General Product Description

General Technical Data and Calculations

General notes

The general technical data and calculations apply to all Ball Rail Systems, i.e., to all ball runner blocks and ball guide rails.

Specific technical data relating to the individual ball runner blocks and ball guide rails is given separately.

Preload classes

To cover the widest possible range of applications, Rexroth ball runner blocks are available in different preload classes.

So as not to reduce the service life, the preload should not exceed 1/3 of the load on bearing F.

In general, the rigidity of the ball runner block rises with increasing preload. If vibrations are expected, an appropriately high preload (≥ 8% C) should be selected.

Guide systems with parallel rails

For the selected preload class, also comply with the permissible parallelism offset of the rails (“Selection Criteria, Accuracy Classes” ☞🗎 26).
The following preload classes are available:
- Ball runner block without preload (preload class C0)
- Ball runner block with 2% C preload (preload class C1)
- Ball runner block with 8% C preload (preload class C2)
- Ball runner block with 13% C preload (preload class C3)

When specifying ball rail systems of accuracy class N, we recommend preload class C0 or C1 to avoid distortive stresses due to the tolerances.

Travel speed

v_{max} : 3 – 10 m/s

For exact values, refer to the individual ball runner blocks.

Acceleration

a_{max} : 250 – 500 m/s²

For exact values, refer to the individual ball runner blocks.
(If $F_{comb} > 2.8 \cdot F_{pr} : a_{max} = 50$ m/s²)

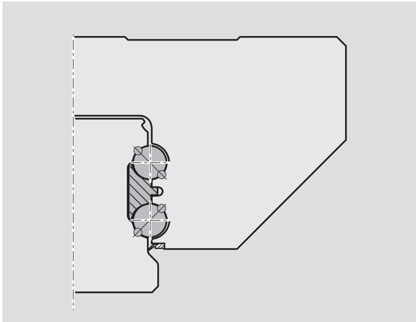
Operating temperature range

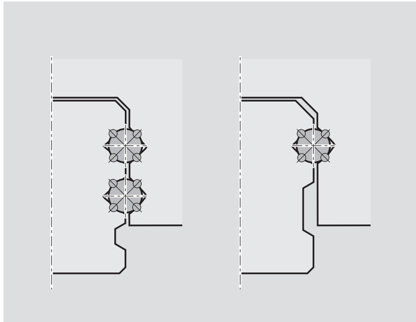
t : 0 – 80 °C

Brief peaks up to 100 °C are permitted.
For sub-zero temperatures, please consult us.
For ball runner blocks without ball chain: lower limit = –10 °C.

Friction

The friction coefficient μ of Rexroth Ball Rail Systems is approx. 0.002 to 0.003 (without friction of the seals).





Rexroth's special design with 4 ball circuits ensures that the balls make **contact at two points** regardless of the direction of loading.
This reduces the friction to a minimum.

Other ball rail systems with 2 or 4 ball circuits with **4-point contact** have multiple friction: in the Gothic-arch raceway profile, the differential slip at side loading, as well as with comparable preload without load, causes higher friction (depending on the conformity and load, this may be up to approx. 5 times the frictional value).
This high friction leads to correspondingly greater heat.

Seals

The purpose of seals is to prevent dirt, chips, metalworking fluids, etc. from entering the ball runner block and thus shortening its service life.

Standard seals (SS)

Universal seals are incorporated as standard in Rexroth ball runner blocks. They provide equal sealing performance on ball guide rails with and without cover strip.
Low friction combined with a good sealing effect was an important factor during design.

Suitable for applications requiring good sealing.

For details, ☞🗎 29

Low-friction (LS) and double-lipped (DS) seals

LS: For applications requiring especially smooth running.
DS: For frequent exposure to fluids.

Available as alternatives.

For details, ☞🗎 29

End seals

For use in environments with fine dirt or metal particles and cooling or cutting fluids.
Replaceable.

End seals can be ordered separately as accessories for mounting by the customer.

FKM seals

For extreme use in environments with coarse dirt or metal particles or where cooling or cutting fluids are used intensively.
Replaceable.

FKM end seals can be ordered separately as accessories for mounting by the customer.

Scraper plates

For use in environments subject to coarse dirt or chips.

Scraper plates can be ordered separately as accessories for mounting by the customer.

General Product Description

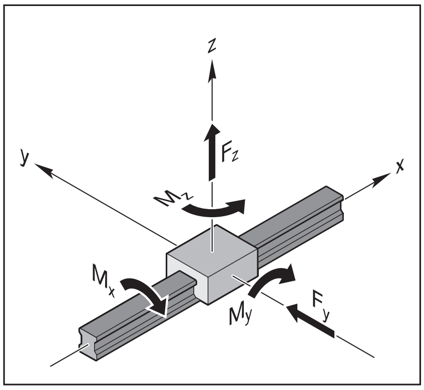
General Technical Data and Calculations

Definitions of forces and load moments

In Rexroth Ball Rail Systems the raceways are arranged at a contact angle of 45°. This results in the same load capacity of the entire system in all four major planes of load application.
The ball runner blocks may be subjected to both forces and load moments.

Forces in the four major planes of load application
- Pull F_z (positive z-direction)
- Push $-F_z$ (negative z-direction)
- Side load F_y (positive y-direction)
- Side load $-F_y$ (negative y-direction)

Moments
- Torsional moment M_x (about the x-axis)
- Longitudinal moment M_y (about the y-axis)
- Longitudinal moment M_z (about the z-axis)



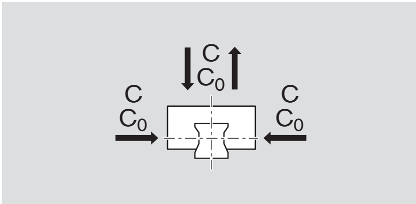
Definition of load capacities

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 10^5 meters distance traveled (as per ISO 14728 Part 1).

Note:
The dynamic load capacities given in the tables are 20% above the ISO values. These values have been confirmed in tests.

Basic static load capacity C_0
Static load in the load direction that corresponds to a calculated load in the center of the contact point with the greatest load between the rolling element (ball) and track zone (guide rail) of 4200 MPa.

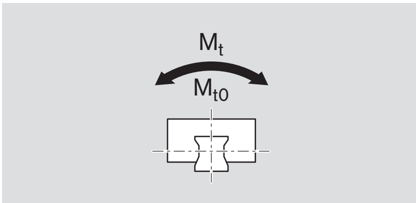
Note:
With this load on the contact point, a permanent overall deformation of the rolling element and track zone occurs, corresponding to around 0.0001 times the ball diameter (as per ISO 14 728-1).



Definition of moment load capacities

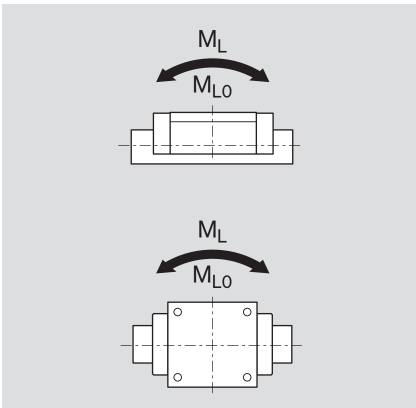
Dynamic torsional moment load capacity M_t
Comparative dynamic moment about the X-axis which causes a load equivalent to the dynamic load capacity C.

Static torsional moment load capacity M_{t0}
Comparative static moment about the X-axis which causes a load equivalent to the static load capacity C_0.



Dynamic longitudinal moment load capacity M_L
Comparative dynamic moment about the Y-axis or the Z-axis which causes a load equivalent to the dynamic load capacity C.

Static longitudinal moment load capacity M_{L0}
Comparative static moment about the Y-axis or the Z-axis which causes a load equivalent to the static load capacity C_0.



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 (as per ISO 14728-1).

Nominal life at constant speed

If the speed is constant, calculate the nominal life L_{10} in meters or $L_{h\,10}$ in hours according to formula (1) or (2):

$$(1) \quad L_{10} = \left(\frac{C}{F_m}\right)^3 \cdot 10^5 \text{ m}$$

$$(2) \quad L_{h\,10} = \frac{L_{10}}{2 \cdot s \cdot n \cdot 60}$$

L_{10}	=	nominal life	(m)
$L_{h\,10}$	=	nominal life	(h)
C	=	dynamic load capacity	(N)
F_m	=	equivalent dynamic load on bearing of ball runner block	(N)
s	=	stroke length[1)]	(m)
n	=	stroke repetition rate (full cycles)	(min^{-1})

1) At a stroke length < 2 · ball runner block length B_1 (see dimension drawings) the load capacities will be reduced. Please consult us.

Nominal life at variable speed

If the speed varies, calculate the nominal life $L_{h\,10}$ in hours according to formula (3) and, if necessary, formula (4):

$$(3) \quad L_{h\,10} = \frac{L_{10}}{60 \cdot v_m}$$

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

L_{10}	=	nominal life	(m)
$L_{h\,10}$	=	nominal life	(h)
v_m	=	average travel speed	(m/min)
$v_1, \ldots v_n$	=	travel speed in phases 1 … n	(m/min)
$q_{t1}, \ldots q_{tn}$	=	discrete time steps for $v_1, \ldots v_n$ in phases 1 … n	(%)

Modified life expectancy calculation

If 90% probability is not sufficient, the nominal life values must be reduced by the factor a_1 as given in the table.

