Mounting Instructions, Ball Runner Blocks and Ball Guide Rails

General Notes

The following notes relating to mounting apply to all Ball Rail Systems.
However, different specifications exist with regard to the parallelism of the guide rails and to mounting the runner blocks with screws and locating pins. This information is provided separately alongside the descriptions of the individual types of Ball Rail Systems.

⚠ **During overhead (top down) or vertical assembly, damage to the runner block resulting in loss or breakage of balls may cause the runner block to come away from the rail. Secure the runner block to prevent it from falling!**
Danger to life and limb!
The use of fall arresting devices is recommended!

Rexroth Ball Rail Systems are high-grade quality products. Particular care must be taken during transportation and subsequent mounting. The same care must be taken with cover strips.
All steel parts are protected with anti-corrosion oil.
It is not necessary to remove this oil provided the recommended lubricants are used.

Mounting examples

Ball guide rails

Each guide rail has ground reference surfaces on both sides.

Possibilities for side fixing:
1 Reference edges
2 Retaining strips
3 Wedge profile retaining strips

Note
– Guide rails without side fixing have to be aligned straight and parallel when mounting, preferably using a straightedge.
– Recommended limits for side load if no additional lateral retention is provided, see the individual ball runner blocks.

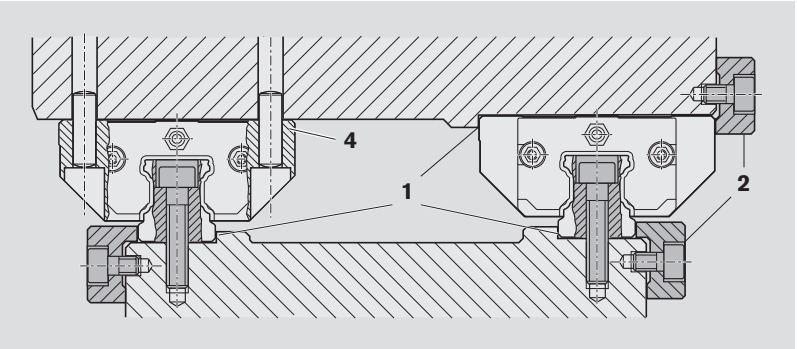
Ball runner blocks
Each runner block has a ground reference edge on one side (see dimension V_1 in the dimension drawings).

Possibilities for additional fixing:
1 Reference edges
2 Retaining strips
4 Locating pins

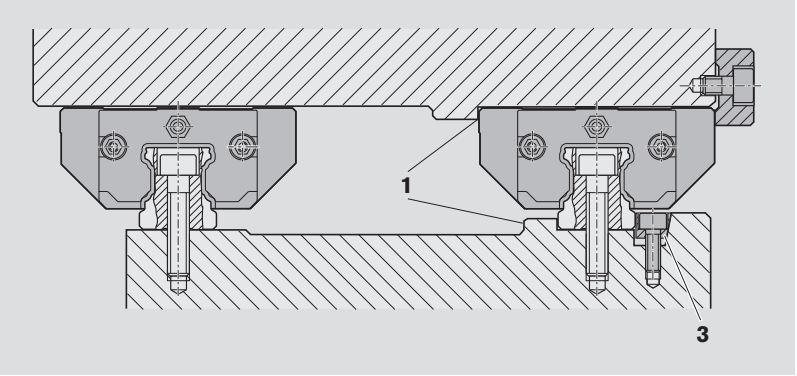
Note
– After mounting, it should be possible to move the runner block easily.

Notes for mounting
– Before installing the components, clean and degrease all mounting surfaces.
– Follow the mounting instructions! Send for the “Mounting Instructions for Ball Rail Systems.”

Mounting with fixing of both guide rails and runner blocks



Mounting with fixing of one guide rail and runner block



Mounting

Load on the screw connections between the guide rail and the mounting base

The high-performance capability of Ball Rail Systems may cause the load limits for screw connections as specified in DIN 645-1 to be exceeded. The most critical point is the screw connection between the guide rail and the mounting base.

⚠ **If the static lift-off loads F or moments M_t exceed the maximum permissible loads in the table, the screw connections must be separately recalculated (see VDI guideline 2230). Side loads must be added to the lift-off loads F, irrespective of whether there is lateral fixing or not.**
☞ 19

1) The values shown in the table apply under the following conditions:
- Mounting screws in quality 12.9 (for screws in quality 8.8, the values will be approximately 40% lower)
- Screws tightened using a torque wrench
- Screws lightly oiled
- Parts screwed down to steel or cast iron bases
- Screw-in depth at least 2 x the thread diameter

