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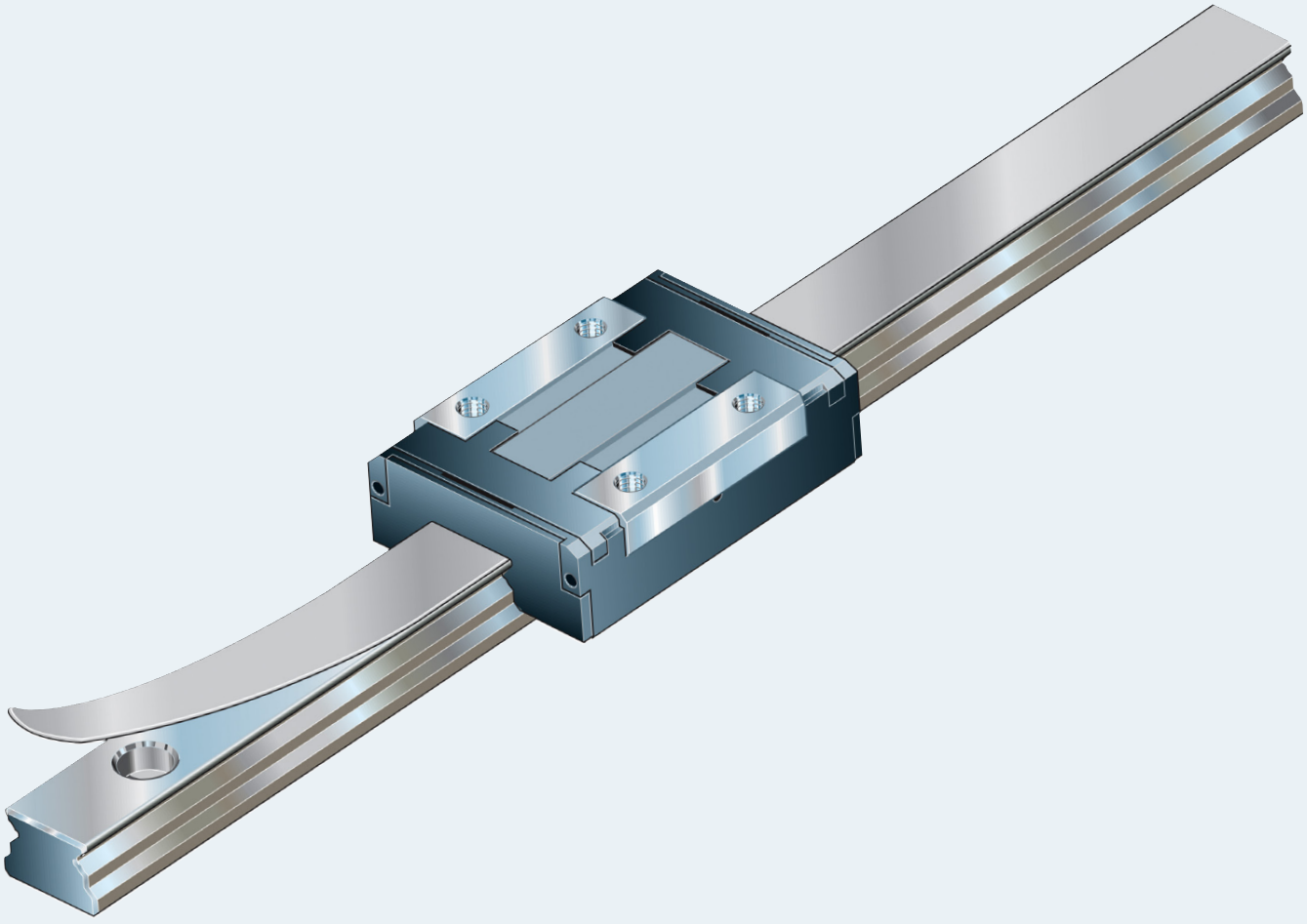
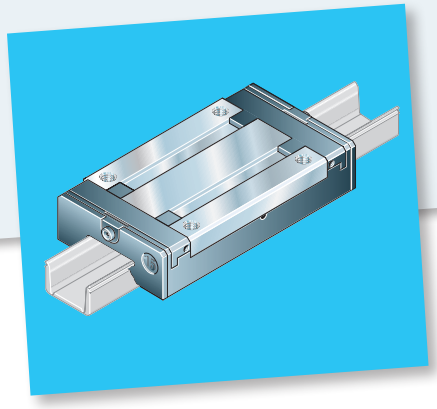
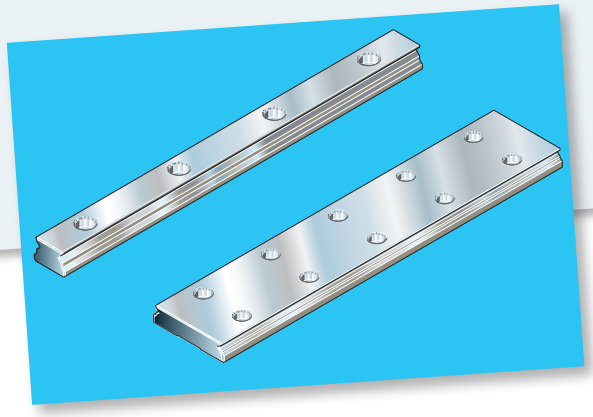
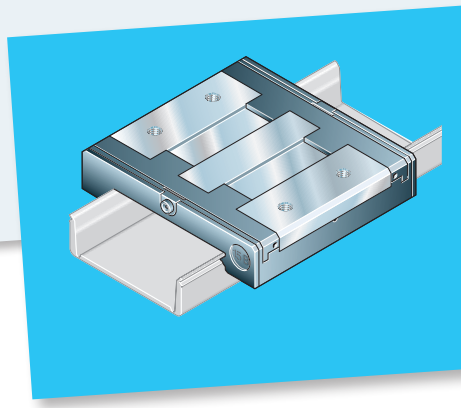
A Bosch Company

Miniature ball rail systems









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Miniature ball rail systems

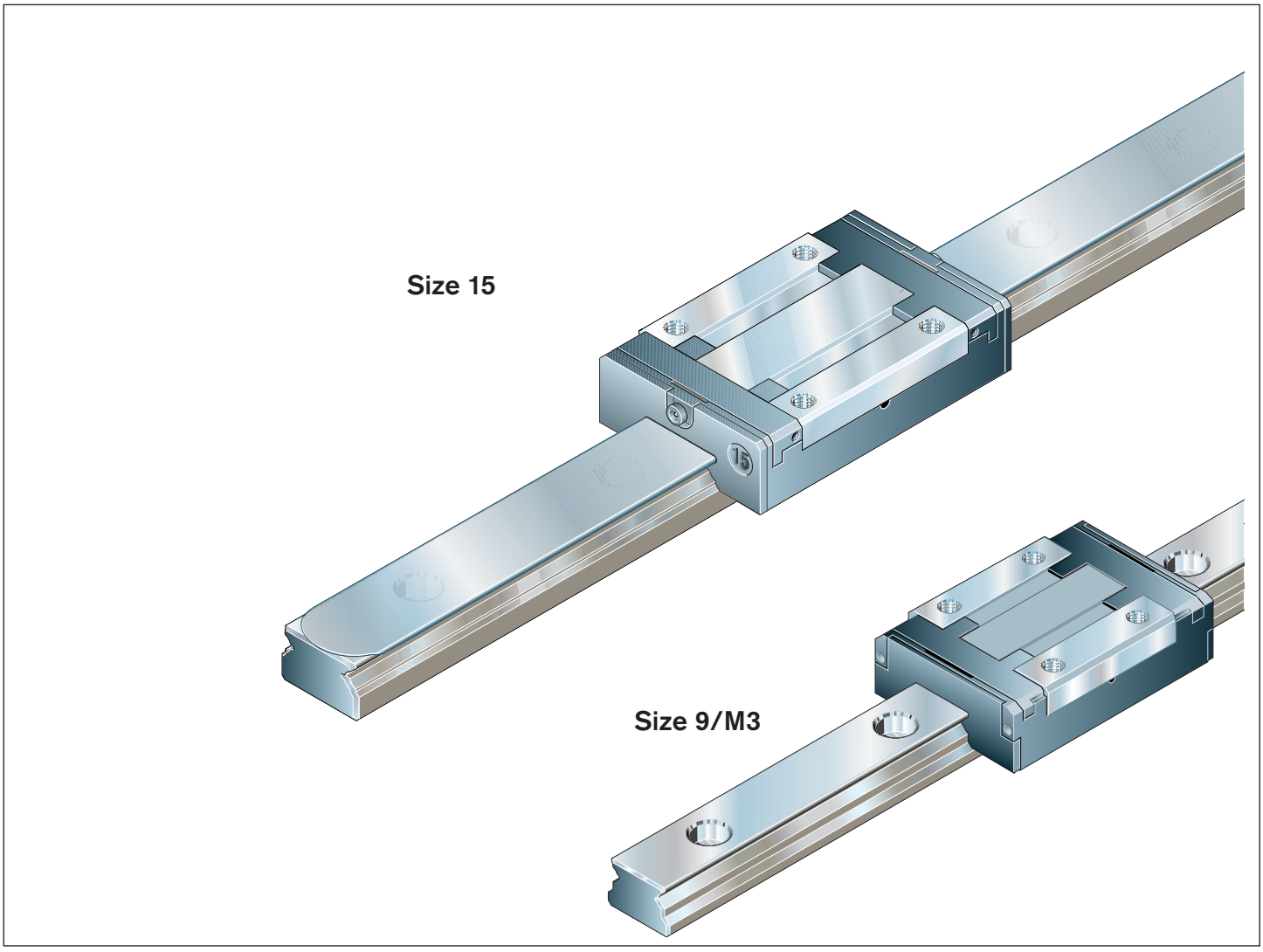
Product overview

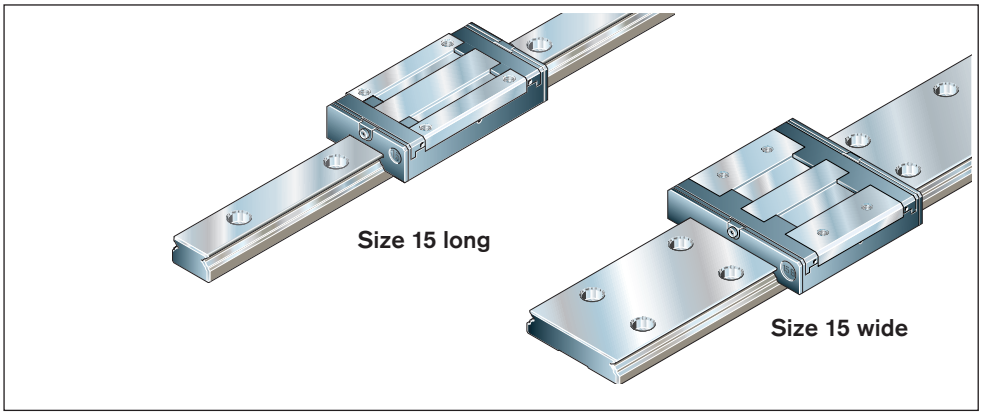
The miniature version of the ball rail system has been developed specifically for the precision engineering sector, i.e. for the production of optical or electronic data processing devices, where rolling-element linear motion guideways of extremely compact dimensions and high load capacity are required.

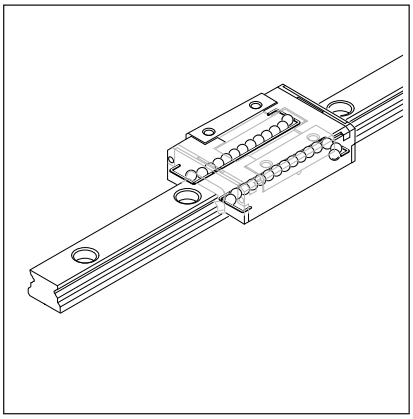
The linear motion guideways have the same high load capacities in all four major directions of load application.

- High load capacities in all load directions, including moments about all axes, due to the use of largest possible ball sizes
- Size 15 and up with lube nipples on the end faces and relubrication ports on the side
- Cover strip as an option (made of stainless steel)
- Low friction
- All steel parts of the runner block and the guide rail are made of corrosionresistant, martensitic steel

CAD files available







- Accuracy classes P, H and N
- Built-in lube ports
- Smooth running thanks to optimized ball recirculation and guidance

- Easy mounting due to ball retention

General technical data and calculations

Definition of dynamic load capacity

The radial loading of constant magnitude and direction which a linear rolling bearing can theoretically endure for a nominal life of 10^5 meters distance traveled (as per DIN 636 Part 2).