Probability of survival (%)	L_{na}	a_1
90	L_{10a}	1
95	L_{5a}	0.62
96	L_{4a}	0.53
97	L_{3a}	0.44
98	L_{2a}	0.33
99	L_{1a}	0.21

$$L_{na} = a_1 \cdot \left(\frac{C}{F}\right)^3 \cdot 10^5 \text{ m}$$

$$L_{ha} = \frac{L_{na}}{2 \cdot s \cdot n \cdot 60}$$

L_{na}	=	modified life expectancy	(m)
L_{ha}	=	modified life expectancy	(h)
C	=	dynamic load rating	(N)
F	=	load on bearing for ball runner block	(N)
a_1	=	life expectancy factor	(–)

General Product Description

General Technical Data and Calculations

Equivalent dynamic load on bearing for calculation of service life

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

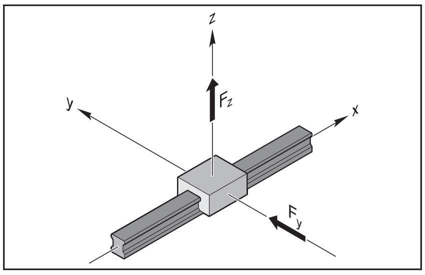
$$(5)\quad F_m = \sqrt[3]{(F_{eff\,1})^3 \cdot \frac{q_{s1}}{100\,\%} + (F_{eff\,2})^3 \cdot \frac{q_{s2}}{100\,\%} + \dots + (F_{eff\,n})^3 \cdot \frac{q_{sn}}{100\,\%}}$$

F_m = equivalent dynamic load on bearing for ball runner block (N)
$F_{eff\,1} \dots F_{eff\,n}$ = effective equivalent load on bearing for runner block in phases 1 ... n (N)
$q_{s1} \dots q_{sn}$ = discrete travel steps for $F_{eff\,1} \dots F_{eff\,n}$ (%)

Equivalent dynamic load with combined load on bearing
The dynamic 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.

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



F_{comb} = combined equivalent dynamic load on bearing (N)
F_y = external load due to a resulting force in the y-direction (N)
F_z = external load due to a resulting force in the z-direction (N)

Note
If F_y and F_z involve different load levels, F_y and F_z must be calculated separately using formula (5). An external load acting at an angle on the ball runner block is to be broken down into its positive and negative F_y and F_z components, and these values are then to be used in formula (6).

Equivalent dynamic load with combined load on bearing in conjunction with a torsional and/or longitudinal moment

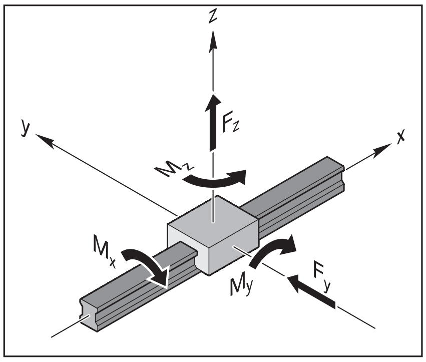
The combined equivalent load on bearing F_{comb} resulting from combined vertical and horizontal external loads in conjunction with a torsional and/or longitudinal moment is calculated according to formula (7).

Note
Formula (7) applies only when using a single guide rail with a single ball runner block. The formula is simpler for other combinations.

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

F_{comb} = combined equivalent dynamic load on bearing (N)
F_y = external load due to a resulting force in the y-direction (N)
F_z = external load due to a resulting force in the z-direction (N)
C = dynamic load capacity[1] (N)
M_t = dyn. torsional moment load[1] (Nm)
M_L = dyn. longitudinal moment load[1] (Nm)
1) Refer to the load capacities and moments for the individual ball runner blocks

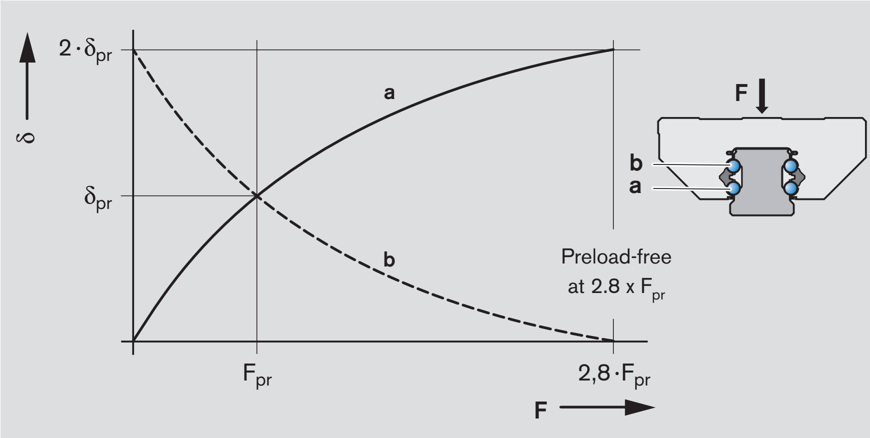
M_x = load due to a resulting dynamic torsional moment about the X-axis (Nm)
M_y = load due to a resulting dynamic longitudinal moment about the Y-axis (Nm)
M_z = load due to a resulting dynamic longitudinal moment about the Z-axis (Nm)



Note
If F_y and F_z involve different load levels, F_y and F_z must be calculated separately using formula (5). An external load acting at an angle on the ball runner block is to be broken down into its positive and negative F_y and F_z components, and these values are then to be used in formula (7).

Equivalent dynamic load on bearing taking account of internal preload force F_{pr}
To increase the rigidity and accuracy of the guide system preloaded runner blocks should be used (see also “Selection Criteria, System Preload” ☞ 24).

For preload classes C2 and C3, the internal preload force must be taken into account since the two rows of balls a and b are designed to be oversized and are therefore preloaded against each other with an internal preload force F_{pr} which causes them to deform by the amount δ_{pr} (see chart).



a = loaded (lower) row of balls
b = non-loaded (upper) row of balls
δ = deformation at rolling contact point at F (–)
δ_{pr} = deformation at rolling contact point at F_{pr} (–)
F = load on the runner block (N)
F_{pr} = internal preload force (N)

Effective equivalent load on bearing

When an external load reaches 2.8 times the internal preload force F_{pr}, one row of balls becomes preload-free.

Note
For highly dynamic load cases, the combined equivalent load on the bearings should be $F_{comb} < 2.8 \cdot F_{pr}$ in order to avoid damage to the rolling bearings due to slip.
In this case, the effective equivalent load on bearing F_{eff} is not calculated according to formula (6) or (7), but according to formula (9).

Two different cases should be considered:

Case 1: $F_{comb} > 2.8 \cdot F_{pr}$

In case 1, the internal preload force F_{pr} has no effect on the service life:

$$F_{eff} = F_{comb} \tag{8}$$

F_{comb} = combined equivalent dynamic load on bearing (N)
F_{eff} = effective equivalent load on bearing (N)

Case 2: $F_{comb} \leq 2.8 \cdot F_{pr}$

In case 2 the preload force F_{pr} is factored into the calculation of the effective equivalent load on bearing:

$$F_{eff} = \left(\frac{F_{comb}}{2.8 \cdot F_{pr}} + 1\right)^{\frac{3}{2}} \cdot F_{pr} \tag{9}$$

F_{pr} = internal preload force (N)
F_{pr} = 8% C (0.08 C) (at preload class C2)
F_{pr} = 13% C (0.13 C) (at preload class C3)

Equivalent static load on bearing

Combined external static load resulting from vertical and horizontal external loads in conjunction with a static torsional and/or longitudinal moment

Calculate the equivalent static load $F_{0\,comb}$ according to formula (10).

Note
The equivalent static load $F_{0\,comb}$ must not exceed the static load capacity C_0.

Formula (10) applies only when using a single guide rail with a single ball runner block. The formula is simpler for other combinations.

$$F_{0\,comb} = |F_{0y}| + |F_{0z}| + C_0 \cdot \frac{|M_{0x}|}{M_{t0}} + C_0 \cdot \frac{|M_{0y}|}{M_{L0}} + C_0 \cdot \frac{|M_{0z}|}{M_{L0}} \tag{10}$$

$F_{0\,comb}$ = static combined equivalent load on bearing (N)
F_{0y} = external static load due to a resulting force in the y-direction (N)
F_{0z} = external static load due to a resulting force in the z-direction (N)
C_0 = static load capacity[1] (N)
M_{t0} = static torsional moment load capacity[1] (Nm)
M_{L0} = static longitudinal moment load capacity[1] (Nm)

1) Refer to the load capacities and moments for the individual ball runner blocks

M_{0x} = load due to a static resulting torsional moment load about the X-axis (Nm)
M_{0y} = load due to a static resulting longitudinal moment load about the Y-axis (Nm)
M_{0z} = load due to a static resulting longitudinal moment load about the Z-axis (Nm)

Note
An external load acting at an angle on the ball runner block is to be broken down into its positive and negative F_{0y} and F_{0z} components, and these values are then to be used in formula (10).

General Product Description

General Technical Data and Calculations

Definitions and calculation for dynamic and static load ratios

The ratio between the load capacity of the ball runner block and the load applied to it can be used to pre-select the type of linear guide. The dynamic load ratio C/F_{max} and the static load ratio $C_0/F_{0\,max}$ should be chosen as appropriate for the application.

This permits calculation of the required load capacity and selection of the rail guide size and runner block design style using the load capacity tables.

$$\boxed{\text{Dynamic ratio} = \frac{C}{F_{max}}}$$

C = dynamic load rating (N)
F_{max} = maximum dynamic load on bearing of the most highly loaded ball runner block (N)

Case 1: Static load $F_{0\,max} > F_{max}$:

$$\boxed{\text{Static ratio} = \frac{C_0}{F_{0\,max}}}$$

C_0 = static load capacity (N)
$F_{0\,max}$ = maximum static load on bearing of the most highly loaded ball runner block (N)
F_{max} = maximum dynamic load on bearing of the most highly loaded ball runner block (N)

Case 2: Static load $F_{0\,max} < F_{max}$:

$$\boxed{\text{Static ratio} = \frac{C_0}{F_{max}}}$$

Recommended values for load ratios

The table below contains recommendations for load ratios.
The values are offered merely as a rough guide reflecting typical customer requirements (e.g. service life, accuracy, rigidity) by sector and application.

