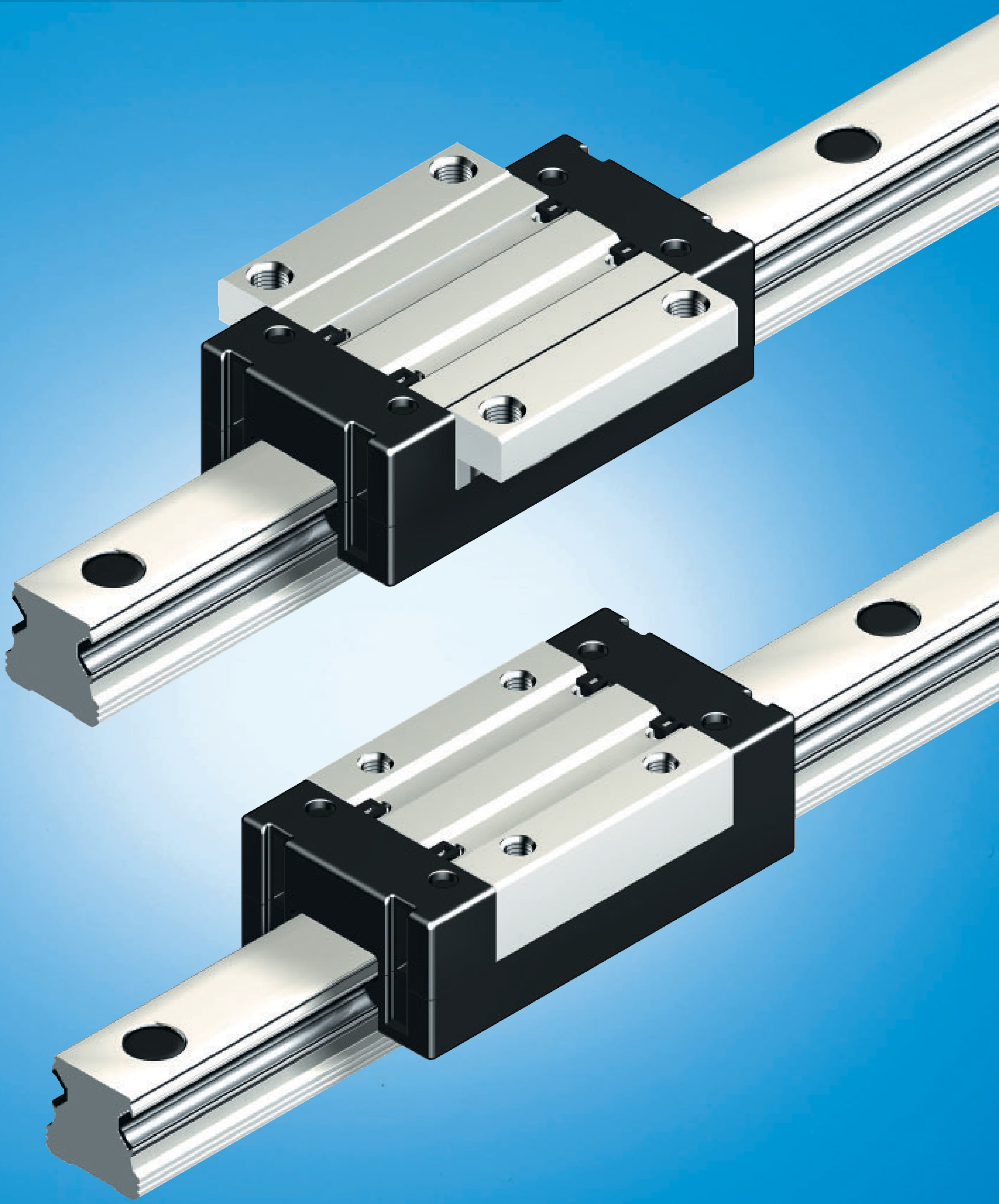
Rexroth
Bosch Group

Ball Rail Systems
eLINE

R310EN 2211 (2004.10)

The Drive & Control Company



Rexroth Linear Motion Technology

Ball Rail Systems	Standard Ball Rail Systems Super Ball Rail Systems Ball Rail Systems with Aluminum Runner Blocks High Speed Ball Rail Systems Corrosion Resistant Ball Rail Systems Wide Ball Rail Systems	
	Ball Rail Systems with Integrated Measuring System Braking and Clamping Units for Ball Rail Systems Gear Racks for Ball Rail Systems Miniature Ball Rail Systems eLINE Ball Rail Systems Cam Roller Guides	
Roller Rail Systems	Standard Roller Rail Systems Wide Roller Rail Systems Heavy Duty Roller Rail Systems Roller Rail Systems with Integrated Measuring System Braking and Clamping Units for Roller Rail Systems Gear Racks for Roller Rail Systems	
Linear Bushings and Shafts	Linear Bushings, Linear Sets Shafts, Shaft Support Rails, Shaft Support Blocks	
	Ball Transfer Units Traditional Engineering Components	
Screw Drives		
Linear Motion Systems	Linear Motion Slides	– Ball Screw Drive – Toothed Belt Drive
	Linear Modules	– Ball Screw Drive – Toothed Belt Drive – Rack and Pinion Drive – Pneumatic Drive – Linear Motor
	Compact Modules	– Ball Screw Drive – Toothed Belt Drive – Linear Motor
	Multi-Axis Motion Systems CMS	
	Precision Modules	– Ball Screw Drive
	Ball Rail Tables	– Ball Screw Drive – Linear Motor
	Controllers, Motors, Electrical Accessories	
	Linear Actuators	

Product Overview, Ball Rail Systems, eLINE

Product background

Profiled rail systems have firmly established themselves as standard linear motion solutions. They were developed for precision applications calling for high accuracy and rigidity of guidance, e.g. in machine tools. In the meantime, a great variety of other applications for rail systems have emerged where high rigidity and accuracy are frequently not the most important considerations.

Rexroth’s eLINE range of ball rail systems was developed for applications of this kind, especially for light machinery and for handling and positioning movements where the main emphasis is on economy and durability.

Made of wrought aluminum alloy with ball tracks of hardened antifriction bearing steel, the runner blocks and guide rails are characterized by their low weight, compact design, and equal load bearing capacity in all four main directions of loading.