Definition of static load capacity

The static loading in the direction of load which corresponds to a calculated stress of 4200 M_{Pa} at the center of the most heavily loaded rolling-element/raceway (rail) contact with a ball conformity of $f_r \leq 0.52$, and 4600 M_{Pa} with a ball conformity of $f_r \geq 0.6$.

Note:
With this contact stress, a permanent overall deformation of the rolling element and the raceway will occur at the contact point corresponding to approx. 0.0001 times the rolling element diameter (as per DIN 636 Part 2).

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).

Calculate the nominal life L or L_h according to formula (1), (2) or (3):

Nominal life at constant speed

(1) $$L = \left(\frac{C}{F_m}\right)^3 \cdot 10^5$$

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

Nominal life at variable speed

(3) $$L_h = \frac{L}{3600 \cdot v_m}$$

(4) $$v_m = \frac{q_{t1} \cdot |v_1| + q_{t2} \cdot |v_2| + ... + q_{tn} \cdot v_n}{100\%}$$

C	=	dynamic load capacity	(N)
F_m	=	equivalent dynamic load	(N)
L	=	nominal life	(m)
L_h	=	nominal life	(h)
n_s	=	stroke repetition rate (full cycles)	(min^{-1})
$q_{t1}, q_{t2}...q_{tn}$	=	discrete time steps for $v_1, v_2...v_n$	(%)
s	=	length of stroke	(m)
$v_1, v_2...v_n$	=	travel speeds	(m/s)
v_m	=	average speed	(m/s)

Equivalent dynamic load on bearing for calculation of service life

If the bearing is subject to variable loads, the equivalent dynamic load F_m must be calculated according to formula (5):

F_m = equivalent dynamic load (N)
F_{eff1}, F_{eff2} ...F_{effn} = discrete load steps (N)
q_{s1}, q_{s2} ... q_{sn} = discrete travel steps for F_{eff1}, F_{eff2} ... F_{effn} (%)

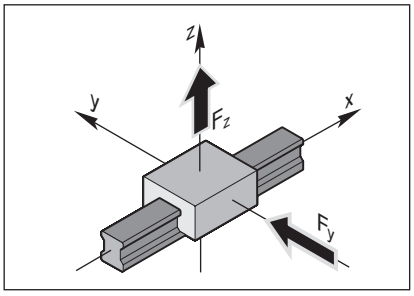
For variable load on bearing

$$(5)\quad F_m = \sqrt[3]{|F_{eff1}|^3 \cdot \frac{q_{s1}}{100\%} + |F_{eff2}|^3 \cdot \frac{q_{s2}}{100\%} + ... + |F_{effn}|^3 \cdot \frac{q_{sn}}{100\%}}$$

For combined load on bearing
The combined equivalent load on bearing F_{comb} resulting from combined vertical and horizontal external loads is calculated according to formula (6):

Note:
The structure of the Ball Rail System permits this simplified calculation.

$$(6)\quad F_{comb} = |F_y| + |F_z|$$

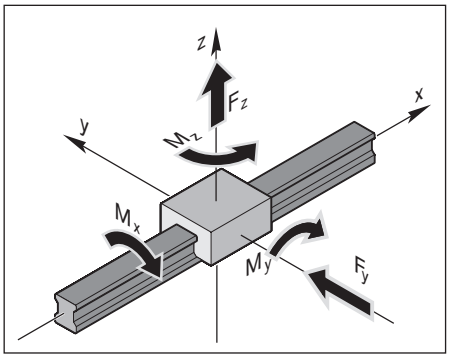


C = dynamic load capacity [2] (N)
F_{comb} = combined equivalent load on bearing (N)
F_y, F_z = dyn. external loads [1] (N)
M_L = dyn. longitudinal moment load capacity [2] (Nm)
M_t = dyn. torsional moment load capacity [2] (Nm)
M_x = dyn. torsional moment about the x-axis (Nm)
M_y = dyn. longitudinal moment load about the y-axis (Nm)
M_z = dyn. longitudinal moment load about the z-axis (Nm)

For combined load on the bearing in conjunction with a torsional moment
The combined equivalent load on bearing F_{comb} resulting from combined vertical and horizontal external loads in conjunction with a torsional moment is calculated according to formula (7):

Formula (7) applies only when using a single guide rail.

$$(7)\quad F_{comb} = |F_y| + |F_z| + C \cdot \frac{|M_x|}{M_t} + C \cdot \frac{|M_y|}{M_L} + C \cdot \frac{|M_z|}{M_L}$$

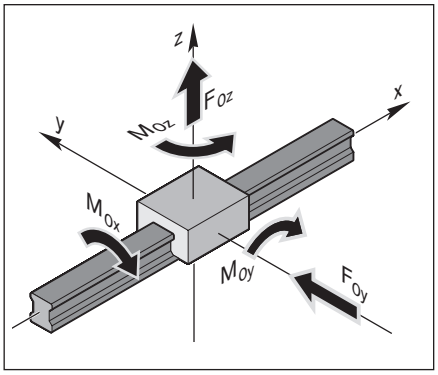


Equivalent static load on bearing

For combined static external loads – vertical and horizontal – in conjunction with a static torsional moment load, calculate the combined equivalent static load on the bearing F_{0comb} using formula (8).
The combined equivalent static load on the bearing F_{0comb} must not exceed the static load capacity C_0.

Formula (8) applies only when using a single guide rail.

$$(8)\quad F_{0comb} = |F_{0y}| + |F_{0z}| + C_0 \cdot \frac{|M_{0x}|}{M_{t0}} + C_0 \cdot \frac{|M_{0y}|}{M_{L0}} + C_0 \cdot \frac{|M_{0z}|}{M_{L0}}$$



C_0 = static load capacity [2] (N)
F_{0comb} = combined equivalent load on bearing (N)
F_{0y}, F_{0z} = stat. external load [1] (N)
M_{0x} = stat. torsional moment load about the x-axis (Nm)
M_{0y} = stat. longitudinal moment load about the y-axis (Nm)
M_{0z} = stat. longitudinal moment load about the z-axis (Nm)
M_{t0} = stat. torsional moment load [2] (Nm)
M_{L0} = stat. longitudinal moment load [2] (Nm)

1) An external load acting at an angle on the runner block is to be broken down into its F_y and F_z components, and these values are then are then to be used in formula.
2) See tables

Technical Data

Travel speed

$v_{max} = 3$ m/s

Speeds of up to 5 m/s are possible. Service life is limited by wear of plastic parts.

Acceleration

$a_{max} = 250$ m/s^2

Only with preloaded systems.
For non-preloaded systems:
$a_{max} = 50$ m/s^2

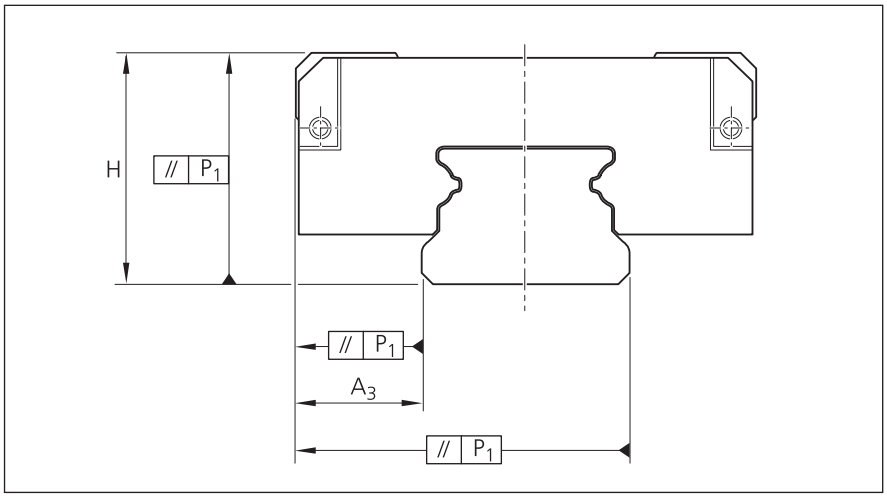
Operating temperature range

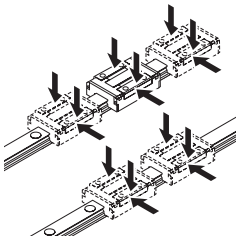
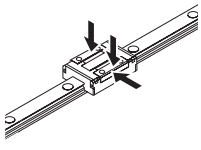
–10 °C ... 80 °C

Brief peaks up to100 °C are permissible.

Accuracy classes and their tolerances (µm)

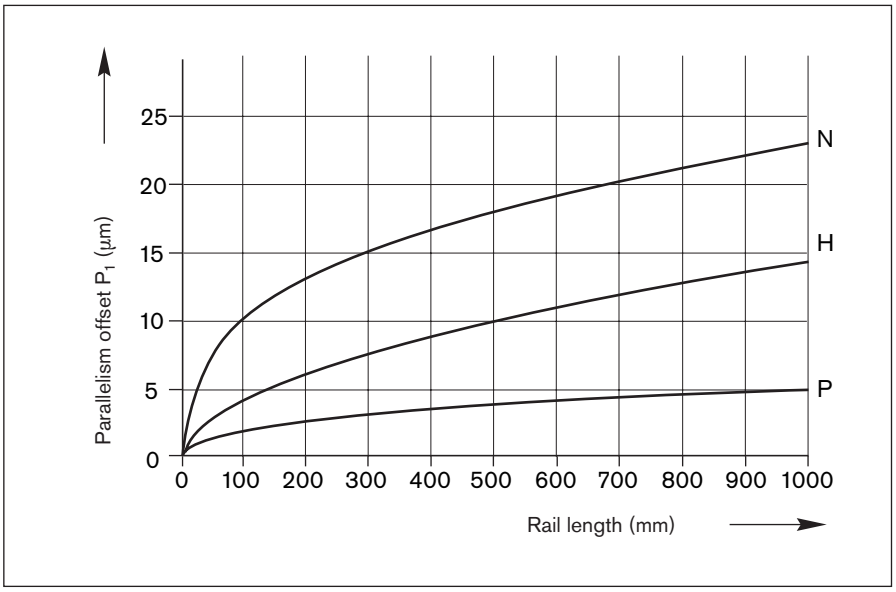
Miniature ball rail systems are offered in 3 different accuracy classes.



Accuracy class	Dimensional tolerance (µm)		Max. difference in dimensions H and A_3 on the same rail
	H	A_3	ΔH, ΔA_3 (µm)
P	± 10	± 10	7
H	± 20	± 20	15
N	± 30	± 30	20
Measured at middle of runner block[1]	 For any block/rail combination at any position on rail		 For different runner blocks at same position on rail

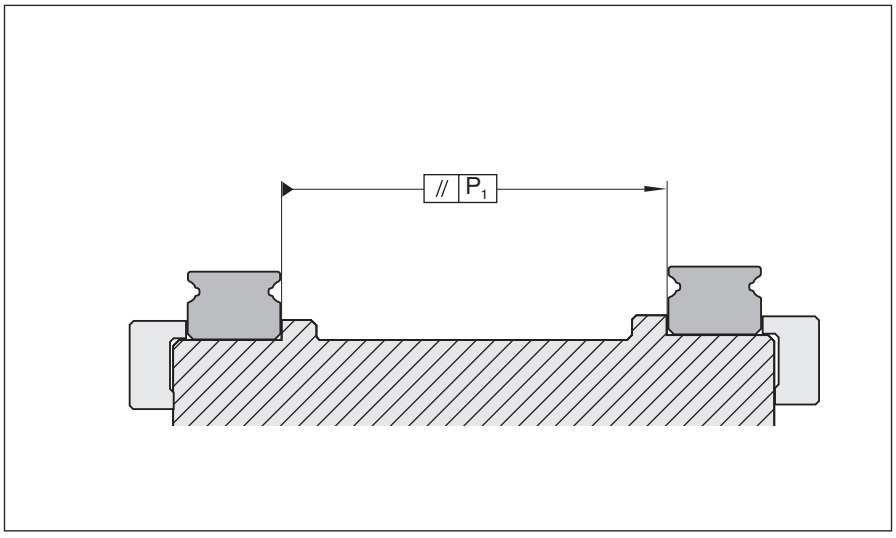
1) For dimensions H and ΔH, the middle of the runner block is calculated from the mean of the two measuring points shown.

