	M6	5.2	2	9.8	19.7	4.4	1170	1100
150	1×100	50	26	72	1.5	10.5	M8	6.8	3	15.8	32.4	6.3	1650	1500
200	1×100	50	26	72	1.5	10.5	M8	6.8	3	15.8	32.4	6.3	2550	2400
200	1×100	50	32	77	2	13.5	M10	8.5	3	19.8	40.2	7.7	2860	2600

Suitable linear bearings: Type R and RD (chapter 5 and 6)

11.4 Fitting dimensions
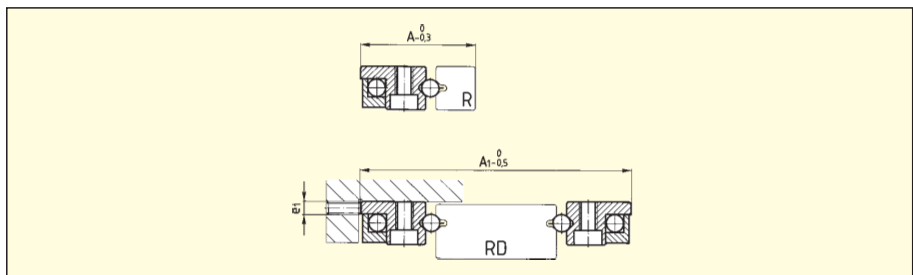
Type	Size			A	A$_1$	e$_1$
SK	**1-022**	**–**		11.5	28	M1.6
SK	**2-032**	**–**		15.5	37	M2.5
SK	**3-075**	**–**		23.5	57	M3
SK	**6-100**	**SKD**	**6-100**	40	94	M5
SK	**6-150**	**SKD**	**6-150**	40	94	M5
SK	**9-150**	**SKD**	**9-150**	61	150	M6
SK	**9-200**	**SKD**	**9-200**	61	150	M6
SK	12-200	SKD	12-200	78	175	M8

11.5 Permissible moments
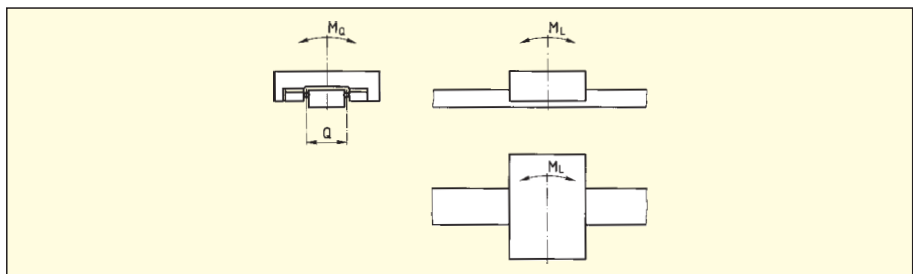
Type	Size			M$_L$ in Nm		M$_Q$ in Nm	
				SK	SKD	SK	SKD
SK	**1-022**	**–**		0.4	–	0.8	–
SK	**2-032**	**–**		1.4	–	2.4	–
SK	**3-075**	**–**		7.2	–	12	–
SK	**6-100**	**SKD**	**6-100**	23	23	32	29
SK	**6-150**	**SKD**	**6-150**	40	40	53	50
SK	**9-150**	**SKD**	**9-150**	81	81	119	108
SK	**9-200**	**SKD**	**9-200**	130	130	184	173
SK	12-200	SKD	12-200	187	187	220	200

Order numbers in bold face are standard articles and lengths.
Order numbers in normal face are special articles and lengths and are available on request.

12.1 Recirculating Unit Type SKC

The recirculating unit type SKC provides unlimited stroke and equal load carrying capacity in all directions. The SKC, designed for low-to-medium loading conditions, operates dry – lubrication is not required!

These units, used with SCHNEEBERGER linear bearings type R or RD, are drop-in-replacements for SCHNEEBERGER SK and SR recirculating units.

The combination of coated stainless steel, ceramic and Teflon® makes this recirculating unit suitable for **lubrication free operation in high vacuum and clean room applications.**

12.2 Material

The precision ground body is made from stainless steel and coated with «Duralloy Ultra-Slide DSV», a thin dense chrome. The load carrying balls are made from ceramic. The ceramic balls are spaced by smaller diameter Teflon® balls.
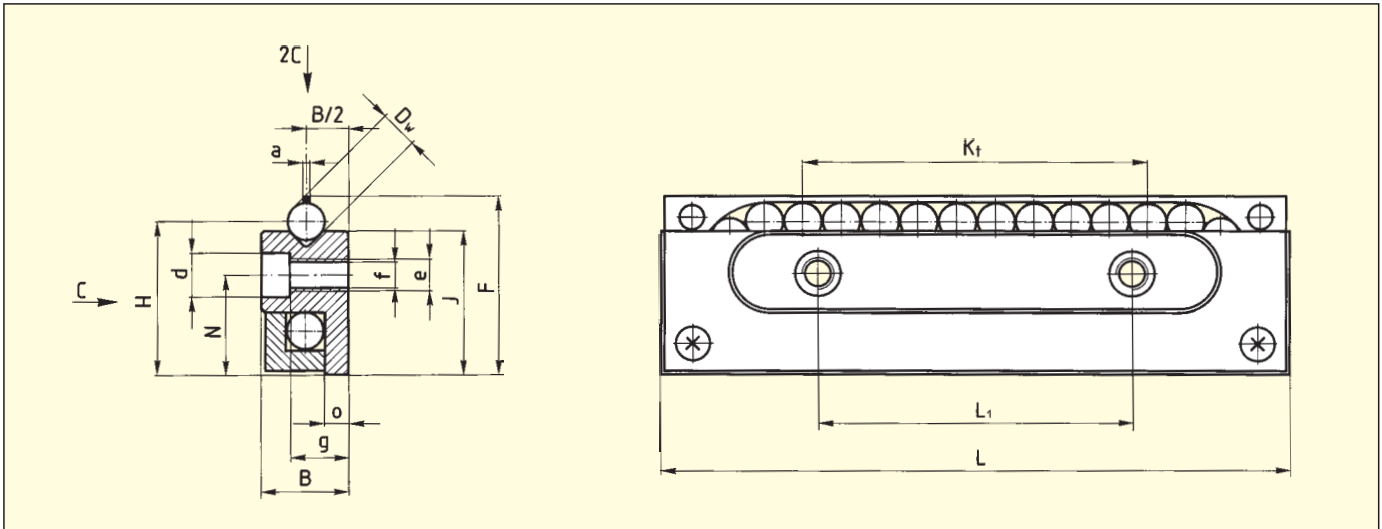
Type	Size	B	Dw	F	H	J	Kt	L	L$_1$	N	a	d	e	f	g	o	*C in N
SKC	3-075	8	3	16.9	14.5	13.8	48	75	25	9	0.5	6	M4	3.3	4.9	2.4	75
SKC	6-100	15	6	28.9	24.5	22.9	60	100	50	15	1	9.5	M6	5.2	9.8	4.4	125

*Load carrying capacity without lubrication

Fitting dimensions/tolerances
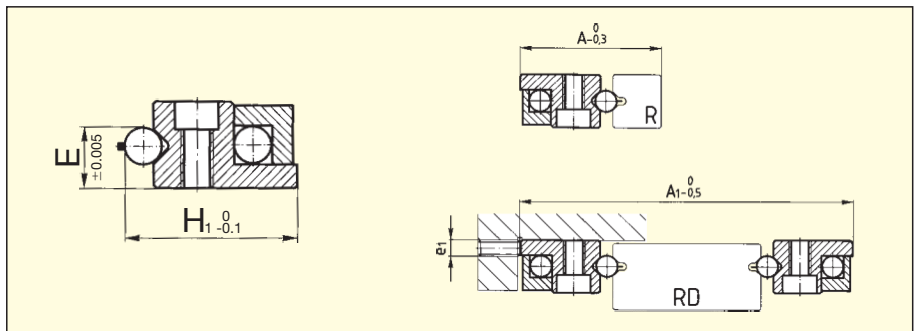
Type	Size	A	A$_1$	e$_1$
SKC	3-075	23.5	57	M3
SKC	6-150	40	94	M5

Matched sets (GP):
Dimension E and H$_1$ within 3 μm

General data

Maximum speed: 120 m/min
Maximum acceleration: 50 m/s^2
Temperature range: −150 to 200° C

13.1 Recirculating Unit Type SR

Size 2

Sizes 3, 6, 9, 12

The SR recirculating unit has cross rollers and is suitable for medium to high loading. When used together with SCHNEEBERGER type R or RD linear bearings the same fitting dimensions result as with type SK, but the load carrying capacity and rigidity are greater.

13.2 Material

With type SR recirculating units the cross rollers run on a hardened and very precisely ground steel carrier. The recirculating housing, made from protectively coated aluminum or plastic, prevents the rollers from falling out. On the standard size 3–12 models the rollers are mounted in plastic inserts.

Recirculating Unit Type SR

13.3   Dimension Table Type SR
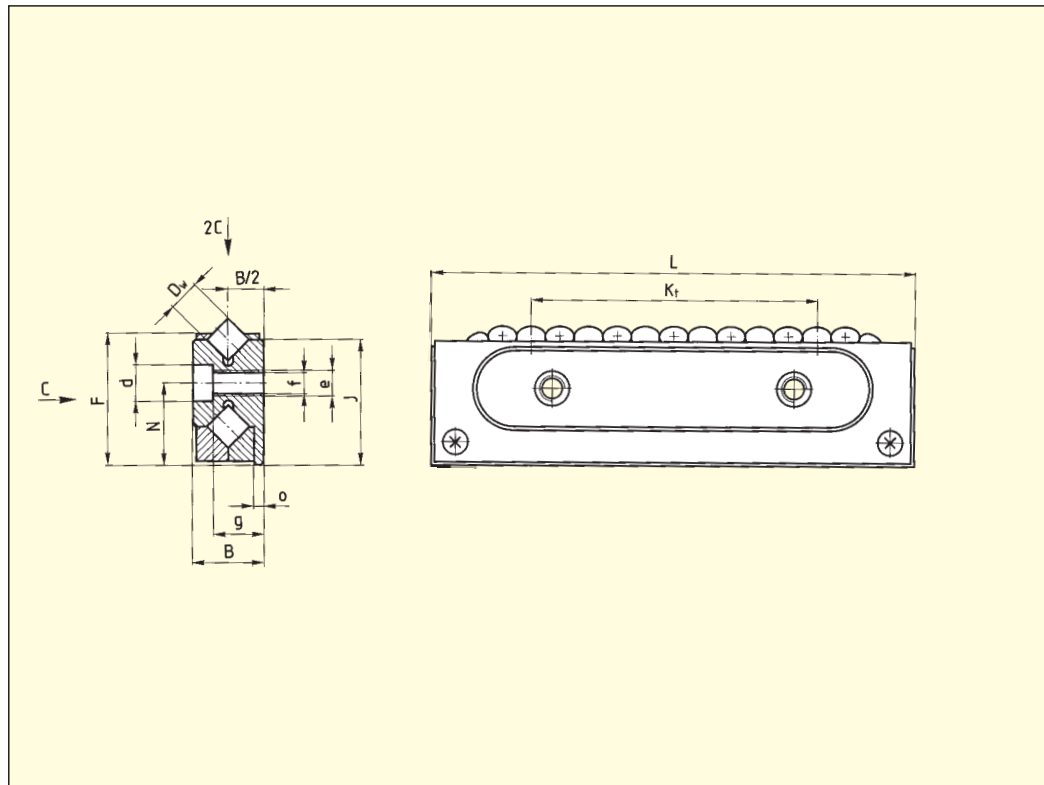
Type	Size	Weight in g	B	D_w	F	J	K_t	L
SR	**2-032**	10	6	2	9.8	9.5	16	32
SR	**3-075**	50	8	3	15	14.5	46	75
SR	**6-100**	210	15	6	25.7	24.5	56	100
SR	**6-150**	310	15	6	25.7	24.5	105	150
SR	**9-150**	750	22	9	40.5	39	92	150
SR	12-200	1580	28	12	51.5	49	112	200

Ordering example: 20 Recirculating units SR 9-150
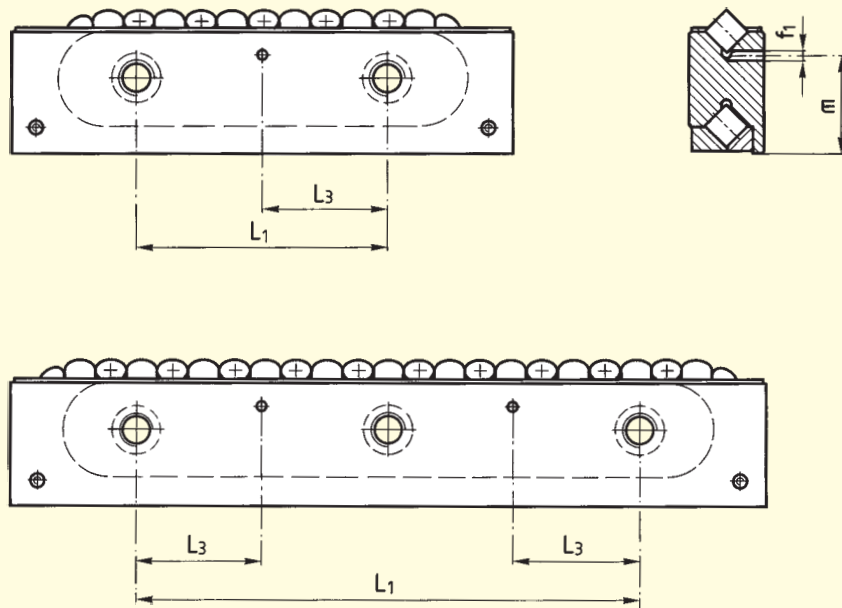
L₁	L₃	N	Q	d	e	f	f₁	g	m	o	C in N
1×15	–	6	18	4.4	M3	2.55	–	4	–	1	380
1×25	12.5	9	28	6	M4	3.3	1.5	4.9	11.8	1.3	850
1×50	25	15	45	9.5	M6	5.2	2	9.8	19.7	2.5	2150
2×50	25	15	45	9.5	M6	5.2	2	9.8	19.7	2.5	3750
1×100	50	26	72	10.5	M8	6.8	3	15.8	32.4	3.5	5850
1×100	50	32	77	13.5	M10	8.5	3	19.8	40.2	4	10000

Suitable linear bearings: Type R and RD (chapter 5 and 6)

13.4 Fitting dimensions
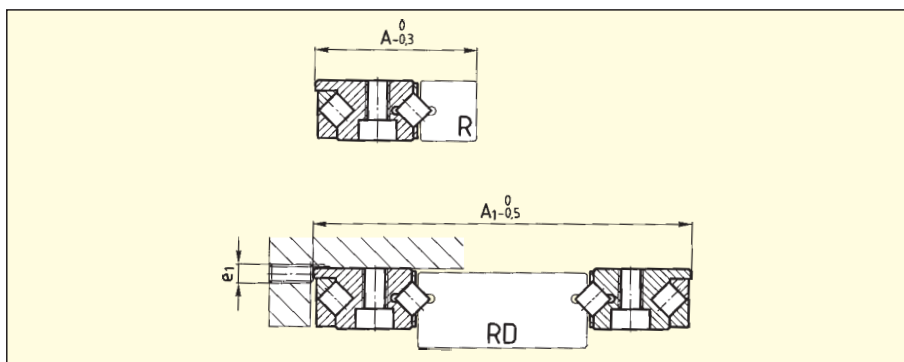
Type	Size	A	A_1	e_1
SR	**2-032**	15.5	37	M2.5
SR	**3-075**	23.5	57	M3
SR	**6-100**	40	94	M5
SR	**6-150**	40	94	M5
SR	**9-150**	61	150	M6
SR	12-200	78	175	M8

13.5 Permissible moments
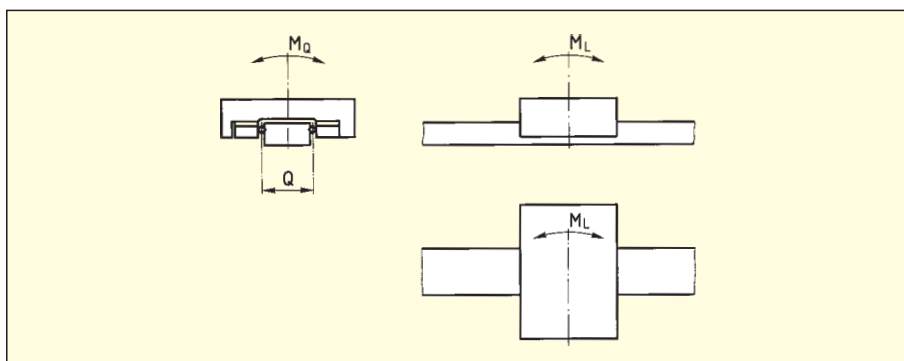
Type	Size	M_L in Nm	M_Q in Nm
SR	**2-032**	3	7
SR	**3-075**	12	24
SR	**6-100**	60	97
SR	**6-150**	112	169
SR	**9-150**	241	421
SR	12-200	553	770

Order numbers in bold face are standard articles and lengths.
Order numbers in normal face are special articles and lengths and are available on request.