Special features of the new eLINE Ball Rail Systems:

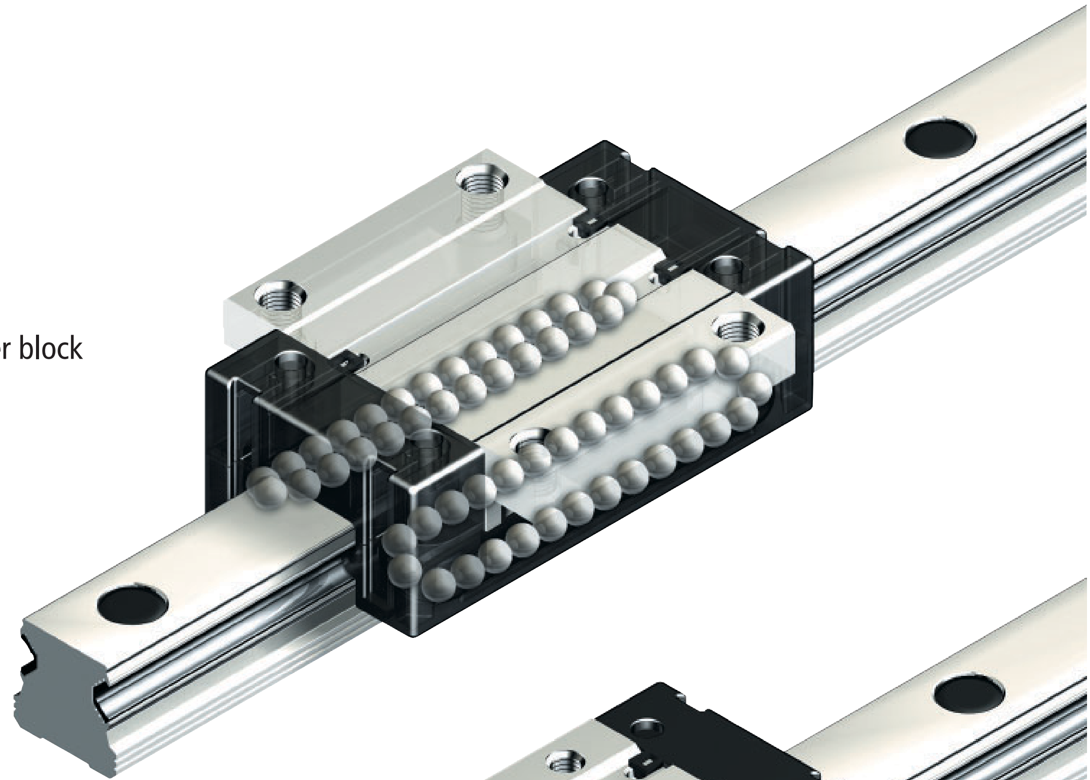
- Available* in the three most common sizes to DIN 645-1
- Structural design allows for much greater parallelism and height offsets of the mounting bases
- Can be mounted even on unmachined mounting surfaces, depending on the application
- Especially compact, lightweight design; 60% weight saving versus steel versions
- Much higher corrosion resistance than steel versions
- Two rows of especially large-diameter balls make this guide less sensitive to dirt while offering higher torsional stiffness
- Runner blocks initially greased in-factory, therefore provided with long-term lubrication
- Available in two accuracy classes and two preload classes
- Ball retainers in the runner blocks allow them to be removed from the rail without any loss of balls
- Optional lube units can be mounted at each end to prolong lubrication intervals still further, often reaching lube-for-life, and provide end sealing action
- Guide rails with reference edge on both sides
- All accuracy classes can be combined with one another
- Interchangeability allows individual stocking of runner blocks and guide rails – top logistics unequalled anywhere in the world
- Same connection dimensions as steel ball rail systems

Application areas:

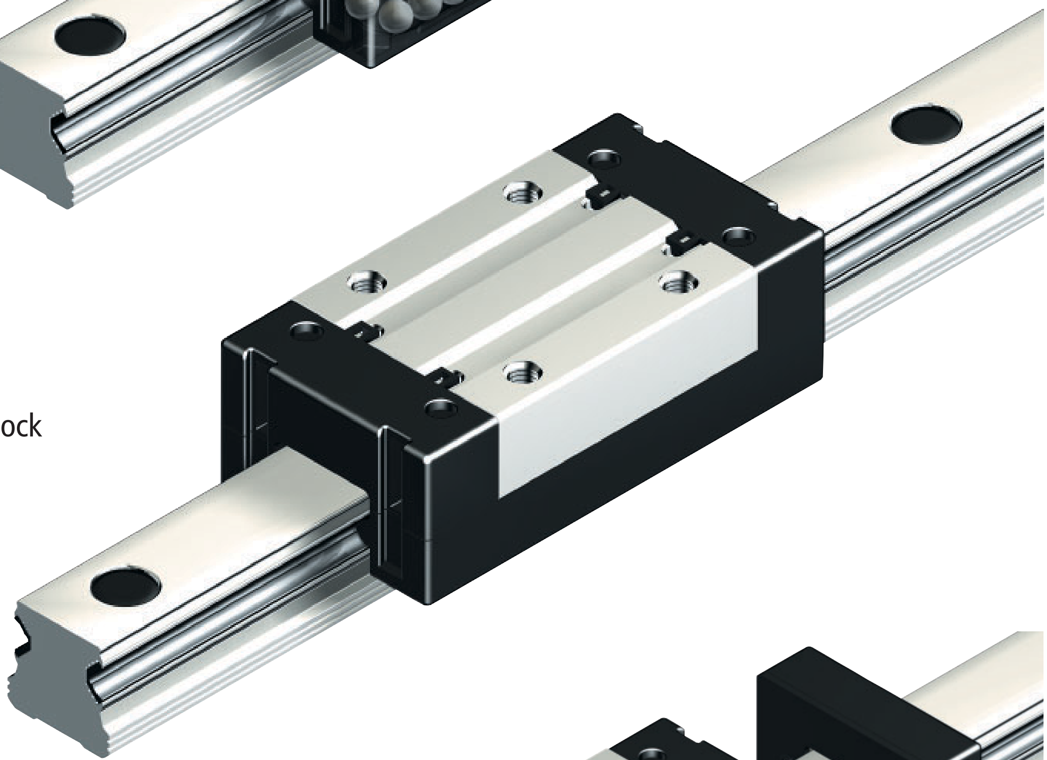
Light machinery, handling technology, jigs and fixtures, assembly technology, positioning units, manual displacement systems, machine enclosures, door and window construction, building services technology, trade show and shop construction, woodworking machinery, DIY equipment, and many more.

* Samples available as of 4th quarter 2004, series production as of 1st quarter 2005