Parallelism offset P_1 of the ball rail system in service



Parallelism offset of the installed rails

measured on the guide rails and on the runner blocks

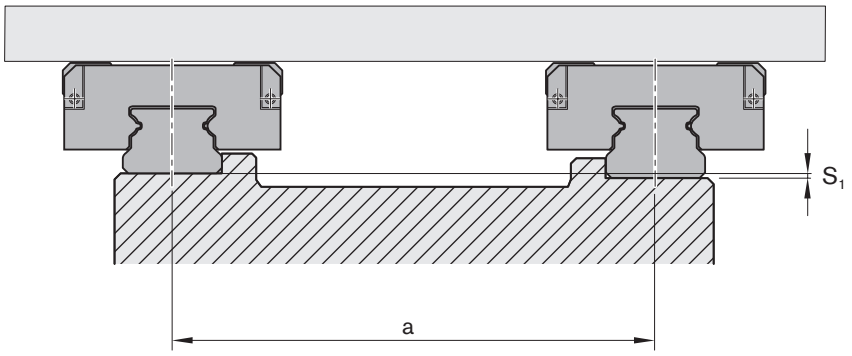


Size	Parallelism offset P_1 (mm)	
	Clearence	Preload
Standard guide rails R0445		
7	0.004	0.002
9/M3	0.005	0.002
12	0.008	0.004
15	0.017	0.008
20	0.025	0.016
Wide guide rails R0455		
9/M3	0.010	0.004
12 B	0.014	0.006
15 B	0.018	0.011

Technical Data

Vertical offset

Permissible vertical offset in transverse direction S_1
The permissible vertical offset S_1 includes the tolerance for dimension H (see accuracy classes).

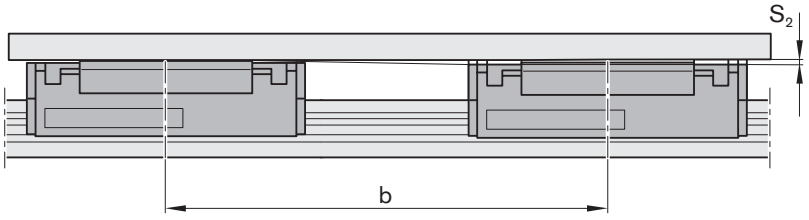


$$S_1 = a \cdot Y$$

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

Calculation factor	For preload class	
	Clearance	Preload
Y	$3.0 \cdot 10^{-4}$	$1.5 \cdot 10^{-4}$

Permissible vertical offset in longitudinal direction S_2
The permissible vertical offset S_2 includes the tolerance "max difference of dimension H on the same rail" ΔH (see accuracy classes).



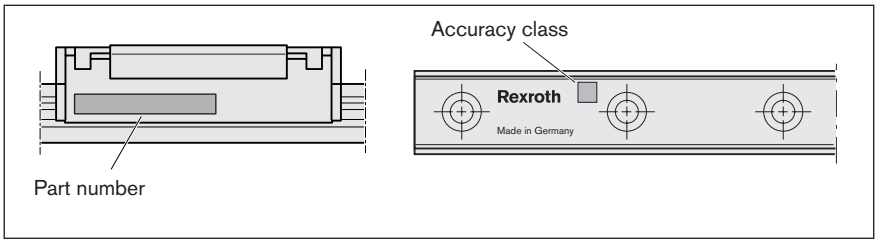
$$S_2 = b \cdot 7 \cdot 10^{-5}$$

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

Preload and clearance

Preload class	Accuracy class			
	P		H	N
	1	1	9	9
Preload and clearance	~0 to moderate preload	~0 to moderate preload	~0 to moderate clearance	Moderate clearance to moderate preload

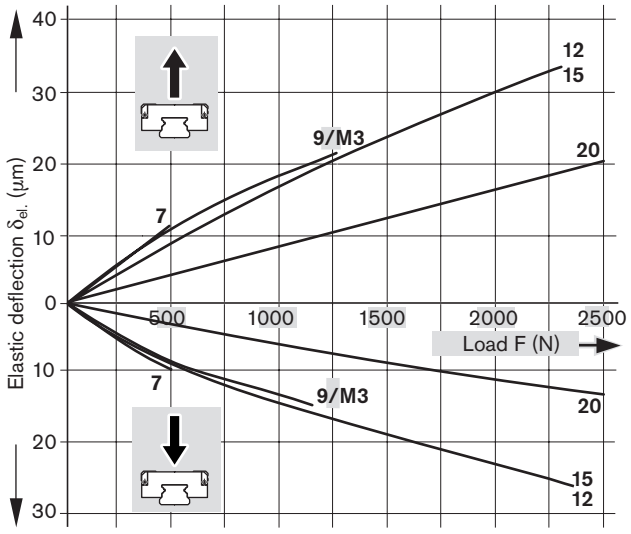
Markings on runner block and guide rail



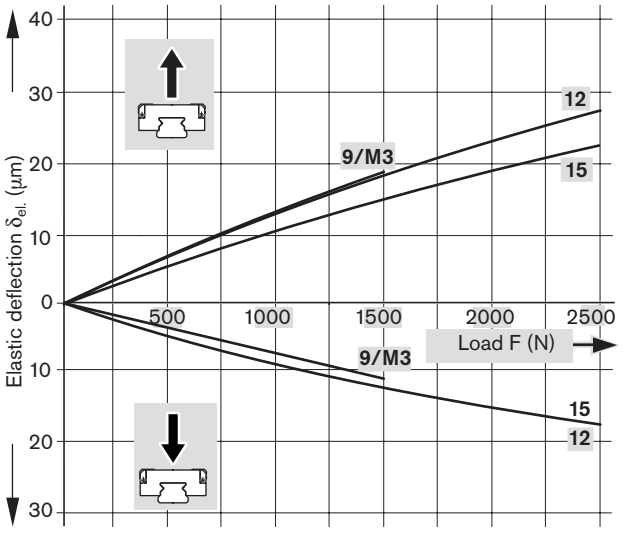
Rigidity of the miniature ball rail system when preloaded

Runner block mounted with 4 screws, strength class 12.9

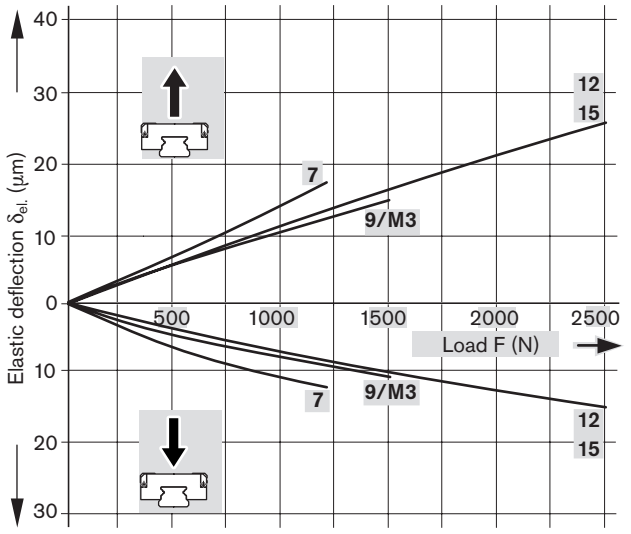
Standard runner block R0442



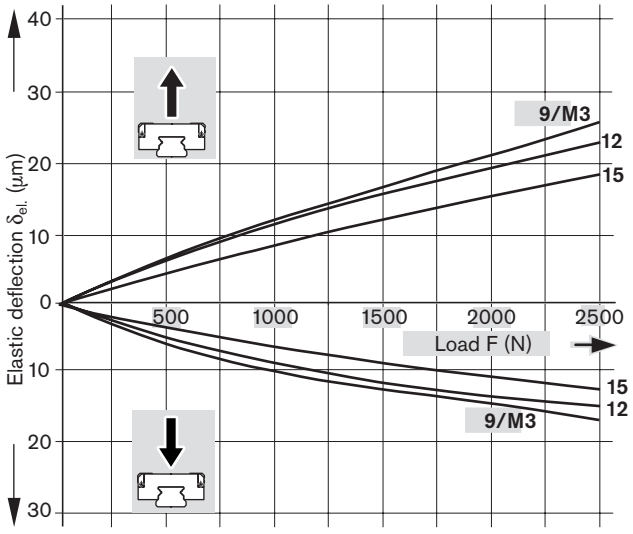
Wide runner block R0443



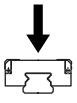
Long runner block R0444



Wide, long runner block R0441




Lift-off load


Down load

Technical Data

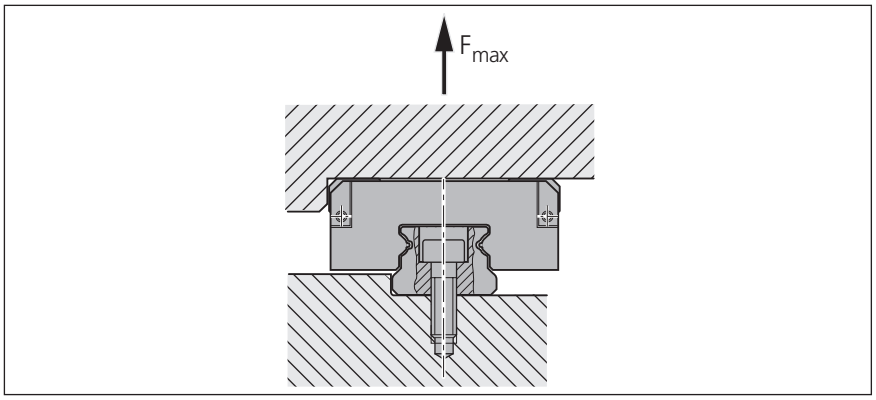
General Notes

The screw connections specified in the DIN 645-1 standard can be overstressed due to the high performance capability of profiled rail systems. The most critical point is the screw connection between the guide rail and the mounting base. If the lift-off loads (F) or moments (M_t) are higher than the respective load values given in the table, the screw connections must be recalculated separately.

The data applies for the following conditions:
- Mounting screw quality 12.9
- Screws tightened using a torque wrench
- Screws lightly oiled
  (For screws in quality 8.8, an approximation factor of 0.6 can be applied)

Miniature ball rail systems

Guide Rails	Runner blocks R0442			Runner blocks R0444	
	Size	$F_{max.}$ (N)	$M_{tmax.}$ (Nm)	$F_{max.}$ (N)	$M_{tmax.}$ (Nm)
R0445	7	1000	3.2	1150	3.7
	12	–	–	4300	23.7
	15	3740	26.0	4280	30.0
	No restriction for sizes				
R0445	R0442:		9/M3, 12 and 20		
	R0444:		9/M3		
R0455	R0441,R0443:		9/M3, 12 and 15		



Friction and seals

The total frictional drag of the runner block is the sum of the frictional drag of the runner block and the frictional drag of the seals (see tables at right).

The runner blocks come standard with low-friction seals.
Part number: R044. ... **01**
(See “Part numbers for runner blocks” tables)

Special versions:
Runner blocks are also available with N seals (excellent wiping action).
Part number: R044. ... **00**
(otherwise as in “Part numbers for runner blocks” tables)

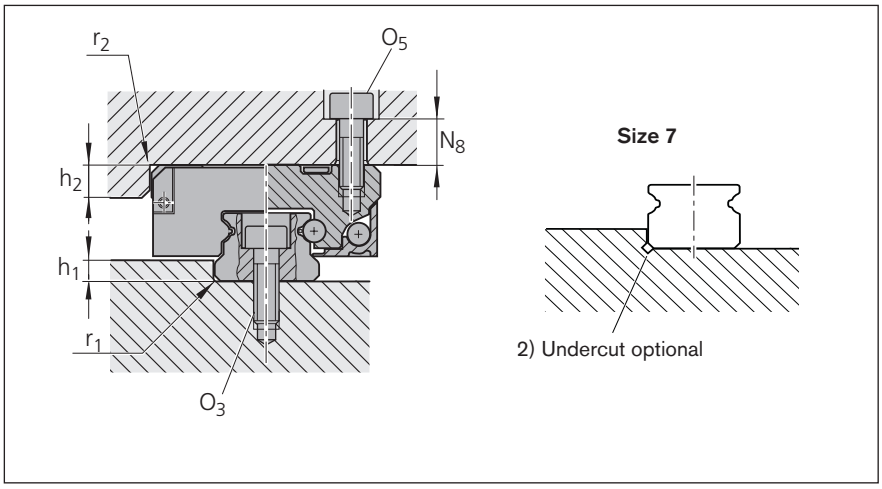
Sizes 15, 20, 9/M3 wide, 12 wide, 15 wide and long runner blocks sizes 9/M3, 12 and 15 have additional longitudinal seals for full sealing.