Standard Ball Rail Systems

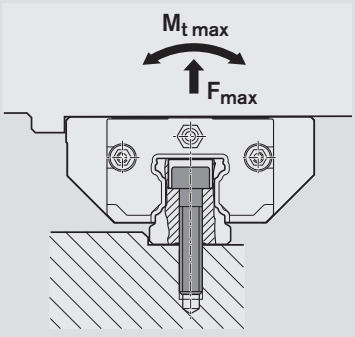
Ball guide rail	Size	Maximum permissible loads[1] Short runner block FKS R1661, FKS R1665, R2000, SKS R1662, SKS R1666, R2010, FKN R1663, SKN R1664		Normal runner block FNS R1631, FNS R1651, R2001, SNS R1622, R2011, SNS R1632, SNH R1621, FNN R1693, SNN R1694		Long runner block FLS R1653, R2002, SLS R1623, R2012, SLH R1624	
		F_{max} (N)	$M_{t\,max}$ (Nm)	F_{max} (N)	$M_{t\,max}$ (Nm)	F_{max} (N)	$M_{t\,max}$ (Nm)
R1605	15	6 040	41	7 050	47	8 060	54
R1606	20	10 000	90	11 700	106	13 400	121
R1645	25	14 600	154	17 100	180	19 500	205
R2045	30	–	360	32 400	420	37 100	480
	35	27 500	440	32 100	510	36 700	580
	45	–	–	78 100	1 680	89 300	1 920
	55	–	–	107 800	2 690	123 200	3 080
	65	–	–	152 300	4 490	174 100	5 130
R1607	15	–	67	11 600	78	13 300	89
R1647	20	–	128	16 500	149	18 900	170
R2047	25	14 300	150	16 700	170	19 100	200
	30	–	350	31 700	410	36 200	470
	35	27 100	430	31 600	500	36 200	570
	45	–	–	77 700	1 670	88 800	1 900
	55	–	–	106 800	2 670	122 100	3 050
	65	–	–	150 850	4 450	172 400	5 080

Wide Ball Rail Systems

Ball guide rail	Size	Maximum permissible loads[1] Wide runner block BNS R1671, CNS R1672	
		F_{max} (N)	$M_{t\,max}$ (Nm)
R1673	20/40	14 100	227
R1675	25/70	33 500	890
R1676	35/90	64 800	2 390
R1677	20/40	13 800	224
	25/70	33 700	900
	35/90	63 700	2 350

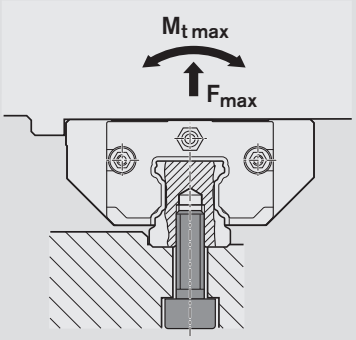
Ball guide rail for mounting from above

SNS: R1605, R1606, R1645, R2045
BNS: R1673, R1675, R1676



Ball guide rail for mounting from below

SNS: R1607, R1647, R2047
BNS: R1677



Mounting Instructions, Ball Runner Blocks and Ball Guide Rails

Mounting

Reference edges, corner radii, screw sizes and tightening torques

Note
The combinations shown here are examples. Basically, any ball runner block may be combined with any of the ball guide rail types offered.

⚠ **Always check the safety of the screws in the case of high lift-off loads!** ☞ 233

Guide rail with normal and long runner blocks

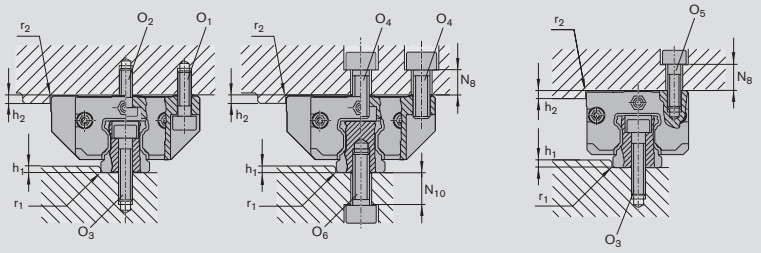
Ball runner blocks (flanged)
FNS, FLS, FNN

Ball runner blocks (slimline)
SNS, SLS, SNH, SLH, SNN

Ball guide rails
R1605, R1606, R1645, R2045
(for mounting from above)

Ball guide rails
R1607, R1647, R2047
(for mounting from below)

Ball guide rails
R1605, R1606, R1645, R2045
(for mounting from above)



Dimensions and recommended limits for side load if no additional lateral retention is provided

Size	Dimensions (mm)							Screw sizes					
								Ball runner block				Ball guide rail	
								O_1 ISO 4762	O_2[2] DIN 6912	O_4[1) 2)] ISO 4762	O_5 ISO 4762	O_3 ISO 4762	O_6 ISO 4762
	$h_{1\,min}$	$h_{1\,max}$	h_2	N_8	N_{10}	$r_{1\,max}$	$r_{2\,max}$	4 pcs	2 pcs	6 pcs	4 pcs		
15	2.5	3.5	4	6	7.0	0.4	0.6	M4x12	M4x10	M5x12	M4x12	M4x20	M5x12
20	2.5	4.0	5	9	9.5	0.6	0.6	M5x16	M5x12	M6x16	M5x16	M5x25	M6x16
				10[3]	–								
25	3.0	5.0	5	10	12.0	0.8	0.8	M6x20	M6x16	M8x20	M6x18	M6x30	M6x20
				11[3]	–								
30	3.0	5.0	6	10	9.0	0.8	0.8	M8x25	M8x16	M10x20	M8x20	M8x30	M8x20
35	3.5	6.0	6	13	13	0.8	0.8	M8x25	M8x20	M10x25	M8x25	M8x35	M8x25
45	4.5	8.0	8	14	13	0.8	0.8	M10x30	M10x25	M12x30	M10x30	M12x45	M12x30
55	7.0	10.0	10	20	23	1.2	1.0	M12x40	M12x30	M14x40	M12x35	M14x50	M14x40
65	7.0	10.0	14	22	26	1.2	1.0	M14x45	M14x35	M16x45	M16x40	M16x60	M16x45