Machine type/sector	Application example	C/F_{max}	$C_0/F_{0\,max}$
Machine tools	General	6 ... 9	> 4
	Turning	6 ... 7	> 4
	Milling	6 ... 7	> 4
	Grinding	9 ... 10	> 4
	Engraving	5	> 3
Rubber and plastics processing machinery	Injection molding	8	> 2
Woodworking and wood processing machines	Sawing, milling	5	> 3
Assembly/handling technology and industrial robots	Handling	5	> 3
Oil hydraulics and pneumatics	Raising/lowering	6	> 4

Definitions and calculation of the static load safety factor S_0

The static load safety factor S_0 is required in order to avoid any inadmissible permanent deformations of the raceways and balls. It is the ratio of the static load capacity C_0 to the maximum load occurring, $F_{0\,max}$ and is always determined using the highest amplitude, even if this is only very short-lived.

$$(11) \qquad S_0 = \frac{C_0}{F_{0\,max}}$$

S_0	=	static load safety factor	(–)
C_0	=	static load capacity	(N)
$F_{0\,max}$	=	maximum static load on bearing of the most highly loaded ball runner block	(N)

Recommendations for the static load safety factor under different conditions of use

Conditions of use	S_0
Normal conditions of use	1 ... 2
Low impact loads and vibrations	2 ... 4
Moderate impact loads and vibrations	3 ... 5
Heavy impact loads and vibrations	4 ... 6
Unknown load parameters	6 ... 15

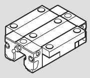
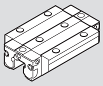
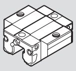
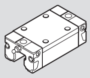
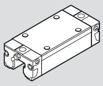
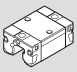
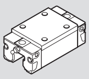
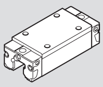
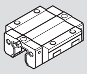
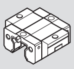
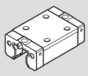
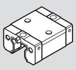
Irrespective of the static load safety factor, it must be ensured that the maximum permissible loads, as indicated for some Ball Rail Systems, are not exceeded in service.

⚠ **The load-bearing capability of the threaded connections must also be checked. These are frequently weaker than the bearings themselves. The load-bearing capability of linear motion technology components is such that the screws used could be over-stressed.**
☞🗎 233

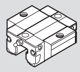
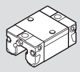
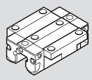
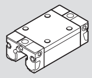
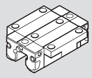
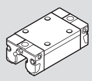
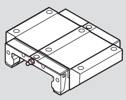
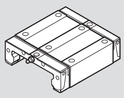
More technical data and details can be found in the “Linear Motion Technology Handbook” R310EN 2017“

Selection Criteria

Design Styles and Versions

Ball runner blocks			Application area	Load capacity	Special feature
Standard Ball Runner Blocks made of steel		**FNS** **R1651**[1,2,5] **R2001**[3,4]	For high rigidity requirements	High	For mounting from above and below
		**FLS** **R1653**[1,2,5] **R2002**[3]	For very high rigidity requirements	Very high	For mounting from above and below
		**FKS** **R1665** **R2000**[3]	For restricted space in the longitudinal direction	Medium	For mounting from above and below Supplementary to DIN 645-1
		**SNS** **R1622**[1,2,5] **R2011**[3,4]	For restricted space in the transverse direction	High	For mounting from above
		**SLS** **R1623**[1,2,5] **R2012**[3]	For restricted space in the transverse direction	Very high	For mounting from above
		**SKS** **R1666** **R2010**[3]	For restricted space in the longitudinal and transverse direction	Medium	For mounting from above
		**SNH** **R1621**[1,2,5]	For restricted space in the transverse direction and high rigidity requirements	High	Higher rigidity than SNS
		**SLH** **R1624**[1,2,5]	For restricted space in the transverse direction and high rigidity requirements	Very high	Higher rigidity than SLS
Standard Ball Runner Blocks made of steel with Resist CR		**FNN** **R1693**	For restricted space in the vertical direction	High	Lower rigidity than FNS Not defined in DIN 645-1
		**FKN** **R1663**	For restricted space in the vertical and longitudinal direction	Medium	Lower rigidity than FKS Not defined in DIN 645-1
		**SNN** **R1694**	For restricted space in the vertical and transverse direction	High	Lower rigidity than SNS Not defined in DIN 645-1
		**SKN** **R1664**	For restricted space in the vertical, longitudinal and transverse direction	Medium	Lower rigidity than SKS Not defined in DIN 645-1

1) Heavy Duty Ball Runner Blocks
2) High Precision Ball Runner Blocks
3) Resist NR
4) Resist NR II
5) Resist CR

Ball runner blocks			Application area	Load capacity	Special feature
Super Ball Runner Blocks made of steel with Resist CR		**FKS R1661**	For compensating large tolerances in the adjoining structure	Medium	At least 2 ball runner blocks per rail required
		**SKS R1662**	For compensating large tolerances in the adjoining structure	Medium	At least 2 ball runner blocks per rail required
Ball Runner Blocks made of aluminum		**FNS R1631**	For lightweight constructions For compensating slight tolerances in the adjoining structure	High	For mounting from above and below
		**SNS R1632**	For lightweight constructions For compensating slight tolerances in the adjoining structure	High	For mounting from above
High-Speed Ball Runner Blocks made of steel		**FNS R2001 ... 9.**	For very high travel speeds (up to 10 m/s)	High	For mounting from above and below
		**SNS R2011 ... 9.**	For very high travel speeds (up to 10 m/s)	High	For mounting from above
Wide Ball Runner Blocks made of steel with Resist CR		**BNS R1671**	For high torsional moments in one-rail applications	Very high	For mounting from above and below
		**CNS R1672**	For high torsional moments in one-rail applications where space is limited at the sides	Very high	For mounting from above

Codes for design styles of all the available runner blocks

FNS = Flanged, normal, standard height
FLS = Flanged, long, standard height
FKS = Flanged, short, standard height
FNN = Flanged, normal, low profile
FKN = Flanged, short, low profile

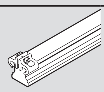
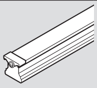
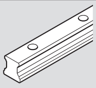
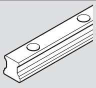
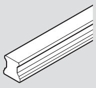
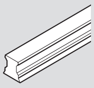
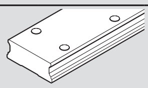
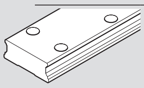
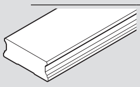
SNS = Slimline, normal, standard height
SLS = Slimline, long, standard height
SKS = Slimline, short, standard height
SNH = Slimline, normal, high
SLH = Slimline, long, high
SNN = Slimline, normal, low profile
SKN = Slimline, short, low profile

BNS = Wide, normal, standard height
CNS = Compact, normal, standard height

Definition Ball Runner Block design style		**Code (example) F**	**N**	**S**
Width	**F**langed	**F**		
	Slimline			
	Wide			
	Compact			
Length	**N**ormal		**N**	
	Long			
	Short			
Height	**S**tandard height			**S**
	High			
	Low			

Selection Criteria

Design Styles and Versions

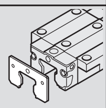
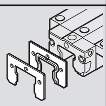
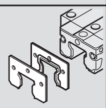
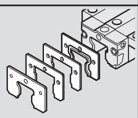
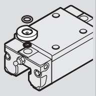
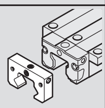
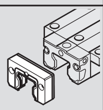
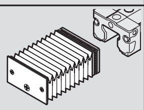
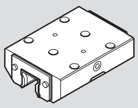
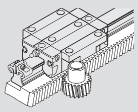
Ball guide rails			Application area	Mounting method	Special feature
Standard Ball Guide Rails made of steel		**SNS** **R1605 .3. ..** **R1605 .B. ..** **R1645 .3. ..[2)]** **R2045 .3. ..[1)]**	Standard version Very harsh environments Robust cover strip fastening	For mounting from above	With cover strip and strip clamps. A single cover for all holes. No holes required in end face for fastening of cover strip.
		**SNS** **R1605 .6. ..** **R1605 .D. ..**	Harsh environments Compact cover strip fastening	For mounting from above	With cover strip and protective end caps. A single cover for all holes.
		**SNS** **R1605 .0. ..** **R1605 .C. ..** **R1645 .0. ..[2)]** **R2045 .0. ..[1)]**	Economical	For mounting from above	With plastic mounting hole plugs. No extra space needed at rail ends.
		**SNS** **R1606 .5. ..**	More resistant to mechanical stressing (e.g. impacts) Very harsh environments	For mounting from above	With steel mounting hole plugs. No extra space needed at rail ends.
		**SNS** **R1607 .0. ..** **R1647 .0. ..[2)]** **R2047 .0. ..[1)]**	Easy access to mounting base underside Best sealing action of end seals	For mounting from below	Larger screw fasteners than for mounting from above. Greater side loads permitted. No extra space needed at rail ends.
V-Guide Rails made of steel		**SNS** **R1608 .1. ..**	Reduced geometric variation in travel characteristics Single-rail applications (mounting in AL profile)	No mounting holes	Installed by press-fitting into mounting base. Economical mounting method.
Wide Ball Guide Rails made of steel		**BNS** **R1675 .0. ..** **R1673 .0. ..[2)]**	High moment load capacity	For mounting from above	With plastic mounting hole plugs. No extra space needed at rail ends.
		**BNS** **R1676 .5. ..**	High moment load capacity More resistant to mechanical stressing (e.g. impacts) Very harsh environments	For mounting from above	With steel mounting hole plugs. No extra space needed at rail ends.
		**BNS** **R1677 .0. ..**	High moment load capacity Best sealing action of end seals	For mounting from below	Larger screw fasteners than for mounting from above. Greater side loads permitted than single-row series. No extra space needed at rail ends.