Size	Frictional drag of runner blocks (without seals)		Frictional drag of seals	
	with clearance (N)	with preload (N)	Low-friction seal (-01) (N)	N-Seal (-00) (N)
Standard runner block R0442				
7	< 0.1	< 0.1	~0	0.1
9/M3	< 0.1	< 0.1	~0	0.5
12	< 0.1	< 0.2	~0	0.9
15	< 0.2	< 0.4	~0	1.2[1)]
20	< 0.2	< 0.5	~0	1.5[1)]
Long runner block R0444				
7	< 0.1	< 0.3	~0	0.2
9/M3	< 0.2	< 0.4	~0	0.6[1)]
12	< 0.2	< 0.4	~0	0.9[1)]
15	< 0.2	< 0.5	~0	1.0[1)]
Wide runner block R0443				
9/M3	< 0.2	< 0.3	~0	1.4[1)]
12	< 0.2	< 0.3	~0	1.6[1)]
15	< 0.2	< 0.4	~0	1.8[1)]
Wide, long runner block R0441				
9/M3	< 0.2	< 0.4	~0	1.5[1)]
12	< 0.2	< 0.4	~0	1.8[1)]
15	< 0.2	< 0.5	~0	2.0[1)]

1) with longitudinal seal

Mounting Instructions

Reference edges, corner radii, screw sizes and tightening torques



Size	h_1 (mm)	r_1 max. (mm)	h_2 (mm)	r_2 max. (mm)	O_5 ISO 4762[1] 4 pcs.	O_3 ISO 4762[1] (rail)	N_8 (mm)
Standard runner block R0442							
7	1.2 $_{-0.1}$	0.1[2]	2.2	0.3	M2x5	M2x5	3.0
9/M3	1.5 $_{-0.2}$	0.3	2.5	0.3	M3x8	M3x8	5.0
12	2.5 $_{-0.5}$	0.3	3.5	0.5	M3x8	M3x8	5.0
15	2.8 $_{-0.5}$	0.5	4.5	0.5	M3x8	M3x10	4.5
20	6.3 $_{-0.5}$	0.5	6.5	0.5	M4x12	M5x14	6.5
Long runner block R0444							
7	1.2 $_{-0.1}$	0.1[2]	2.2	0.3	M2x5	M2x5	3.0
9/M3	1.0 $_{-0.1}$	0.3	2.5	0.3	M3x8	M3x8	5.0
12	2.0 $_{-0.2}$	0.3	3.5	0.5	M3x8	M3x8	5.0
15	2.8 $_{-0.5}$	0.5	4.5	0.5	M3x8	M3x10	4.5
Wide runner block R0443; wide, long R0441							
9/M3	1.8 $_{-0.2}$	0.3	2.5	0.3	M3x8	M3x8	5.5
12	2.8 $_{-0.5}$	0.5	3.0	0.4	M3x8	M4x10	4.5
15	2.8 $_{-0.5}$	0.5	4.5	0.5	M4x10	M4x12	6.0

1) Formerly DIN 912

Tightening torques for the mounting screws

$\mu K = \mu G = 0.125$

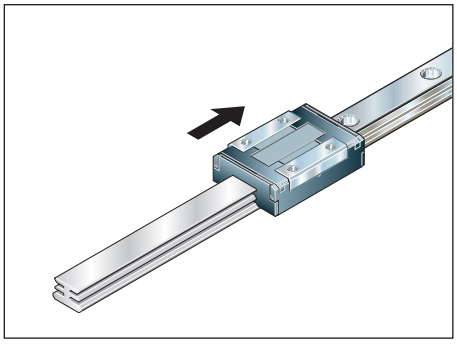
8.8		M2	M3	M4	M5
Nm	**A2-70**	0.35	1.1	2.0	3.9
	12.9	0.50	2.1	4.6	9.5

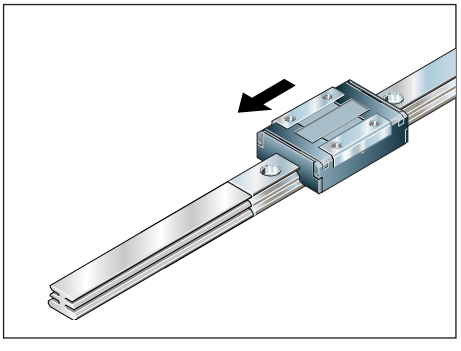
Note on installation

The runner blocks are delivered mounted on a plastic arbor.

– Position the runner block complete with the arbor at the head of the rail and push on; the arbor will thus be pushed out of the runner block.

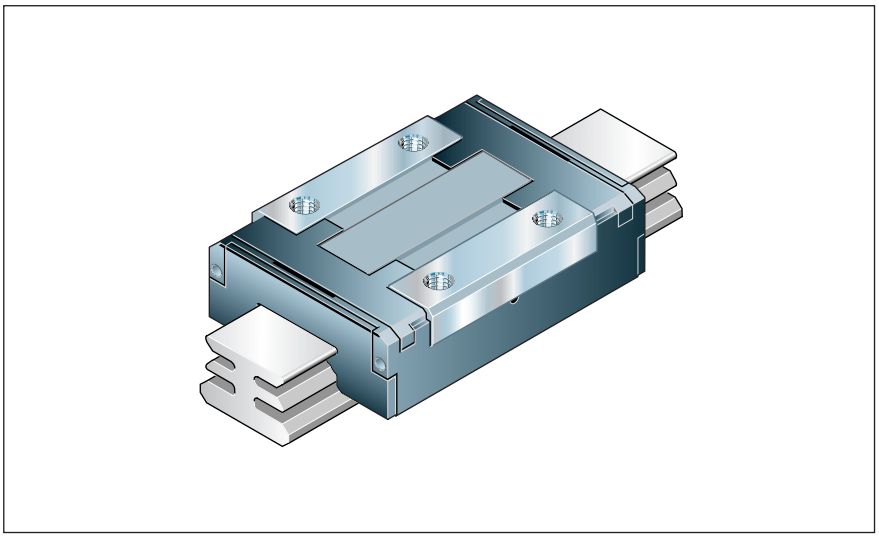
When removing the runner block, carry out the above operations in reverse sequence.





Standard runner blocks R0442

All steel parts of the runner block are made of corrosion-resistant, martensitic steel.
The runner blocks are delivered mounted on arbors.



Part numbers for runner blocks
Standard seals: low-friction seals.
Part number: R0442 ... **01** (see table)
Special versions:
Runner blocks are also available:
– with N seals
(excellent wiping action)
Sizes 15 and 20 have additional longitudinal seals for full sealing.
Part number: R0442 ... **00**
(otherwise as per table)
– without basic lubrication for individual lubrication.
  – sizes 15 and 20 additionally with N seals and longitudinal seals
  Part number: R0442 ... **40**
  (otherwise as per table)
  – with low-friction seals
  Part number: R0442 ... **41**
  (otherwise as per table)

Size	Accuracy class	Part numbers for runner blocks	
		Clearance 9	Preload 1
7	P	-	R0442 712 01
	H	R0442 793 01	R0442 713 01
	N	R0442 794 01	-
9/M3	P	–	R0442 812 01
	H	R0442 893 01	R0442 813 01
	N	R0442 894 01	–
12	P	–	R0442 212 01
	H	R0442 293 01	R0442 213 01
	N	R0442 294 01	–
15	P	–	R0442 512 01
	H	R0442 593 01	R0442 513 01
	N	R0442 594 01	–
20	P	–	R0442 012 01
	H	R0442 093 01	R0442 013 01
	N	R0442 094 01	–

Take frictional drag of the respective seals into account.
See “Technical Data”, section “Friction and seals”.

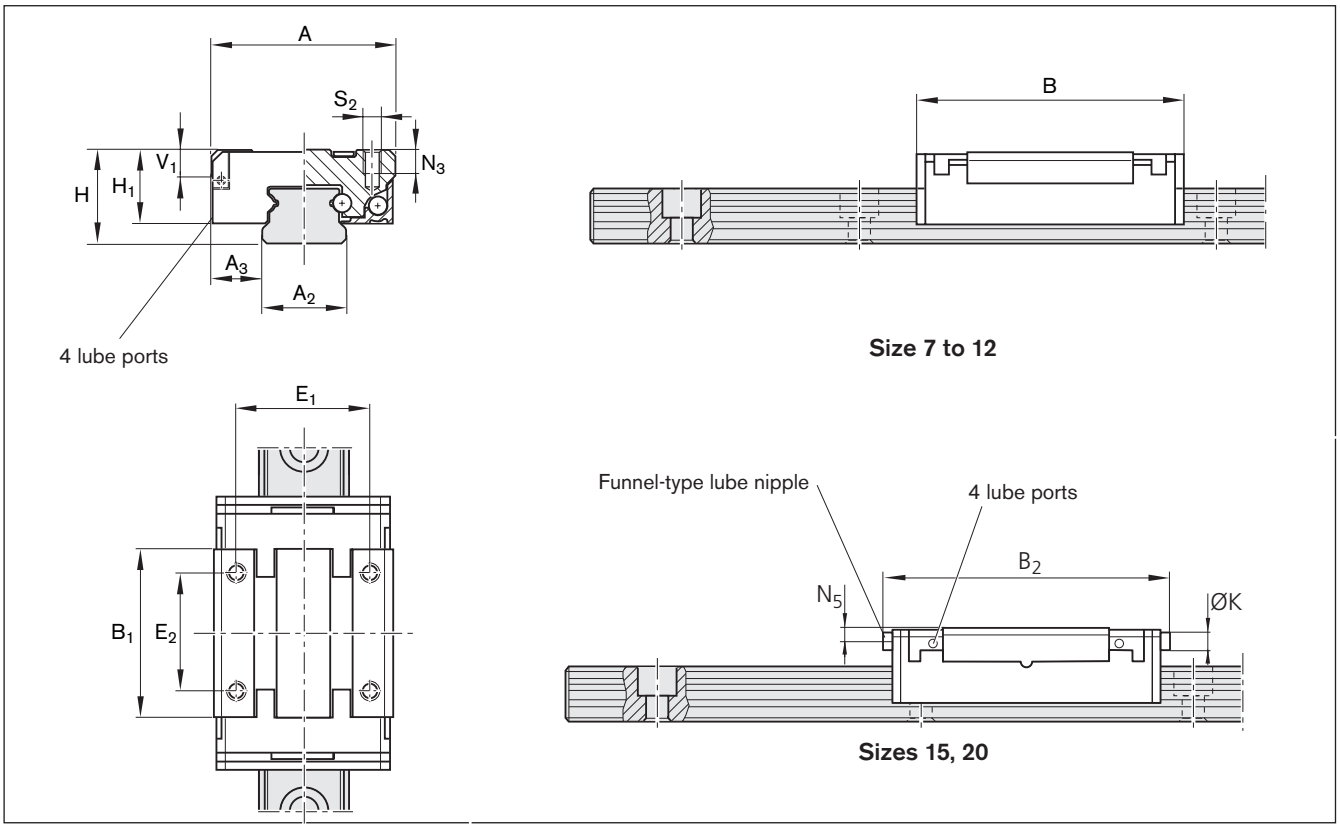
Note on dynamic load capacities and moments (see table)
Determination of the dynamic load capacities and moments is based on a travel life of 100,000 m.
Often only 50,000 m are actually stipulated.
For comparison:
Multiply values **C, M_t** and **M_L** from the table by 1.26.