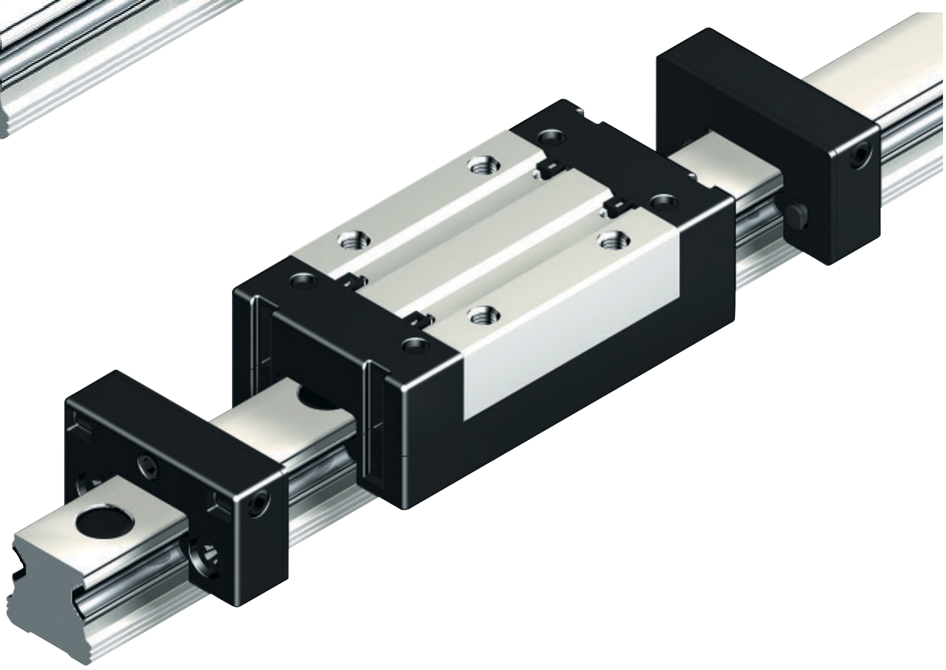
For additional information on the Ball Rail Systems range, see main catalog, “Rexroth Ball Rail Systems”.



eLINE flanged runner block



eLINE slimline runner block



Lube unit with sealing function
for eLINE Ball Rail Systems
(accessories)

General Technical Data and Calculations

Speed

$v_{max.} = 2$ m/s

Acceleration

$a_{max.} = 30$ m/s^2

Temperature resistance

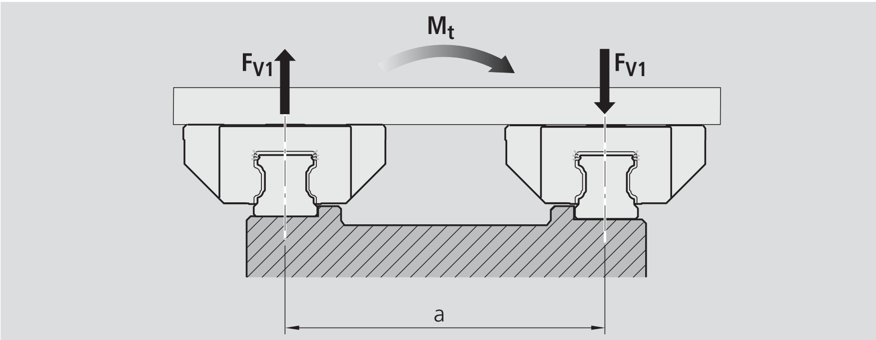
$t_{max.} = 60^{o}$C

Sealing

Lube units with sealing function DSE are available for Rexroth eLINE ball rail systems.

Information on moment load calculation

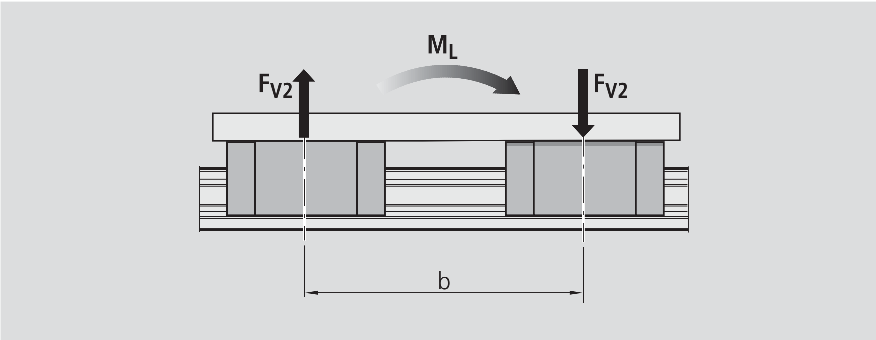
Conversion of a torsional moment acting on a table



$$F_{V1} = \frac{M_t}{a}$$

F_{V1}	=	external dynamic load	(N)
M_t	=	external torsional moment	(Nmm)
a	=	distance between guide rails	(mm)

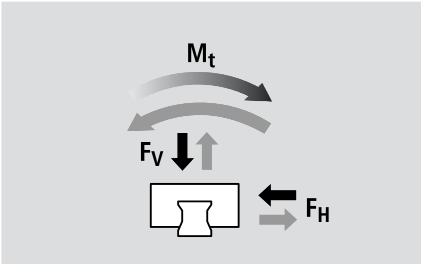
Conversion of a longitudinal moment acting on a table

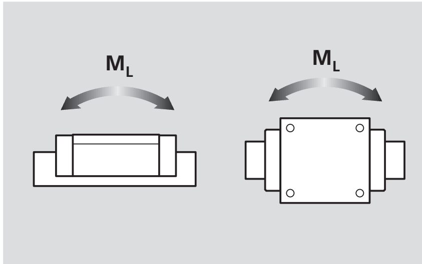


$$F_{V2} = \frac{M_L}{b}$$

F_{V2}	=	external dynamic load	(N)
M_L	=	external longitudinal moment	(Nmm)
b	=	distance between runner blocks	(mm)

Determination of required sizes





Calculation of bearing load for a runner block

$$P_{act.} \leq P_{max.}$$

$$P_{act.} = k_f \cdot (|F_V| + |F_H| + k_t \cdot |M_t| + k_L \cdot |M_L|)$$

$P_{act.}$ = equivalent load (N)
F_V, F_H = external dynamic load (N)
M_t = external torsional moment[1] (Nm)
M_L = external longitudinal moment[2] (Nm)
k_t = torsional moment coefficient (m^{-1})
k_L = longitudinal moment coefficient (m^{-1})
k_f = operating factor (see table for values)

1) The moment M_t will only be fully effective in an application with only one guide rail. For all other cases, see "Information on moment load calculation".

2) The moment M_L will only be effective when only one runner block is mounted on a guide rail. For all other cases, see "Information on moment load calculation".

Maximum permissible load

Size	$P_{max.}$ [N]
15	750
20	1 700
25	2 500

Example:
For $P_{act.}$ = 1 500 N, use at least size 20.

Coefficients k_t and k_L

Size	k_t	k_L
15	139	173
20	109	121
25	97	109

Recommended operating factors k_f

k_f	Application
0.8	Linear motion guide with manual drive
1.0	Door guides, seat adjustment, slide units for lamps, guidance of protective wire meshes, general laboratory applications, slide units for measuring devices
1.2	Application in a linear motion axis with ball screw drive
1.3	Application in a linear motion axis with rack and pinion drive
1.5	Application in a linear motion axis with toothed belt drive
2.0	Auxiliary axis of machine tool not subject to dirt
7.0	Application in a linear motion axis with linear motor drive
8.0	Application in a linear motion axis with pneumatic drive
9.0	Application in very dirty applications
Not for use in applica-tions like	Main axis of a machine tool Aggressive wood dust environment Oscillating conveyors Temperatures > 60°C, v > 2 m/s, a > 30 m/s² Danger to life and limb (e.g. unsecured overhead installation)

Service life

When the condition $P_{act.} \leq P_{max.}$ is observed, the minimum service life given in the table will apply.