1) Resist NR II
2) Resist CR

Codes for design styles of all the available ball guide rails

SNS = Slimline, normal, standard height
BNS = Wide, normal, standard height

Definition Ball guide rail design style		Code (example)		
		S	**N**	**S**
Width	Slimline	**S**		
	Wide			
Length	Normal		**N**	
Height	Standard height			**S**

Accessories **Add-on elements are available as options for the ball runner blocks.**	**Application area**
Scraper Plate 	The scraper plate serves to remove coarse particles or dirt that has become encrusted on the ball guide rail. When making your selection, consider whether the ball guide rail is to be used with or without a cover strip.
End Seal two-piece 	External end seals provide effective protection for the ball runner block, preventing dirt, small particles and liquids from working their way in. This further improves the sealing performance. The two-piece end seal can be retrofitted over the ball guide rail.
FKM Seal one-piece and two-piece 	Better sealing performance than the end seal, but with higher friction. For use in environments with high contamination levels, metalworking fluids or aggressive media. Resistant to chemicals and high temperatures.
Seal Kit 	The seal kit is recommended in cases where both a scraper plate and end seal are required.
Lubrication Adapter 	For oil and grease lubrication from above for SNH and SLH ball runner blocks (high versions).
Lube Plate 	Enables further variations for lubrication of ball runner blocks. Available in designs with metric threads or pipe threads.
Front Lube Unit 	For applications requiring very long relubrication intervals. Under normal loads, they allow travel distances of up to 10,000 km without relubrication. The function is only assured where there is no exposure to liquids and little contamination. The maximum operating temperature is 60 °C.
Bellows 	Bellows come in a variety of designs, e.g. with or without lubricating plate. The heat-resistant versions are metallized on one side, making them non-combustible, non-flammable and resistant to sparks, welding splatter or hot shavings. They can withstand temperatures of up to 200 °C for brief periods and operating temperatures of 80 °C.
Clamping and Braking Units 	The clamping units serve to prevent the Ball Rail System from moving when they are at rest. The braking units can be used to bring moving Ball Rail Systems to a standstill and keep them stationary during rest phases. The following versions are available: hydraulic, pneumatic and manual clamping units.
Rack and pinion 	Gear racks and pinions are space-saving solutions for driving linear motion guides. For transmission of high forces within a small space and with low noise generation. All attachments such as gear reducers, motors and controllers are also available.

Selection Criteria

System Preload

Definition of the preload class

Preloading force relative to the dynamic load capacity C of the respective ball runner block.

Example
- Ball Runner Block FNS R1651 314 20
- Preload class C1
- Dynamic load capacity C = 41,900 N (☞🗎 37, size 35, load capacity C)

Calculation:
C1 = 2% C
= 838 N

This runner block is mounted with an internal preload force F_{pr} of 838 N.

Selection of the preload class

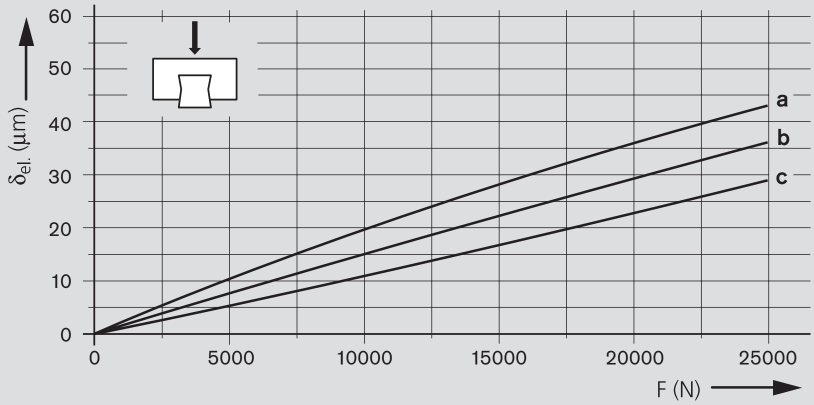
In Ball Runner Blocks without preload (preload class C0) there is a clearance between the runner block and the guide rail of between 1 and 10 µm.
When using two rails and more than one runner block per guide rail, this clearance is usually equalized by parallelism tolerances.

Code	Preload	Application area
C0	**Without preload**	For particularly smooth-running guide systems with the lowest possible friction for applications with large installation tolerances. Clearance versions are available only in accuracy classes N and H.
C1	**2% C**	For precise guide systems with low external loads and high demands on overall rigidity.
C2	**8% C**	For precise guide systems with both high external loading and high demands on overall rigidity; also recommended for single-rail systems. Above average moment loads can be absorbed without significant elastic deflection. Further improved overall rigidity with only medium moment loads.
C3	**13% C**	For highly rigid guide systems such as precision machine tools, etc. Above average loads and moments can be absorbed with the least possible elastic deflection. Ball runner blocks with preload C3 available only in accuracy classes UP, SP and XP; heavy duty ball runner blocks only in UP, SP and P.

Elastic deflection dependent on the preload class and the runner block

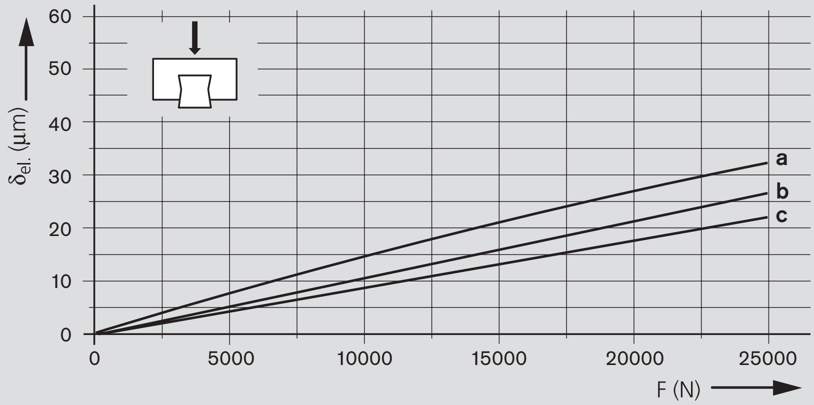
Example
Ball Runner Block FNS
Flanged, normal, standard height

Size 35:
a) Ball Runner Block R1651 31. 20 with preload C1 (2% C)
b) Ball Runner Block R1651 32. 20 with preload C2 (8% C)
c) Ball Runner Block R1651 33. 20 with preload C3 (13% C)



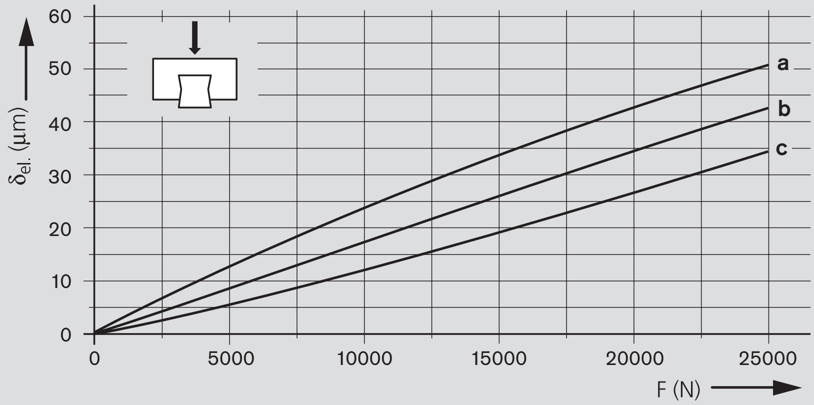
Example
Ball Runner Block FLS
Flanged, long, standard height

Size 35:
a) Ball Runner Block R1653 31. 20 with preload C1 (2% C)
b) Ball Runner Block R1653 32. 20 with preload C2 (8% C)
c) Ball Runner Block R1653 33. 20 with preload C3 (13% C)



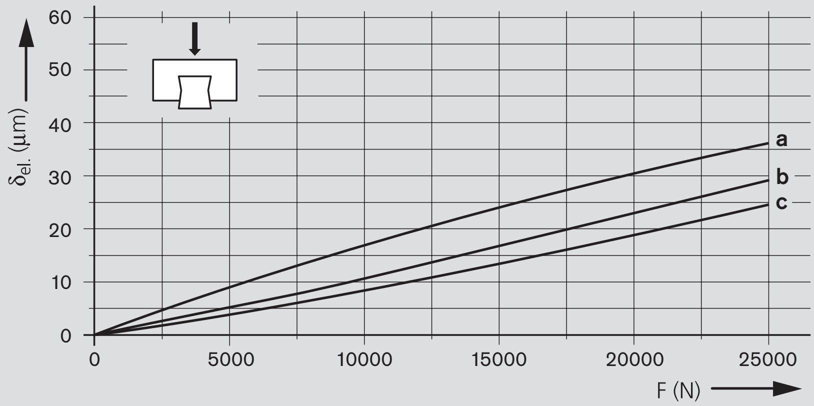
Example
Ball Runner Block SNS
Slimline, normal, standard height

Size 35:
a) Ball Runner Block R1622 31. 20 with preload C1 (2% C)
b) Ball Runner Block R1622 32. 20 with preload C2 (8% C)
c) Ball Runner Block R1622 33. 20 with preload C3 (13% C)



Example
Ball Runner Block SLS
Slimline, long, standard height

Size 35:
a) Ball Runner Block R1623 31. 20 with preload C1 (2% C)
b) Ball Runner Block R1623 32. 20 with preload C2 (8% C)
c) Ball Runner Block R1623 33. 20 with preload C3 (13% C)



Key to illustration
δ_{el} = elastic deflection (µm)
F = load (N)

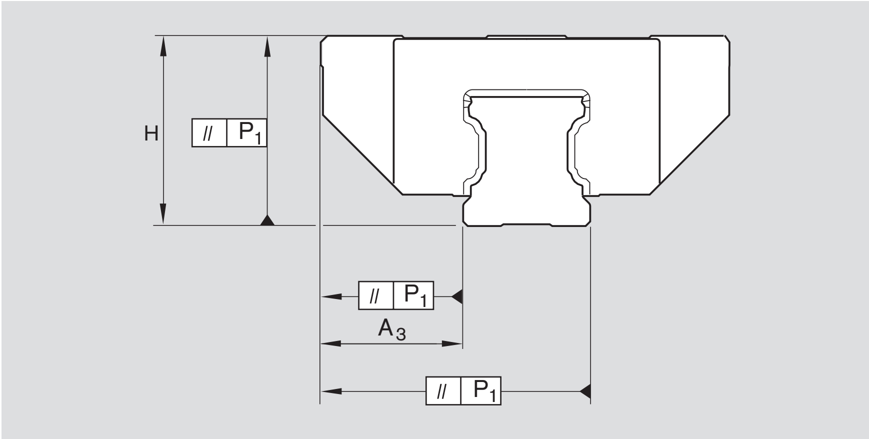
Selection Criteria

Accuracy Classes

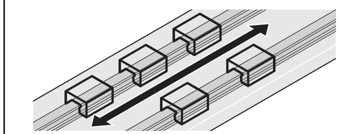
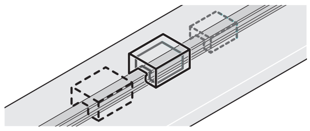
Accuracy classes and their tolerances

In Ball Rail Systems, the runner blocks are available in six accuracy classes and the guide rails in five accuracy classes.