Ordering example 1:
Runner block size 12, accuracy class P, preloaded, standard seals
Ordering data: **R0442 212 01**

Ordering example 2:
Runner block size 7, accuracy class H, clearance, N seals
Ordering data: **R0442 793 00**

Ordering example 3:
Runner block size 15, accuracy class H, preloaded, N seals and longitudinal seals, no basic lubrication
Ordering data: **R0442 513 40**

Ordering example 4:
Runner block size 9/M3, accuracy class N, clearance, standard seals, no basic lubrication
Ordering data: **R0442 894 41**



Size	Dimensions (mm)															
	A	A_2	A_3	B	B_1	B_2	H	H_1[1)]	H_1[2)]	V_1	E_1	E_2	K	N_3	N_5	S_2
7	17	7	5.0	24.0	14.9	–	8	6.5	–	2.0	12	8	–	2.5	–	M2
9/M3	20	9	5.5	31.0	20.7	–	10	8.0	–	2.8	15	10	–	3.0	–	M3
12	27	12	7.5	34.8	21.6	–	13	10.0	–	3.3	20	15	–	3.5	–	M3
15	32	15	8.5	43.0	27.2	46	16	12.0	12.65	4.7	25	20	4	4.0	2.1	M3
20	46	20	13.0	66.0	45.1	69	25	17.5	18.15	7.0	38	38	4	6.0	3.1	M4

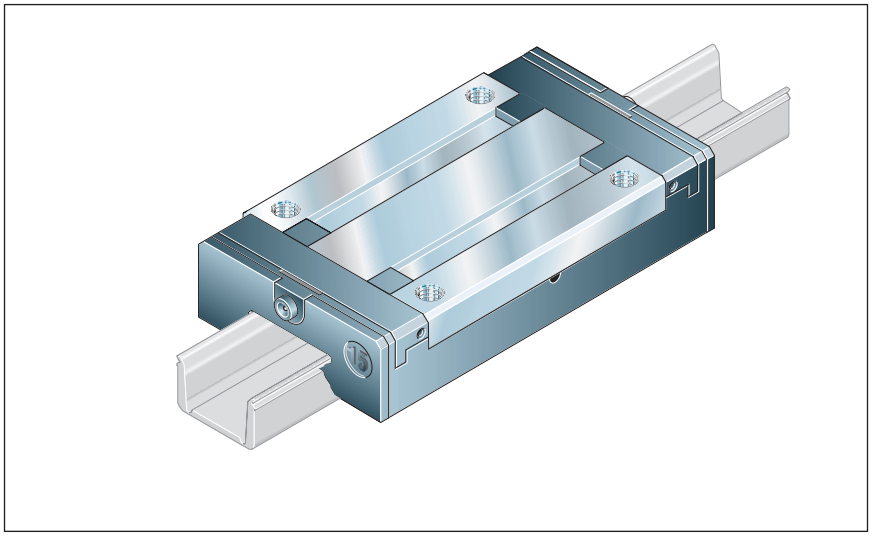
1) Without longitudinal seal
2) With longitudinal seal

Size	Weight Runner block (g)	Load capacities (N)		Moments (Nm)			
		C[1)]	C_0[1)]	M_t[2)]	M_{t0}[2)]	M_L[2)]	M_{LO}[2)]
7	9	860	1400	3.1	5.1	1.9	3.2
9/M3	16	1180	2100	5.4	9.6	3.6	6.4
12	33	2310	3470	13.7	20.6	7.9	11.8
15	47	4200	6260	31.2	46.3	18.3	27.0
20	177	7900	12230	81.4	126.0	51.7	80.0

1) Calculated values conforming to DIN 636, Part 2
2) Calculated values (based on C, C_0)

Long runner blocks R0444

All steel parts of the runner block are made of corrosion-resistant, martensitic steel.
The runner blocks are delivered mounted on arbors.



Part numbers for runner blocks
Standard seals: low-friction seals.
Part number: R0444 ... **01** (see table)
Special versions:
Runner blocks are also available:
- with N seals
  (excellent wiping action)
  Sizes 9/M3, 12 and 15 have additional longitudinal seals for full sealing.
  Part number: R0444 ... **00**
  (otherwise as per table)
- without basic lubrication for individual lubrication.
  - sizes 9/M3, 12 and 15 additionally with N seals and longitudinal seals.
    Part number: R0444 ... **40**
    (otherwise as per table)
  - with low-friction seals
    Part number: R0444 ... **41**
    (otherwise as per table)

Size	Accuracy class	Part numbers for runner blocks	
		Clearance 9	Preload 1
7	P	–	R0444 712 01
	H	R0444 793 01	R0444 713 01
	N	R0444 794 01	–
9/M3	P	–	R0444 812 01
	H	R0444 893 01	R0444 813 01
	N	R0444 894 01	–
12	P	–	R0444 212 01
	H	R0444 293 01	R0444 213 01
	N	R0444 294 01	–
15	P	–	R0444 512 01
	H	R0444 593 01	R0444 513 01
	N	R0444 594 01	–

Take frictional drag of the respective seals into account.
See “Technical Data”, section “Friction and seals”.

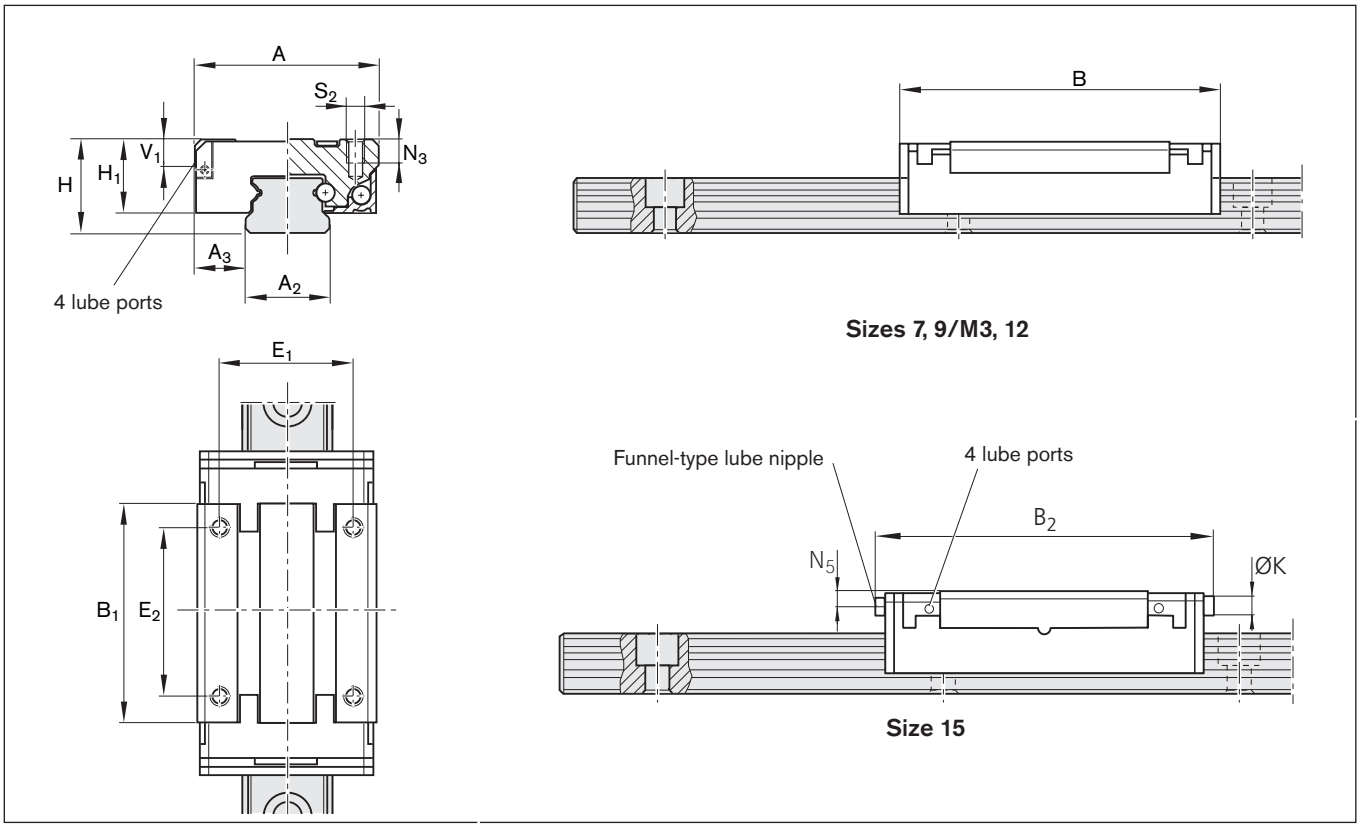
Note on dynamic load capacities and moments (see table)
Determination of the dynamic load capacities and moments is based on a travel life of 100,000 m.
Often only 50,000 m are actually stipulated.
For comparison:
Multiply values **C, M_t** and **M_L** from the table by 1.26.

Ordering example 1:
Runner block size 12, accuracy class P, preloaded, standard seals
Ordering data: **R0444 212 01**

Ordering example 2:
Runner block size 7, accuracy class H, clearance, N seals
Ordering data: **R0444 793 00**

Ordering example 3:
Runner block size 15, accuracy class H, preloaded, N seals and longitudinal seals, no basic lubrication
Ordering data: **R0444 513 40**

Ordering example 4:
Runner block size 9/M3, accuracy class N, clearance, standard seals, no basic lubrication
Ordering data: **R0444 894 41**



Size	Dimensions (mm)															
	A	A_2	A_3	B	B_1	B_2	H	H_1[1]	H_1[2]	V_1	E_1	E_2	K	N_3	N_5	S_2
7	17	7	5.0	33.0	24.1	–	8	6.5	–	2.0	12	13	–	2.5	–	M2
9/M3	20	9	5.5	41.4	31.3	–	10	8.0	8.65	2.8	15	16	–	3.0	–	M3
12	27	12	7.5	47.5	34.5	–	13	10.0	10.65	3.3	20	20	–	3.5	–	M3
15	32	15	8.5	60.8	45.0	63.8	16	12.0	12.65	4.7	25	25	4	4.0	2.1	M3

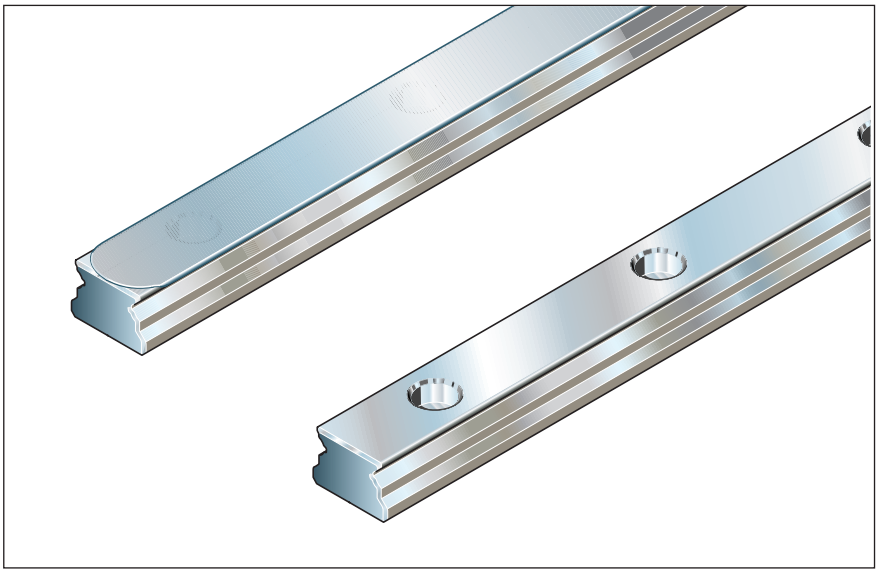
1) Without longitudinal seal
2) With longitudinal seal

Size	Weight Runner block (g)	Load capacities (N)		Moments (Nm)			
		C[1]	C_0[1]	M_t[2]	M_{t0}[2]	M_L[2]	M_{LO}[2]
7	14	1220	2340	4.5	8.5	4.3	8.3
9/M3	26	1570	3150	7.2	14.5	7.0	14.0
12	51	3240	5630	19.3	33.5	16.8	29.2
15	94	5940	10170	44.0	75.3	39.2	67.1

1) Calculated values conforming to DIN 636, Part 2
2) Calculated values (based on C, C_0)

Standard guide rails R0445

For runner blocks R0442 and R0444.
Guide rails made of corrosion-resistant, martensitic steel.



Part numbers for guide rails

Size	Accuracy class	Part numbers for guide rails Part number, length L (mm) **without** cover strip	 **with** cover strip
7	P	R0445 702 31,....	–
	H	R0445 703 31,....	–
	N	R0445 704 31,....	–
9/M3	P	R0445 802 31,....	R0445 862 31,....
	H	R0445 803 31,....	R0445 863 31,....
	N	R0445 804 31,....	R0445 864 31,....
12	P	R0445 202 31,....	R0445 262 31,....
	H	R0445 203 31,....	R0445 263 31,....
	N	R0445 204 31,....	R0445 264 31,....
15[1)]	P	R0445 502 31,....	R0445 562 31,....
	H	R0445 503 31,....	R0445 563 31,....
	N	R0445 504 31,....	R0445 564 31,....
20	P	R0445 002 31,....	R0445 062 31,....
	H	R0445 003 31,....	R0445 063 31,....
	N	R0445 004 31,....	R0445 064 31,....