⚠ Do not exceed the maximum loading of the screw connections!

⚠ Take account of the general service life of lubricants!

Service life	Condition
4 000 km	Use of standard runner block with initial greasing
12 500 km	Additional use of two lube units
25 000 km	Relubrication of the lube units after 12 500 km

General Technical Data and Calculations

Definition of dynamic load capacity C

The radial loading of constant magnitude and direction which a linear rolling bearing can theoretically endure for a nominal life of 100 km distance traveled (to DIN 636 Part 2).

Note on maximum load $F_{max.}$

Because of the weight-optimized design of eLINE Ball Rail Systems, the maximum permissible forces for static and dynamic loads must not be exceeded.

Definition and calculation of the nominal life

The calculated service life which an individual linear rolling bearing, or a group of apparently identical rolling element bearings operating under the same conditions, can attain with a 90% probability, with contemporary, commonly used materials and manufacturing quality under conventional operating conditions (to DIN 636 Part 2) and optimal installation conditions.

Calculate the nominal life L or L_h according to formulas (1) or (2):

Nominal life at constant speed

(1) $$L = \left(\frac{C}{F}\right)^3 \cdot 100$$

(2) $$L_h = \frac{L}{2 \cdot s \cdot n \cdot 60}$$

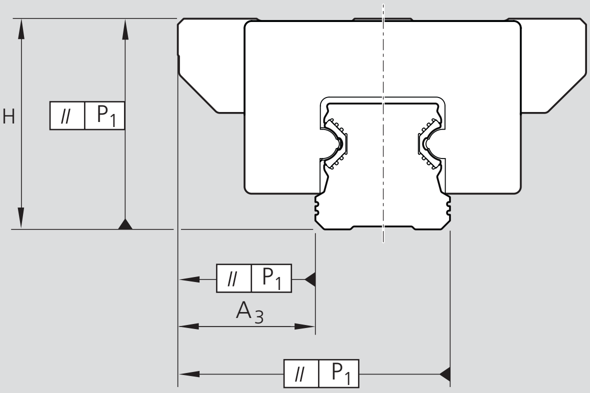
L	=	nominal life	(km)
L_h	=	nominal life	(h)
C	=	dynamic load capacity	(N)
F	=	equivalent load	(N)
s	=	length of stroke*	(m)
n	=	stroke repetition rate (complete cycles/min.)	(min^{-1})

* For a stroke length < 2 x runner block length, the load capacities will be reduced. Please consult us.

Selection Criteria, Accuracy Classes

Accuracy classes and their tolerances

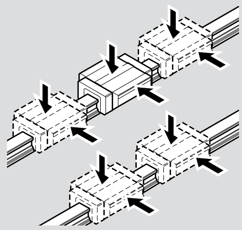
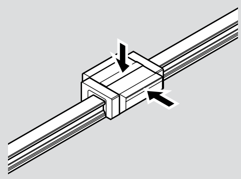
eLINE ball rail systems are offered in two different accuracy classes.



Built-in interchangeability through precision machining

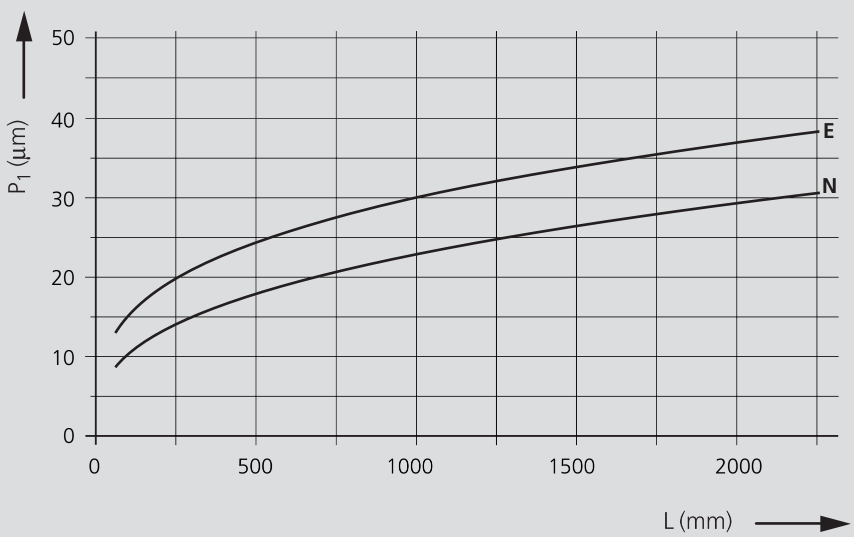
Rexroth manufactures its guide rails and runner blocks with such high precision, especially in the ball track zone, that each individual component element can be replaced by another at any time.

For example, different runner blocks can be used without problems on one and the same guide rail of the same size.

Accuracy classes	Tolerances dimension H and A_3 (µm) H	A_3	Max. difference in dimension H and A_3 on one guide rail ΔH, ΔA_3 (µm)
N	± 100	± 40	30
E	± 120	± 70	60
Measured at middle of runner block:	 **For any runner block/rail combination at any position on rail**		 **For different runner blocks at same position on rail**

Parallelism offset P_1 of the ball rail system in service

Measured at middle of runner block



Key to graph

P_1 = parallelism offset
L = rail length

Selection Criteria, Combination of Accuracy Classes

Runner blocks		Rails N (µm)	Rails E (µm)
N	Tolerance dimension H	+/– 100	+/– 110
	Tolerance dimension A3	+/– 40	+/– 60
	Max. difference in dimensions H and A3 on one rail	30	30
E	Tolerance dimension H	+/– 115	+/– 120
	Tolerance dimension A3	+/– 50	+/– 70
	Max. difference in dimensions H and A3 on one rail	60	60

Recommendations for combining accuracy classes

Recommended for short strokes and close spacing of runner blocks:

Runner blocks in higher accuracy class than guide rail.

Recommended for long strokes and larger runner block spacing:

Guide rail in higher accuracy class than runner blocks.

Selection Criteria, System Preload

Selection of the preload class

In versions without preload there will be a slight clearance between the runner block and the rail. With two rails and use of more than one runner block per rail, this clearance is usually equalized by parallelism tolerances.

Code	Version	Areas of application
C0	without preload	For particularly smooth running guide systems with the lowest possible friction and a minimum of external influences
C1	with preload	For more accurate guide systems with low external load

General Mounting Instructions

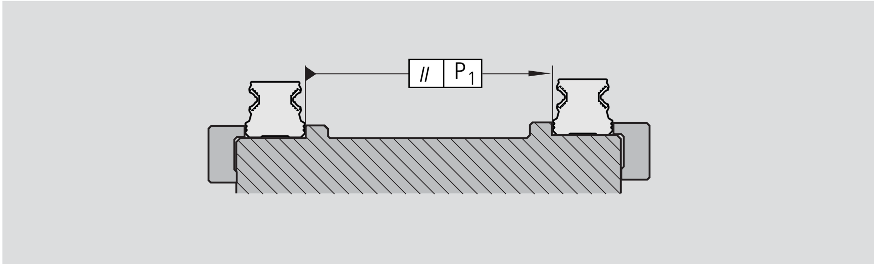
Parallelism of the installed rails

measured at the guide rails and at the runner blocks

The parallelism offset P_1 causes a slight increase in preload on one side of the assembly.