Permissible side load
The recommended limits for permissible side loads without additional lateral retention indicate the approximate upper limits for screws in two strength classes. In other cases, the permissible side load must be calculated from the screw tension force. This can be up to about 15% less when using screws in strength class 10.9 instead of 12.9.

Screw strength class	Permissible side load without lateral retention[4]					
	Ball runner block				Ball guide rail	
	O_1	O_2[7]	O_4	O_5	O_3	O_6
8.8[5]	11% C	15% C	23% C	11% C	6% C	6% C
8.8[6]	8% C	13% C	18% C	8% C	4% C	4% C
12.9[5]	18% C	22% C	35% C	18% C	10% C	10% C
12.9[6]	14% C	18% C	26% C	14% C	7% C	7% C

1) When mounting the runner block from above using only 4 O_4 screws: Permissible side load 1/3 lower, and lower rigidity
2) For runner block mounting with 6 screws: Tighten the centerline screws with the tightening torque M_A for strength class 8.8.
3) Ball Runner Block SNN
4) Calculated with stiction coefficient $\mu = 0.12$
5) Ball Runner Blocks FNS, FNN, SNS, SNN, SNH
6) Ball Runner Blocks FLS, SLS, SLH
7) When mounting with 2 O_2 screws and 4 O_1 screws

Recommended tightening torques M_A of the fastening screws per VDI 2230
for $\mu_K = \mu_G = 0.125$

		M4	M5	M6	M8	M10	M12	M14	M16
8.8	M_A max (Nm)	2.7	5.5	9.5	23	46	80	125	195
12.9		4.6	9.5	16.0	39	77	135	215	330

Locating pins

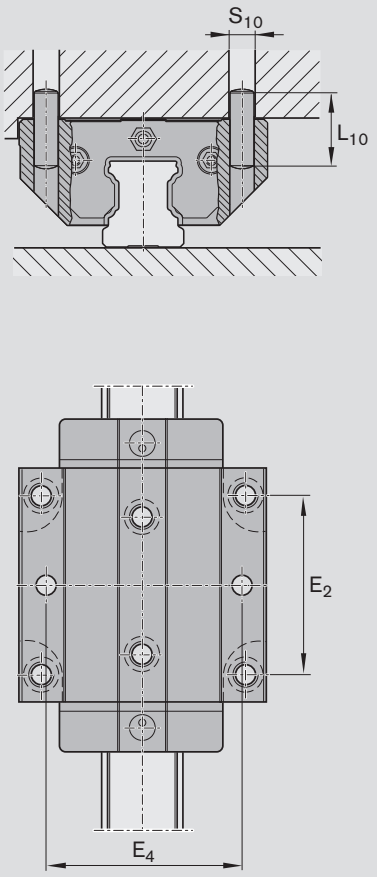
⚠ **If the recommended limits for permissible side loads are exceeded (see values for the individual runner block types), the runner block must be additionally fixed by means of locating pins.**

Recommended dimensions for the pin holes are indicated in the drawings and table.

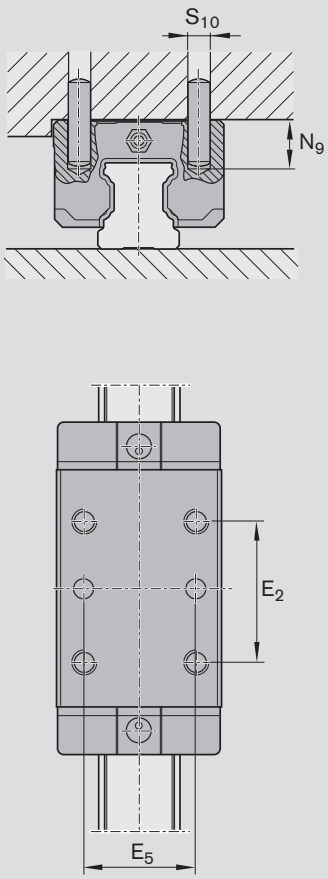
Possible pin types
- Taper pin (hardened) or
- Straight pin ISO 8734

Note
- Rough-drilled holes made for production reasons may exist at the recommended pin hole positions on the runner block centerline ($Ø < S_{10}$). These may be bored open to accommodate the locating pins.
- If the locating pins have to be driven in at another point (e.g. when the lube port is central), dimension E_2 must not be exceeded in the longitudinal direction (for dimension E_2, see the tables for the individual runner block types).
  Observe dimensions E_1 and E_4!
- Only prepare the pin holes after the installation is complete.
- Send for the publication “Mounting Instructions for Ball Rail Systems.”