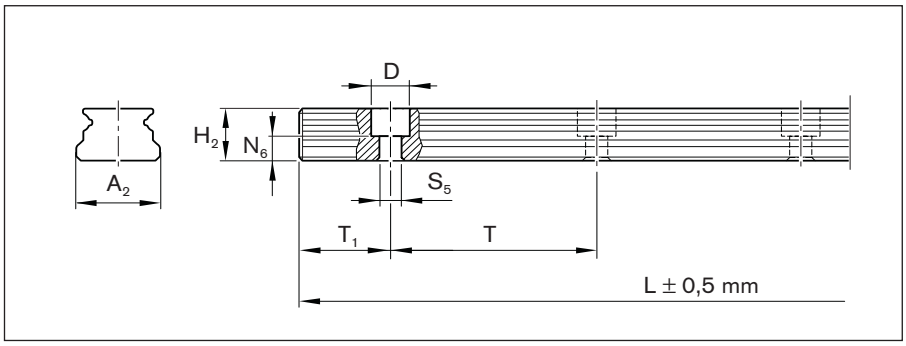
1) Also available in versions for mounting from below (please ask).

Recommended rail lengths

$$L = n_B \cdot T - 4$$

L	=	rail length	(mm)
T	=	hole spacing	(mm)
n_B	=	number of holes	

Dimensions and weights



Position tolerance of the mounting holes for
– L < 500 mm ⊕ | Ø 0.3
– L < 1000 mm ⊕ | Ø up to 0.6 increasing in linear proportion

Size	Dimensions (mm)									Weight
	A_2	H_2 1)	N_6	D	S_5	T_{1min}	T_{1max}	T	L_{1max} 2)3)	g/100 mm
7	7	4.7	2.2	4.3	2.5	5.0	11.5	15	1000	22
9/M3	9	5.5	2.2	6.0	3.5	6.0	15.5	20	1000	33
12	12	7.8	3.0	6.0	3.5	6.0	20.5	25	1000	61
15	15	9.5	4.7	6.0	3.5	6.0	35.5	40	1000	97
20	20	15.0	6.5	9.5	6.0	6.5	53.5	60	1000	211

1) Dimensions without cover strip
2) For rail lengths longer than L_{max} factory-made mating sections are joined end-to-end.
3) For special cases one-piece guide rails up to 2000 mm length possible (please ask).

Ordering Examples

☞ If no T_1 is specified by the customer, both ends of the guide rail will be identical. The rail lengths were calculated using the formula for recommended rail lengths.

Ordering example 1
(up to L_{max}):
Guide rail size 12, accuracy class P, recommended rail length 771 mm (30 · T, number of holes $n_B = 31$, T_1 is identical at both ends of the guide rail)
Ordering data: **R0445 202 31, 771 mm**

Ordering example 2
(up to L_{max} with cover strip):
Guide rail size 12 with cover strip, accuracy class P, recommended rail length 771 mm (30 · T, number of holes $n_B = 31$, T_1 at one end of guide rail = 4.5 mm)
Ordering data:
R0445 262 31, 771 mm, T1 = 4.5 mm
(At the other end of the guide rail T_1 = 16.5 mm for production reasons.)

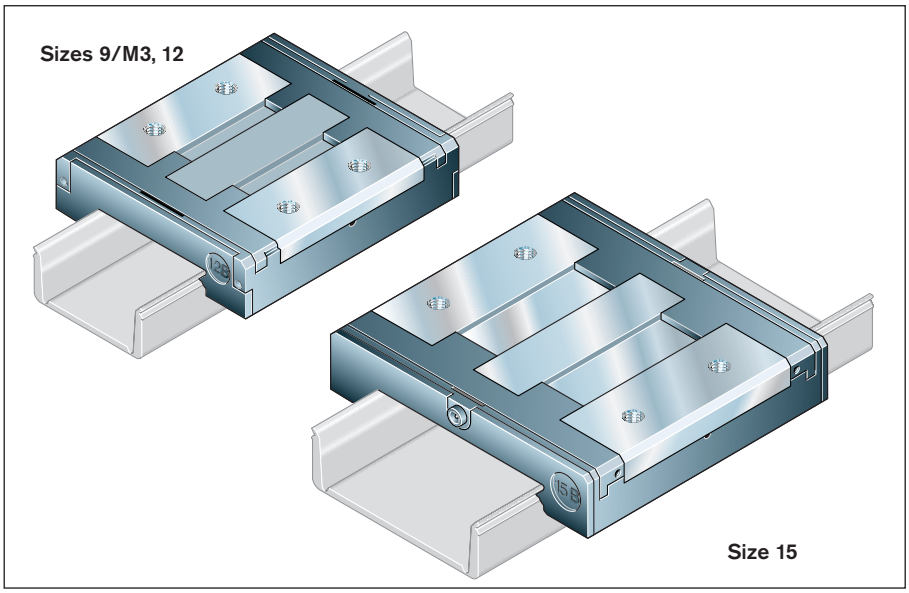
Ordering example 3
(composite rail over L_{max}):
Guide rail size 12, accuracy class N, recommended rail length 1271, mm, **2** sections (50 · T, number of holes $n_B = 51$, T_1 is identical at both ends of the composite guide rail)
Ordering data: **R0445 204 32, 1271 mm**

Number of sections

Ordering example 4
(one-piece over L_{max}):
Guide rail size 12, accuracy class P, recommended rail length 1771 mm (70 · T, number of holes $n_B = 71$, T_1 is identical at both ends of the guide rail)
Ordering data: **R0445 202 31, 1771 mm**

Wide runner blocks R0443

All steel parts of the runner block are made of corrosion-resistant, martensitic steel.
The runner blocks are delivered mounted on arbors.



Part numbers for runner blocks
Standard seals: low-friction seals.
Part number: R0443 ... **01** (see table)
Special versions:
Runner blocks are also available:
- with N seals (excellent wiping action) and longitudinal seals for full sealing.
  Part number: R0443 ... **00**
  (otherwise as per table)
- without basic lubrication for individual lubrication.
  - with N seals and longitudinal seals
    Part number: R0443 ... **40**
    (otherwise as per table)
  - with low-friction seals
    Part number: R0443 ... **41**
    (otherwise as per table)

Size	Accuracy class	Part numbers for runner blocks	
		Clearance **9**	Preload **1**
9/M3	P	–	R0443 812 01
	H	R0443 893 01	R0443 813 01
	N	R0443 894 01	–
12	P	–	R0443 212 01
	H	R0443 293 01	R0443 213 01
	N	R0443 294 01	–
15	P	–	R0443 512 01
	H	R0443 593 01	R0443 513 01
	N	R0443 594 01	–

Take frictional drag of the respective seals into account.
See “Technical Data”, section “Friction and seals”.

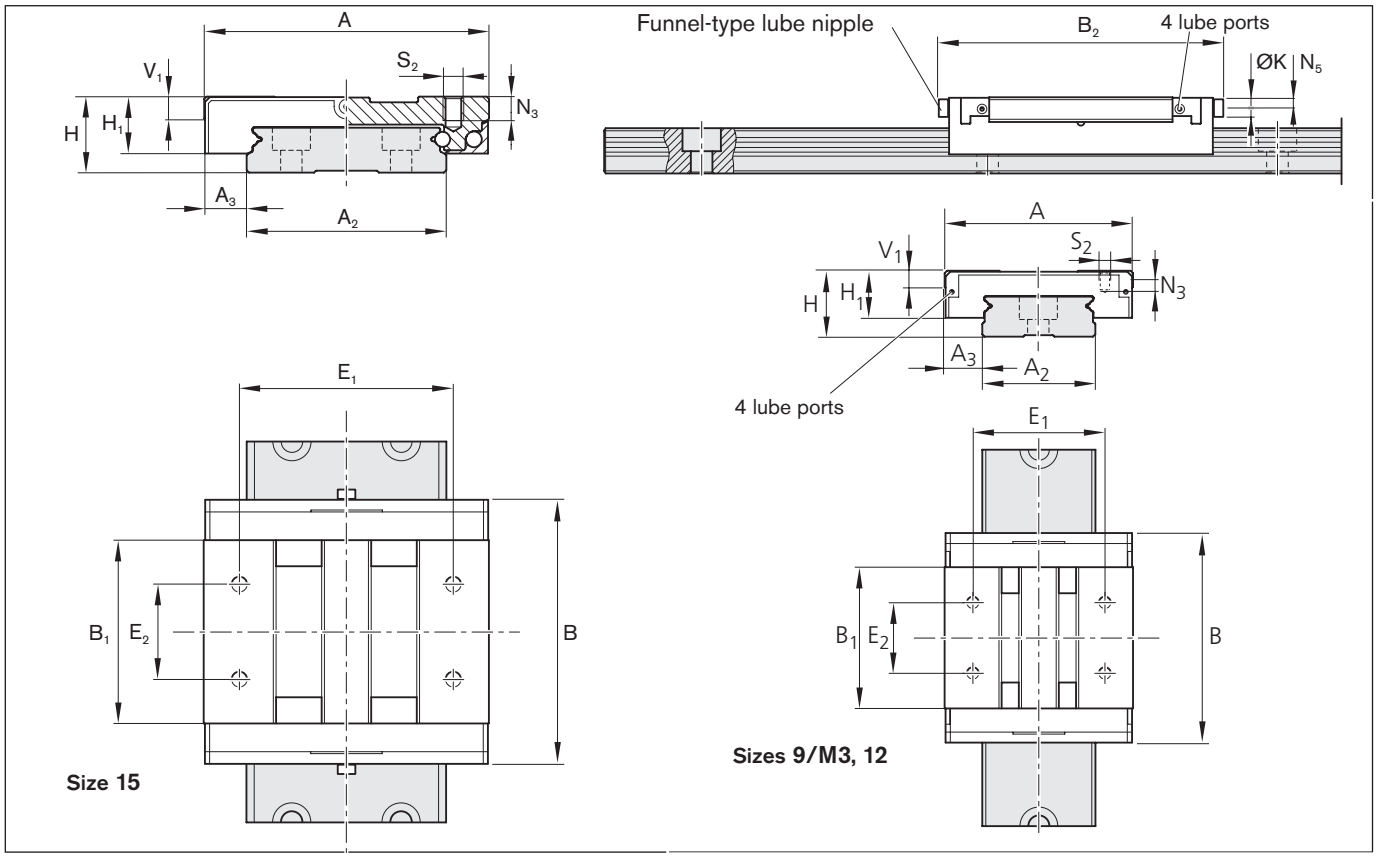
Note on dynamic load capacities and moments (see table)
Determination of the dynamic load capacities and moments is based on a travel life of 100,000 m.
Often only 50,000 m are actually stipulated.
For comparison:
Multiply values **C, M_t** and **M_L** from the table by 1.26.

Ordering example 1:
Runner block size 12, accuracy class P, preloaded, standard seals
Ordering data: **R0443 212 01**

Ordering example 2:
Runner block size 12, accuracy class H, clearance, N seals
Ordering data: **R0443 293 00**

Ordering example 3:
Runner block size 15, accuracy class H, preloaded, N seals and longitudinal seals, no basic lubrication
Ordering data: **R0443 513 40**

Ordering example 4:
Runner block size 9/M3, accuracy class N, clearance, standard seals, no basic lubrication
Ordering data: **R0443 894 41**



Size	Dimensions (mm)															
	A	A_2	A_3	B	B_1	B_2	H	H_1[1)]	H_1[2)]	V_1	E_1	E_2	K	N_3	N_5	S_2
9/M3	30	18	6.0	39.0	31.3	–	12	9.0	9.65	2.8	21	12	–	3.2	–	M3
12	40	24	8.0	44.5	34.5	–	14	10.0	10.65	3.3	28	15	–	4.0	–	M3
15	60	42	9.0	55.5	45.0	58.5	16	12.0	12.65	4.7	45	20	4	4.5	2.1	M4

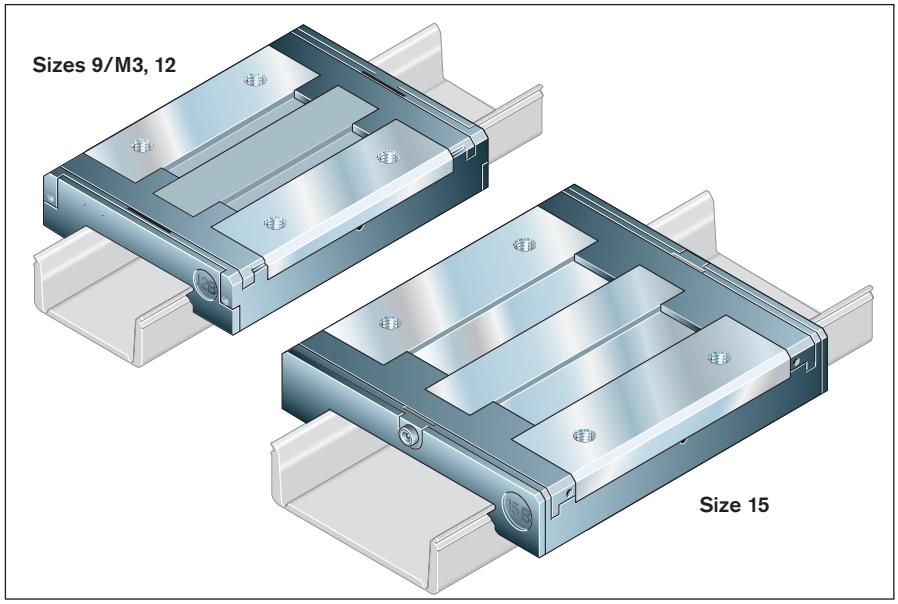
1) Without longitudinal seal
2) With longitudinal seal

Size	Weight Runner block (g)	Load capacities (N)		Moments (Nm)			
		C[1)]	C_0[1)]	M_t[2)]	M_{t0}[2)]	M_L[2)]	M_{LO}[2)]
9/M3	26	1920	3330	15.9	27.6	7.4	12.9
12	51	3200	5340	37.9	63.2	14.3	23.9
15	110	5285	8610	107.0	174.0	30.0	49.0

1) Calculated values conforming to DIN 636, Part 2
2) Calculated values (based on C, C_0)

Wide, long runner blocks R0441

All steel parts of the runner block are made of corrosion-resistant, martensitic steel.
The runner blocks are delivered mounted on arbors.