14.1 Recirculating Unit Type NRT and Preload Wedge Type NRV
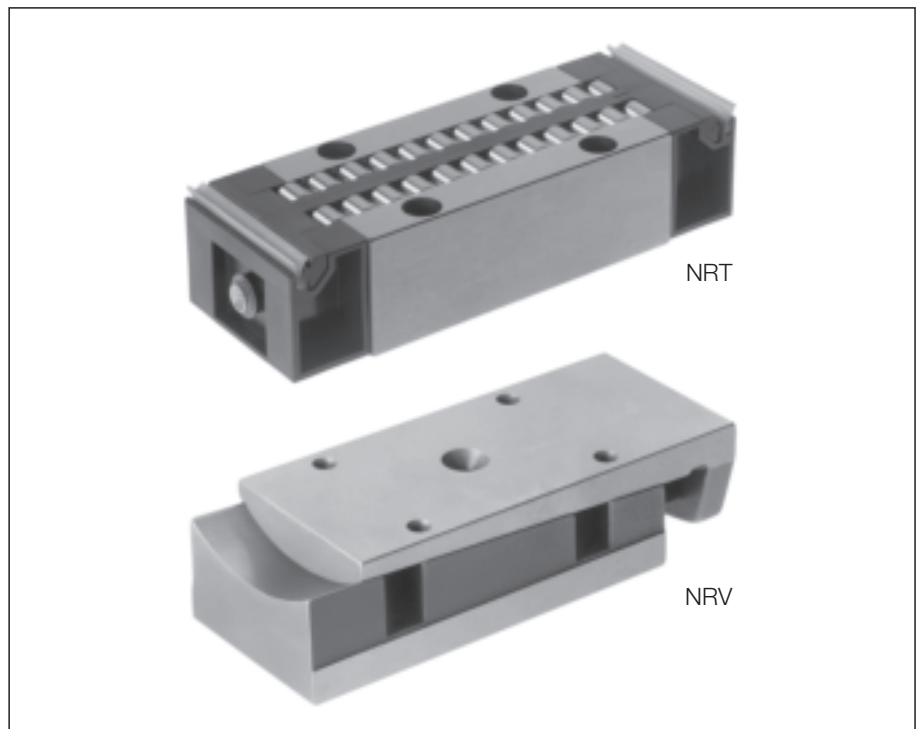
NRT

NRV

The roller recirculating units NRT are designed for medium to heavy loads, high rigidity and high precision. Together with suitable SCHNEEBERGER linear bearings, adjusting wedge or attaching part ingenious constructions can be realized.

These wedges are used normally to adjust the preload. At the same time, by suitably shaping the cylindrically ground wedge bars, small angular deviations and deformations in the surrounding construction can be compensated. The parts are made from hardened steel.

14.2 Material

NRT
Steel body: through hardened, very precisely ground steel
Recirculation: plastic

NRV
hardened steel

14.3 Standard version

The design of the twin race recirculating unit type NRT, is based on a through hardened, highly accurately ground steel carrier and two plastic components to recirculate the rollers. On each front face there is a double lipped wiper and a lubricating nipple. There is also an additional lubricating hole in the roller return passage.

14.4   Dimension Table Type NRT and NRV

Recirculating Unit NRT

1: With lubricating nipple ∅ 4 type D1a on both sides
2: Lubricating hole
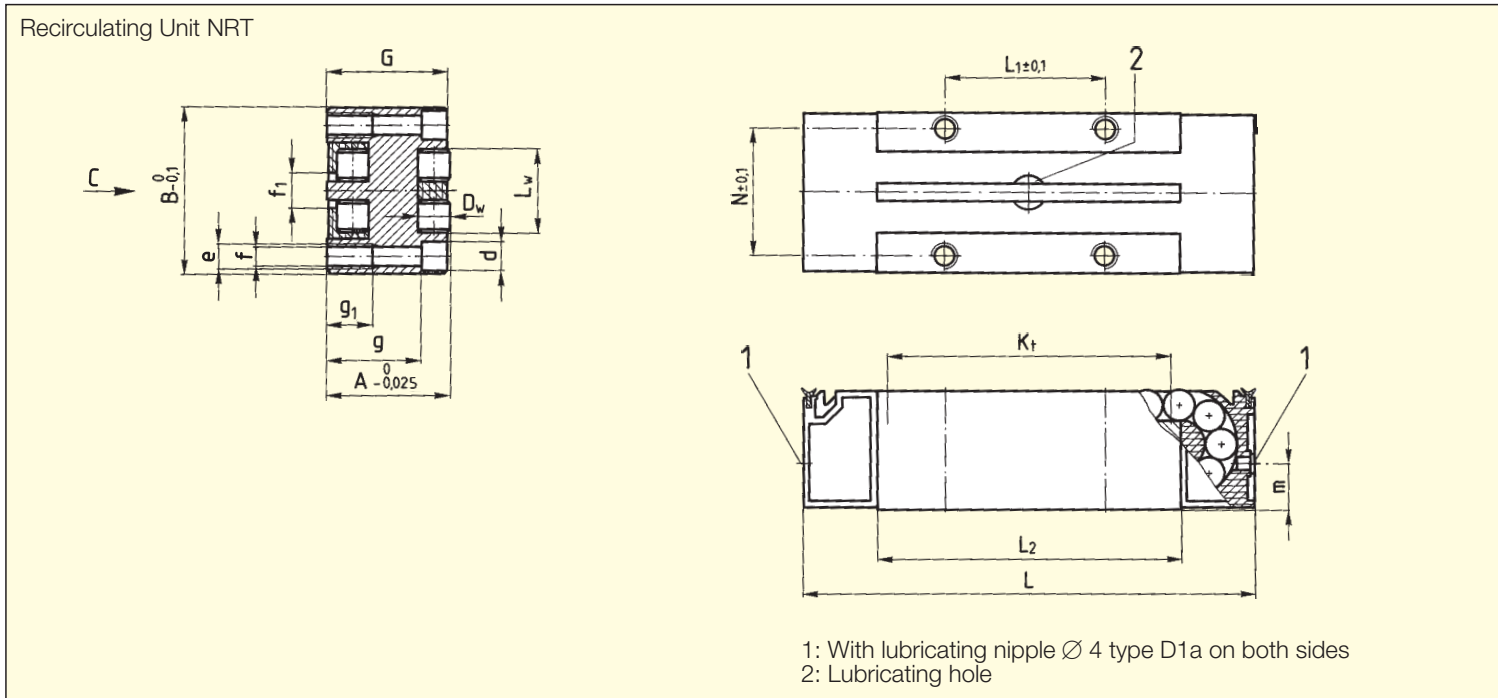
Type	Size	Weight in g	A	B	D_w	G	K_t
NRT	19077	185	19	27	5	18.85	45
NRT	26111	570	26	40	7	25.85	70
NRT	38144	1390	38	52	10	37.8	90

Ordering example: 20 Recirculating Units NRT 19077, matched in sets of 4

Type	Size	Weight in g	A min.	B	H max.	L max.	L_1	L_2
NRV	19077	195	16	27	7	72	25.5	22.5
NRV	26111	670	25	40	8	105	44	29
NRV	38144	1300	30	52	8	130	51	37.5

Ordering example: 20 Preload wedges NRV 19077

Preload wedge NRV
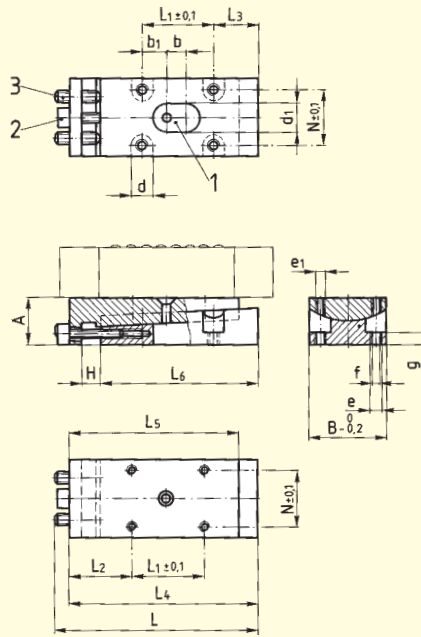
1: Lubricating hole
2: Preload Adjust screw
3: Counter-pressure screws

Recirculating Unit Type NRT

L	L₁	L₂	Lw	N	d	e	f	f₁	g	g₁	m	C in N
77	25.5	49.2	13	20.6	6	M4	3.3	6	15.5	6	5.3	43000
111	44	75.6	19	30	8	M6	5	9	20	10	10.3	98000
144	51	96.8	26	41	11	M8	6.8	11	29	14	14.5	181000

L₃	L₄ max.	L₅	L₆	N	b	b₁	d	d₁	e	e₁	f	g
16.5	68	61	56	20.6	7	9	7	9	M4	M3	3.3	4.5
21	98	90	83	30	9	17.5	8	11	M6	M4	5	8
28.5	121	113	105	41	10	20.5	11	14	M8	M6	6.8	8

14.5 Special version

Recirculating Units with One-sided Connection for Central Lube System
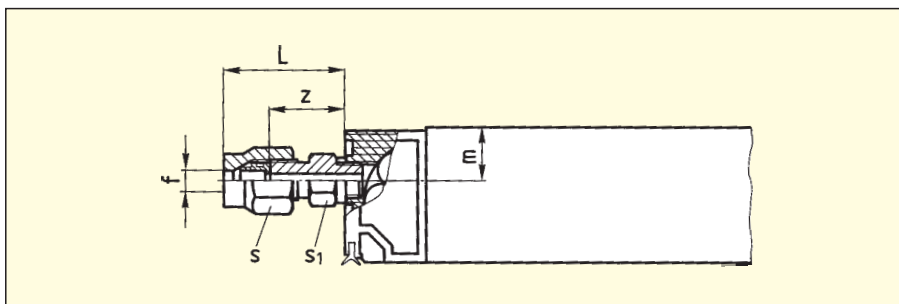
Type	Size	L	f	m	s	s₁	z
NRT	19077-ZS-2	13	2	5.3	8	7	10.5
NRT	19077-ZS-3	14.5	3	5.3	8	7	11
NRT	26111-ZS-2	13	2	10.3	8	7	10.5
NRT	26111-ZS-3	14.5	3	10.3	8	7	11
NRT	26111-ZS-4	18.5	4	10.3	10	8	14
NRT	26111-ZS-5	19	5	10.3	10	8	14
NRT	26111-ZS-6	20	6	10.3	12	10	14
NRT	38144-ZS-2	13	2	14.5	8	7	10.5
NRT	38144-ZS-3	14.5	3	14.5	8	7	11
NRT	38144-ZS-4	18.5	4	14.5	10	8	14
NRT	38144-ZS-5	19	5	14.5	10	8	14
NRT	38144-ZS-6	20	6	14.5	12	10	14

Ordering example: 4 Recirculating Units NRT 26111-ZS-2

14.6 Preload Adjustment

Preload Wedge Type NRV

These wedges are used normally to adjust the preload. At the same time, by suitably shaping the cylindrically ground wedge bars, small angular deviations and deformations in the surrounding construction can be compensated. The parts are made from hardened steel.

Adjustment Figures

Type	Size	Δ A*	Per Thread Revolution
NRV	19077	0.35	0.035
NRV	26111	0.4	0.0625
NRV	38144	0.4	0.075

*Max. difference in height of the preload wedge

15.1 Tolerances

Along with the geometrical accuracy of the components used, the running and positioning accuracy are dependent on the careful alignment of the linear bearings on an adequately machined, low deformation base construction.

Parallelism Tolerances
SCHNEEBERGER linear bearings are manufactured in 3 quality grades:
NQ   Normal quality; corresponds to standard requirement for precise anti-friction guideways in machine construction.
SQ   Special quality; foreseen for high requirements. It can be supplied for all types independent of their length.
SSQ Super special quality for the most stringent requirements. Can be supplied for all types manufactured from tool steel No. 1.2510 or 1.2842 up to a length of RF-1200 mm and in quality corrosion resistant until 600 mm.

The quality grades SQ and SSQ require increased accuracy and rigidity in the base construction.
The relative tolerance value (Δ) for the parallelism of the running surfaces to the supporting and abutting surfaces can be read from the diagram below:
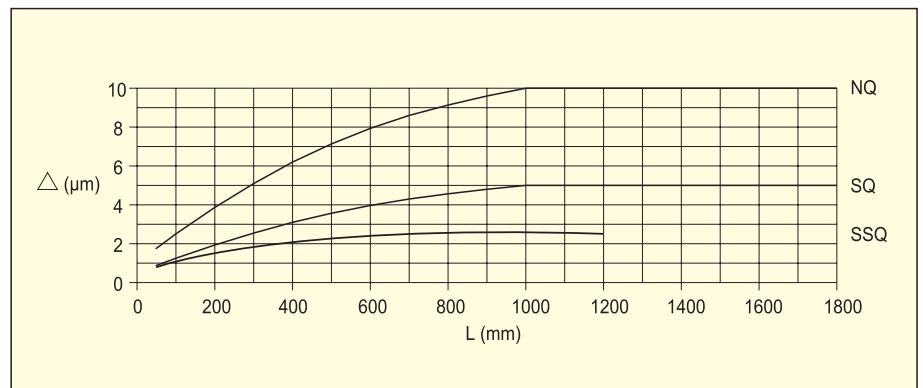
To achieve a high running accuracy with preloaded guideways not only the parallelism is important but also, the distance of the supporting surface to the running surface. This dimension is therefore on SCHNEEBERGER linear bearings, also very closely toleranced ($\pm$ 0.005 mm).
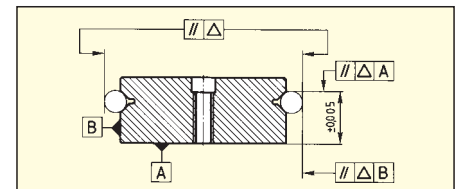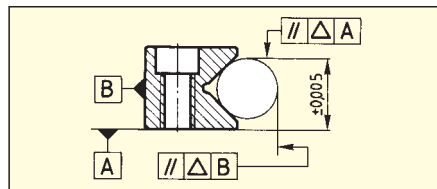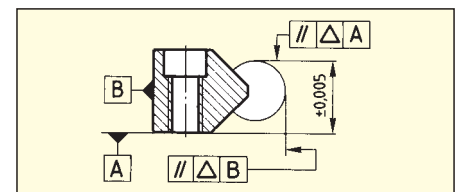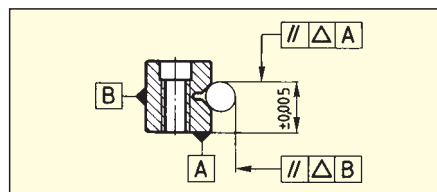
Length and Attaching Hole Pitch Tolerances

Length	$L \leq 300$:	$\pm$ 0.3 mm
Length	$L > 300$:	$\pm$ 1‰ of L
Pitch	L_1:	$\pm$ 0.3 mm
Dimension	$x_n \leq 350$:	$\pm$ 0.3 mm
Dimension	$x_n > 350$:	$\pm$ 0.8‰ of x_n
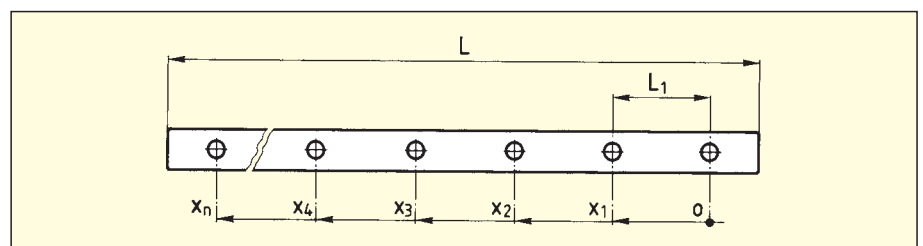
Multi-section linear bearings

If the required total length of the guide is greater than the maximum length indicated in the catalogue, the individual guideways will be ground together. The offset between the individual guide rails should not exceed 0.002 mm. The linear tolerance L should lie between +/- 2 mm. When assembling the guideways, the numbering at the junction must be observed.
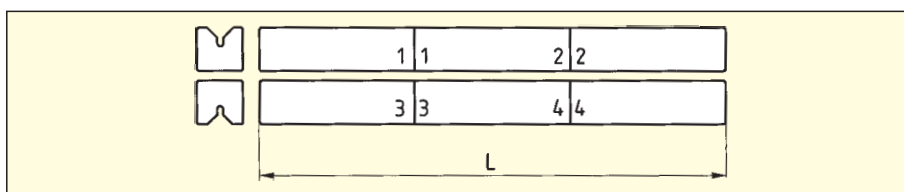
Tolerance of Height Matched Linear Bearings (HA)

With gravity loaded guides which are matched for height, a tolerance of ± 0.01 on dimension $A_{-0.3}^{0}$ from A_1 to A_2 is held and the parts are marked accordingly. If several sets are supplied they are numbered consecutively.
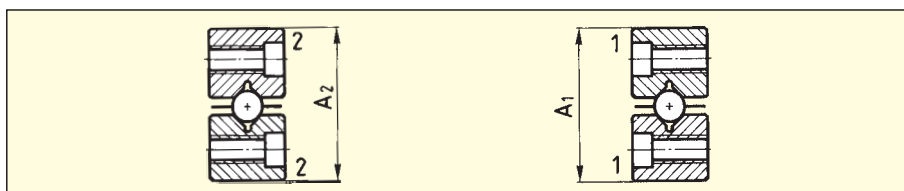
Tolerances of Matched Recirculating Units (GP)

If two or more recirculating units are arranged one behind the other, then they should be ordered with the suffix «matched». They are then selected in groups and marked accordingly.
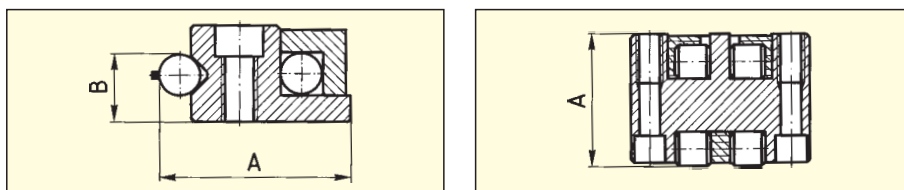
Type	Manufacturing Tolerances		Group Tolerances in µm with Matched Sets	
	A	**B**	**A**	**B**
SK 1+2 SR 2	0 −0.1	± 0.005	2	2
SK 3–12 SKC 3+6 SKD 6–12 SR 3–12	0 −0.1	± 0.005	3	3
			Grading	Marking
NRT	0 −0.025	–	0 to – 5 – 5 to –10 –10 to –15 –15 to –20 –20 to –25	Red – Blue Yellow Green White

Marking:
With the exception of type NRT, all matched recirculating units in the same group are given a number i. e. same number = same tolerance group

15.2 Materials

SCHNEEBERGER **linear bearings** are normally manufactured from tool steel No. 1.2510 or 1.2842. The hardness is between 58 and 62 HRC, or min. 54 HRC for certain **corrosion resistant** models (material No. 1.4037).
The maximum lengths for the guideways indicated in the catalogue do not apply to corrosion-resistant steel.
The whole SCHNEEBERGER **rolling element range** is made generally from bearing steel No. 1.3505. The hardness is between 58 and 64 HRC, or min. 56 HRC for corrosion-resistant models.
For SCHNEEBERGER recirculating units all supporting components are made from bearing steel No. 1.2510 or 1.2842.
The **retainers** and **recirculating components** are, according to the model, made from steel, plastic or surface treated aluminum – for details see the individual Tables of Dimensions.