For details of the available runner blocks and guide rails, see the “Part numbers” tables.



Built-in interchangeability through precision machining
Rexroth manufactures its ball guide rails and ball 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, a runner block can be used without problems on various guide rails of the same size.
Similarly, different ball runner blocks can also be used on one and the same ball guide rail.

	H	A_3	ΔH, ΔA_3
			
Measured at middle of runner block	For any ball runner block/rail combination at any position on rail		For different ball runner blocks at same position on rail

Ball Rail System made of steel, aluminum, Resist NR and Resist NRII

Accuracy classes	Dimensional tolerances (µm)		Max. difference in dimensions H and A_3 on the same rail (µm)
	H	A_3	ΔH, ΔA_3
N	±100	±40	30
H	±40	±20	15
P	±20	±10	7
XP[1)]	±11	±8	7
SP	±10	±7	5
UP	±5	±5	3

1) Ball runner block in accuracy class XP, ball guide rail with accuracy class SP

Ball Rail System, Resist CR, matte-silver hard chrome plated

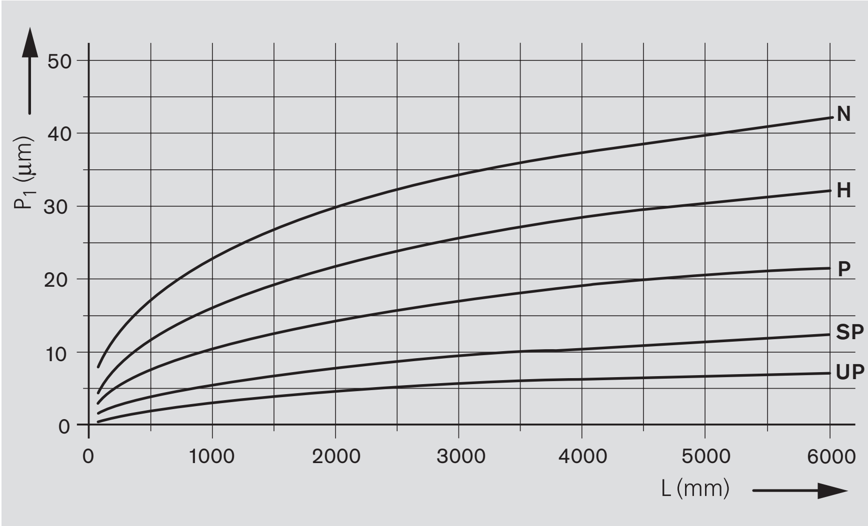
Accuracy classes	Dimensional tolerances (µm)				Max. difference in dimensions H and A_3 on the same rail (µm)	
	H		A_3		ΔH, ΔA_3	
	Runner block/ Guide rail	Guide rail	Runner block/ Guide rail	Guide rail	Runner block/ Guide rail	Guide rail
H	+47 −38	+44 −39	±23	+19 −24	18	15

Key to illustration

H	=	height tolerance	(µm)
A_3	=	lateral tolerance	(µm)
P_1	=	parallelism offset	(µm)
L	=	rail length	(mm)

Parallelism offset P_1 of the ball rail system in service

Values measured at middle of runner block for ball rail systems without surface coating
For hard chrome plated ball guide rails Resist CR, the values may increase by up to 2 μm.



Tolerances for combination of accuracy classes

Ball Runner Blocks			Ball Guide Rails N (μm)	H (μm)	P (μm)	SP (μm)	UP (μm)
N	Tolerance dimension H	(μm)	**±100**	**±48**	±32	±23	±19
	Tolerance dimension A_3	(μm)	**±40**	**±28**	±22	±20	±19
	Max. difference in dimensions H and A_3 on one rail	(μm)	**30**	**30**	30	30	30
H	Tolerance dimension H	(μm)	**±92**	**±40**	**±24**	±15	±11
	Tolerance dimension A_3	(μm)	**±32**	**±20**	**±14**	±12	±11
	Max. difference in dimensions H and A_3 on one rail	(μm)	**15**	**15**	**15**	15	15
P	Tolerance dimension H	(μm)	±88	**±36**	**±20**	**±11**	±7
	Tolerance dimension A_3	(μm)	±28	**±16**	**±10**	**±8**	±7
	Max. difference in dimensions H and A_3 on one rail	(μm)	7	**7**	**7**	**7**	7
XP	Tolerance dimension H	(μm)	±88	**±36**	**±20**	**±11**	±7
	Tolerance dimension A_3	(μm)	±28	**±16**	**±10**	**±8**	±7
	Max. difference in dimensions H and A_3 on one rail	(μm)	7	**7**	**7**	**7**	7
SP	Tolerance dimension H	(μm)	±87	±35	**±19**	**±10**	**±6**
	Tolerance dimension A_3	(μm)	±27	±15	**±9**	**±7**	**±6**
	Max. difference in dimensions H and A_3 on one rail	(μm)	5	5	**5**	**5**	**5**
UP	Tolerance dimension H	(μm)	±86	±34	±18	**±9**	**±5**
	Tolerance dimension A_3	(μm)	±26	±14	±8	**±6**	**±5**
	Max. difference in dimensions H and A_3 on one rail	(μm)	3	3	3	**3**	**3**

Recommendations for combining accuracy classes

Recommended for **wide runner block spacing** and **long strokes**:
Ball guide rail in higher accuracy class than ball runner blocks.

Recommended for **close runner block spacing** and **short strokes**:
Ball runner blocks in higher accuracy class than ball guide rail.

Selection criterion Travel accuracy

Perfected ball entry and exit zones in the runner blocks and optimized spacing of the mounting holes in the guide rails provide very high travel accuracy with very low pulsation.

These high accuracy systems are especially suitable for high-precision machining processes, measurement systems, high-precision scanners, EDM equipment, etc.
(See also “High Precision Ball Runner Blocks” ☞🗎 72)

Selection criteria

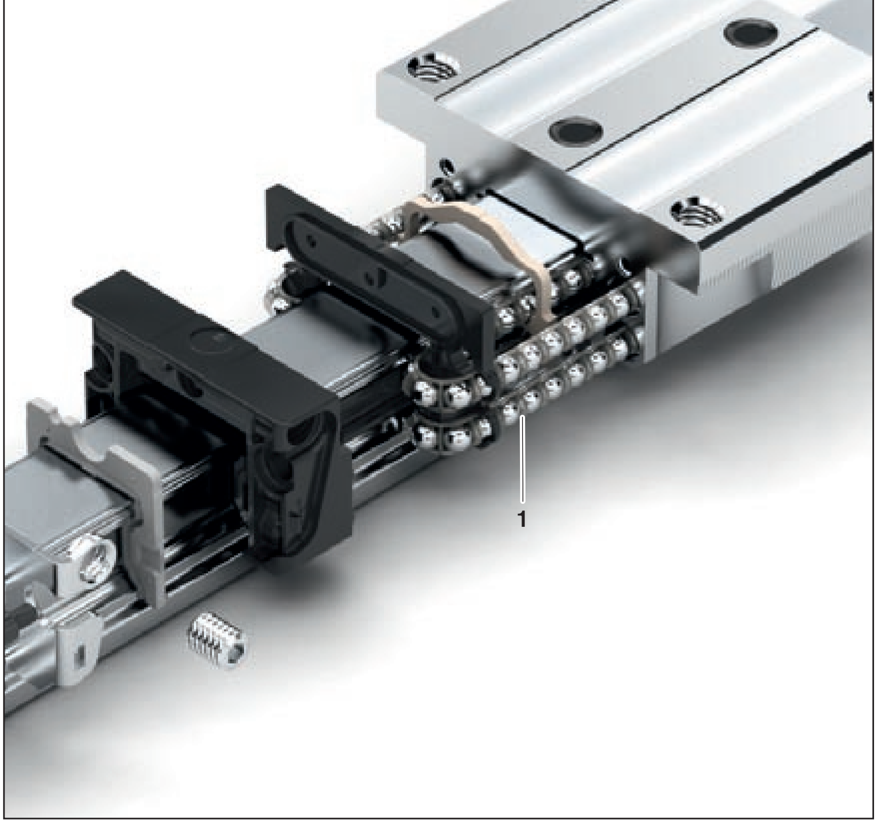
Ball Chain

Ball chain

Rexroth recommends using a ball chain particularly in applications calling for low noise levels.

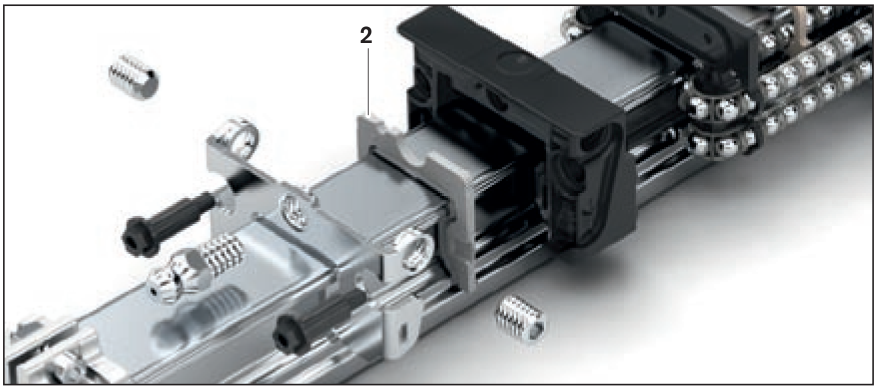
Ball runner blocks can be equipped with a ball chain (1) as an option. The ball chain prevents the balls from bumping into each other and ensures smoother travel. This reduces the noise level. Runner blocks with ball chains have fewer load-bearing balls, which may result in lower load and load moment capacities (“Product Overview, with Load Capacities and Load Moments” ☞🗎 8).