Ball runner block (flanged)
FNS, FLS, FNN



Ball runner block (slimline)
SNS, SLS, SNH, SLH, SNN



Size	Dimensions (mm)				
	E_4	E_5	L_{10} [1)]	$N_{9\ max}$	S_{10} [1)]
15	38	26	18	6.0	4
20	53	32	24	7.5	5
	49 [2)]			6.5 [2)]	
25	55	35	32	9.0	6
	60 [2)]			7.0 [2)]	
30	70	40	36	12.0	8
35	80	50	40	13.0	8
45	98	60	50	18.0	10
55	114	45	60	19.0	12
65	140	76	60	22.0	14

1) Taper pin (hardened) or straight pin (ISO 8734)
2) Ball Runner Block FNN and SNN

Mounting Instructions, Ball Runner Blocks and Ball Guide Rails

Mounting

Reference edges, corner radii, screw sizes and tightening torques

Note
The combinations shown here are examples. Basically, any ball runner block may be combined with any of the ball guide rail types offered.

Screw mounting of runner blocks using two screws is fully sufficient up to maximum load.
(See maximum permissible force and moment loads indicated under the individual runner block types.)

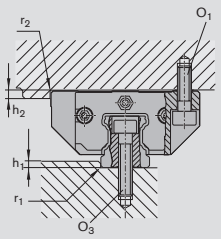
⚠ **Always check the safety of the screws in the case of high lift-off loads!** ☞ 233

Guide rail with short and super runner blocks

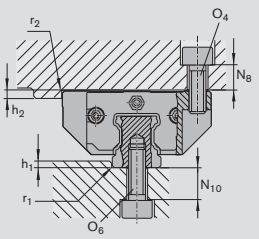
Ball runner blocks (flanged)
FKS, FKN

Ball runner blocks (slimline)
SKS, SKN

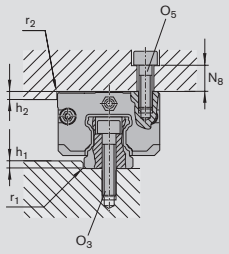
Ball guide rails
R1605, R1606, R1645
(for mounting from above)



Ball guide rails
R1607, R1647
(for mounting from below)



Ball guide rails
R1605, R1606, R1645
(for mounting from above)



Dimensions and recommended limits for side load if no additional lateral retention is provided

Size	Dimensions (mm)							Screw sizes				
								Ball runner block			Ball guide rail	
								O_1 ISO 4762	O_4 ISO 4762	O_5 ISO 4762	O_3 ISO 4762	O_6 ISO 4762
	$h_{1\ min}$	$h_{1\ max}$	h_2	N_8	N_{10}	$r_{1\ max}$	$r_{2\ max}$	2 pcs	2 pcs	2 pcs		
15	2.5	3.5	4	6	7.0	0.4	0.6	M4x12	M5x12	M4x12	M4x20	M5x12
20	2.5	4.0	5	9	9.5	0.6	0.6	M5x16	M6x16	M5x16	M5x25	M6x16
				10[1]	–							
25	3.0	5.0	5	10	12.0	0.8	0.8	M6x20	M8x20	M6x18	M6x30	M6x20
				11[1]	–							
30	3.0	5.0	6	10	9.0	0.8	0.8	M8x25	M10x20	M8x20	M8x30	M8x20
35	3.5	6.0	6	13	13.0	0.8	0.8	M8x25	M10x25	M8x25	M8x35	M8x25

Permissible side load
The recommended limits for permissible side loads without additional lateral retention indicate the approximate upper limits for screws in two strength classes. In other cases, the permissible side load must be calculated from the screw tension force. This can be up to about 15% less when using screws in strength class 10.9 instead of 12.9.

Screw strength class	Permissible side load without lateral retention[2]				
	Ball runner block			Ball guide rail	
	O_1	O_4	O_5	O_3	O_6
8.8	8% C	12% C	8% C	9% C	9% C
12.9	13% C	21% C	13% C	15% C	15% C

1) Ball runner block SKN
2) Calculated with stiction coefficient $\mu = 0.12$

Recommended tightening torques M_A of the fastening screws per VDI 2230
for $\mu_K = \mu_G = 0.125$

		M4	M5	M6	M8	M10
8.8	M_A max (Nm)	2.7	5.5	9.5	23	46
12.9		4.6	9.5	16.0	39	77

Locating pins

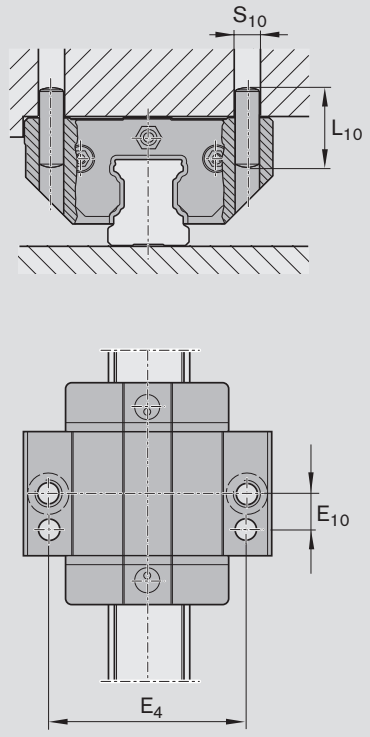
⚠ **If the recommended limits for permissible side loads are exceeded (see values for the individual runner block types), the runner block must be additionally fixed by means of locating pins**