If the tolerances given in the table are not exceeded, the reduction in travel life will as a rule be negligible.

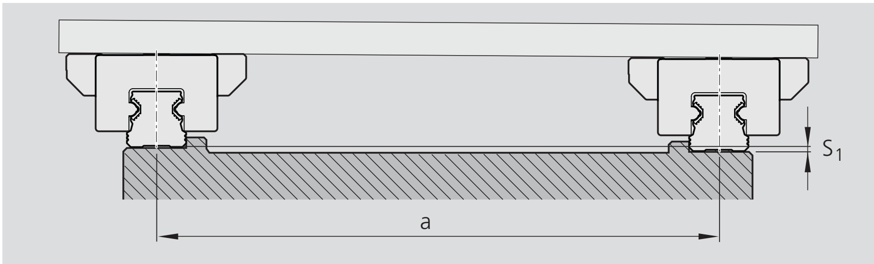
⚠ eLINE ball rail systems allow substantially higher installation tolerances compared to steel rail systems.



Size	Parallelism offset P_1 (mm) for preload class	
	C0	C1
15	0.020	0.008
20	0.026	0.010
25	0.031	0.014

Vertical offset

If the permissible vertical offset S_1 and S_2 is not exceeded, the reduction in travel life will as a rule be negligible.



Permissible vertical offset in the transverse direction S_1

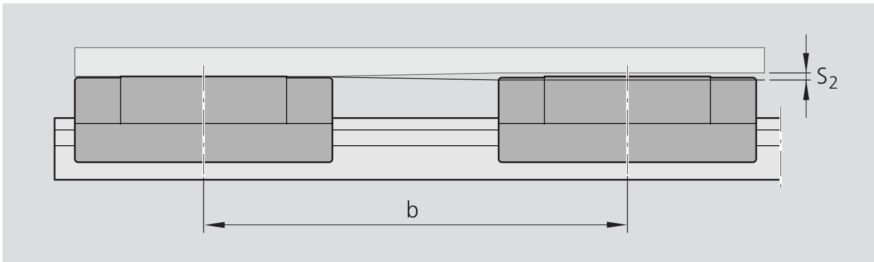
$$S_1 = a \cdot Y_1$$

S_1 = permissible vertical offset (mm)
a = distance between guide rails (mm)
Y_1 = calculation factor

Calculation factor	for preload class	
	C0	C1
Y_1	$1.2 \cdot 10^{-3}$	$3.5 \cdot 10^{-4}$

Permissible vertical offset in the longitudinal direction S_2

The permissible vertical offset S_2 takes into account the tolerance for the "max. difference in dimensions H on the same rail" according to the table on page 9.



$$S_2 = b \cdot Y_2$$

S_2 = permissible vertical offset (mm)
b = distance between runner blocks (mm)
Y_2 = calculation factor

Calculation factor	for preload class	
	C0	C1
Y_2	$6 \cdot 10^{-4}$	$2.1 \cdot 10^{-4}$

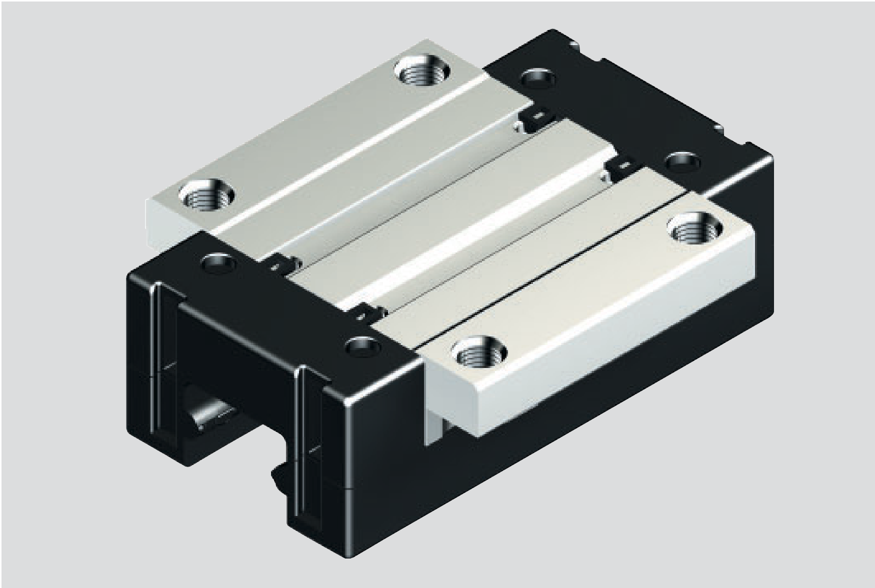
Preload classes
C0 = without preload
C1 = with preload