Coating

For applications requiring a special corrosion protection, because of a high relative humidity or an increased resistance against wear of the surfaces is required, Linear bearings and recirculating unit can also be supplied in a hard-chromed version. The essential advantages of this coating type **Durraloy®** applied by electro-plating are:
● Very good corrosion protection
● Very high resistance against wear and very high load bearing capacity of the surface
● Exceptional adhesive power and uniform distribution of the thickness of the coating
● Good sliding and therefore emergency running characteristics, because of the micropearl structure

Please note that the ZG Option (ground together) is not available and the maximum lengths for the guideways indicated in the catalogue do not apply.

In air without organic lubricants, the running surfaces of standard linear bearings are completely destroyed after only 10 000 rotations of the rolling elements – **DryRunner** bearings keep running and running… and running absolutely dry for more than 100 million rotations. This represents an **improvement in lifetime by a** factor of 10 000 compared to dry running.

Technical Information

In vacuum, a total lack of lubrication of standard steel-on-steel bearings leads to almost immediate destruction of running surfaces and rolling elements by cold welding effects. Here, **DryRunner** bearings still work for more than 50 million rotations of the rolling elements. **DryRunner** bearings may also be used with standard organic lubricants.

As the coating only delays corrosion, but does not stop it permanently, the coating is only applied to the running surfaces. If corrosion resistance is needed, the RF material option must be specified.

- Completely dry running
- suitable for standard air as well as vacuum applications
- absolutely free of any organic lubricants
- minimal abrasive wear

When ordering it is essential to specify whether the version is to be used in **air** or under **vacuum.** The DryRunner coating is obtainable only together with the cage assist. Deviations in version only after consultation.

SCHNEEBERGER products conform to EU directives 2002/95/EC (RoHS).

15.3 Permissible Operating Temperatures

SCHNEEBERGER linear bearings and recirculating units can be used at temperatures between – 40° C and + 80° C. Temperatures of up to + 120° C are premissible for short periods.

For applications under higher temperatures special versions are available. Please consult us.

15.4 Lubrication

SCHNEEBERGER anti-friction guideways should be lubricated to protect them against corrosion and wear and tear. The guides and recirculating units should not be heavily lubricated. One lubrication can – according to the loading – suffice for years.

Generally, bearing grease on a lithium saponified base (bearing grease KP2K per DIN 51502 respectively DIN 51825) should be used. Drip feed oiling, occasional oiling, with oil nipples or lubricating by means of overspill oil are sufficient. To achieve the lowest rolling friction resistance, mineral base oils are recommended (CLP or HLP; viscosities of ISO VG 15 to 100 per DIN 51519).

The lubricant is normally applied between the linear bearings and the recirculating units or, sometimes, through the standard lubricating holes or nipples in the recirculating units. If, for design reasons, this is not possible (e.g. vertical fitting), linear bearings with lubricating holes can be supplied. Oil mist lubrication systems are especially recommended which, with a small over-pressure, help to keep the guides clean. Environmental conditions however restrict their use.

Soluble oil or coolant emulsions should, on the other hand, be kept away from the guides as they dilute or wash away the lubricant. In addition, coolant emulsions tend to dry-out and become tacky. Lubricants with solid base additives are also unsuitable.

Lubrication intervals depend on various factors such as the loading, ambient conditions, etc. Experience has shown that lubricating 2–5 times at equal intervals during the calculated operational life suffices.

With very long guideways, we recommend that, before they are put into operation, lubricant is distributed along the linear bearings in order to prevent the recirculating units from running dry.

15.5 Permissible Velocities and Accelerations

Under normal fitting conditions SCHNEEBERGER anti-friction guideways can be used at velocities of up to 50 m/min. and accelerations of 50 m/s^2. Higher velocities are possible under certain conditions but need, however, light and stable cage constructions. They are also dependent on the size, lubrication, fitting location, preloading, loading and on the type of linear bearing selected.

Under normal fitting conditions SCHNEEBERGER recirculating units can be used up to the following speeds:
  50 m/min. for NRT
120 m/min. for SK/SKD, SR
The maximum acceleration is 50 m/s^2.
Higher velocities and accelerations are possible under certain conditions. They depend on the size, lubrication, mounting position, preload, loading and the type of recirculating unit selected.

15.6 Sealing and Guarding

Falling swarf, fine grain cutting particles, dirt blown-in while cleaning and any other kind of contamination are a danger for the running characteristics and operational life of the anti-friction guideways.
The amount of effort expended to protect the SCHNEEBERGER linear bearings and recirculating units should conform to the operating conditions of the case in question. The use of SCHNEEBERGER frictionless tables as standard equipment can be especially economical.
Due to their running geometry, balls are less sensitive to dirt than rollers. Wherever there is an increased danger of the ingress of dirt, the use of balls should be taken into consideration. Note however the lower load carrying capacity of balls as opposed to rollers and needles. Examples of sealing and guarding can be found in the Design Information (see chapter 16.5).
Recirculating units NRT and SK/SKD sizes 3 to 12 have replaceable plastic wipers as standard fittings. If necessary, the design should incorporate additional seals or guards (see chapter 16.5).

15.7 Friction, Running Accuracy and Smoothness

In the manufacture of SCHNEEBERGER anti-friction guideways the requisites for perfect running smoothness are created. Great attention is paid especially when the junctions of ground together linear bearings are manufactured. The entries and exits for protruding cages are also given great attention. Great attention is paid to the passage of the rolling elements from the unloaded into the loaded zone. The SCHNEEBERGER plastic and plastic composite cages also play an important part. For guides with cages, coefficients of friction range from 0.0005 to 0.003 and, with travel-independent recirculating units, up to 0.005.
For successful application special care must be taken with careful alignment of the linear bearings on an adequately machined, low deformation base.
You will find further details in the following section.

Technical Information

SCHNEEBERGER linear bearings are not load carrying construction components, but are designed only as guide units. They are, with a few exceptions, through-hardened.

16.1 Types of Fitting

All applications where the direction of motion is horizontal are designated horizontal fitting. All applications where the direction of motion deviates from the horizontal are designated vertical fitting.

The **pre-loaded guideway** can be loaded by moments and forces in any direction. The rigidity and running accuracy can be influenced by changing the preload.
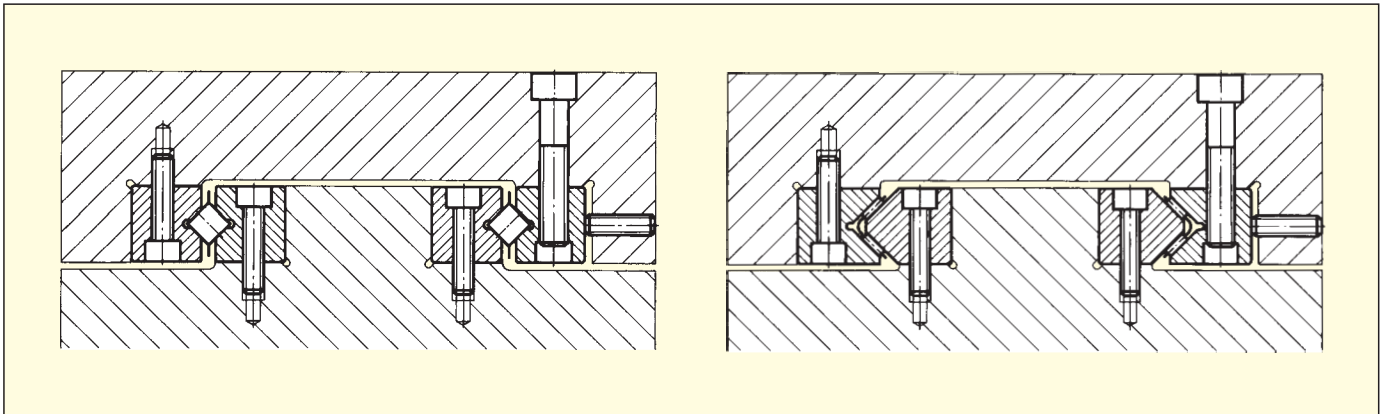
Preloaded anti-friction guideway with type R or RNG linear bearings

Preloaded anti-friction guideway with type N/O
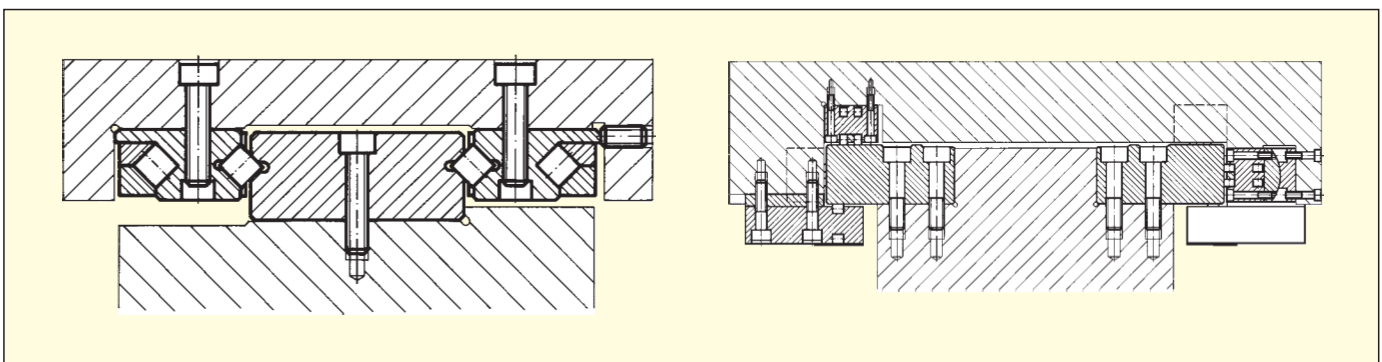
Preloaded anti-friction guideway with type RD linear bearing and type SR or SK recirculating units

Preloaded anti-friction guideway with special linear bearings and type NRT recirculating units

Gravity loaded Guideways can, in most cases, only be used with loads acting vertically on the guideway. They accept heavy loads and are usually easy to fit. They are especially advantageous when
– lateral expansion due to heat has to be compensated
– large supporting widths have to be bridged
– no deformation may occur through bracing of the base construction.
For gravity loaded fittings the two pairs of linear bearings must be ordered with dimension A matched for height (–HA).

Gravity loaded anti-friction guideway with type R and special linear bearings
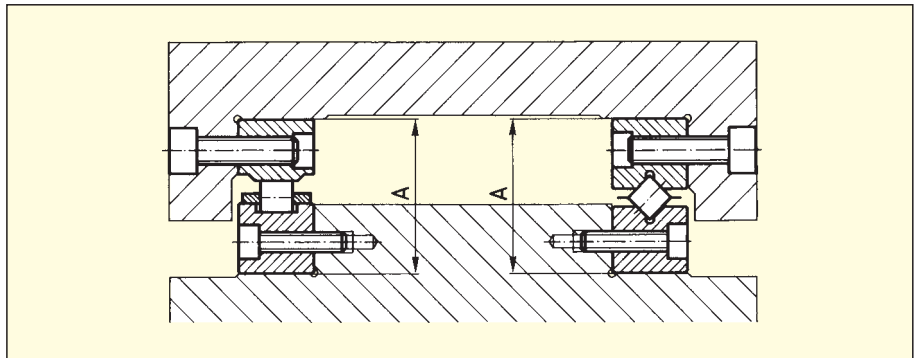
Suspension gravity loaded fitting with type N/O and special linear bearings (specify mode of fitting when ordering). In this case dimensions A and B have to be matched for height.
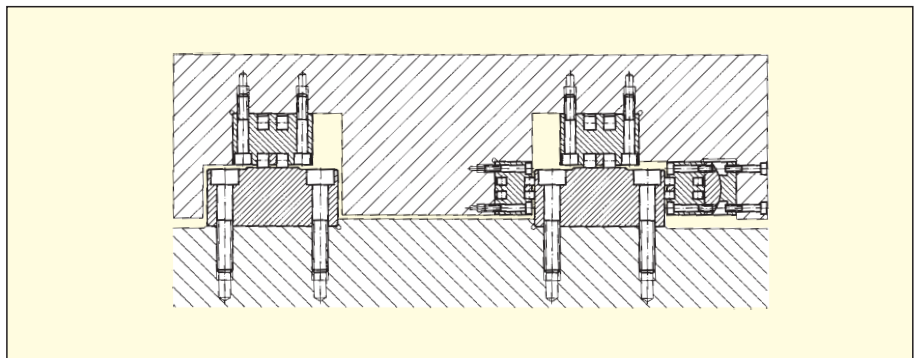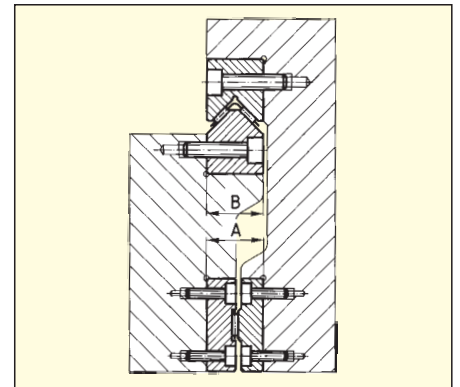
Gravity loaded anti-friction guideway with special bearings and type NRT recirculating units

Design and Fitting Guidelines

16.2 Attaching Linear Bearings and Recirculating Units

SCHNEEBERGER linear bearings can be attached to the base construction in 2 ways:

A: Using the threaded holes
B: Using the through holes

Whenever possible method A is to be preferred. It permits a stronger fitting and is, according to the diameter of the holes in the base construction, less sensitive with regard to deviations in the hole pitch. It can, with certain adjusting methods, be the only way possible to attach the linear bearing after the preload has been set.

Somewhat more «freedom of movement» is given by method B by using the special attaching screws, which are available for practically all SCHNEEBERGER linear bearings. See the tables under the relative linear bearings for sizes.

Linear Bearings
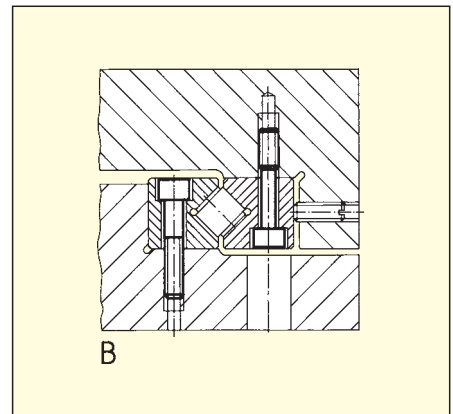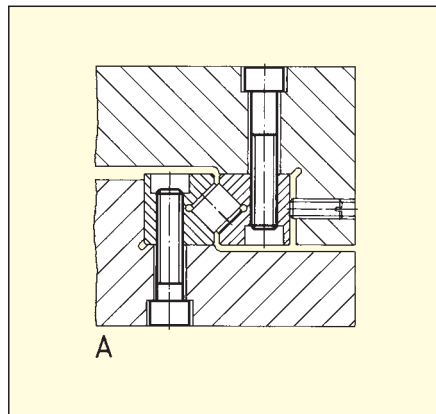
Recirculating Unit
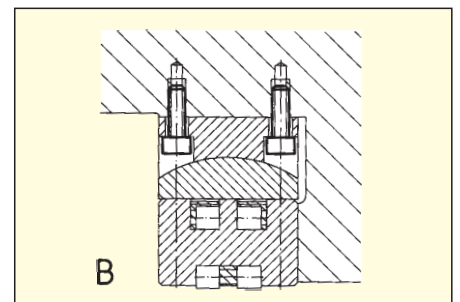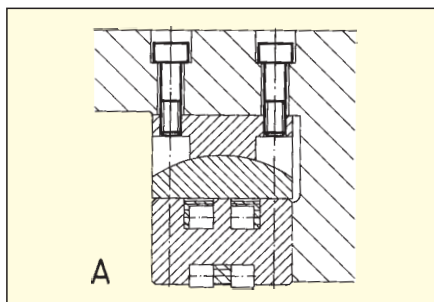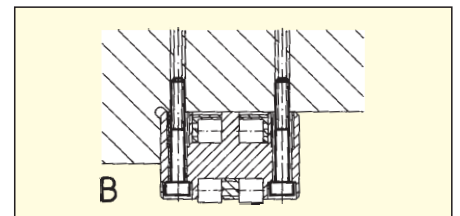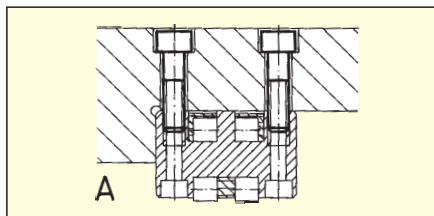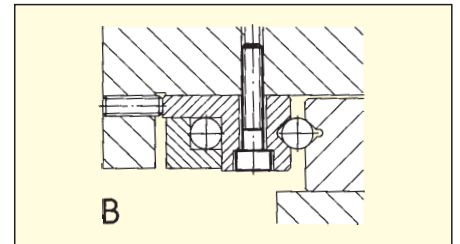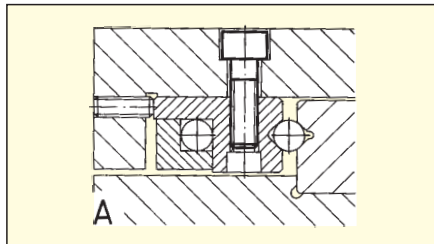
Recommended tightening torques for attaching screws

Below is a table of recommended tightening torques for attaching screws. These values are valid for screws with a oil protection or oiled. If grease containing MoS_2 is applied to the attaching screw, the torque can drop to half of the value indicated in the table below.