Recommended dimensions for the pin holes are indicated in the drawings and table

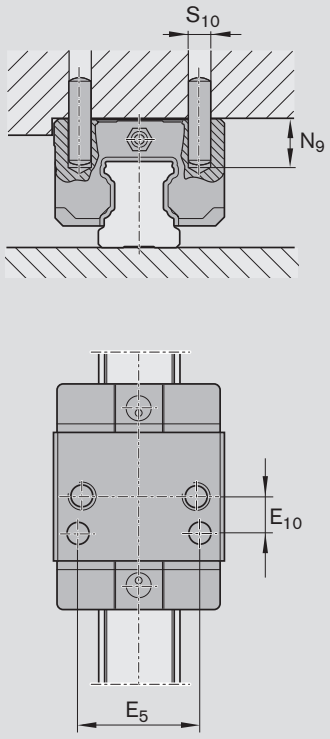
Possible pin types
- Taper pin (hardened) or
- Straight pin ISO 8734

Note
- Rough-drilled holes made for production reasons may exist at the recommended pin hole positions on the runner block centerline ($Ø < S_{10}$). These may be bored open to accommodate the locating pins. Observe dimensions E_4 and E_5!
- Only prepare the pin holes after the installation is complete.
- Send for the publication “Mounting Instructions for Ball Rail Systems.”

Ball runner block (flanged)
FKS, FKN



Ball runner block (slimline)
SKS, SKN

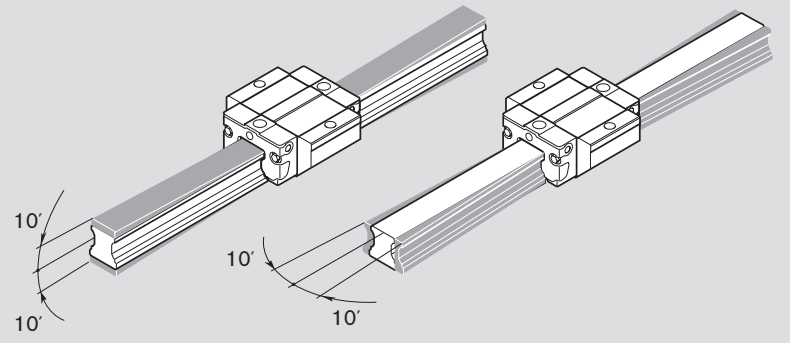


Size	Dimensions (mm)					
	E_4	E_5	E_{10}	L_{10} [1)]	$N_{9\ max}$	S_{10} [1)]
15	38	26	9	18	3.0	4
20	53	32	10	24	3.5	5
	49 [2)]				2.0 [2)]	
25	55	35	11	32	7.0	6
	60 [2)]				5.0 [2)]	
30	70	40	14	36	10.0	8
35	80	50	15	40	12.0	8

1) Taper pin (hardened) or straight pin (ISO 8734)
2) Ball Runner Block FKN and SKN

Permitted alignment error for Super Ball Runner Blocks

at the guide rail and at the runner block



Mounting Instructions, Ball Runner Blocks and Ball Guide Rails

Mounting

Reference edges, corner radii, screw sizes and tightening torques

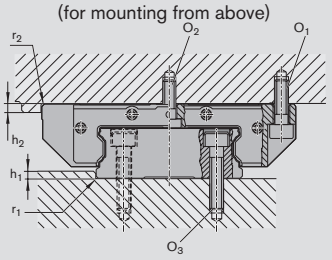
Note
The combinations shown here are examples. Basically, any ball runner block may be combined with any of the ball guide rail types offered.

⚠ **Always check the safety of the screws in the case of high lift-off loads!** ☞ 233

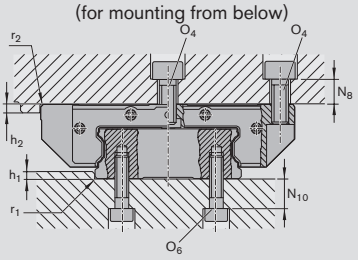
Guide rail with wide runner block

Ball runner blocks (flanged) BNS

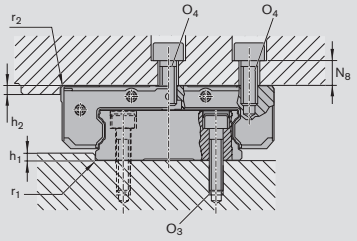
Ball guide rails
R1673, R1675, R1676
(for mounting from above)



Ball guide rails
R1677
(for mounting from below)



Ball runner blocks (compact) CNS
Ball guide rails R1673, R1675, R1676
(for mounting from above)