Part numbers for runner blocks
Standard seals: low-friction seals.
Part number: R0441 ... **01** (see table)
Special versions:
Runner blocks are also available:
– with N seals (excellent wiping action) and longitudinal seals for full sealing.
  Part number: R0441 ... **00**
  (otherwise as per table)
– without basic lubrication for individual lubrication.
  – with N seals and longitudinal seals
    Part number: R0441 ... **40**
    (otherwise as per table)
  – with low-friction seals
    Part number: R0441 ... **41**
    (otherwise as per table)

Size	Accuracy class	Part numbers for runner blocks	
		Clearance	Preload
		9	1
9/M3	P	–	R0441 812 01
	H	R0441 893 01	R0441 813 01
	N	R0441 894 01	–
12	P	–	R0441 212 01
	H	R0441 293 01	R0441 213 01
	N	R0441 294 01	–
15	P	–	R0441 512 01
	H	R0441 593 01	R0441 513 01
	N	R0441 594 01	–

Take frictional drag of the respective seals into account.
See “Technical Data”, section “Friction and seals”.

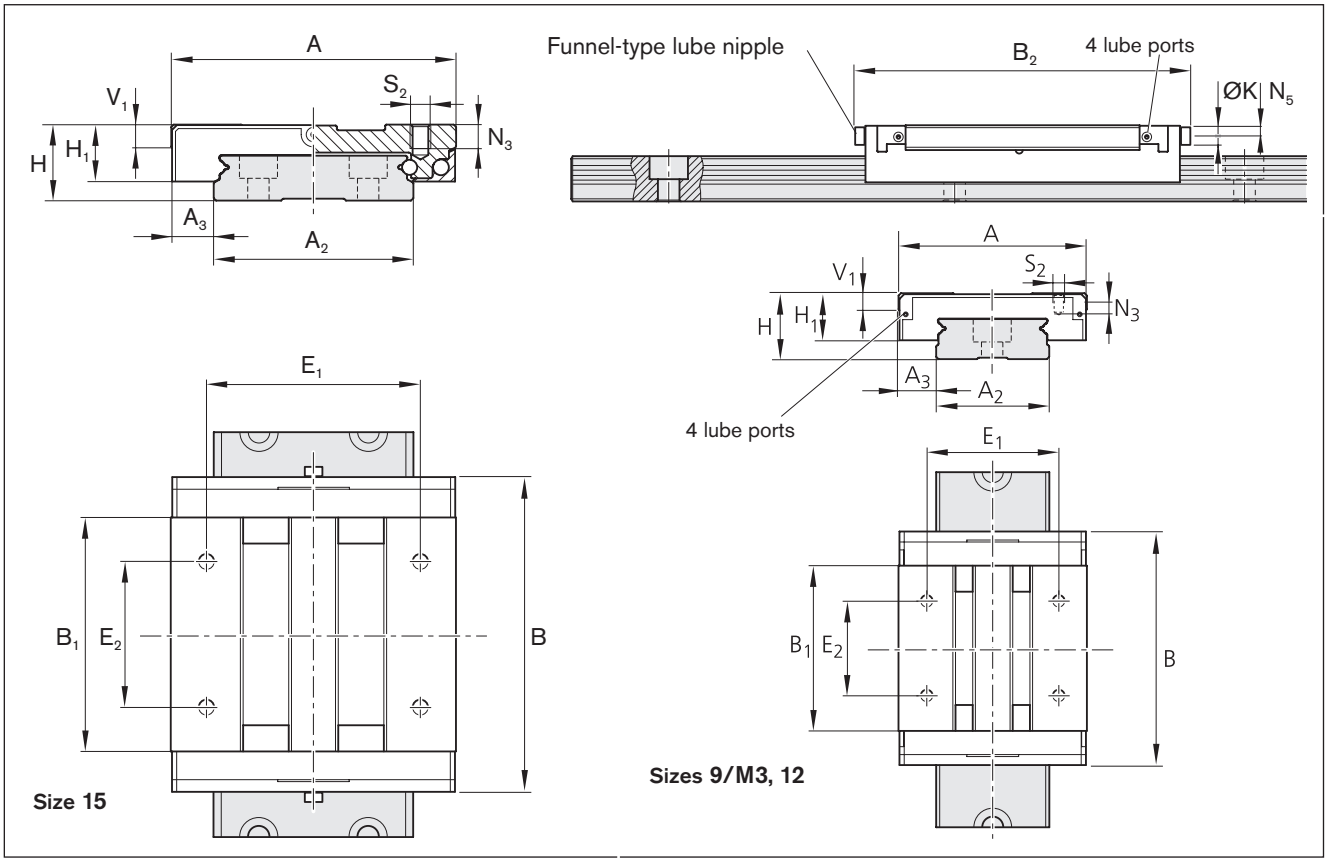
Note on dynamic load capacities and moments (see table)
Determination of the dynamic load capacities and moments is based on a travel life of 100,000 m.
Often only 50,000 m are actually stipulated.
For comparison:
Multiply values **C, M_t** and **M_L** from the table by 1.26.

Ordering example 1:
Runner block size 12, accuracy class P, preloaded, standard seals
Ordering data: **R0441 212 01**

Ordering example 2:
Runner block size 12, accuracy class H, clearance, N seals
Ordering data: **R0441 293 00**

Ordering example 3:
Runner block size 15, accuracy class H, preloaded, N seals and longitudinal seals, no basic lubrication
Ordering data: **R0441 513 40**

Ordering example 4:
Runner block size 9/M3, accuracy class N, clearance, standard seals, no basic lubrication
Ordering data: **R0441 894 41**



Size	Dimensions (mm)															
	A	A_2	A_3	B	B_1	B_2	H	H_1[1]	H_1[2]	V_1	E_1	E_2	K	N_3	N_5	S_2
9/M3	30	18	6.0	51.0	38.0	–	12	9.0	9.65	2.8	23	24	–	3.2	–	M3
12	40	24	8.0	59.5	45.0	–	14	10.0	10.65	3.3	28	28	–	4.0	–	M3
15	60	42	9.0	74.5	57.6	77.5	16	12.0	12.65	4.7	45	35	4	4.5	2.1	M4

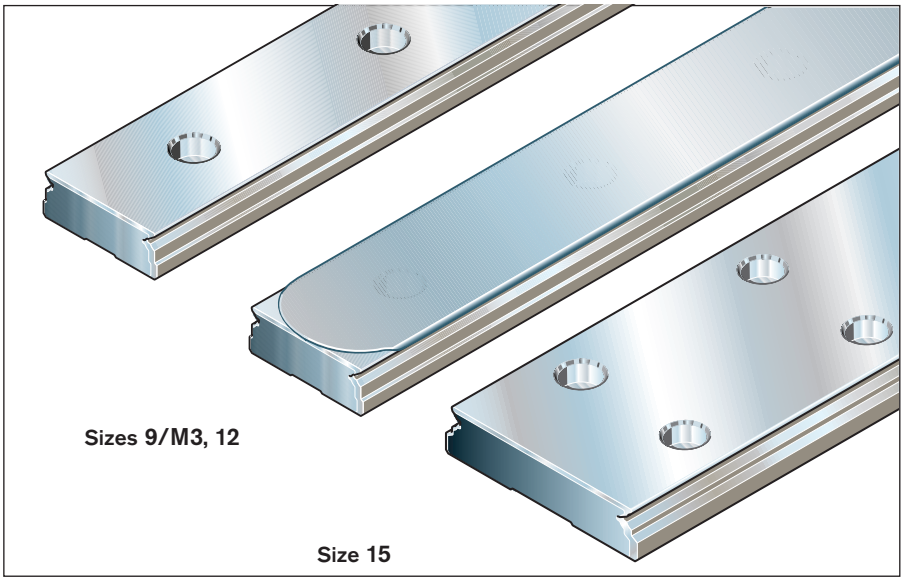
1) Without longitudinal seal
2) With longitudinal seal

Size	Weight Runner block (g)	Load capacities (N)		Moments (Nm)			
		C[1]	C_0[1]	M_t[2]	M_{t0}[2]	M_L[2]	M_{LO}[2]
9/M3	41	2825	5590	23.5	46.4	15.8	31.2
12	76	4340	8250	51.4	97.7	28.7	54.6
15	170	7460	14085	151.0	285.2	66.1	125.0

1) Calculated values conforming to DIN 636, Part 2
2) Calculated values (based on C, C_0)

Wide guide rails R0455

For runner blocks R0443 and R0441
Mounting hole pattern, size 9/M3, 12:
– single row
Mounting hole pattern, size 15:
– double row
Guide rails made of corrosion-resistant, martensitic steel.



Part numbers for guide rails

Size	Accuracy class	Part numbers for wide guide rails Part number, length L (mm)	
		without cover strip	**with** cover strip
9/M3	P	R0455 802 31,....	R0455 862 31,....
	H	R0455 803 31,....	R0455 863 31,....
	N	R0455 804 31,....	R0455 864 31,....
12	P	R0455 202 31,....	R0455 262 31,....
	H	R0455 203 31,....	R0455 263 31,....
	N	R0455 204 31,....	R0455 264 31,....
15	P	R0455 502 31,....	R0455 562 31,....
	H	R0455 503 31,....	R0455 563 31,....
	N	R0455 504 31,....	R0455 564 31,....

Recommended rail lengths

$$L = n_B \cdot T - 4$$

L = rail length (mm)
T = hole spacing (mm)
n_B = number of holes per row

Ordering Examples

☞ If no T_1 is specified by the customer, both ends of the guide rail will be identical. The rail lengths were calculated using the formula for recommended rail lengths.