Strength grade: 8.8

Size	Tightening torque (Ncm)	
	Attaching screws DIN 912	Special attaching screws GD, GDN
M 2	35	28
M 2.5	73	58
M 3	128	102
M 4	290	232
M 5	575	460
M 6	990	792
M 8	2 400	1 920
M 10	4 800	3 840
M 12	8 300	6 640
M 14	13 200	10 560
M 16	20 000	

16.3   Preloading Linear Bearings

The **amount of preload** is set in accordance with the application of the SCHNEEBERGER linear bearings and recirculating units and is largely dependent on the rigidity of the base construction. It is normally between 2 and 20 % of the permissible load C.

Linear Bearings

The playfree setting of a guideway is normally executed using setscrews. A playfree, uniform motion can only be achieved when preloading is made at that point where the balls or rollers are. For this purpose the guide should be moved in sequence as each setscrew is adjusted.

With protruding cages the shorter linear bearing should preferably be adjusted.

For economic and practical purposes the following methods are normally used:

A: Setscrews
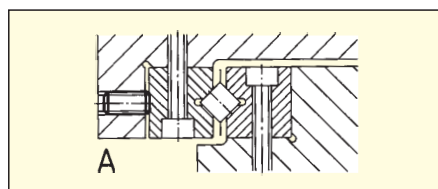
Further possibilities are:
B: Adjusting bar
C: Adjusting wedge
D: Adjusting cylinder
E: Longitudinal wedge
F: Double longitudinal wedge
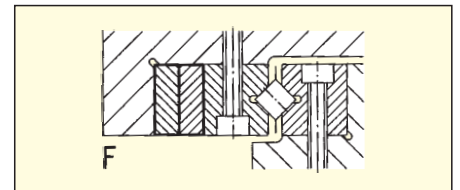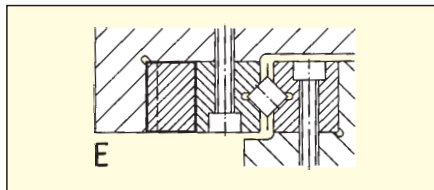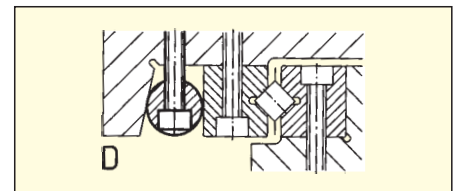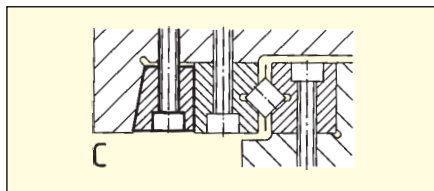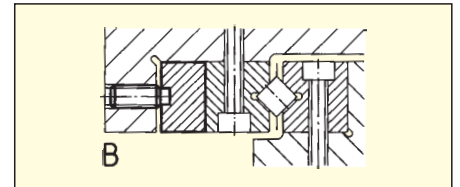
When setscrews are used at least one setscrew must be used per attaching screw. The setscrew thread should match the one in the SCHNEEBERGER linear bearing.
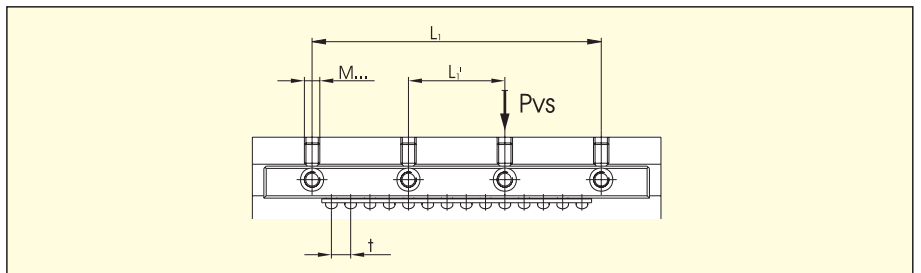
Example for a calculation

Linear bearing R 3:	L_1' = 25 mm
Roller cage type AC 3:	t = 5 mm; C = 130 N
Adjusting screw:	M4
Factor f: (for rollers = 1; for balls/needles = 2)	f = 1
Preload p: (2–20% of C)	p = 10%

Forces per adjusting screw Pvs = $L_1'/t \cdot C \cdot p/100 \cdot f$ = 25/5 · 130 · 10/100 · 1 = 65 N
Recommended tightening torques **Mds** = Pvs · a = 65 · 0.0469 = **3.05** Ncm

Tapped hole	M2	M2.5	M3	M4	M5	M6	M8	M10	M12	M14	M16
a [cm]:	0.0238	0.0294	0.0350	0.0469	0.0580	0.0699	0.0926	0.1152	0.1378	0.1591	0.1811

Design and Fitting Guidelines

Recirculating Unit

The following preloading methods can be used to achieve a playfree guideway respectively to increase the rigidity:
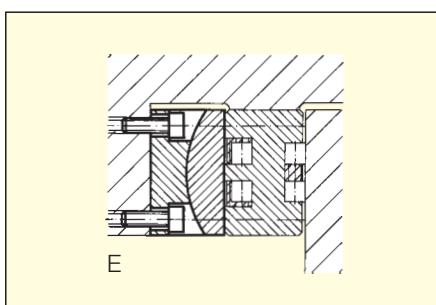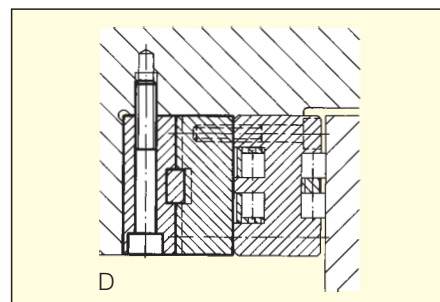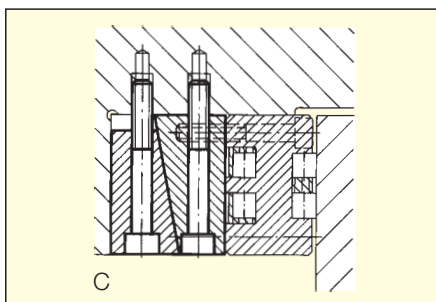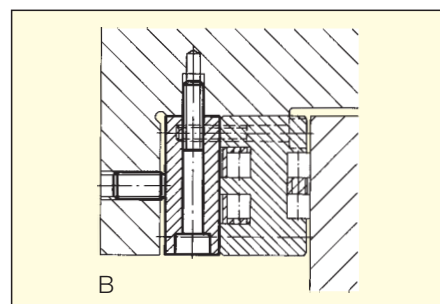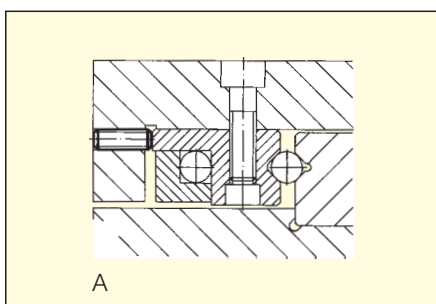
A: Setscrew
B: Setscrew with adjusting plate
C: Adjusting wedges
D: Double longitudinal wedge
E: Preload wedge, type NRV
      (see chapter 14)

The lengthwise **adjustment** on recirculating units must always be within the load carrying length K_t. The crosswise arrangement of the setscrews can be seen in the drawings on page • 70.
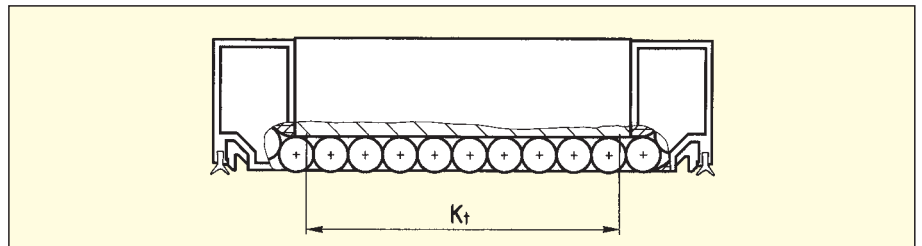
Linear Bearings and Recirculating Units

The preload on the setscrews can be set uniformly and quantitatively with a torque wrench. The optimal torque must be determined by trial and error. When adjusting wedges or adapter plates are used, the ideal preload has to be determined over the total elastic deformation δ_A (see chapter 17.2).

The playfree setting with heavy loads can be made more sensitively when the load is balanced by lifting it.

When adjusting a SCHNEEBERGER anti-friction guideway having plastic type EE roller cages, the cage must first be compressed slightly before the rollers make contact.

Fundamentally, preloading increases the rigidity of an anti-friction guideway. A high preload requires, however, a stable base construction. Otherwise, angular errors will be created which cause unfavorable end pressure on the rollers or needles which, in turn, has a negative effect on the load carrying capacity.

With type NRT recirculating units the use of SCHNEEBERGER type NRV preload wedges offers a practical solution which can partially compensate angular errors or deformations of the base construction.

17.4 Design of Base Unit

The advantages of SCHNEEBERGER linear bearings and recirculating units are best exploited on a rigid, low-deformation, accurately machined machine construction. The surface quality of the supporting surfaces has no direct influence on the operational behavior of the linear bearings. We recommend, however, that the supporting and abutting surfaces should be manufactured with a surface roughness of between N 5 and N 7, in order to achieve the desired flatness and parallelism tolerances.

Linear Bearings

The **angular error** of the supporting surfaces should not exceed 0.3 µm per mm and the parallelism must correspond to that of the SCHNEEBERGER linear bearings. These **parallelism tolerances** are also valid when recirculating units are used.

The angular error resulting from **offset in height** or elastic deformations may not exceed the following:

Rollers (R, RN, RNG) 0.3 µm / mm
Needles (N/O) 0.1 µm / mm
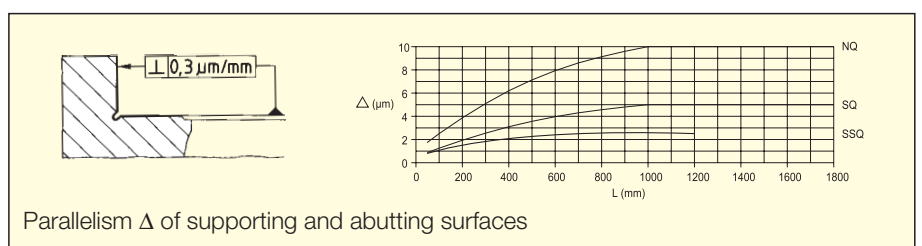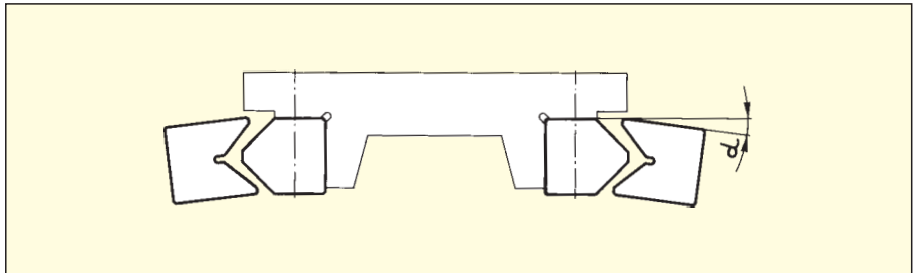
Parallelism Δ of supporting and abutting surfaces

**Design and Fitting Guidelines**

The above guidelines represent the recommended support structure for SCHNEEBERGER bearing assemblies. Slight deviations from these guidelines are permissible to lower manufacturing costs of your structure. However, undesirable disadvantages such as edge pressure, cage creep, higher friction, noise and a shorter operational life may result from these deviations. Through this kind of adaption to operating requirements optimum economic solutions can result.

Recirculating Units

The **angular error of the supporting surfaces** should not exceed 0.3 µm per mm.
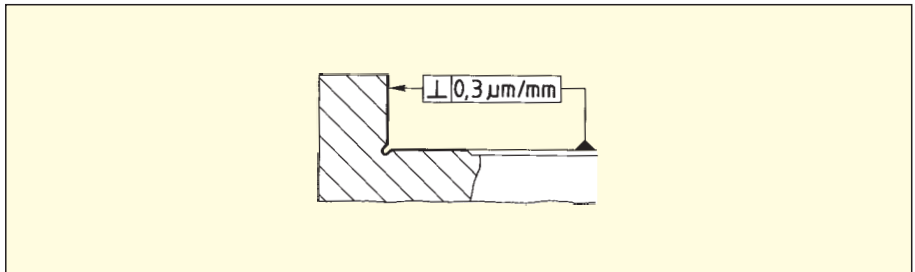
The **parallelism tolerance** of the supporting and abutting surfaces can be read from the diagram below.
For tolerances of linear bearing supporting and abutting surfaces, see above.
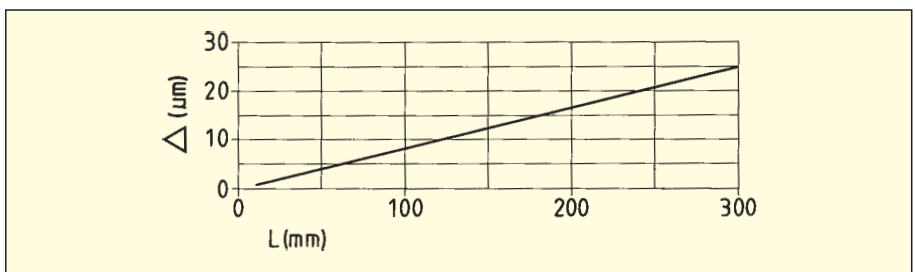
The angular error resulting from **offset in height** or elastic deformation should not exceed the following values:

ECO-ROLL   0.6 µm/mm
SR, NRT   0.3 µm/mm
SK, SKD   3   µm/mm
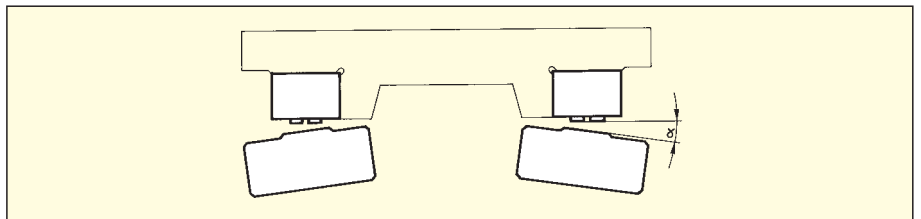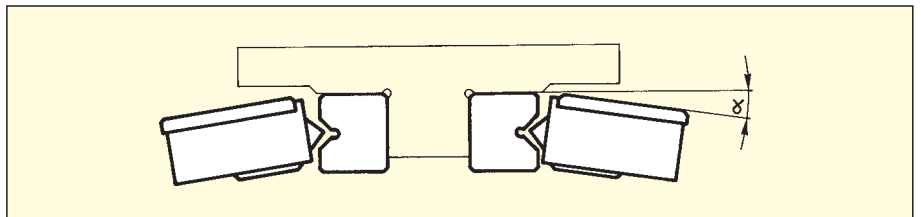
In addition the following **guidelines** should be observed:

When the NRT recirculating units are combined with the SCHNEEBERGER preload wedges type NRV, it is essential that the recirculating unit is aligned with the abutting surface. In addition the preload wedge must also be aligned with the recirculating unit.
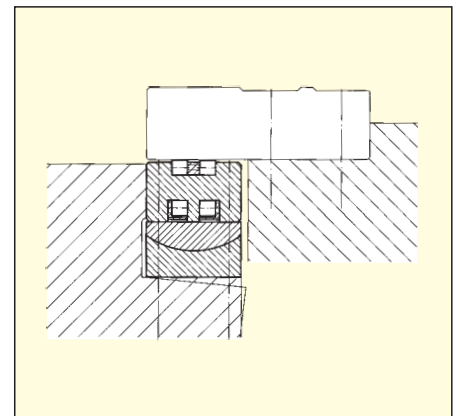
The above guidelines represent the recommended support structure for SCHNEEBERGER bearing assemblies. Slight deviations from these guidelines are permissible to lower the manufacturing cost of your structure. However, undesirable disadvantages such as edge pressure, higher friction, noise and a shorter operational life may result from these deviations. Through this kind of adaption to operating requirements optimum economic solutions can result.

Design and Fitting Guidelines

16.5   Design of Seals and Guards

Linear Bearings

In chapter 15.6 we have already mentioned the importance of seals and guards so that here we shall only mention design factors.

Wipers suffice in places where there is only a small amount of dirt present. Generally their braking effect can be ignored. When endpieces with wipers are used the limitation in stroke length must be noted, as the wiper should not travel further than the guide it is wiping.
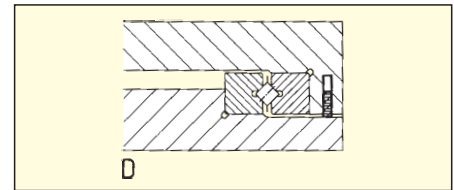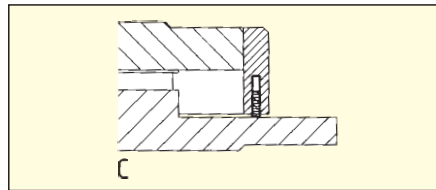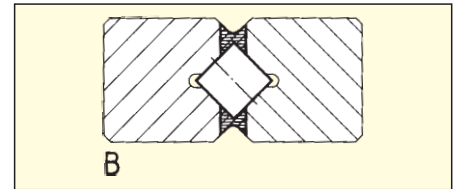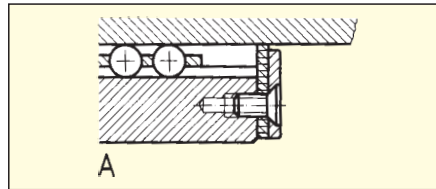

A: Endpiece with wiper
B: Plastic roller cage, type EE (only sizes R 6 and R 9)
C: Wiper on end face
D: Wiper at side

Guards are used where there is a danger that damage can be caused to the guides. While wipers only remove the dirt from the guides in the zone where they move, guards provide the possibility to protect them also against the lateral ingress of dirt.