Ball runner block with ball chain



Seals

Wiper seals

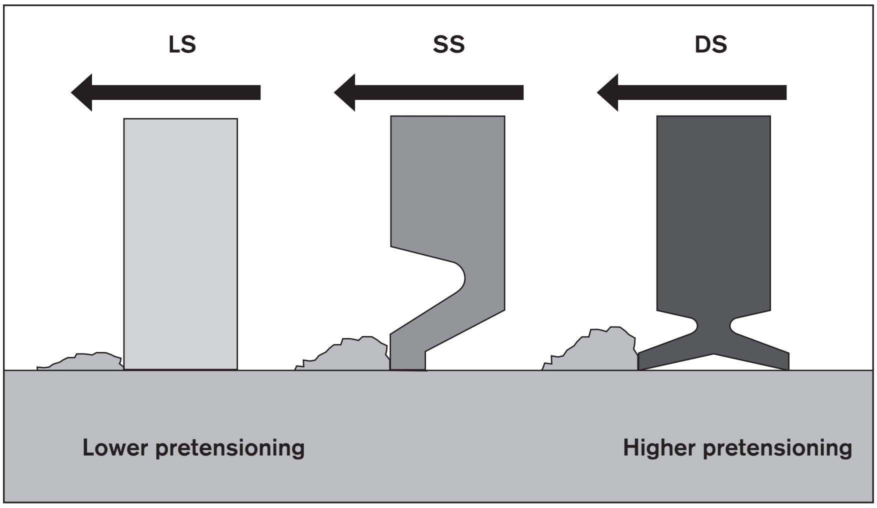


The sealing plate (2) on the end face protects the runner block internals from dirt particles, shavings and liquids. It also reduces lubricant drag-out. Optimized sealing lip geometry results in minimal friction. Sealing plates are available with black standard seals (SS), beige low-friction seals (LS), or green double-lipped seals (DS).

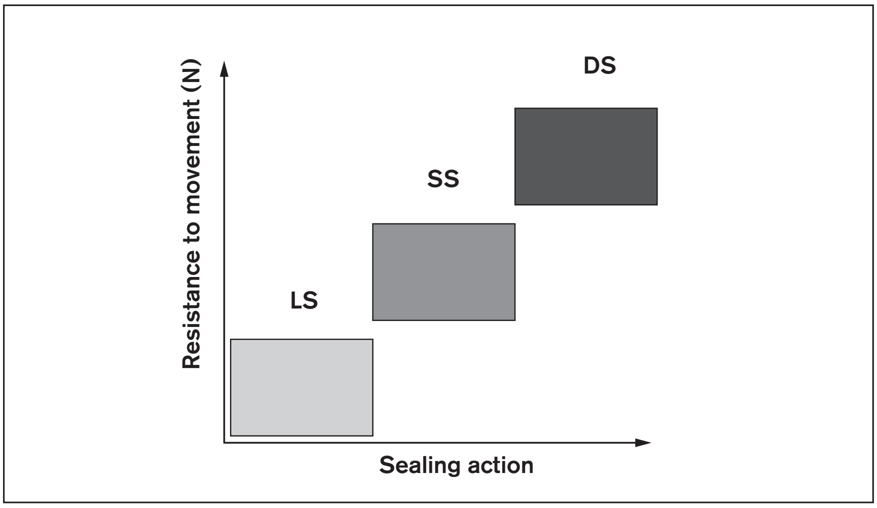
Low-friction seal (LS)
The low-friction seal was developed for applications requiring especially smooth running with minimal lubricant drag-out. It consists of an open-pored polyurethane foam and has only limited wiping action.

Standard seal (SS)
The standard seal is sufficient for most applications. It offers good wiping action while still permitting long relubrication intervals.

Double-lipped seal (DS)
Rexroth recommends using the double-lipped seal for applications where the rail guide is exposed to high levels of contamination such as metal chips, wood dust, metalworking fluids, etc. This seal provides excellent wiping action, but friction levels will be higher and the relubrication intervals are shorter.



Sealing action and resistance to movement
The resistance to movement is influenced by the seal's geometry and the material it is made of.
The chart at right shows the sealing action and resistance to movement in relation to the seal design.



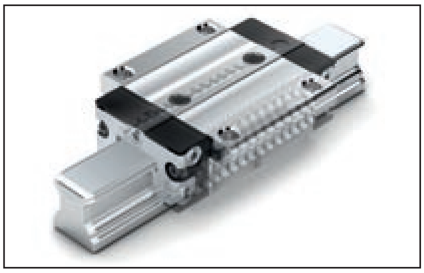
Key to illustration
LS = Low-friction seal
SS = Standard seal, universal seal with good sealing action
DS = Double-lipped seal, seal with very good sealing action

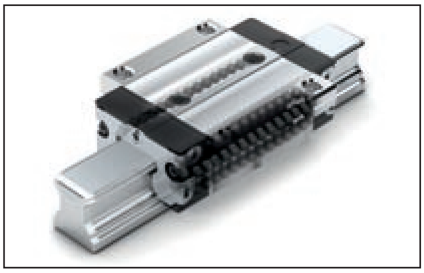
Selection Criteria

Materials

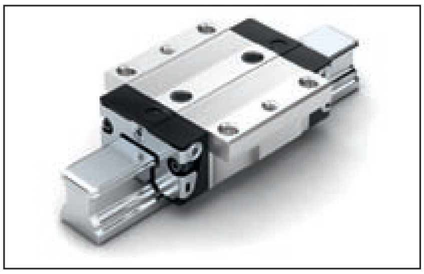
Rexroth offers Ball Runner Blocks in a variety of materials to meet the requirements of different applications.

A Standard Ball Runner Block made of steel
The most commonly used version, made of carbon steel.
An economical solution, but provides no protection against corrosion.
It is, however, sufficient for most industrial machinery applications.





B High-Speed Ball Runner Block made of steel
Basically the same as the standard steel runner block, but with ceramic balls instead of steel ones. Since the ceramic material is less dense than steel, the forces in the recirculation zones of the ball circuits remain the same even at the higher permissible travel speed.
As a result, there is no reduction in life expectancy, even when the system is operated at speeds of up to 10 m/s. The load capacities and moments are slightly lower than those of the standard version.



Ball Runner Blocks with limited corrosion resistance

C Ball Runner Block made of aluminum
The ball runner block body is made of a wrought aluminum alloy. The balls, steel inserts, and the mounting screws at the end face are made of carbon steel. The runner blocks have the same load capacities as the standard version. Since the yield point of aluminum is lower than that of steel, the load-bearing capability of the aluminum runner blocks is limited by F_{max} and M_{max}.
An economical alternative offering limited corrosion protection.

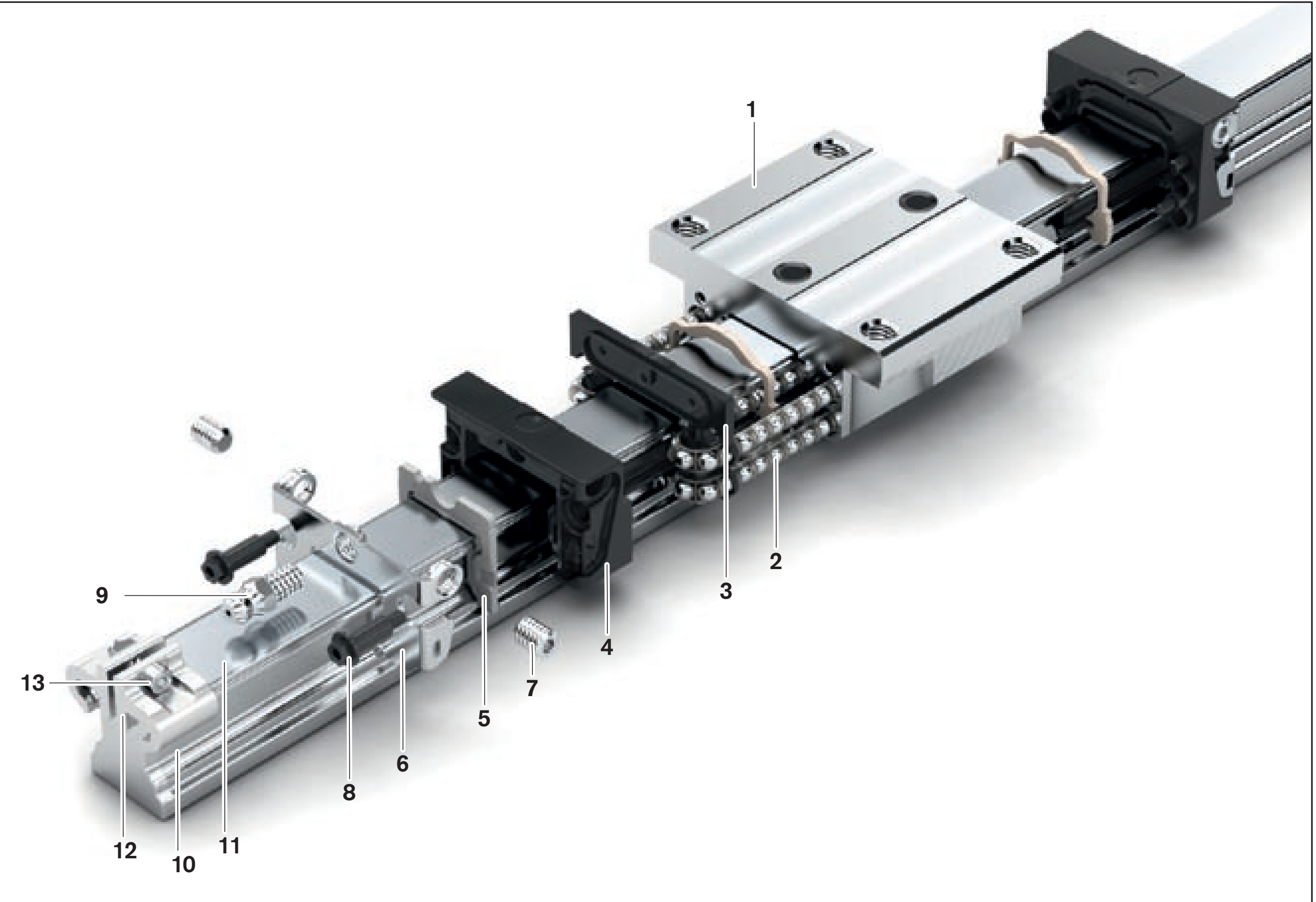
Corrosion-Resistant Ball Runner Blocks

D Resist NR
The ball runner block body is made of a corrosion-resistant material. Offers limited corrosion protection. The balls, steel inserts, and the mounting screws at the end face are made of carbon steel. The runner blocks have the same load capacities and moments as the standard versions.
Rexroth recommends this version for applications requiring corrosion protection.
Fast delivery.