eLINE Runner Blocks

Runner block FNS R2031

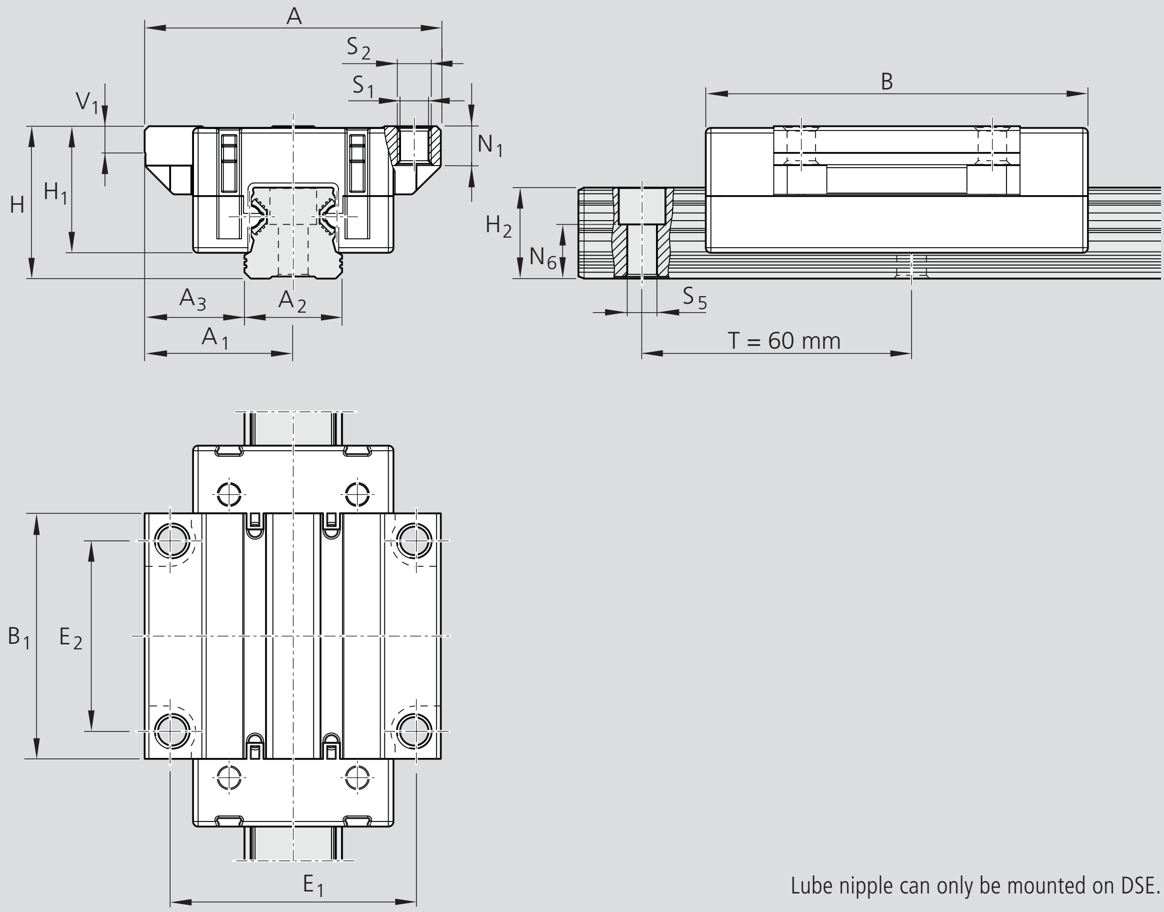
Flanged, normal, standard height

- Runner block body made from wrought aluminum alloy
- Hardened steel running tracks
- Steel balls to DIN 5401
- Without seals
- Initial greasing with Dynalub 510
- For $P_{act.} \leq P_{max.}$, no relubrication necessary throughout the stated minimum service life



Size	Accuracy class	Part numbers – Runner blocks	
		Clearance	Preload
15*	N	R2031 194 10	R2031 114 10
	E	R2031 195 10	–
20*	N	R2031 894 10	R2031 814 10
	E	R2031 895 10	–
25*	N	R2031 294 10	R2031 214 10
	E	R2031 295 10	–

* Samples available as of 4th quarter 2004, series production as of 1st quarter 2005



Lube nipple can only be mounted on DSE.

Size	Dimensions (mm)																Weight[1)]
	A	A_1	A_2	A_3	B	B_1	H	H_1	H_2	V_1	E_1	E_2	N_1	$N_6^{\pm 0.5}$	S_1	S_2	S_5	(kg)
15	47	23.5	15	16.0	59.0	37.8	24	19.8	14.3	4.1	38	30	6.0	8.1	4.3	M5	4.4	**0.08**
20	63	31.5	20	21.5	80.3	51.5	30	24.7	19.3	5.5	53	40	8.0	11.6	5.3	M6	6.0	**0.18**
25	70	35.0	23	23.5	90.0	58.0	36	29.9	21.8	6.4	57	45	9.3	12.9	6.7	M8	7.0	**0.26**

1) Please note the low weight of the runner block.

	Load capacities (N)[2)]		Moments (Nm)			
Size	**C** **dyn.**	**$F_{max.}$**	**M_t** **dyn.**	**$M_{t\,max.}$** **stat.**	**M_L** **dyn.**	**$M_{L\,max.}$** **stat.**
15	5 000	2 000	36	14	29	12
20	11 000	4 400	101	40	89	35
25	16 000	6 400	165	66	147	59

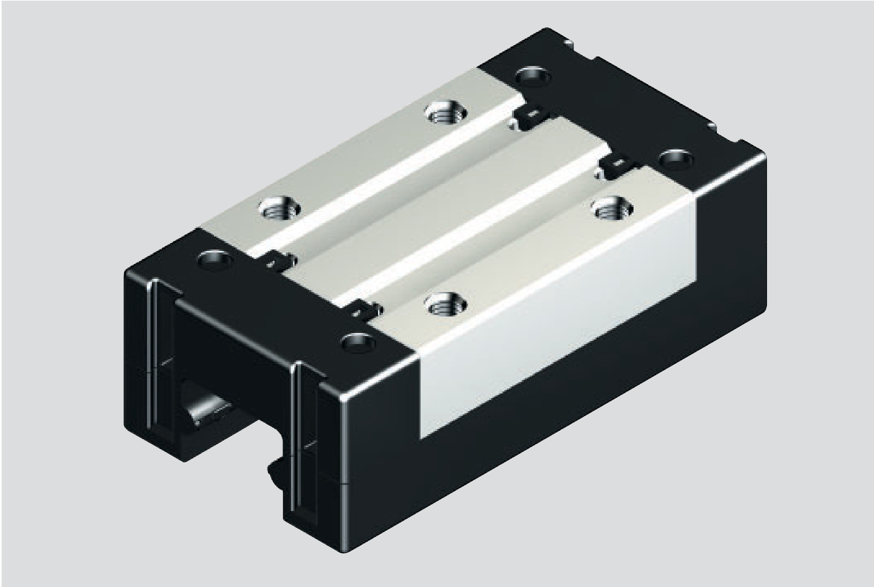
2) Determination of dynamic load capacities and moments is based on a travel life of 100 000 m. However, frequently this is determined on the basis of only 50 000 m. In this case for comparison: multiply values C, M_t and M_L by 1.26 in accordance with the table.

eLINE Runner Blocks

Runner block SNS R2032

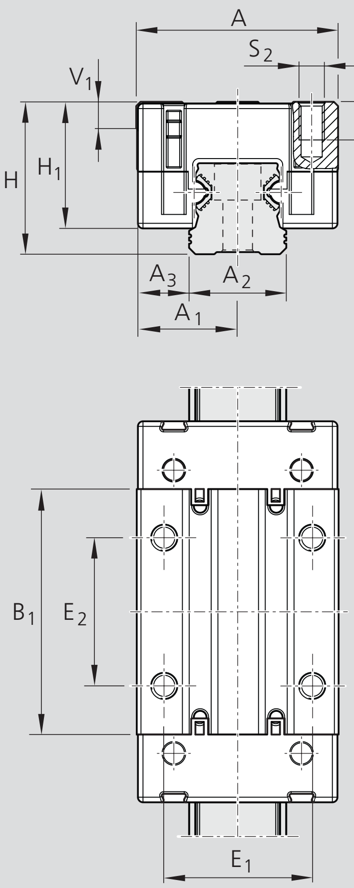
Slimline, normal, standard height

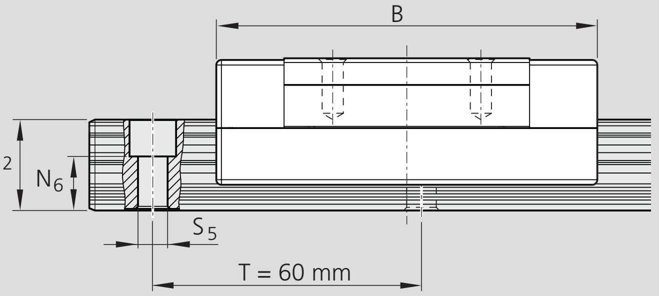
- Runner block body made from wrought aluminum alloy
- Hardened steel running tracks
- Steel balls to DIN 5401
- Without seals
- Initial greasing with Dynalub 510
- For $P_{act.} \leq P_{max.}$, no relubrication necessary throughout the stated minimum service life



Size	Accuracy class	Part numbers – Runner blocks	
		Clearance	Preload
15*	N	R2032 194 10	R2032 114 10
	E	R2032 195 10	–
20*	N	R2032 894 10	R2032 814 10
	E	R2032 895 10	–
25*	N	R2032 294 10	R2032 214 10
	E	R2032 295 10	–

* Samples available as of 4th quarter 2004, series production as of 1st quarter 2005





Lube nipple can only be mounted on DSE.