E: Diverting swarf and coolant with guards
F: Labyrinth seals often provide effective and economic protection.
    They must, however, be properly designed
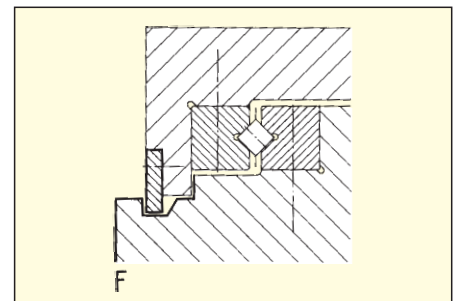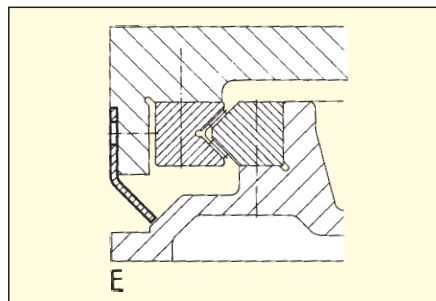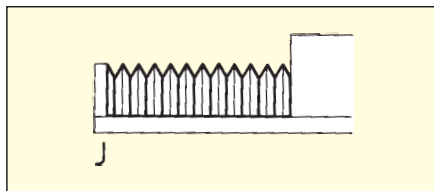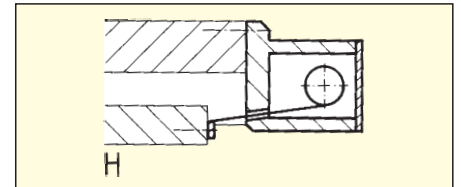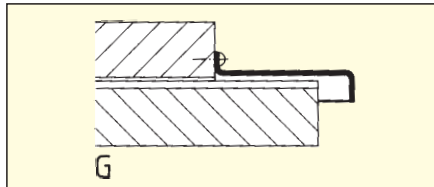
G: Simple metal cover
H: Self-tensioning guards
J: Bellows at top and bottom
K: Telescopic cover

Overpressure e. g. with compressed air can also help to prevent contamination. The over-pressure must, however, also be present during work breaks.
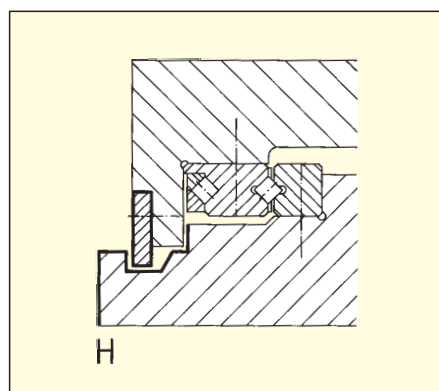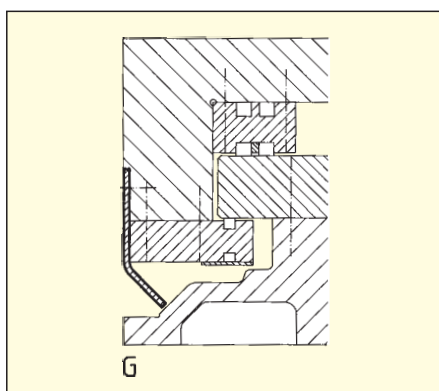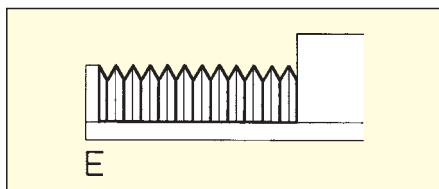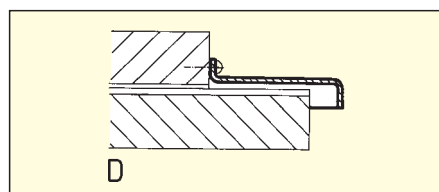
Recirculating Units
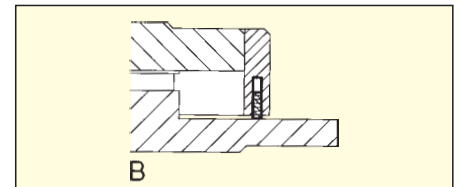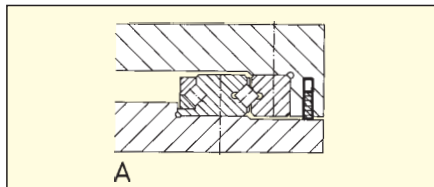
A: Lateral wipers

B: End wipers

Design and Fitting Guidelines

Guards are used where there is a danger that damage can be caused to the guides. While wipers only remove the dirt from the guides in the zone where they move, guards provide the possibility to protect them also against the lateral ingress of dirt.
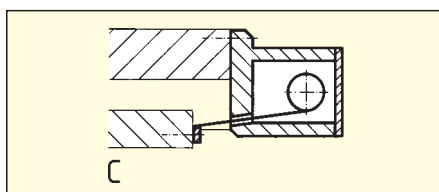

C: Self-tensioning guards
D: Simple metal cover
E: Bellows at top or bottom
F: Telescopic cover
G: Diverting swarf and coolant with guards
H: Labyrinth seals often provide effective and economic protection.
   They must, however, be properly designed.

Overpressure e. g. with compressed air can also help to prevent contamination. The overpressure must, however, also be present during work breaks.

16.6 Assembly

With clean, careful preparation, you will achieve a perfect anti-friction guideway in the most economical manner.

The following instructions are valid in a general sense for all types of SCHNEEBERGER linear bearings.
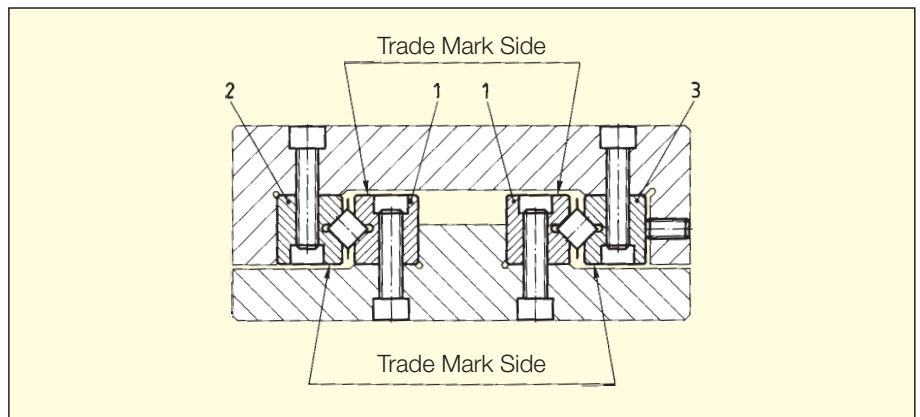

– At least with linear bearings which have been ground together the attaching holes in the base should be located directly from the holes in the linear bearings. By using the special attaching screws, differences in hole pitch can be compensated for in most cases. The side with the trade mark may not be used as the supporting surface
– To ensure perfect seating of the SCHNEEBERGER linear bearings deburr all holes with a fine stone after drilling
– Wash the linear bearings before fitting with a cleaning agent. Oil lightly to avoid secondary damage
– Press the fixed pair of linear bearings (1) onto the base using a suitable tool and secure with the attaching screws. The use of a torque wrench is recommended

Design and Fitting Guidelines
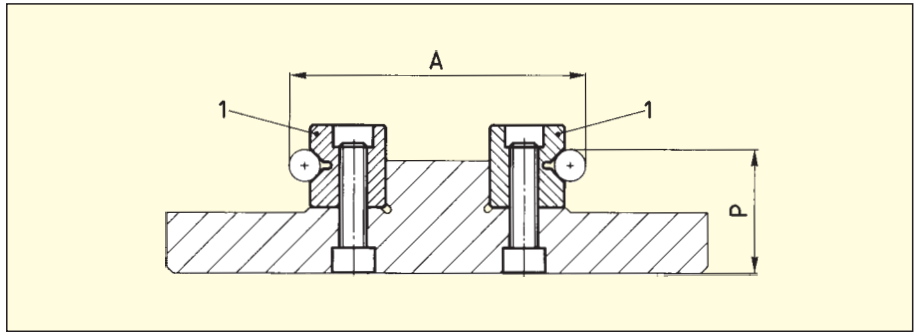
– Check the parallelism (Δ A and Δ P) of the fixed pair of linear bearings. The measured parallelism must be within the linear bearing tolerance (chapter 15.1)
– Fit fixed linear bearing (2) of opposite pair
– Fit adjusting guide (3) and lightly tighten the attaching screws
– Slide in cage with rolling elements and position exactly
– Fit endpieces
– Adjust linear bearing until desired preload is achieved and assembly is playfree (chapter 16.3)
– Secure the attaching screws on the adjusting linear bearing (3)

When using type NRV preload wedge it is essential that both counterscrews are secured alternately with the same torque after the preload has been set.

The setting of the preload with the preload screws should be executed in the following steps. Please adjust the screws sequentially according to the numbers.
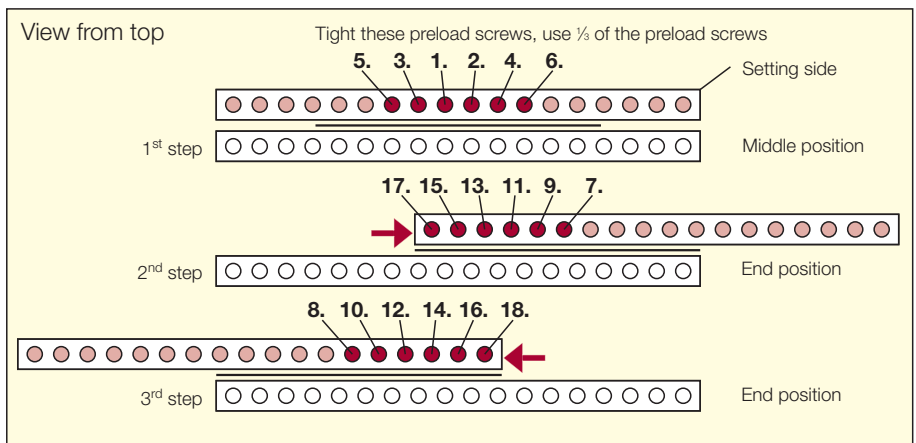
16.7 Layout of SCHNEEBERGER Linear Bearings and Recirculating Units

The versatile range of application of SCHNEEBERGER linear bearings has produced a multitude of different types of linear bearings; see product overview, chapter 1. The differing requirements placed on anti-friction guideways using recirculating units have produced recirculating units of various shapes; see Product Overview, chapter 1. Smooth running, velocity, load carrying capacity, operating conditions (heat; lubrication; dirt), and the construction as well as the ease of motion are decisive for the selection of the most suitable model.

Most important for the selection of size and length of the guideway are the load carrying capacity, operational life and rigidity.

The load carrying capacity can be increased when rollers or needles are used as opposed to balls. Decisive within the roller and needle types is, in the first place, the length of the rolling element. With regard to rigidity, many small rolling elements are better than a few big ones. Economic factors are also decisive for the type of linear bearing. In this consideration, balls are more economical than rollers or needles.

Linear Bearings

With regard to stroke and length and also the side spacing Q on the linear bearings, the following rules should be followed: For the linear bearing length L following factors are relevant: the cage length K and the stroke H as well as the kinetic factors, according to which the cage always moves half the stroke of the moving linear bearing.

As a guideline we recommend:

– For the relationship of stroke to linear bearing length:

$$\frac{H}{L} \leq 0.7 \ \text{(for H} \leq 400 \ \text{mm)}$$

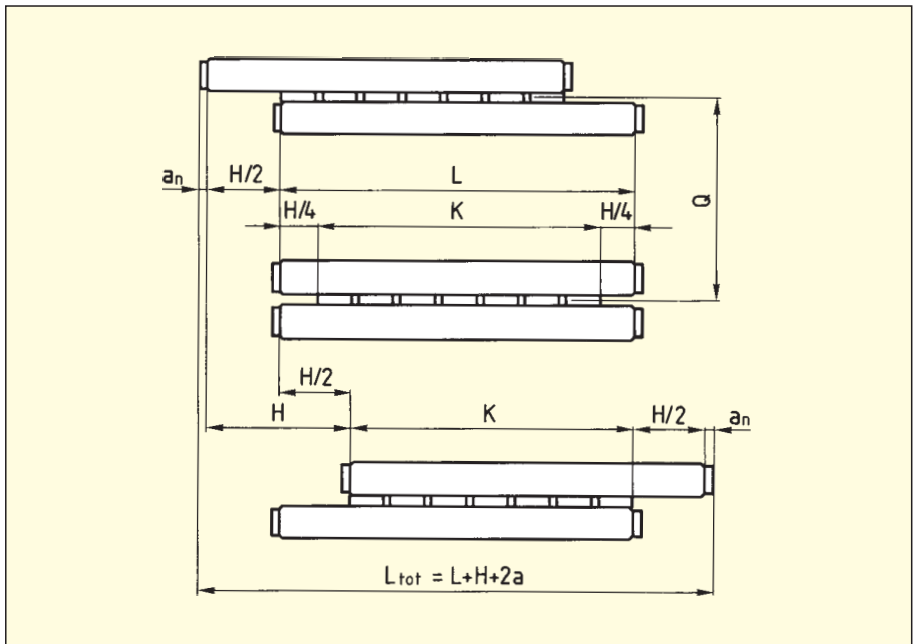$$\frac{H}{L} \leq \ 1 \ \text{(for H} > 400 \ \text{mm)}$$

– For cage length K

$$K \leq L - \frac{H}{2}$$

Design and Fitting Guidelines

– For the relationship cage length K to linear bearing spacing Q; CL to CL

$$\frac{K}{Q} \geqslant 1$$

K = Cage length
H = Stroke
L = Length of linear bearing
Q = Linear bearing spacing; CL to CL
a_n = Endpiece thickness
L_{tot} = Necessary fitting space

Protruding cages are practical when a short table is to be moved on a long guideway. They ensure that the upper section is always supported over the whole length, which is favorable for the load carrying capacity and the rigidity. In this case short linear bearings with rounded entries must be ordered (–EG).
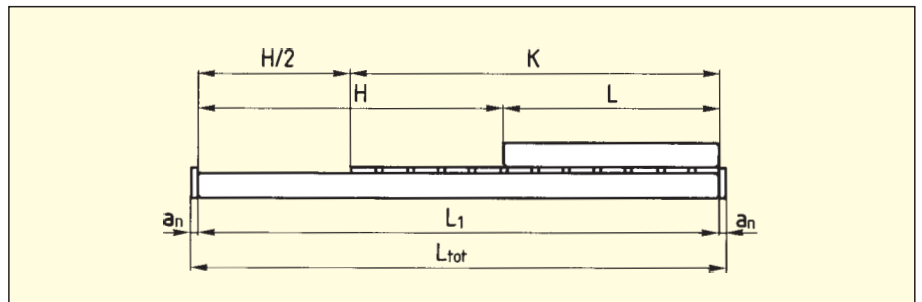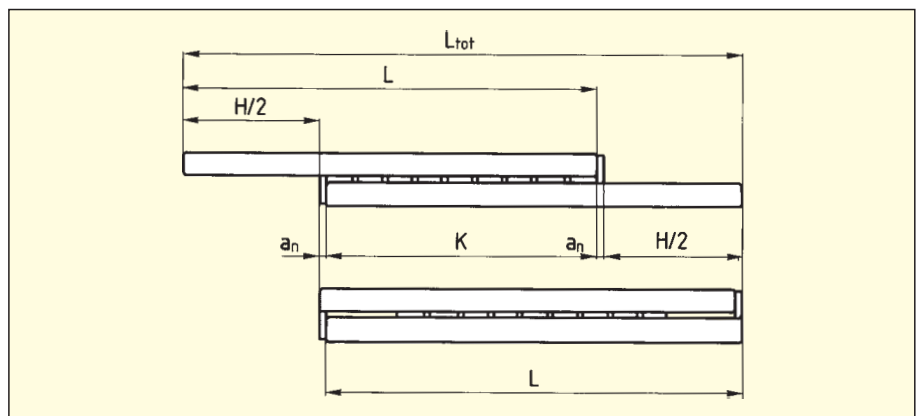

Maximum permissible fitting relationship $L : L_1$
– For preloaded guideways 1 : 2
– For gravity loaded guideways 1 : 4

On various linear bearings endpieces with wipers can be used. Two fitting options are feasible. In both cases the following length relationship results:

1st Option: Anti-friction guideways with wipers and equal length linear bearings
$K = L - H/2 - a_n$
$L_{tot} = L + H/2 + a_n$

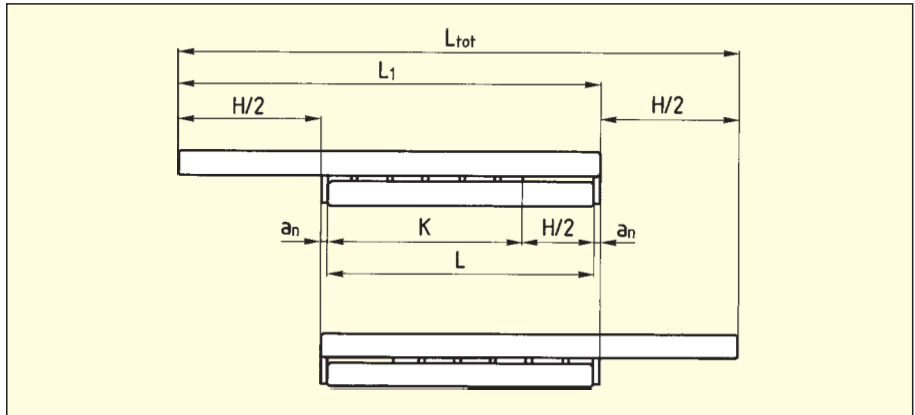With this design the linear bearings must be fitted offset by the amount a_n.