Dimensions and recommended limits for side load if no additional lateral retention is provided

Size	Dimensions (mm)								Screw sizes				
									Ball runner block			Ball guide rail	
									O_1 ISO 4762	O_2[2] DIN 6912	O_4[1) 2)] ISO 4762	O_3 ISO 4762	O_6 ISO 4762
	$h_{1\,min}$	$h_{1\,max}$	h_2	N_8	N_8[3)]	N_{10}	$r_{1\,max}$	$r_{2\,max}$	4 pcs	2 pcs	6 pcs		
20/40	2.0	2.5	4	9.5	11	5.5	0.5	0.5	M5x16	M5x12	M6x16	M4x20	M5x12
25/70	3.0	4.5	5	10.0	13	9.0	0.8	0.8	M6x20	M6x16	M8x20	M6x30	M6x20
35/90	3.5	6.0	6	13.0	–	11.0	0.8	0.8	M8x25	M8x20	M10x25	M8x35	M8x25

Permissible side load
The recommended limits for permissible side loads without additional lateral retention indicate the approximate upper limits for screws in two strength classes. In other cases, the permissible side load must be calculated from the screw tension force. This can be up to about 15% less when using screws in strength class 10.9 instead of 12.9.

Screw strength class	Permissible side load without lateral retention[4)]				
	Ball runner block			Ball guide rail	
	O_1	O_2[5)]	O_4	O_3	O_6
8.8	8% C	11% C[4)]	16% C	8% C	8% C
12.9	13% C	16% C[4)]	24% C	13% C	13% C

1) When mounting the runner block from above using only 4 O_4 screws:
Permissible side load 1/3 lower, and lower rigidity
2) For runner block mounting with 6 screws:
Tighten the centerline screws with the tightening torque M_A for strength class 8.8.
Centerline screws should always be used, otherwise the preload may be reduced.
3) Ball runner blocks CNS
4) Calculated with stiction coefficient $\mu = 0.12$
5) When mounting with 2 O_2 screws and 4 O_1 screws

Recommended tightening torques M_A of the fastening screws per VDI 2230
for $\mu_K = \mu_G = 0.125$

		M4	M5	M6	M8	M10
8.8	M_A max	2.7	5.5	9.5	23	46
12.9	(Nm)	4.6	9.5	16.0	39	77

Locating pins

⚠ **If the recommended limits for permissible side loads are exceeded (see values for the individual runner block types), the runner block must be additionally fixed by means of locating pins**

Recommended dimensions for the pin holes are indicated in the drawings and table

Possible pin types
- Taper pin (hardened) or
- Straight pin ISO 8734

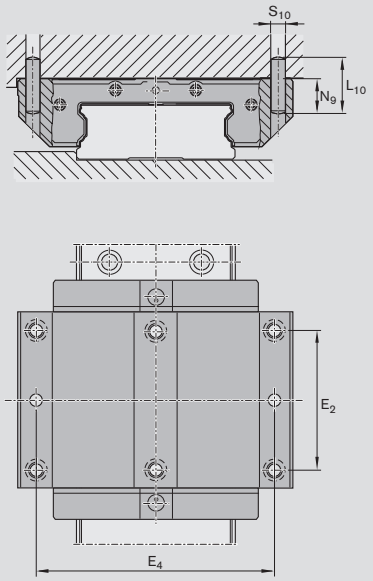
Note
- Rough-drilled holes made for production reasons may exist at the recommended pin hole positions on the runner block centerline ($Ø < S_{10}$). These may be bored open to accommodate the locating pins.

- If the locating pins have to be driven in at another point (e.g. when the lube port is central), dimension E_2 must not be exceeded in the longitudinal direction (for dimension E_2, see the tables for the individual runner block types).
  Observe dimensions E_4 and E_5!

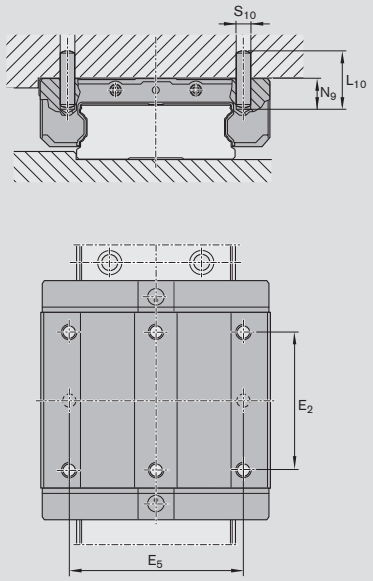
- Only prepare the pin holes after the installation is complete.

- Send for the publication “Mounting Instructions for Ball Rail Systems.”