Size	Dimensions (mm)															Weight[1)
	A	A_1	A_2	A_3	B	B_1	H	H_1	H_2	V_1	E_1	E_2	N_1	$N_6^{\pm 0.5}$	S_2	S_5	(kg)
15	34	17	15	9.5	59.0	37.8	24	19.8	14.3	4.1	26	26	6.0	8.1	M4	4.4	**0.07**
20	44	22	20	12.0	80.3	51.5	30	24.7	19.3	5.5	32	36	7.5	11.6	M5	6.0	**0.15**
25	48	24	23	12.5	90.0	58.0	36	29.9	21.8	6.4	35	35	9.0	12.9	M6	7.0	**0.22**

[1)] Please note the low weight of the runner block.

	Load capacities (N)[2)]		Moments (Nm)			
Size	**C** **dyn.**	$F_{max.}$	M_t **dyn.**	$M_{t\,max.}$ **stat.**	M_L **dyn.**	$M_{L\,max.}$ **stat.**
15	5 000	2 000	36	14	29	12
20	11 000	4 400	101	40	89	35
25	16 000	6 400	165	66	147	59

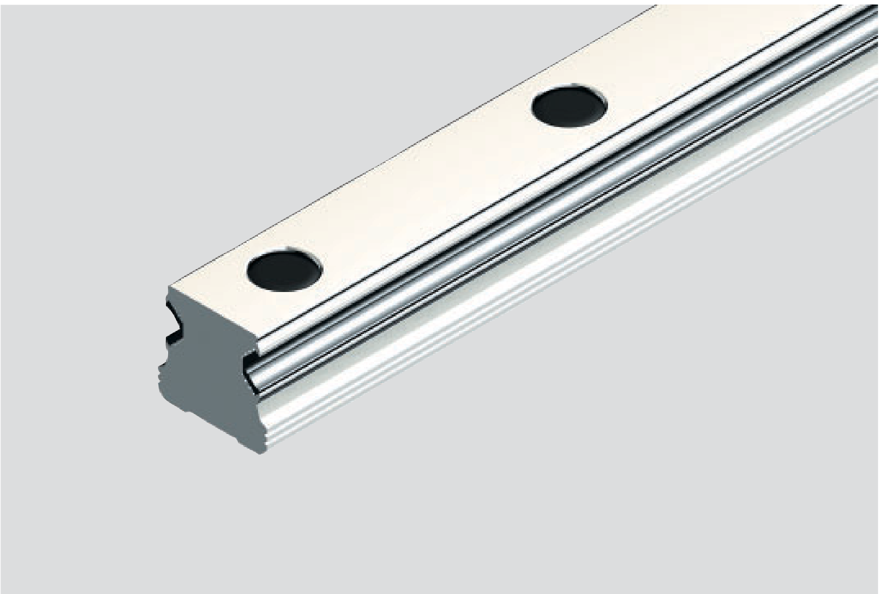
[2)] Determination of dynamic load capacities and moments is based on a travel life of 100 000 m. However, frequently this is determined on the basis of only 50 000 m. In this case for comparison: multiply values C, M_t and M_L by 1.26 in accordance with the table.

eLINE Guide Rails

Guide rails
R2035

For mounting from above, with plastic mounting hole plugs (supplied)

- Rail body made from wrought aluminum alloy, anodized
- Ball running tracks made from hardened antifriction bearing steel

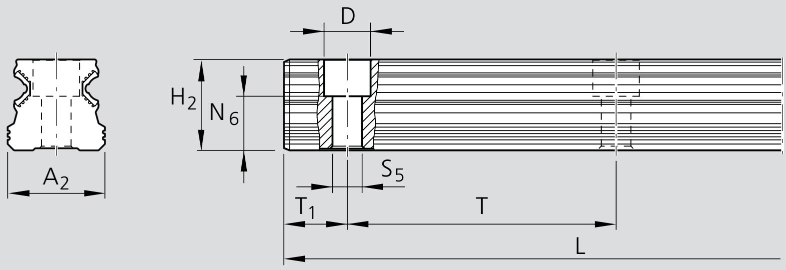


Part numbers and rail lengths

Size	Accuracy class	Guide Rail One-piece Part number, Rail length L (mm)	Guide Rail Composite Part number, Number of sections, Rail length L (mm)	Spacing T (mm)	Recommended rail length Number of holes n_B / Rail length L (mm)				
15*	N	R2035 104 31,....	R2035 104 3.,....	60	2/ 80	5/ 280	8/ 460	13/ 776	25/ 1496
	E	R2035 105 31,....	R2035 105 3.,....		2/ 90	5/ 296	8/ 476	14/ 836	30/ 1796
20*	N	R2035 804 31,....	R2035 804 3.,....		2/ 100	6/ 340	9/ 536	16/ 956	32/ 1916
	E	R2035 805 31,....	R2035 805 3.,....		2/ 116	6/ 356	10/ 596	18/ 1076	
25*	N	R2035 204 31,....	R2035 204 3.,....		3/ 176	7/ 400	11/ 656	20/ 1196	
	E	R2035 205 31,....	R2035 205 3.,....		4/ 236	7/ 416	12/ 716	22/ 1316	

* Samples available as of 4th quarter 2004, series production as of 1st quarter 2005

Dimensions and weights



Size	Dimensions (mm)									Weight[2)]
	A_2	H_2	$N_6^{\pm 0.5}$	D	S_5	$T_{1S}^{\pm 0.5}$	$T_{1\ min.}$	T	$L_{max.}$[1)]	kg/m
15	15	14.3	8.1	7.4	4.4	28.0	10	60	2000	**0.57**
20	20	19.3	11.6	9.4	6.0	28.0	10	60	2000	**0.98**
25	23	21.8	12.9	11.0	7.0	28.0	10	60	2000	**1.25**

1) One-piece guide rails
2) Please note the low weight per meter of the guide rail.