2nd Option: Anti-friction guideways with wipers and unequal length linear bearings
$K = L - H/2$
$L_{tot} = L_1 + H/2$
(when long guideway moves)
$L_{tot} = L_1$ (when short guideway moves)

Basically, the stroke should be limited by means of stops on the table and not by the cages. The stops should preferably be fitted on the symmetrical axis of the guideway in order to prevent additional forces acting on the linear bearing.

Recirculating Units

When recirculating units are used, there are no limitations in travel as, for long strokes, linear bearings can be ground together (chapter 15.1).

With regard to spacing K of the recirculating unit to the linear bearing spacing Q, the following relationship is recommended:
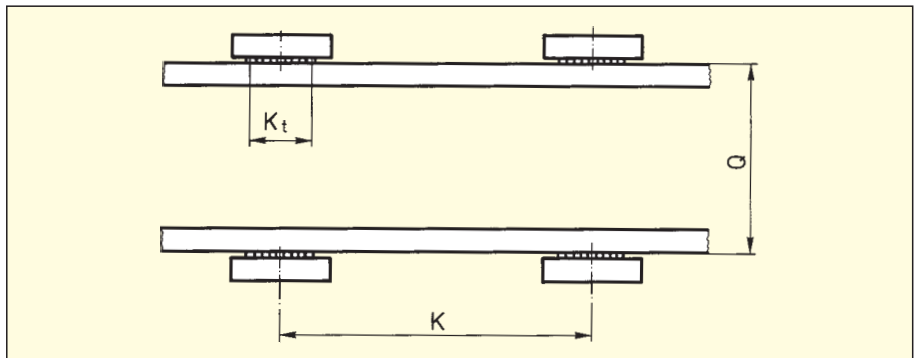

– When more than 2 recirculating units are used: Middle/middle of recirculating units K to guideway spacing Q

$$\frac{K}{Q} \geq 1$$

– When a total of 2 recirculating units are used: Load carrying length K_t to guideway spacing Q

$$\frac{K_T}{Q} \geq 1$$

Basically the stroke should be limited by means of stops on the table. It is advantageous to place the drive and the stops in the symmetrical axis of the guideway to prevent additional forces acting on the recirculating units.
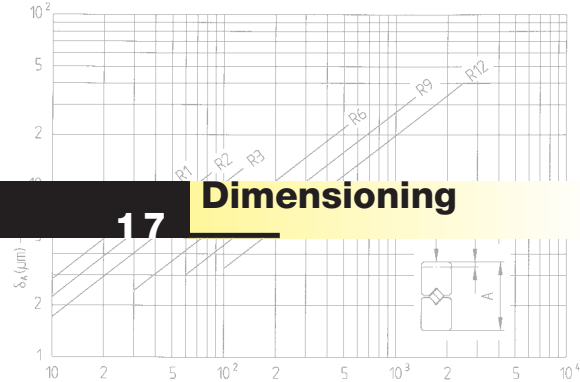
17.1 Load Carrying Capacity and Operational Life

In dimensioning anti-friction guideways, the loads encountered in relationship to the load carrying capacity are decisive. The length must be adapted to the stroke and in addition the elastic deformation, or the rigidity, must be noted.

The load carrying capacities of the individual anti-friction guideways are based on the fundamentals established by ISO for the calculation of roller bearings (ISO standard 281). The load carrying capacity C is the load with which a nominal operational life of 100 000 m travel results, given that the size and direction of the load remain unchanged and the line of application is vertical onto the rolling element.

The latest research results have shown that the static load should not be greater than the dynamic load. The reason for this lies in the fatigue behavior which is always initiated at the highest loaded point. In the case of an absolutely constant load during standstill and in operation, the fatigue process will start at that point where the static load is present longest.

The C-values given are to be used in the operational life equation to calculate the permissible load, or the operational life resulting with a given load.

The operational life is the travel in meters which is made by a linear bearing before the first signs of material fatigue on any of the components appear. The nominal operational life is achieved when 90 % of a large number of the same type of linear bearings achieve or exceed the prescribed amount of travel.

As previously mentioned, the load carrying capacity value C is based on an operational life of 100 000 m. Some manufacturers use, for various reasons, a larger load carrying capacity with 50 000 m operational life. The C_{50} values for SCHNEEBERGER anti-friction guideways are calculated as follows:

$C_{50} = C \cdot 1{,}23$ for rollers and needles
$C_{50} = C \cdot 1{,}26$ for balls

The operational life L, the load carrying capacity C (N) and the loading P (N) have the following relationship:

$$L = a \left(\frac{C_{eff}}{P}\right)^{10/3} \cdot 10^5 \text{ m for rollers and needles}$$

$$L = a \left(\frac{C_{eff}}{P}\right)^{3} \cdot 10^5 \text{ m for balls}$$

whereby a is the probable life expectancy factor. The operational life in hours can be calculated when the single stroke H (m) and the time needed for it t (s) are known:

$$L_h = \frac{L \cdot t}{H \cdot 3600} \text{ in h}$$

Life Expectancy

According to the ISO standard the load carrying capacities for roller bearings are given in such a manner that from the operational life equation a value results which, with 90% probability, will be exceeded. Should this probability not suffice, then the operational life must be shortened with a factor as in the following table:

Life Expectancy %	90	95	96	97	98	99
a	1	0.62	0.53	0.44	0.33	0.21

Load Carrying Capacity

One can only speak of a permissible load, or load carrying capacity, for anti-friction guideways when it is mentioned together with the operational life desired. As can be seen from the previous calculation, the value $L = 100\,000$ m is used as the standard operational life.

Other influences can reduce the load carrying capacity C so that a C_{eff} has to be calculated.

$$C_{eff} = f_H \cdot f_T \cdot C$$

Running Surface Hardness

Anti-friction guideways using materials hardened to less than 58 HRC have a reduced load carrying capacity as determined by factor f_H:

Running Surface Hardness (HRC)	20	30	40	50	55	56	57	58
Hardness Factor f_H	0.1	0.2	0.3	0.6	0.8	0.88	0.95	1

The reduced load carrying capacity is given by: $C_{fH} = f_H \cdot C$

Temperature

Increased temperatures can influence the operating characteristics negatively (lubrication, material properties) and have to be taken into consideration with factor f_T :

Temperature of Guide (° C)	150	200	250	300
Temperature Factor f_T	1.0	0.9	0.75	0.6

The reduced load carrying capacity is given by: $C_{fT} = f_T \cdot C$
Note the limitations in chapter 15.3

Dynamic Equivalent Loading
With stepped changes in load for rollers and needles

$$P = \sqrt[10/3]{\frac{1}{L} \ (F_1^{10/3} \cdot L_1 + F_2^{10/3} \cdot L_2 + \ldots + F_n^{10/3} \cdot L_n)}$$

With stepped changes in load for balls

$$P = \sqrt[3]{\frac{1}{L} \ (F_1^{3} \cdot L_1 + F_2^{3} \cdot L_2 + \ldots + F_n^{3} \cdot L_n)}$$

With sinusoidal loading for rollers, needles and balls

$$P = 0.7 \ F_{max}$$

$F_1 \ldots F_n$	Single load during partial stroke $L_1 \ldots L_n$ in N
$L_1 \ldots L_n$	Partial stroke of a single load during one load cycle in mm
$L = L_1 + \ldots + L_n$	Total stroke during one load cycle in mm
P	Equivalent load in N
F_{max}	Single load in N

17.2   Elastic Deformation and Rigidity

The total deformation δ_A – that is the deformation of the rolling elements in connection with hard guideways (min. 58 HRC) – can be read from the following diagrams: The deformation of the pre-loaded assembly can be determined from the same diagrams.
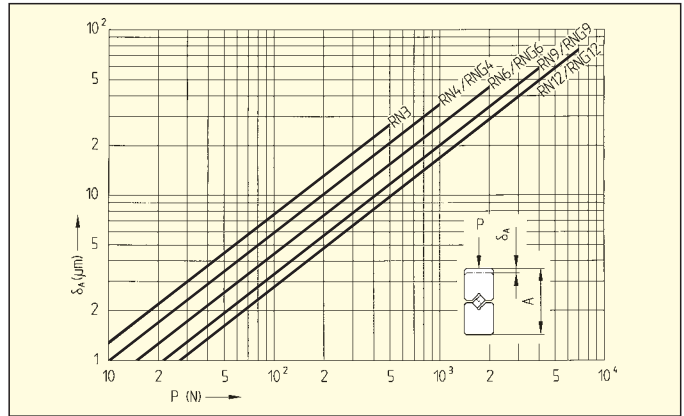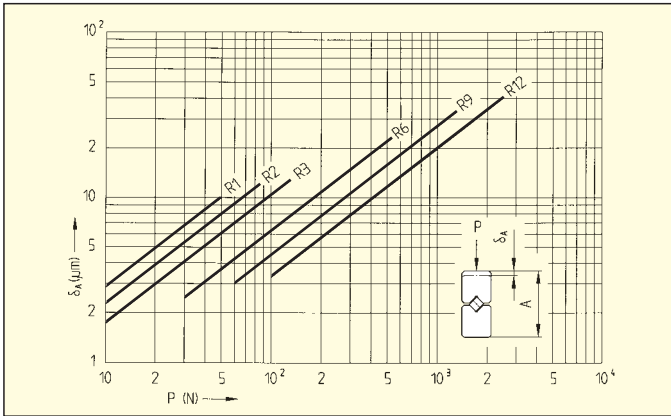

Diagram 1:
Elastic deformation of type R linear bearings with reference to P per roller

Diagram 2:
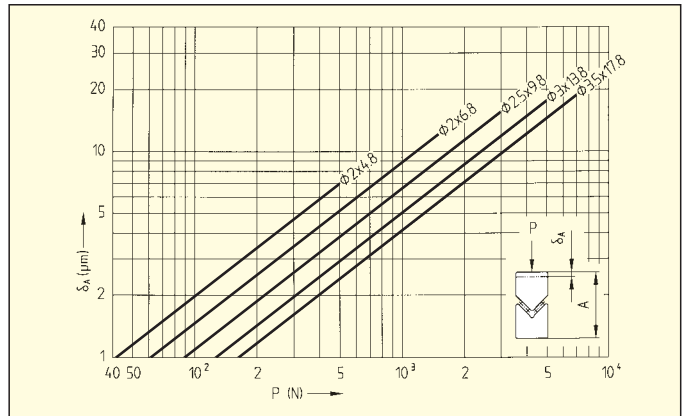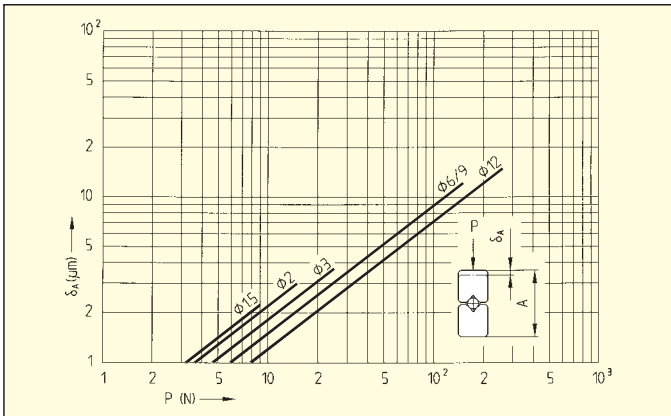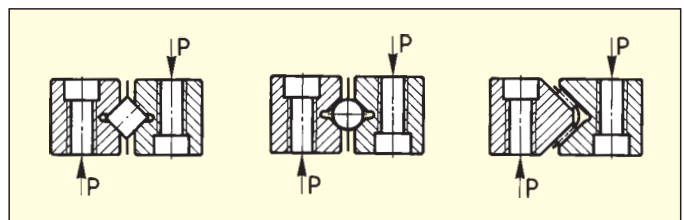Elastic deformation of type RNG linear bearings with reference to P per roller

Diagram 3:
Elastic deformation of type R linear bearings with reference to P per ball

The deformation of pre-loaded assemblies can be determined from the same diagrams.

When calculating cross-roller linear bearings it should be noted that as opposed to needles and balls only every second roller can accept loading.

Diagram 4:
Elastic deformation of type N/O linear bearings with reference to P for N/O per pair of needles
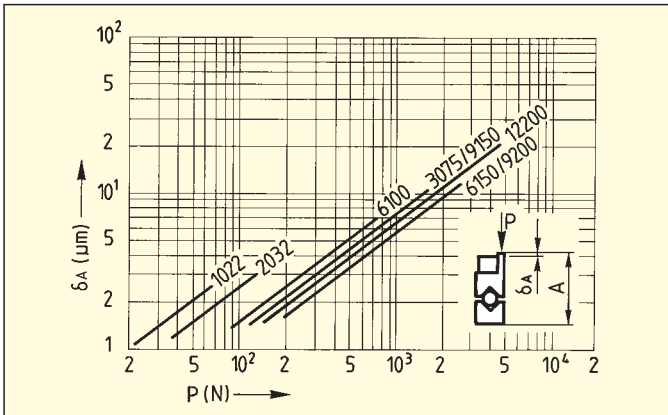
Recirculating Units

Diagram 1: Elastic deformation of type SK recirculating units used with type R or RD linear bearings
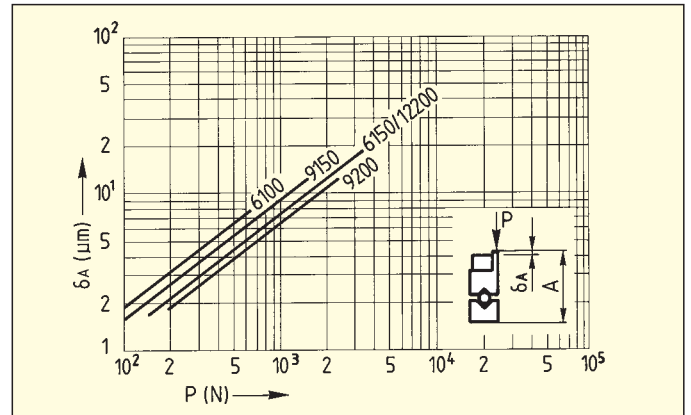

Diagram 2: Elastic deformation of type SKD recirculating units used with type R or RD linear bearings
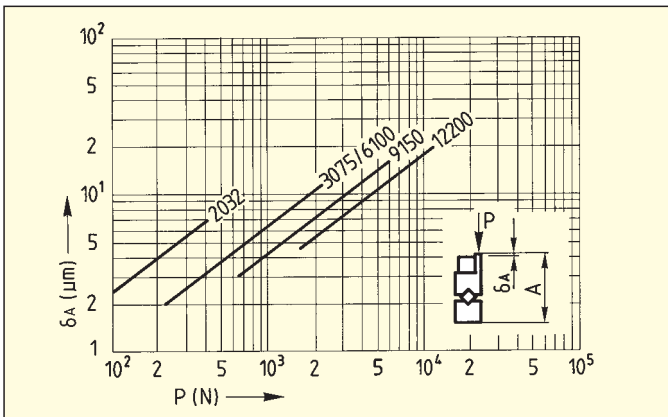

Diagram 3: Elastic deformation of type SR recirculating units used with type R or RD linear bearings
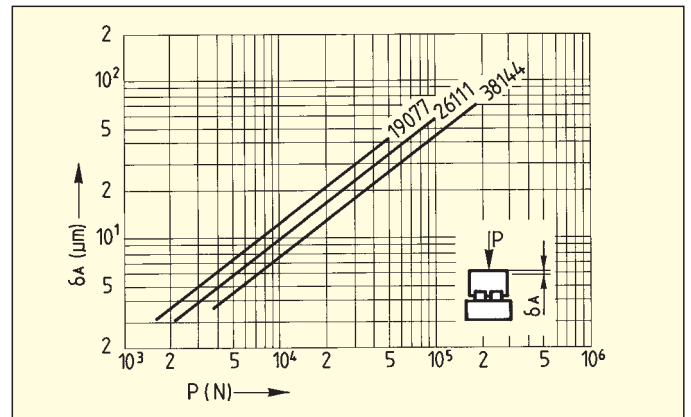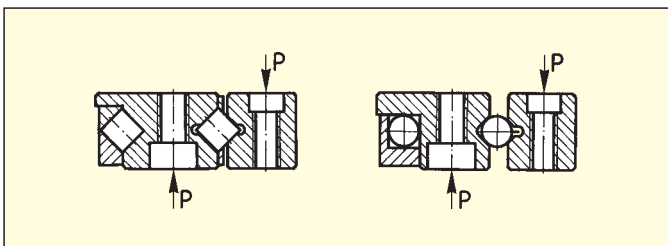

Diagram 4: Elastic deformation of type NRT recirculating units used with hardened guideways

The deformation of preloaded assemblies can be determined from the same diagrams.

When calculating crossroller linear bearings it should be noted that as opposed to needles and balls only every second roller can accept loading.