Ordering example 1
(up to L_{max}):
Guide rail size 12, accuracy class P, recommended rail length 836 mm (20 · T, number of holes $n_B = 21$, T_1 is identical at both ends of the guide rail)
Ordering data: **R0455 202 31, 836 mm**

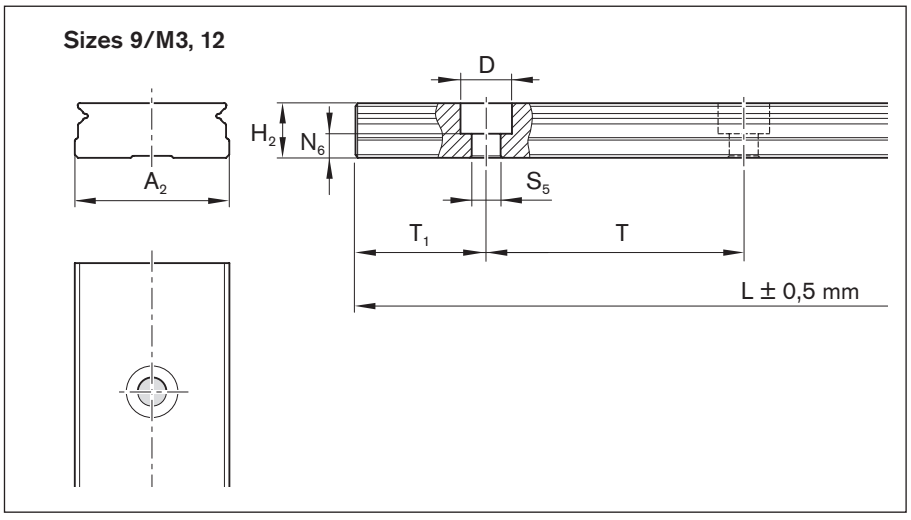
Ordering example 2
(up to L_{max} with cover strip):
Guide rail size 9/M3, accuracy class H, recommended rail length 926 mm (30 · T, number of holes $n_B = 31$, T_1 at one end of guide rail = 4.5 mm)
Ordering data:
R0455 863 31, 926 mm, $T_1 = 4.5$ mm
(At the other end of the guide rail T_1 = 21.5 mm mm for production reasons)

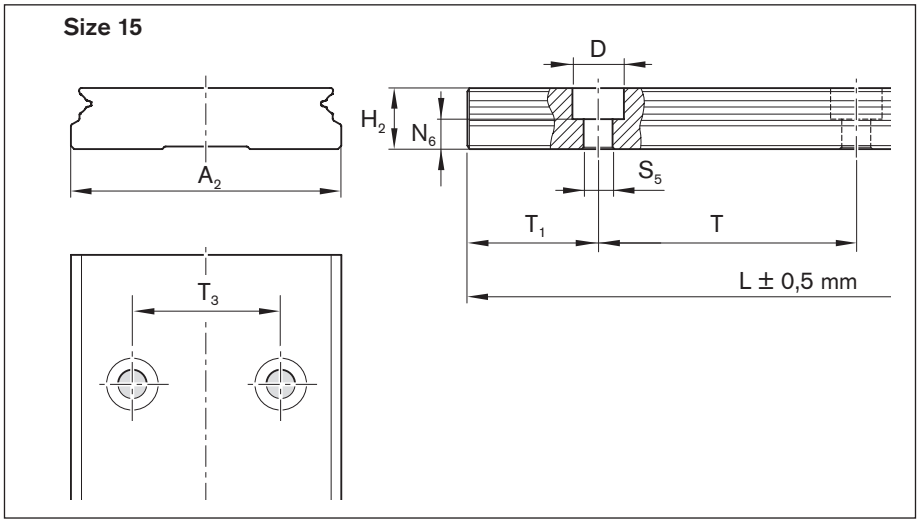
Ordering example 3
(composite rail over L_{max}):
Guide rail size 15, accuracy class N, recommended rail length 1436 mm, **2** sections (35· T, number of holes $n_B = 36$ per row, T_1 is identical at both ends of the composite guide rail)
Ordering data: **R0455 504 32, 1436 mm**

Number of sections

Ordering example 4
(one-piece over L_{max}):
Guide rail size 12, accuracy class P, recommended rail length 1636 mm (40 · T, number of holes $n_B = 41$, T_1 is identical at both ends of the guide rail)
Ordering data: **R0455 202 31, 1636 mm**

Dimensions and weights





Position tolerance of the mounting holes for

L < 500 mm | ⊕ | Ø 0.3

L < 1000 mm | ⊕ | Ø up to 0.6 increasing in linear proportion

Size	Dimensions (mm)										Weight
	A_2	H_2 1)	N_6	D	S_5	T_{1min}	T_{1max}	T	T_3	L_{1max} 2)3)	(g/100 mm)
9/M3	18	7.5	2.7	6.0	3.5	6.0	25.5	30	–	1000	92
12	24	8.5	3.7	8.0	4.5	6.0	34.5	40	–	1000	145
15	42	9.5	4.7	8.0	4.5	6.0	34.5	40	23	1000	286

1) Dimensions without cover strip

2) For rail lengths longer than L_{max} factory-made mating sections are joined end-to-end.

3) For special cases one-piece guide rails up to 2000 mm length possible (please ask).

Start-up and maintenance

Start-up

Initial lubrication of runner blocks is necessary before miniature ball rail systems are put into service!

Runner blocks are available:
– prelubricated with a lithium soap grease, consistency class NLGI 00, Dynalub 520
– without initial lubrication for individual grease or oil lubrication.

Initial lubrication with grease

We recommend a grease lubricant per DIN 51825, class KP00K.
A grease of this type, Dynalub 520, is available in the following versions:
– Maintenance kit with 5 ml dispensing unit, part number R0419 090 01
– 400 g cartridge for use in grease guns, part number R3416 043 00

Note:
- Grease the runner block as per table.
- Move the runner block in the direction of the lube port used to distribute the grease evenly.
- Make sure there is a visible film of grease on the guide rail.

Initial lubrication with oil

We recommend the use of oils meeting the minimum requirements for CLP lubricant oils (DIN 51517, Part 3) or HLP hydraulic oils (DIN 51524, Part 2). The oil must have a viscosity of 100 mm^2/s at 40 °C.

- Follow the manufacturer's instructions.
- It is essential to check that the lubricant will reach all rolling elements in the installed condition (orientation).
- Apply oil until excess emerges.

⚠ **Add the entire oil quantity in one go!**

Maintenance

The maintenance intervals depend on the application and the ambient conditions.

Under normal conditions no in-service lubrication is required.

Cleaning

Dirt can settle and encrust on the guide rails, especially when these are not enclosed. This dirt must be removed to protect the seals.

- Always run a cleaning cycle before shutting down the machine.

In-service lubrication

Initial lubrication (long-term lubrication) is sufficient for 5,000 km travel where:
– $F < 0.1\ C$
– $v_m = 0.65$ m/s
– 90 mm stroke
– low-friction seals
- For in-service lubrication with grease or oil, follow instructions as for initial lubrication.

⚠ **The in-service lubrication intervals depend on ambient conditions, loading and type of load!**

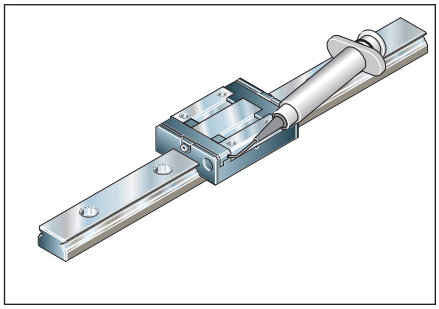
Ambient conditions include: swarf, metallic and other abrasion, solvents and temperature. Load types include vibrations, impacts and tilting.

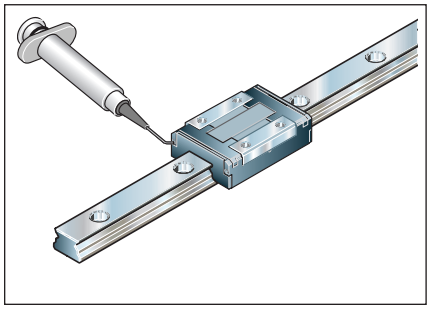
⚠ **The service conditions are unknown to the manufacturer. Users can only determine the in-service lubrication intervals with certainty by conducting in-house tests or by careful observation.**

⚠ **Do not allow guide rails or runner blocks to come into contact with water-based metalworking fluids!**

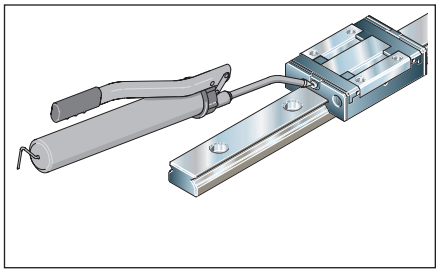
Maintenance kit

A **special syringe** is used to apply lubricant to the **lube ports** at the sides or end faces of the runner block (part number: R0419 090 01).





If the **funnel-type lube nipples** on the runner block end faces are preferred, use a **grease gun** instead.



Short stroke
(stroke < 2 runner block lengths)

See “Lubrication quantities and methods” for the method to be used for short-stroke applications.

For strokes < 0.5 runner block length, slide the runner block over 2 complete runner block lengths per lubrication cycle. If this is not possible, please consult us.

Lubrication quantities and methods

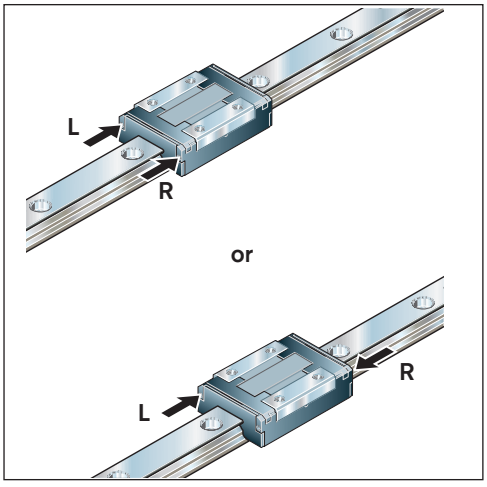
The lubrication method depends on the size, as given in the table:

Size	Lubrication by method 1	method 2
Standard runner block R0442		
7	✓	
9/M3	✓	
12	✓	
15		✓
20		✓
Long runner block R0444		
7	✓	
9/M3	✓	
12	✓	
15		✓
Wide runner block R0443; wide, long R0441		
9/M3	✓	
12	✓	
15		✓

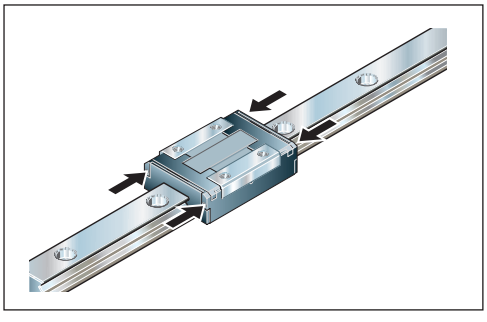
Method 1

Apply lubricant through the lube ports on the end face.

Size	Initial lubrication with grease	
	Partial amount per side (L/R)* (cm^3)	Total amount (L+R)* (cm^3)
Standard runner block R0442		
7	0.025	0.05
9/M3	0.030	0.06
12	0.075	0.15
Long runner block R0444		
7	0.04	0.08
9/M3	0.045	0.09
12	0.12	0.24
Wide runner block R0443		
9/M3	0.040	0.08
12	0.075	0.15
Wide, long runner block R0441		
9/M3	0.060	0.12
12	0.11	0.22



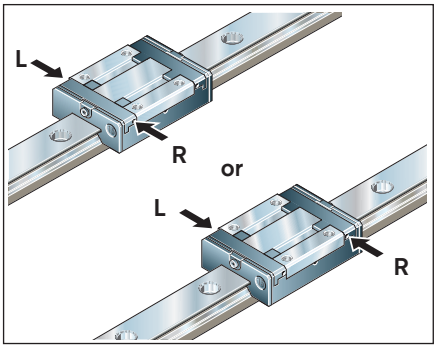
For **short stroke** applications, apply the partial amount per side as given in the table to each end-face lube port.
* (L = left, R = right)

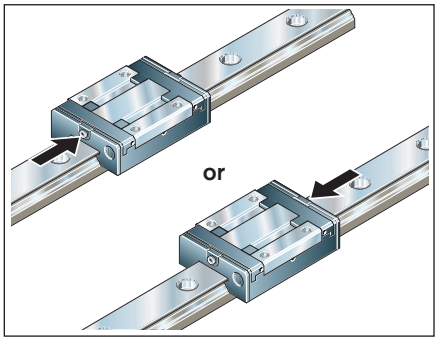


Method 2

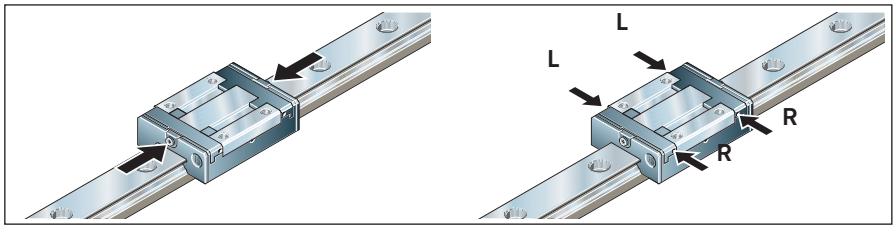
Apply lubricant through the lube ports at the sides (partial amount per side) or the lube nipple on the end face (total amount).

Size	Initial lubrication with grease	
	Partial amount per side (L/R) (cm^3)	Total amount via end face (cm^3)
Standard runner block R0442		
15	0.06	0.12
20	0.09	0.18
Long runner block R0444		
15	0.10	0.20
Wide runner block R0443		
15 B	0.09	0.18
Wide, long runner block R0441		
15	0.13	0.26





For **short-stroke** applications, apply either the total amount as per table to each end-face lube nipple, or the partial amount per side as given in the table to each side lube port.



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