Ball runner block (flanged)
BNS



Ball runner block (compact)
CNS



Size	Dimensions (mm)				
	E_4	E_5	L_{10} [1)]	$N_{9\ max}$	S_{10} [1)]
20/40	70	46	24	7	5
25/70	107	76	32	8	6
35/90	144	–	32	8	8

1) Taper pin (hardened) or straight pin (ISO 8734)

Mounting Instructions, Ball Runner Blocks and Ball Guide Rails

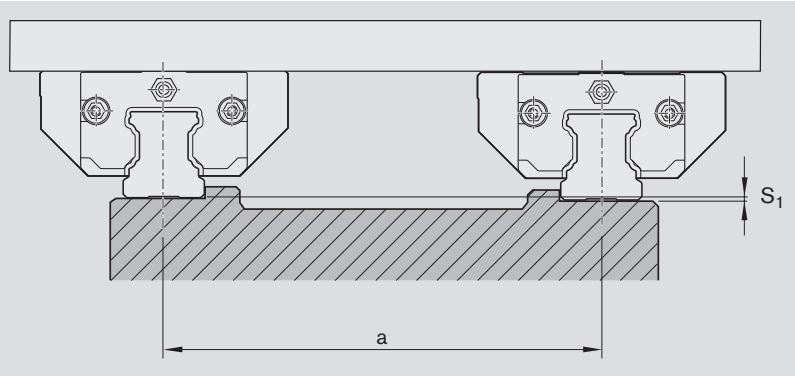
Installation Tolerances

Vertical offset

The vertical offset values S_1 and S_2 apply to all ball runner blocks of the standard range.

Provided the vertical offset is kept within the stated tolerances for S_1 and S_2, its influence on the service life can generally be neglected.

Permissible vertical offset in the transverse direction S_1



The tolerance for dimension H ("Accuracy classes and their tolerances" ☞ 26) must be ducted from the permissible vertical offset S_1.
If $S_1 < 0$, select other tolerances when combining accuracy classes ☞ 27.

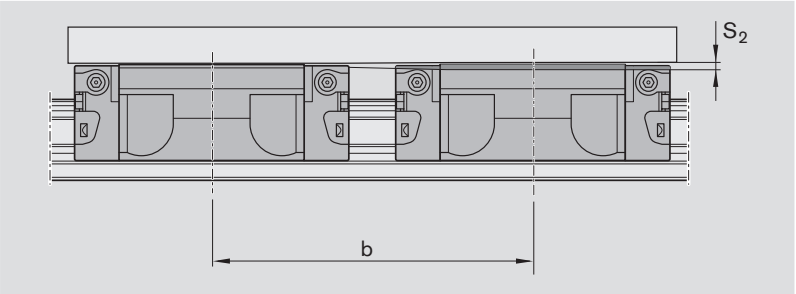
$$S_1 = a \cdot Y$$

S_1	=	permissible vertical offset of the guide rails	(mm)
a	=	distance between guide rails	(mm)
Y	=	calculation factor, transverse direction	(–)

Ball runner blocks	Calculation factor Y for preload class			
	C0	C1	C2	C3
Steel Ball Runner Blocks	$4.3 \cdot 10^{-4}$	$2.8 \cdot 10^{-4}$	$1.7 \cdot 10^{-4}$	$1.2 \cdot 10^{-4}$
Steel Ball Runner Blocks, short	$5.2 \cdot 10^{-4}$	$3.4 \cdot 10^{-4}$	–	–
Super Ball Runner Blocks	$8.0 \cdot 10^{-4}$	$6.0 \cdot 10^{-4}$	–	–
Aluminum Ball Runner Blocks	$7.0 \cdot 10^{-4}$	$5.0 \cdot 10^{-4}$	–	–

Preload classes
C0 = without preload
C1 = preload 2% C
C2 = preload 8% C
C3 = preload 13% C

Permissible vertical offset in the longitudinal direction S_2



The tolerance “max. difference of dimension H on the same rail” (“Accuracy classes and their tolerances” ☞ 26) must be deducted from the permissible vertical offset S_2 of the ball runner blocks.
If $S_2 < 0$, select other tolerances when combining accuracy classes ☞ 27.

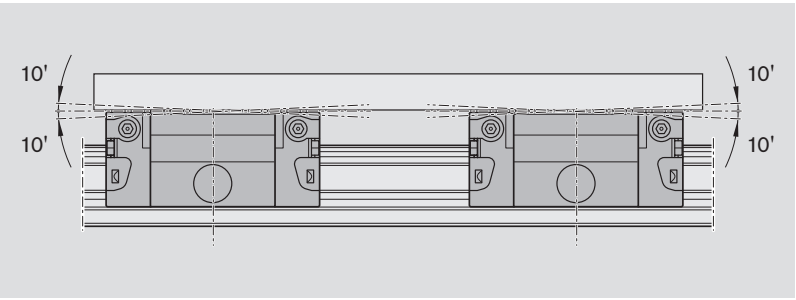
$$S_2 = b \cdot X$$

S_2	=	permissible vertical offset of the runner blocks	(mm)
b	=	distance between runner blocks	(mm)
X	=	calculation factor, longitudinal direction	(–)

Ball runner blocks	Calculation factor X for preload class		
	Short	Normal	Long
Steel Ball Runner Blocks	$6.0 \cdot 10^{-5}$	$4.3 \cdot 10^{-5}$	$3.0 \cdot 10^{-5}$
Aluminum Ball Runner Blocks	–	$6.0 \cdot 10^{-5}$	–

Permissible deviation from straightness in the longitudinal direction with two consecutive Super Ball Runner Blocks

The runner blocks can automatically compensate for longitudinal offsets of up to 10'.