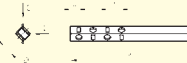## 17.3 The Essentials Summarized

Linear Bearings

Dimensioning

Relationship of stroke to length of linear bearing

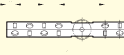$$\frac{H}{L} \leqslant 0.7 \ (H \leqslant 400 \ mm) \qquad \frac{H}{L} \leqslant 1 \ (H > 400 \ mm)$$

Cage length

$$K \leqslant L - \frac{H}{2}$$

Number of rolling elements per cage KBN, AC, AK, EE, SHW, HW

$$R_A = \frac{K - 2w}{t} + 1 \ \text{or} \ R_A = \frac{K_t}{t} + 1$$

Number of rolling elements per cage KBS

$$R_A = \frac{K - (2w + t_z)}{t} + 2$$

Cage length to linear bearing spacing; CL to CL

$$\frac{K}{Q} \geqslant 1$$

K	= Cage length in mm
L	= Length of linear bearing in mm
H	= Stroke in mm
R_A	= Total number of rolling elements per cage
w	= Distance start of cage to middle of first rolling element in mm
t	= Cage pitch in mm
K_t	= Load carrying length in mm
Q	= Linear bearing spacing; CL to CL in mm
R_T	= Number of load carrying rolling elements per cage
R_{Tmin}	= Correction factor dependent on rolling element
δ_A	= Deformation in µm

Operational Life

Operational life of rollers and needles $\qquad L = a \left(\dfrac{C_{eff}}{P}\right)^{10/3} \cdot 10^5$

Operational life of balls $\qquad L = a \left(\dfrac{C_{eff}}{P}\right)^{3} \cdot 10^5$

Effective load carrying capacity $\qquad C_{eff} = f_H \cdot f_T \cdot C$

L	= Nominal operational life in m
C	= Max. permissible load carrying capacity per rolling element in N
C_{eff}	= Effective load carrying capacity per rolling element in N
a	= Probable life expectancy factor
P	= Equivalent load in N
f_H	= Hardness factor
f_T	= Temperature factor

Recirculating Units

Dimensioning

Relationship of spacing K or K_t to average linear bearing spacing

$$\frac{K}{Q} \geqslant 1 \quad \text{or} \quad \frac{K_t}{Q} \geqslant 1$$

H	= Stroke in mm
K_t	= Load carrying length in mm
L	= Length of recirculating unit in mm
M_L	= Permissible moment loading in Nm lengthwise and sidewise
M_Q	= Permissible moment loading in Nm crosswise
K	= Distance middle/middle of outermost recirculating units in mm
Q	= Linear bearing spacing; CL to CL in mm
R_T	= No. of load carrying recirculating units on one guideway side
R_{Tmin}	= Correction factor dependent on rolling element

Operational life

Operational life of rollers $\quad L = a \left(\frac{C_{eff}}{P} \right)^{10/3} \cdot 10^5$

Operational life of balls $\quad L = a \left(\frac{C_{eff}}{P} \right)^{3} \cdot 10^5$

Effective load carrying capacity $\quad C_{eff} = f_H \cdot f_T \cdot C$

L	= Nominal operational life in m
C	= Max. permissible load carrying capacity per recirculating unit in N
C_{eff}	= Effective load carrying capacity per recirculating unit in N
a	= Probable life expectancy factor
P	= Equivalent load in N
f_H	= Hardness factor
f_T	= Temperature factor
δ_A	= Deformation in µm

18.1 Load carrying capacity and operational life

In the previous sections it was explained how, from the given load carrying capacity and the loads occurring, the operational life can be calculated. The crucial significance of a realistic calculation of the forces occurring is obvious. It is equally important to estimate the behavior of the base construction when the forces are transmitted to the anti-friction guideway. Elastic deformation of a machine bed leads, for example, to the fact that only a few of the rolling elements fitted actually can accept loading. Geometric errors have the same effect.

Reliable propositions on this application-specific problem can usually only be compiled with great effort either with measurements on functional models or with calculations using the finite element method. The result is that normal dimensioning is made using simplified measures i.e. the external load is distributed over only a few rollers by means of the correction factor R_{Tmin}.
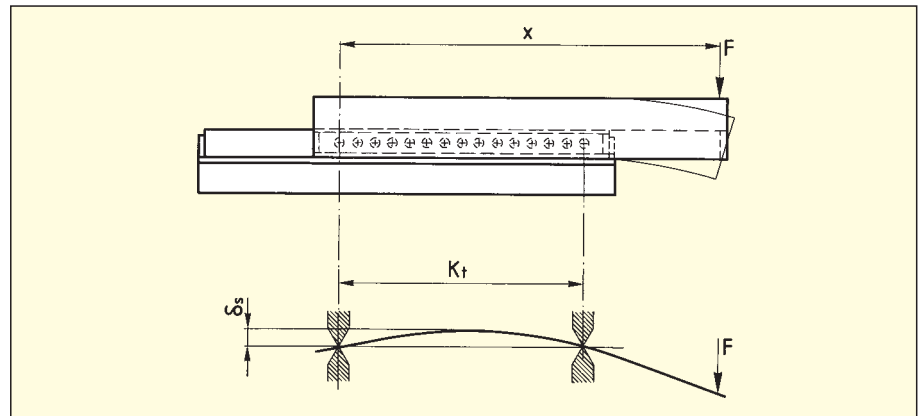
The load carrying capacities C/Roller in this catalog are empirically determined and do not correspond to DIN-calculated figures.

Correction Factor R_{Tmin}

To determine R_{Tmin} the base construction must first be assessed using the following empirical figures:

A: Extra rigid construction $\delta_S \leqslant 0.1 \cdot \delta_A$
B: Rigid construction $\delta_S > \delta_A$

F:	Load in N
x:	Spacing in mm
K_t:	Load carrying cage length in mm
δ_S:	Deformation of base construction in μm
δ_A:	Deformation of rolling elements and linear bearings (Diagram chapter 17.2) in μm

From the following diagram the values for R_{Tmin} are:

Construction	A (Extra rigid)	B (Rigid)
$X > K_t$	R_{Tmin} to $R_T/4$	R_{Tmin}
$X < K_t$	Per Diagram	Per Diagram
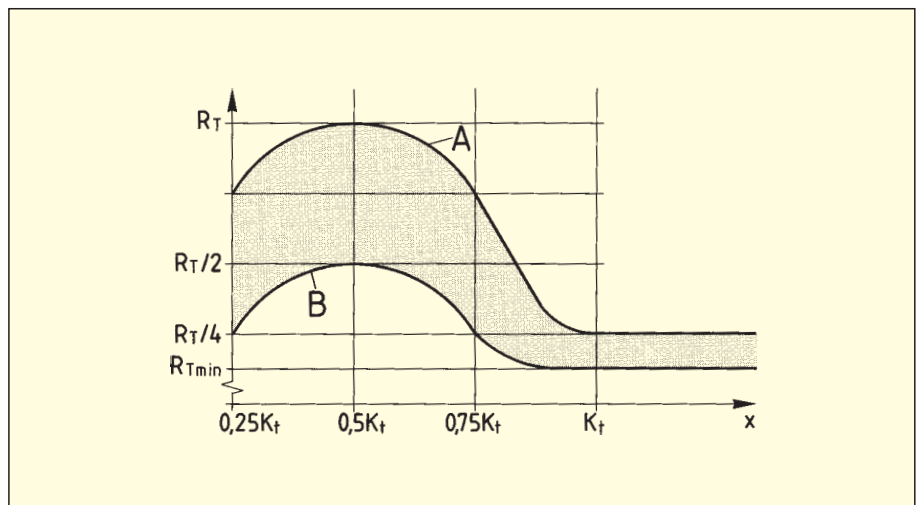
| R_{Tmin}	Rolling Element	Type of Cage
2	Balls	AK
1	Cross rollers	AC, EE, KBN, KBS
5	Needles	SHW, HW
0.5	For Recirculating Units with Rollers	
1	For Recirculating Units with Balls	

The effect of preload must be taken into consideration as follows: External loads which load the individual rolling elements more heavily then the preload: no influence. With the intermittent absence of the external load or if the preload should exceed the external load, then the preload is contributory to, or determines, the operational life.

Exception: When only 2 recirculating units are used per guide then the moments indicated in the tables (M_L, M_Q) may not be exceeded.

The following calculation examples illustrate the procedure with a few typical problems.

Calculation Examples

1ˢᵗ Example

Given: Linear bearings type R 6
R_A = 8 rollers
F   = 350 N
x   = 120 mm

a) Roller cage type AC 6 K_t = $(R_A - 1) \cdot t$
                                    R_{Tmin} = 1
                                    C   = 530 N

b) Ball cage type AK 6 K_t = $(R_A - 1) \cdot t$
                                      R_{Tmin} = 2
                                    C   = 65 N
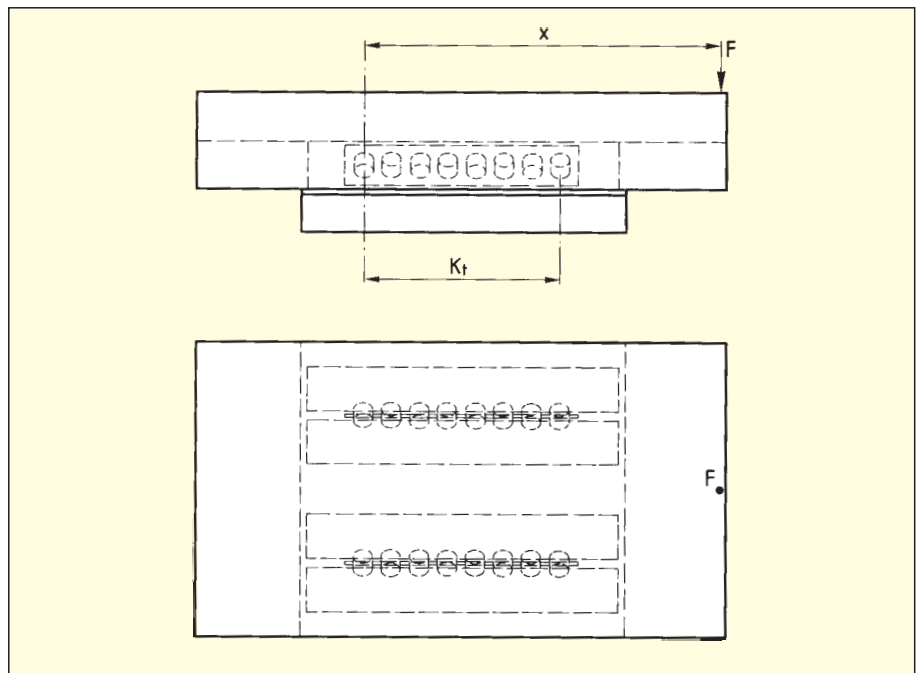
The asymmetrical distribution of force is most reliably taken into consideration when the load is reduced on the number of loaded rolling elements (R_{Tmin}) in the guide.

Control calculation:

For rollers $P = \dfrac{F \cdot x}{K_t \cdot 2} \cdot \dfrac{1}{R_{Tmin}} = \dfrac{350 \cdot 120}{63 \cdot 2} \cdot \dfrac{1}{1} = 334$ N

For balls $P = \dfrac{F \cdot x}{K_t \cdot 2} \cdot \dfrac{1}{R_{Tmin}} = \dfrac{350 \cdot 120}{63 \cdot 2} \cdot \dfrac{1}{2} = 167$ N*

*Possibly new control calculation with modified design

2nd Example

Given:
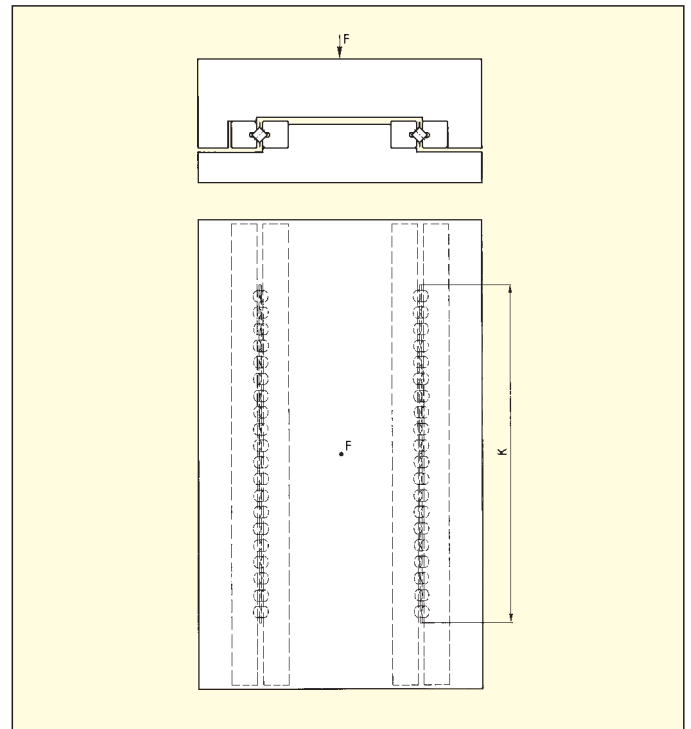Linear bearings type R 6
Roller cages type AC 6
R_A = 20 rollers

$$R_T = \frac{R_A}{2} = \frac{20}{2} = 10 \text{ rollers}$$

K = $(R_A - 1) \cdot t + 2w = (20 - 1) \cdot 9 + 12 = 183$ mm
F = 6500 N
C = 530 N

Control calculation: $P \quad \frac{F}{2} \cdot \frac{1}{R_T} = \frac{6500}{2} \cdot \frac{1}{10} = 325$ N

3rd Example

Given:
Rigid table construction
Linear bearings type R 6
Ball cage type AK 6
R_A = R_T = 12 balls
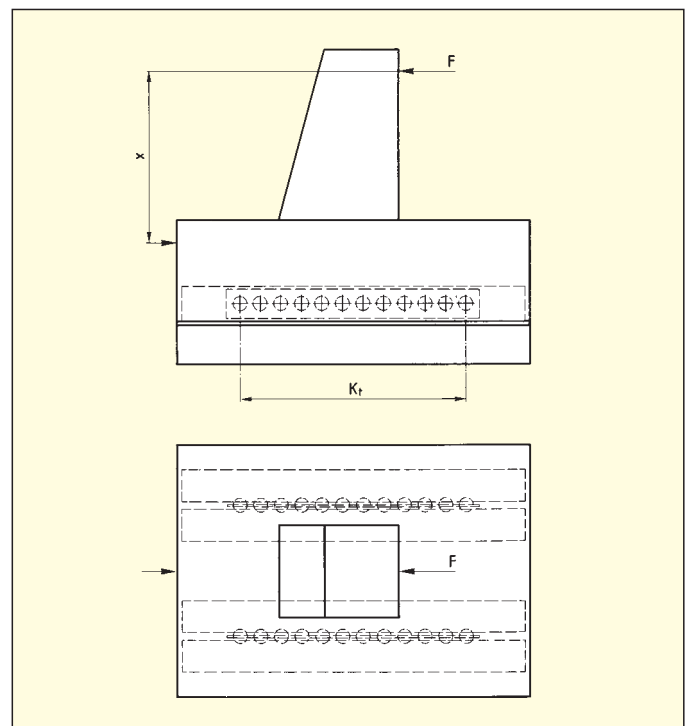R_{Tmin} = 3 $\triangleq R_T/4$ (see diagram, chapter 18.1)
K_t = $(R_A - 1) \cdot t$
F = 240 N
x = 75 mm (distance F to counter force)
C = 65 N

Control calculation: $P \quad \frac{F \cdot x}{K_t \cdot 2} \cdot \frac{1}{R_{Tmin}} = \frac{240 \cdot 75}{99 \cdot 2} \cdot \frac{1}{3} = 30$ N

Calculation Examples

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4th Example

Given:
Linear bearings type RNG
Roller cage type KBN

R_A = 10 rollers

$R_T = \dfrac{R_A}{2} = \dfrac{10}{2}$ = 5 rollers
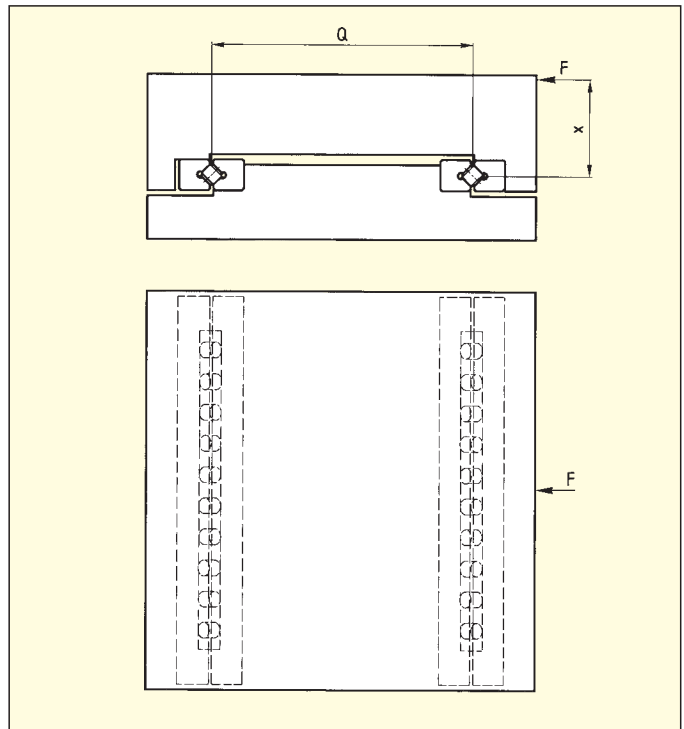
F   = 15 000 N
x   = 50 mm
Q   = 100 mm

Calculation:

$P_1 = \dfrac{F \cdot x}{Q} \cdot \dfrac{1}{R_T} = \dfrac{15\,000 \cdot 50}{100} \cdot \dfrac{1}{5} = 1500$ N

$P_2 = \dfrac{F}{R_A} = \dfrac{15\,000}{10} = 1500$ N

$P = P_1 + P_2 = 1500 + 1500 = 3000$ N*

*According to the tables in chapter 7.1, the next loading limit is
 C = 3900 N, corresponding to Size 9