Accessories

Lube unit with sealing function DSE for eLINE ball rail systems

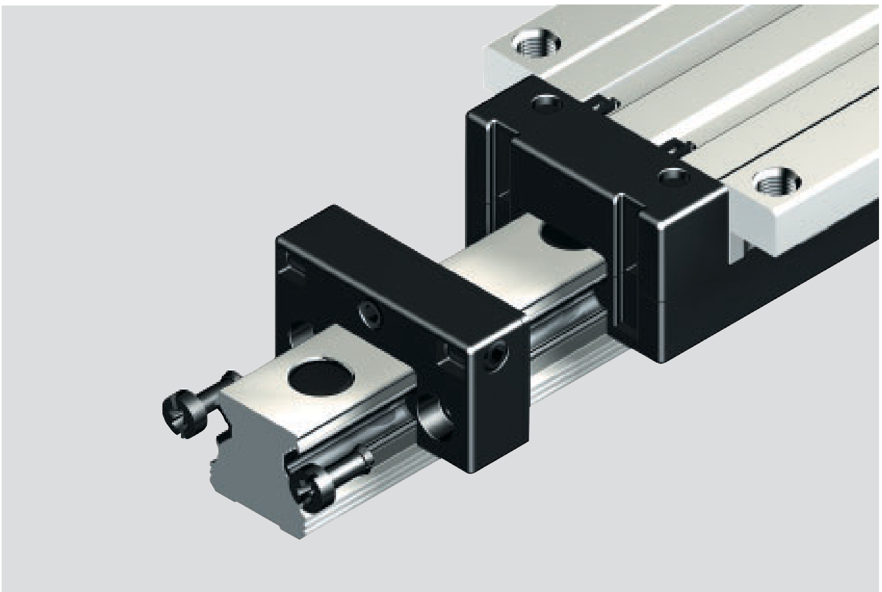
– Material: special plastic
– Acts as an end seal
– Relubricatable

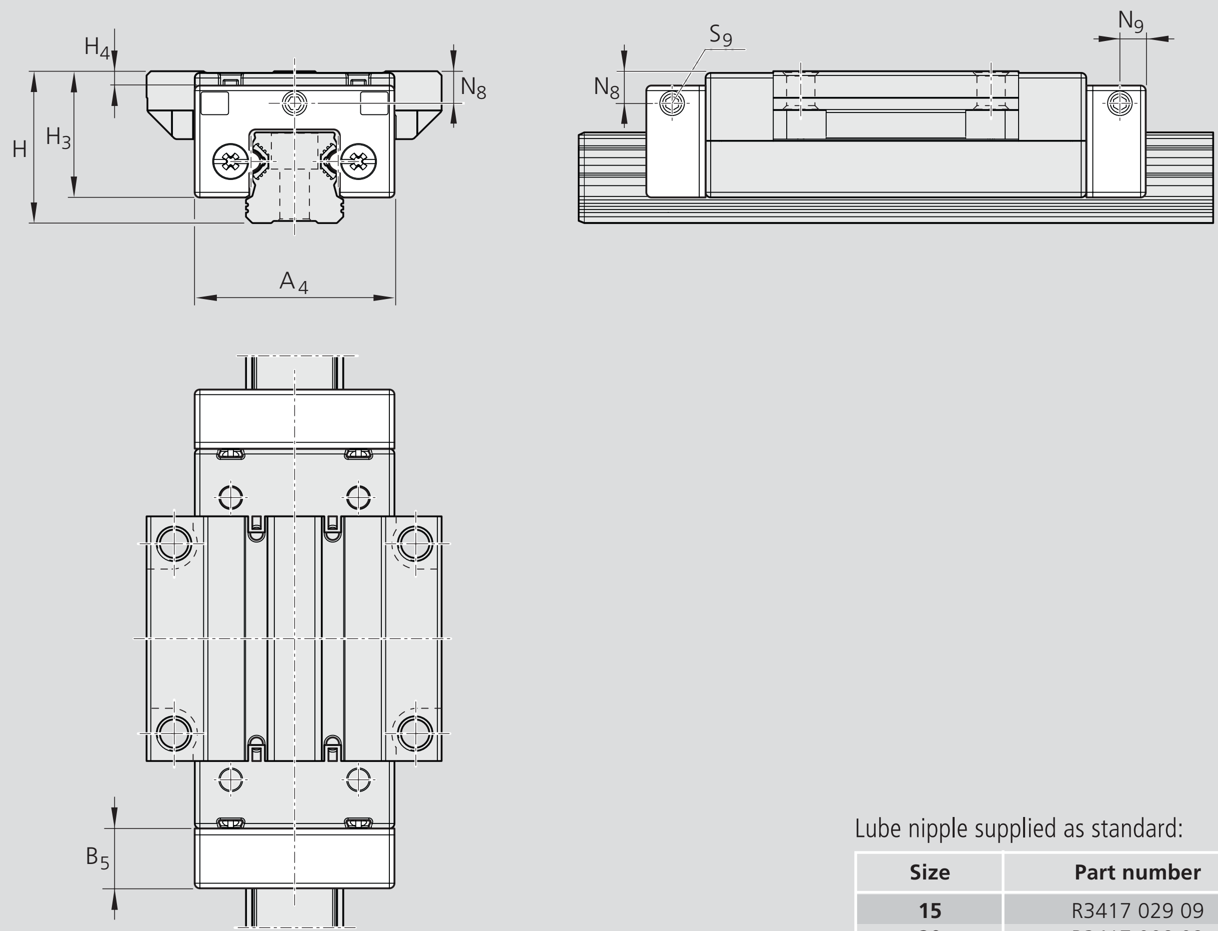
Mounting instructions:

The required fastening elements and lube nipples are supplied along with the unit.

Lube units are prefilled with ISO VG 1000 oil and therefore ready for mounting.

- Push the lube unit onto the guide rail and fasten it to the runner block.





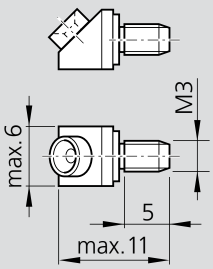
Lube nipple supplied as standard:

Size	Part number
15	R3417 029 09
20	R3417 008 02
25	R3417 008 02

Size	Dimensions (mm)									
	Part number	A_4	B_5	H	H_3	H_4	N_8	N_9	S_8	Oil (cm^3)
15	R2030 125 00	31.7	11.5	24	19.4	0.4	4.5	5.0	M3	0.65
20	R2030 825 00	43.2	13.0	30	24.3	0.4	5.0	5.0	M6	1.35
25	R2030 226 00	47.2	14.0	36	30.0	3.4	7.6	6.1	M6	1.7

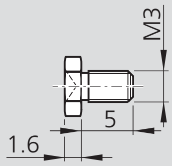
Accessories

Funnel-type lube nipple



Part number

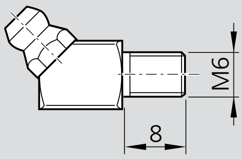
R3417 004 09



Part number

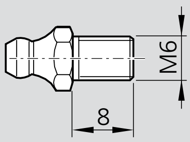
R3417 029 09

Hydraulic-type lube nipple



Part number

R3417 007 02



Part number

R3417 008 02

Mounting instructions:

The lube nipples can only be mounted on the lube unit DSE.

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