Mounting Instructions, Ball Runner Blocks and Ball Guide Rails

Installation Tolerances

Parallelism of the rails after mounting

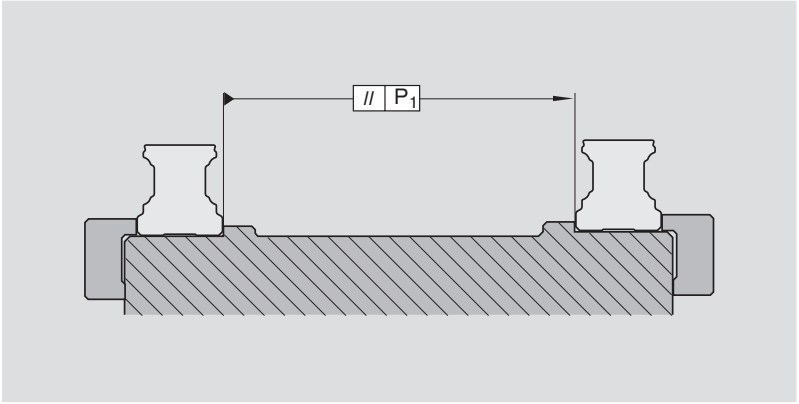
measured at the guide rails and at the runner blocks

The values for parallelism offset P_1 apply to all ball runner blocks of the standard range.

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

Provided the parallelism offset P_1 is kept within the stated tolerances, its influence on the service life can generally be neglected.

Permissible parallelism offset P_1



Ball runner blocks	Size	Parallelism offset P_1 (mm) for preload class			
		C0	C1	C2	C3
Steel Ball Runner Blocks for precision installations [1]	**15**	0.015	0.009	0.005	0.004
	20	0.018	0.011	0.006	0.004
	25	0.019	0.012	0.007	0.005
	30	0.021	0.014	0.009	0.006
	35	0.023	0.015	0.010	0.007
	45	0.028	0.019	0.012	0.009
	55	0.035	0.025	0.016	0.011
	65	0.048	0.035	0.022	0.016
Steel Ball Runner Blocks, short	**15**	0.018	0.011	–	–
	20	0.022	0.013	–	–
	25	0.023	0.014	–	–
	30	0.025	0.017	–	–
	35	0.028	0.018	–	–
Super Ball Runner Blocks	**15**	0.025	0.017	–	–
	20	0.029	0.021	–	–
	25	0.032	0.023	–	–
	30	0.035	0.026	–	–
	35	0.040	0.030	–	–
Aluminum Ball Runner Blocks	**15**	0.021	0.014	–	–
	25	0.026	0.017	–	–
	30	0.029	0.019	–	–
	35	0.035	0.022	–	–

1) In precision installations the adjoining structures are rigid and highly accurate.
In standard installations the adjoining structures are compliant, allowing parallelism offset tolerances up to **twice** those for precision installations.

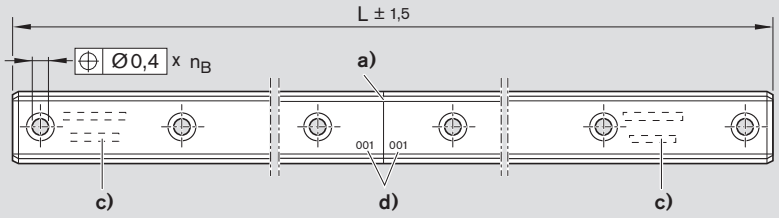
Preload classes
C0 = without preload
C1 = preload 2% C
C2 = preload 8% C
C3 = preload 13% C

Composite Ball Guide Rails

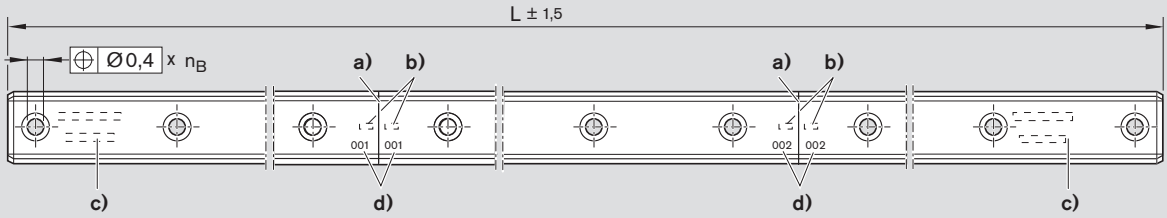
Notes on guide rails

- Matching sections of a composite guide rail are identified as such by a label on the packaging.
- All sections of the same rail have the same serial rail number.
- The numbering is marked on the top of the guide rail.

Guide rail made up of two sections



Guide rail made up of three or more sections



L = rail length (mm)
n_B = number of holes (–)

a) Joint
b) Serial rail number
c) Full rail identification code on first and last sections
d) Joint number

Note on cover strip

- For composite rails, a one-piece cover strip to cover the total length L is supplied separately.
- Secure the cover strip!