E Resist NR II
All of the ball runner block parts are made of a corrosion-resistant material.
These runner blocks offer the greatest possible protection against corrosion with only a slight reduction in load capacities and moments.

F Resist CR
The ball runner block body is provided with a corrosion-resistant matte-silver hard chrome-plated coating. The balls, steel inserts, and the mounting screws at the end face are made of carbon steel. The runner blocks have the same load capacities and moments as the standard versions.
An alternative when the NR version is not available.

Material specifications



Item	Part	Ball runner block A Steel	 B Steel (high-speed)	 C Aluminium	 D Resist NR	 E Resist NR II	 F Resist CR
1	Ball runner block body	Heat-treated steel	Heat-treated steel	Wrought aluminum alloy	Corrosion-resistant steel 1.4122	Corrosion-resistant steel 1.4122	Heat-treated steel, chrome-plated
2	Balls	Antifriction bearing steel	Si_3N_4	Antifriction bearing steel	Antifriction bearing steel	Corrosion-resistant steel 1.4112	Antifriction bearing steel
3	Recirculation plate	Plastic TEE-E					
4	Ball guide	Plastic POM (PA6.6)					
5	Sealing plate	Plastic TEE-E					
6	Threaded plate	Corrosion-resistant steel 1.4306					
7	Set screw	Corrosion-resistant steel 1.4301					
8	Flanged screws	Carbon steel				Corrosion-resistant steel 1.4303	Carbon steel
9	Lube nipple					Corrosion-resistant steel 1.4305	
Item	**Part**	**Ball guide rail**					
10	Ball guide rail	Heat-treated steel				Corrosion-resistant steel 1.4116	Heat-treated steel
11	Cover strip	Corrosion-resistant steel 1.4310					
12	Strip clamp	Anodized aluminum					
13	Clamping screw with nut	Corrosion-resistant steel 1.4301					

Standard Ball Runner Blocks made of steel

Product Description

Characteristic features

- Same load capability in all four main load directions
- Low noise level and outstanding travel performance
- Excellent dynamic characteristics:
  Travel speed: $v_{max} = 5$ m/s
  Acceleration: $a_{max} = 500$ m/s^2
- Long-term lubrication, up to several years
- Minimum quantity lubrication system with integrated reservoir for oil lubrication[1)]
- Lube ports with metal threads on all sides[1)]
- Limitless interchangeability; all ball guide rail versions can be combined at will with all ball runner block versions within each accuracy class
- Optimum system rigidity through preloaded O-arrangement
- Integrated, inductive and wear-free measuring system as an option
- Top logistics that are unique worldwide due to interchangeability of components within each accuracy class
- Attachments can be bolted to ball runner blocks from above or below[1)]
- Improved rigidity under lift-off and side loading conditions when additional mounting screws are used in the two holes provided at the center of the runner block[1)]
- Extensive range of accessories
- Mounting threads provided on end faces for fixing of all add-on elements

Further highlights

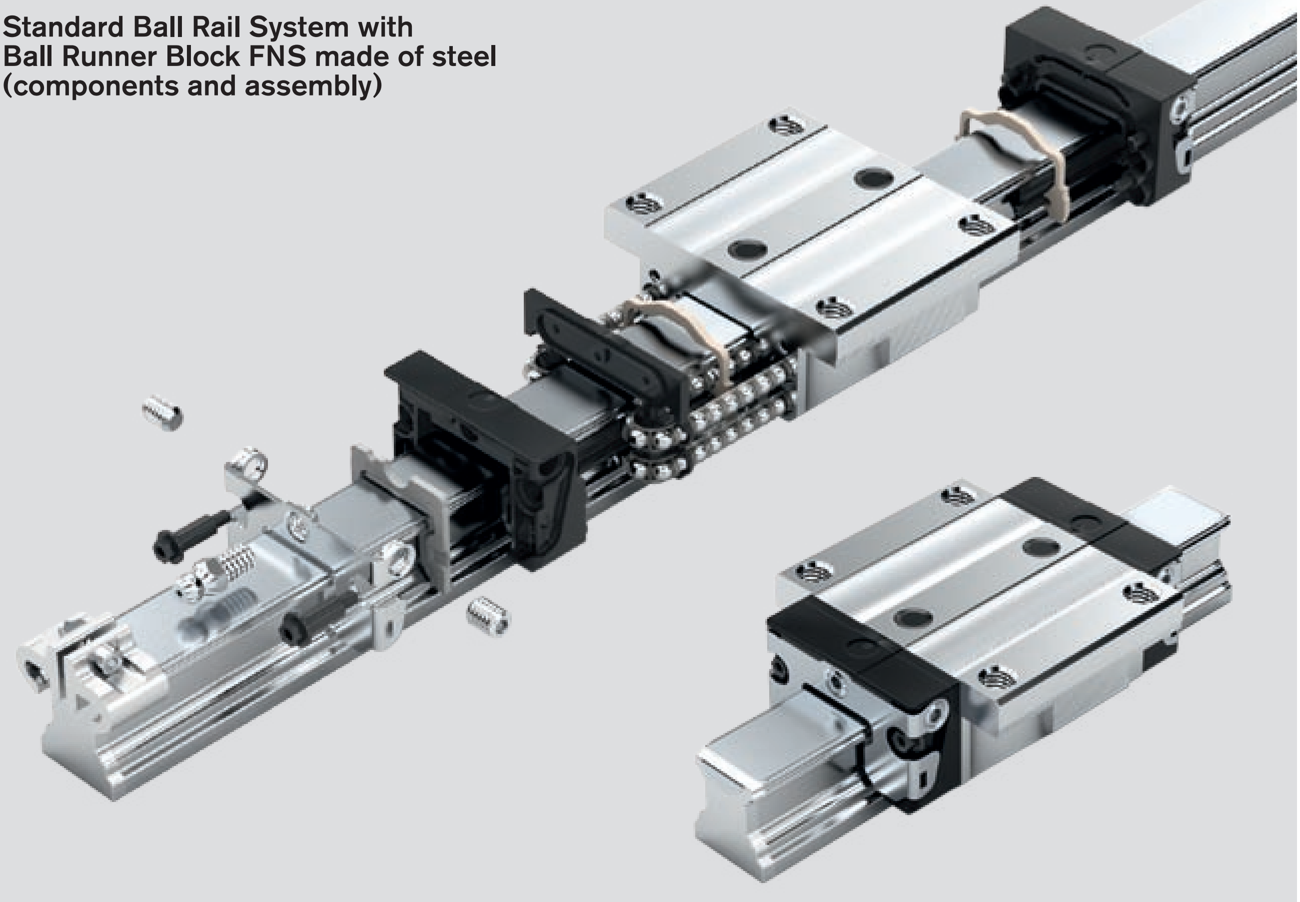
- High rigidity in all load directions – permits applications with just one runner block per rail
- Integrated all-round sealing
- High torque load capacity
- Optimized entry-zone geometry and high number of balls per track minimizes variation in elastic deflection
- Smooth, light running thanks to optimized ball recirculation and ball or ball chain guidance
- Various preload classes
- Ball runner blocks pre-lubricated in factory[1)]
- Available with ball chain as an option[1)]

Corrosion protection (optional)[1)]

- Resist NR:
  Ball runner block body made of corrosion-resistant steel per EN 10088
- Resist NR II:
  Ball runner block body, ball guide rail and all steel parts made from corrosion-resistant steel per EN 10088
- Resist CR:
  Ball runner block body and ball guide rail made of steel with matte-silver hard-chrome plated corrosion-resistant coating

1) depends on type

Standard Ball Rail System with Ball Runner Block FNS made of steel (components and assembly)



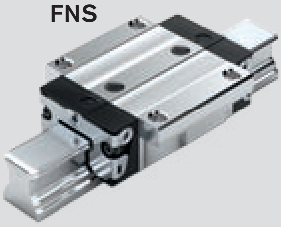
Standard Ball Runner Blocks made of steel

Product Description

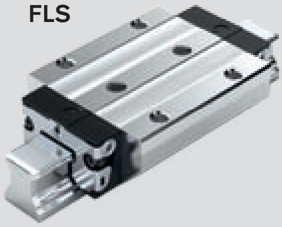
Overview of Standard and Heavy Duty Ball Runner Block models made of steel

Standard Ball Runner Blocks[1] up to size 45

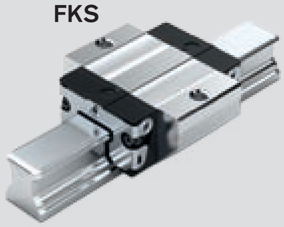
FNS



FLS



FKS

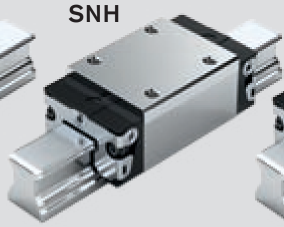


SNS

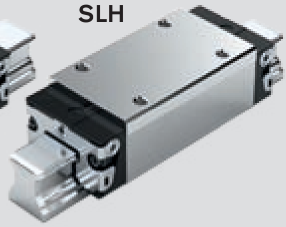
SLS

SKS

SNH



SLH

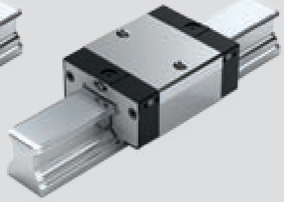


FNN[2]