5th Example

Given:
Linear bearings type N/O 2025
Needle cage type SHW 15

K   = 194 mm

$R_A = R_T = \dfrac{K - 2w}{t} + 1$
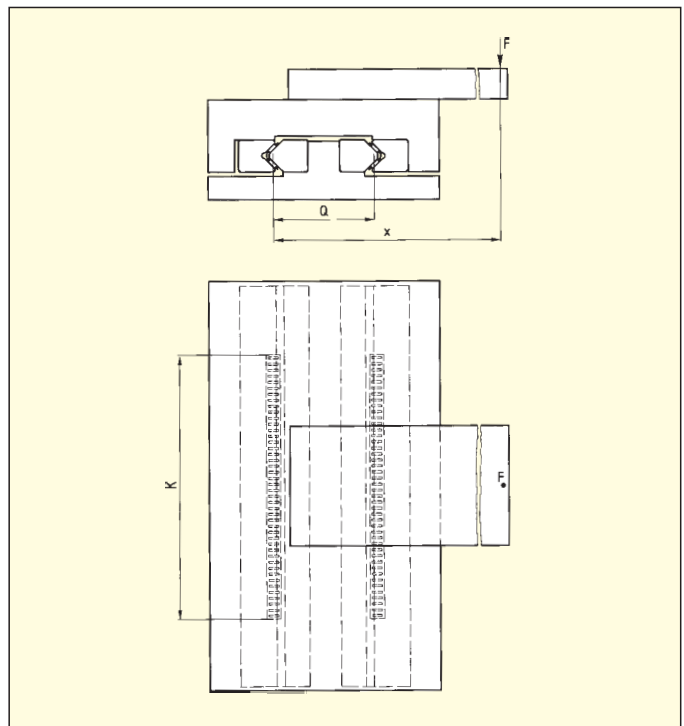
$= \dfrac{194 - 6}{4} + 1 = 48$ needles

F   = 5000 N
x   = 280 mm
Q   = 75 mm
C   = 750 N

Control calculation: $P \dfrac{F \cdot x}{Q} \cdot \dfrac{1}{R_T} = \dfrac{5000 \cdot 280}{75} \cdot \dfrac{1}{48} = 389$ N

6th Example

Given:
Rigid construction
Linear bearings type R 12
Roller cage type AC 12

K = 400 mm

K_t = $K - 2w = 400 - 22 = 378$ mm

R_A = $\dfrac{K_t}{t} + 1 = \dfrac{378}{18} + = 22$ rollers

R_T = $\dfrac{R_A}{2} = \dfrac{22}{2} = 11$ rollers

$x > K_t$ = $R_T/4$ (see diagram, chapter 18.1)

$R_{TQ(Cross)}$ = R_T

$R_{TL(Lengthwise)}$ = $\dfrac{R_T}{4} = \dfrac{11}{4} = 2{,}75$ rollers (rounded-off to 2)

F = 2000 N

x = 500 mm

x_1 = 200 mm

Q = 100 mm

C = 2500 N

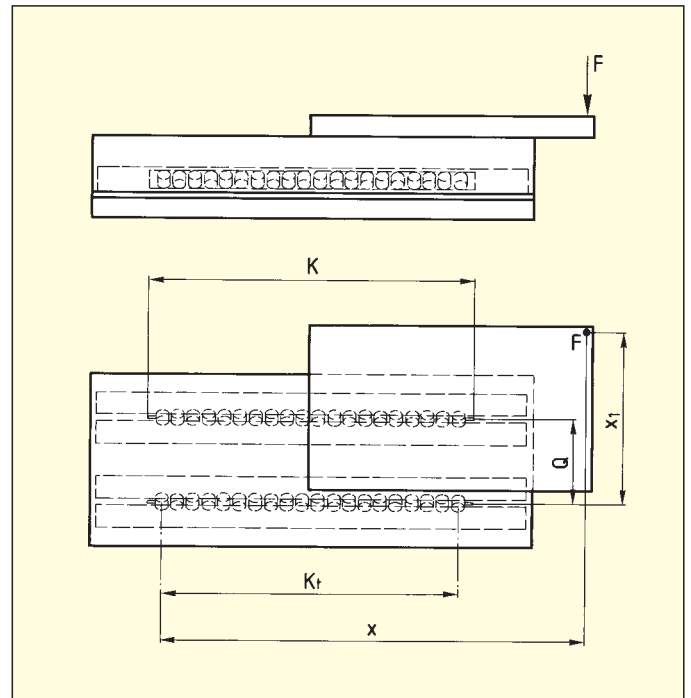Control calculation:
Crosswise loading

$$P_Q = \frac{F \cdot x_1}{Q} \cdot \frac{1}{R_{TQ}} = \frac{2000 \cdot 200}{100} \cdot \frac{1}{11} = 364 \text{ N}$$

Lengthwise loading

$$P_L = \frac{F \cdot x}{K_t \cdot 2} \cdot \frac{1}{R_{TL}} = \frac{2000 \cdot 500}{378 \cdot 2} \cdot \frac{1}{2} = 662 \text{ N}$$

$$P = P_Q + P_L = 364 + 662 = 1026 \text{ N*}$$

*For design reasons size 12 is selected. From the loading point-of-view the next smaller guideway cross section would suffice. Possibly check design.

7th Example

Given:
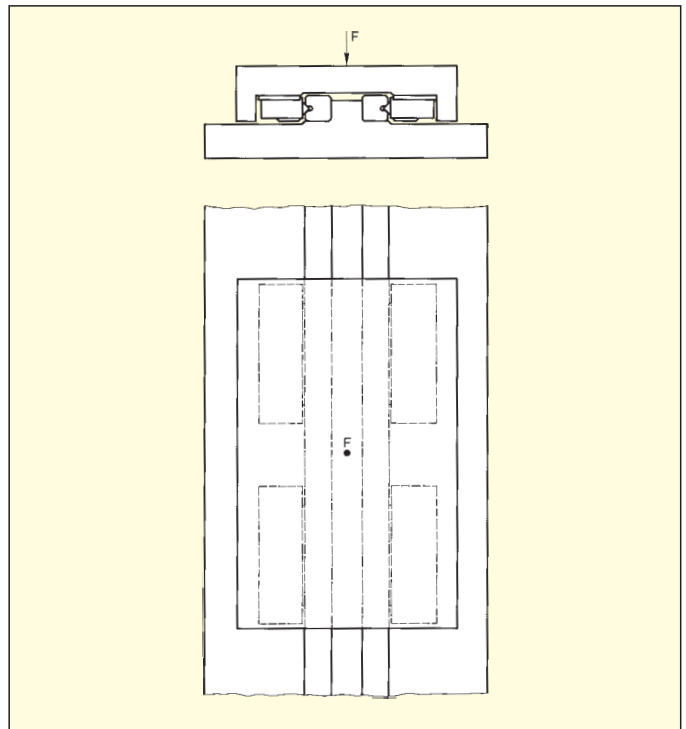Recirculating units type SR 6-100
Linear bearings type R 6
R_T = 2 Recirculating units
F = 6000 N
C = 2150 N

Control calculation:
$$P = \frac{F}{2} \cdot \frac{1}{R_T} = \frac{6000}{2} \cdot \frac{1}{2} = 1500 \text{ N}$$

8th Example

Given:
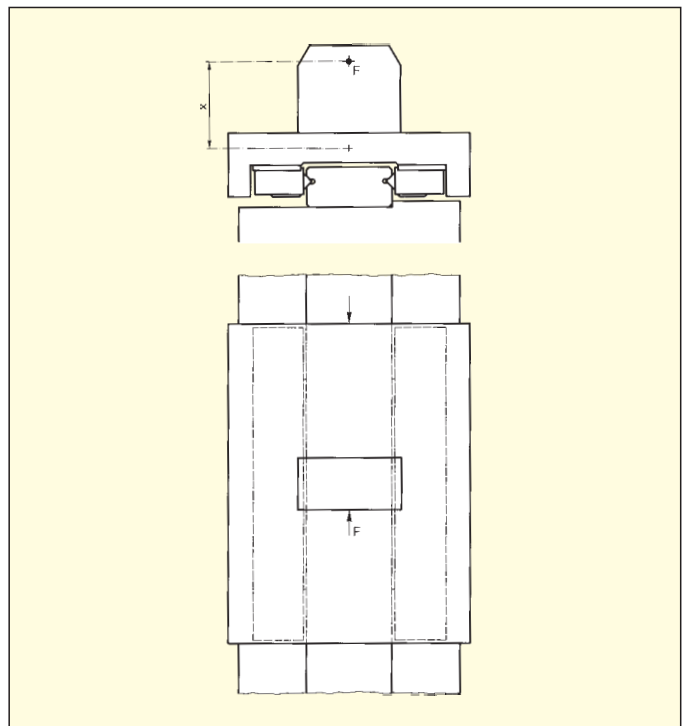Recirculating units type SR 6-150
Linear bearing type RD 6
M_L = 112 Nm
x = 45 mm (Distance F to counter force)
F = 2000 N

Control calculation:

$$M = F \cdot x = 2000 \cdot 0.045 = 90 \text{ Nm}$$

9th Example

Given:
Recirculating units top type NRT 26 111, C = 98 000 N
Recirculating units bottom type NRT Special, C = 61 000 N
Recirculating units lateral type NRT 19 077, C = 43 000 N
Special linear bearings

K $\quad$ = $\quad$ 700 mm
K_1 $\quad$ = $\quad$ 450 mm
R_{Tmin} $\quad$ = $\quad$ 0.5
F $\quad$ = $\quad$ 83 000 N
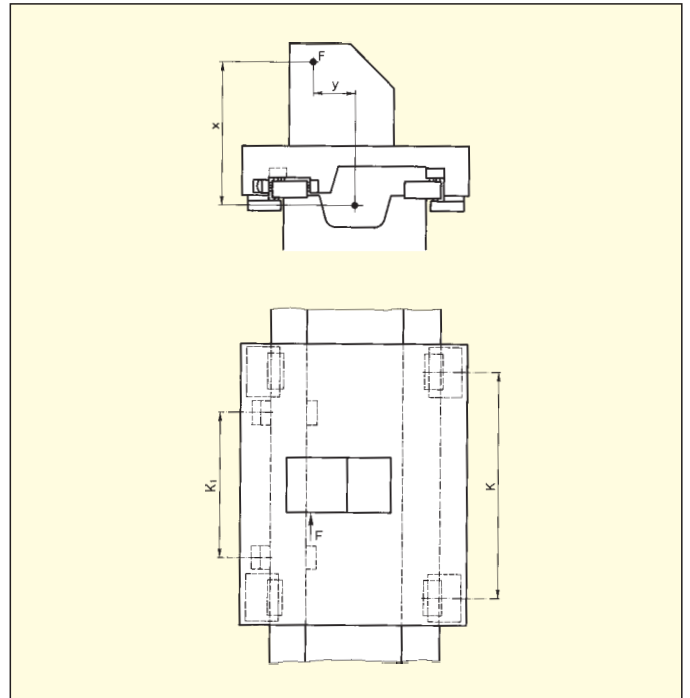x $\quad$ = $\quad$ 500 mm
y $\quad$ = $\quad$ 100 mm

Control calculation:
Lengthwise loading

$$P_L = \frac{F \cdot x}{K \cdot 2} \cdot \frac{1}{R_{Tmin}} = \frac{83\,000 \cdot 500}{700 \cdot 2} \cdot \frac{1}{0.5} = 59\,286 \text{ N}$$

Crosswise loading

$$P_Q = \frac{F \cdot y}{K_1} \cdot \frac{1}{R_{Tmin}} = \frac{83\,000 \cdot 100}{450} \cdot \frac{1}{0.5} = 36\,889 \text{ N}$$

Calculation Examples

Product Denotations

Type	Accessories	Chapter
RN	Cages: KBN Endpieces: GAN, GA Special Attaching Screws: GD	3
RNG	Cages: KBN Endpieces: GBN, GCN, GCN-A Special Attaching Screws: GDN	4
R	Cages: AC, AK, EE Endpieces: GA, GB, GC, GC-A Special Attaching Screws: GD Recirculating Units: SK, SKC, SKD, SR	5
RD	Cages: AC, AK Recirculating Units: SK, SKC, SKD, SR	6
N and O	Cages: SHW, HW Endpieces: GFN, GFO, GH, GH-A, GW, GW-A Special Attaching Screws: GD	8
M and V	Cages: SHW, HW Endpieces: EM/EV, EAM, EAV	9
SK/SKD	–	11
SKC	–	12
SR	–	13
NRT	Connection to Central Lube System Preload Wedges: NRV	14

In order to process an order correctly we require the following data:
– Quantity
– Order No.
– Type of cage, length or number of rolling elements
– Endscrews or endpieces

Every non-standard component must be specially quoted.

Linear Bearings

Deviations from the standard Model	Suffix (quote when ordering)
Special Quality	– SQ e.g. N 2535–800–SQ
Corrosion resistant Model (Only Type R 1–R 12)	– RF e.g. R 3–200–RF
Entries rounded for Protruding Cages	– EG e.g. RNG 9–200–EG
For Roller Cages Type EE (Dim. J toleranced)	– EE e.g. R 6–300–EE
Linear Bearings ground together when L is greater than standard Length	– ZG, ground together to … e.g. RD 6–1700–ZG, ground together of RD 6–800 and RD 6–900
Height matched Linear Bearing with gravity loaded Fitting	– HA, Height matched e.g. R 9600–HA
Coating type Duralloy ®	– DU e.g. R 9–600–DU
Integrated cage assist	– KS e.g. RN 6–600–KS

Recirculating units
Matched sets (chapter 15.1), Suffix **matched** (GP), e.g. 12 Recirculating units SR 9-150, matched in sets of 3

Ordering example for 1 complete anti-friction guideway RNG 9 with protruding cage, 500 mm long base section and 200 mm stroke.
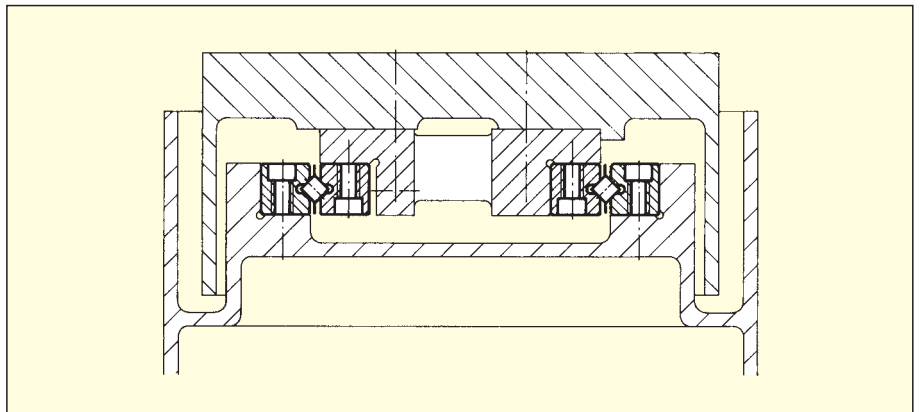
The following ordering data result:
2 Linear bearings RNG 9-500
2 Linear bearings RNG 9-300–EG
2 Roller cages KBN 9×33 rollers*
4 Endpieces GCN 9
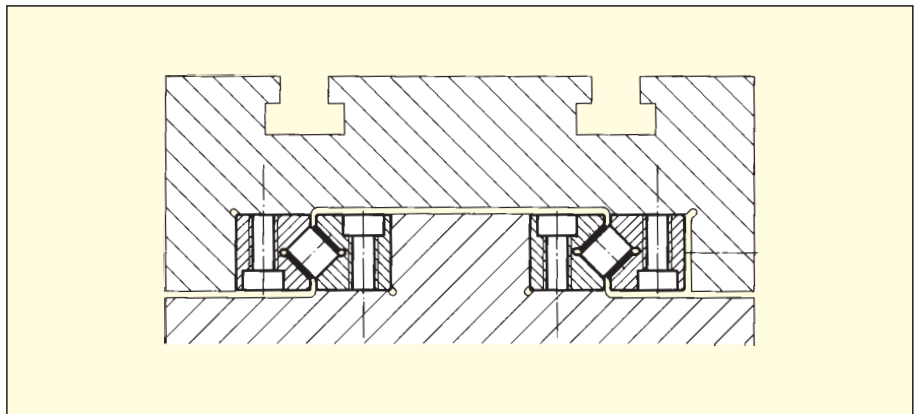
Ordering example for 1 complete anti-friction guideway R 9-700 with rollers, stroke 400 mm, horizontal fitting.

The following ordering data result:
4 Linear bearings R 9-700
2 Roller cages AC 9×35 rollers*
8 Endscrews GA 9

*   The cage length K is calculated from
    2 · dimension w (start and end) and
    Number of divisions · Pitch t
    Condition:
    $K \leqslant L - H/2$ (see also chapter 16.7)

Ordering example for a complete anti-friction guideway with recirculating units type SK, linear bearing type RD and sliding top section 410 mm long.

The following ordering data result:
4 Recirculating units SK 9-150, matched in sets of 2
1 Linear bearing RD 9-1000
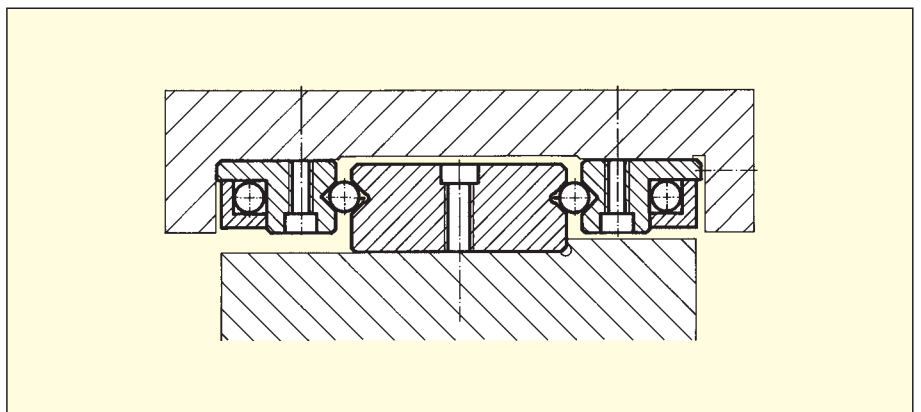
Special Linear Bearings and Recirculating Units

Our comprehensive standard range can be complemented with specially manufactured models, so that every wish can be realized with the best possible technical solution. We are in a position to provide complete solutions to specific problems in accordance with the demands placed. Please consult our specialists.

Ordering Information