FKN[2]

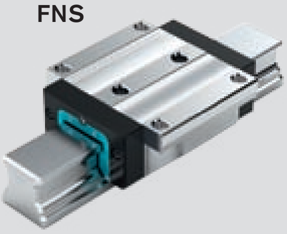
SNN[2]

SKN[2]

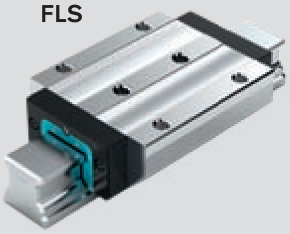


Heavy Duty Ball Runner Blocks[2] from size 55

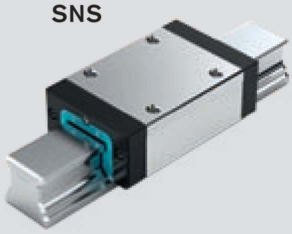
FNS



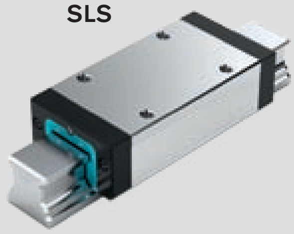
FLS



SNS

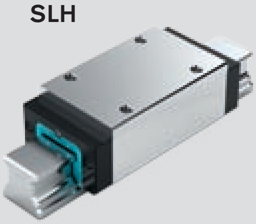


SLS



SNH

SLH



Ball chain (optional)
– Optimizes noise levels

1) With ball chain
2) Without ball chain

Ordering Example

Ordering of Ball Runner Blocks

The part number is composed of the code numbers for the individual options Each option (grey background) has its own code number (white background).

The following ordering example applies to all ball runner blocks.

Explanation of the option "Ball runner block with size"
The design style of the ball runner block – in this example, a Standard Ball Runner Block FNS – is specified on the respective product page.

Coding in the part number:
R1651 7
Design style Size

Ordering example
Options:
- Ball Runner Block FNS
- Size 30
- Preload class C1
- Accuracy class H
- With standard seal, without ball chain

Part number: R1651 713 20

Size	Ball runner block with size	Preload class			Accuracy class			Seal for ball runner block without ball chain			with ball chain		
		C0	C1	C2	N	H	P	SS	LS[1]	DS	SS	LS[1]	DS
15	R1651 1	9			4	3	–	20	21	–	22	23	–
			1		4	3	2	20	21	–	22	23	–
				2	–	3	2	20	–	–	22	–	–
20	R1651 8	9			4	3	–	20	21	–	22	23	–
			1		4	3	2	20	21	2Z	22	23	2Y
				2	–	3	2	20	–	2Z	22	–	2Y
25	R1651 2	9			4	3	–	20	21	–	22	23	–
			1		4	3	2	20	21	2Z	22	23	2Y
				2	–	3	2	20	–	2Z	22	–	2Y
30	R1651 7	9			4	3	–	20	21	–	22	23	–
			1		4	3	2	20	21	2Z	22	23	2Y
				2	–	3	2	20	–	2Z	22	–	2Y
35	R1651 3	9			4	3	–	20	21	–	22	23	–
			1		4	3	2	20	21	2Z	22	23	2Y
				2	–	3	2	20	–	2Z	22	–	2Y
45	R1651 4	9			4	3	–	20	–	–	22	–	–
			1		4	3	2	20	–	2Z	22	–	2Y
				2	–	3	2	20	–	2Z	22	–	2Y
e.g.	R1651 7		1			3		20					

1) Only with accuracy classes N and H

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

Seals
SS = standard seal
LS = low-friction seal
DS = double-lipped seal

Key to table
Gray numbers
= version/combination not preferred (longer delivery times in some cases)

Definition Ball Runner Block design style		Code (example) F	N	S
Width	Flanged	F		
	Slimline			
	Wide			
	Compact			
Length	Normal		N	
	Long			
	Short			
Height	Standard height			S
	High			
	Low			

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

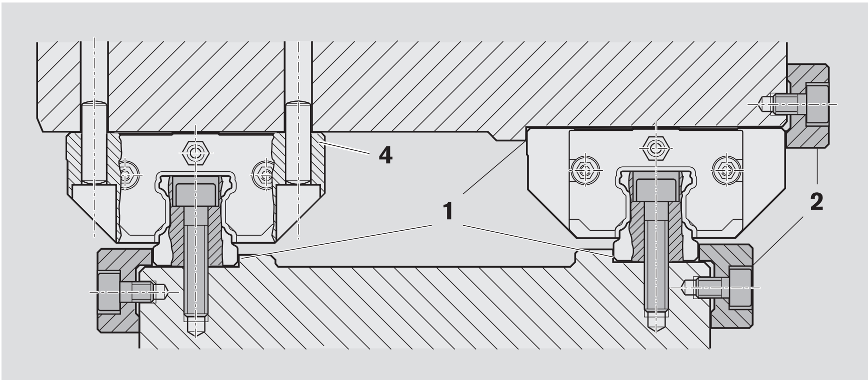
Note
– Guide rails without side fixing have to be aligned straight and parallel when mounting, preferably using a straight-edge.
– Recommended limits for side load if no additional lateral retention is provided, see the individual ball runner blocks.

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

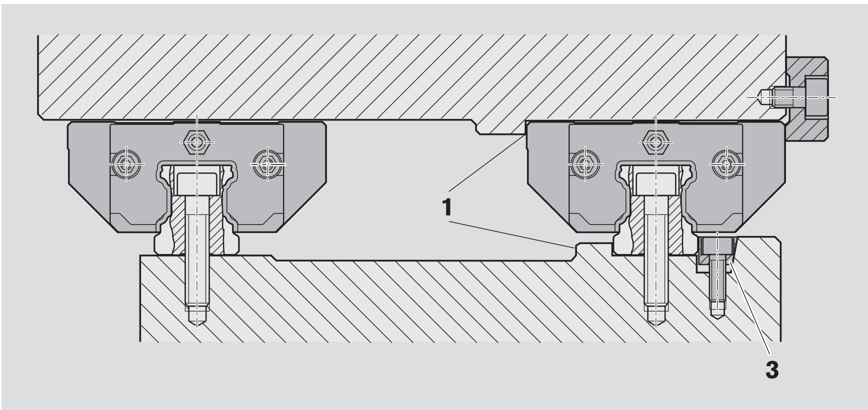
Possibilities for additional fixing:
1 Reference edges
2 Retaining strips
4 Locating pins

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

Mounting with fixing of both guide rails and runner blocks



Mounting with fixing of one guide rail and runner block



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

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

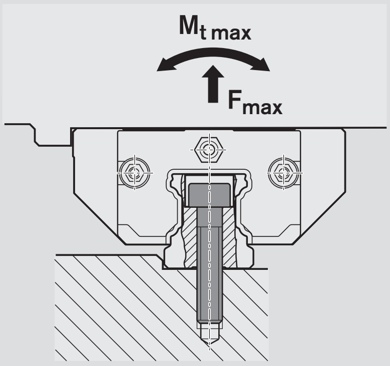
Ball guide rail	Size	Maximum permissible loads[1] Short runner block **FKS R1661 FKS R1665, R2000 SKS R1662 SKS R1666, R2010 FKN R1663 SKN R1664**		Normal runner block **FNS R1631 FNS R1651, R2001 SNS R1622, R2011 SNS R1632 SNH R1621 FNN R1693 SNN R1694**		Long runner block **FLS R1653, R2002 SLS R1623, 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

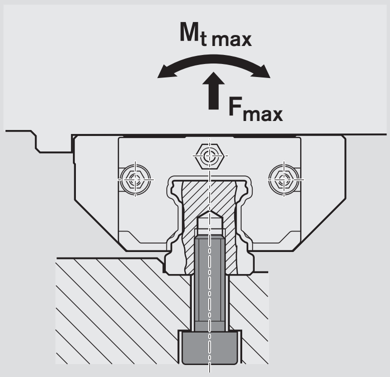
Ball guide rail for mounting from above

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

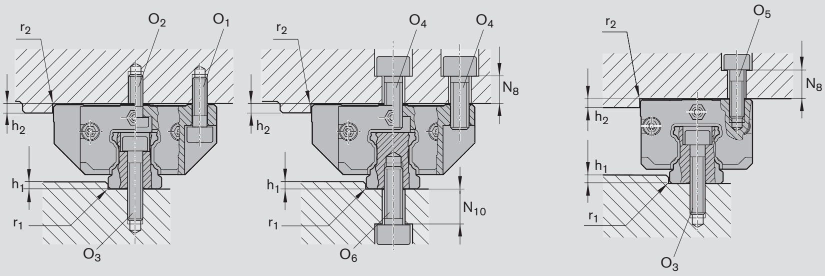
Reference edges, corner radii, screw sizes and tightening torques

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 4 pcs	O_2 2) DIN 6912 2 pcs	O_4 1) 2) ISO 4762 6 pcs	O_5 ISO 4762 4 pcs	O_3 ISO 4762	O_6 ISO 4762
	$h_{1\ min}$	$h_{1\ max}$	h_2	N_8	N_{10}	$r_{1\ max}$	$r_{2\ max}$						
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 10 3)	9.5 –	0.6	0.6	M5x16	M5x12	M6x16	M5x16	M5x25	M6x16
25	3.0	5.0	5	10 11 3)	12.0 –	0.8	0.8	M6x20	M6x16	M8x20	M6x18	M6x30	M6x20
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	2.7	5.5	9.5	23	46	80	125	195
12.9		(Nm)	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

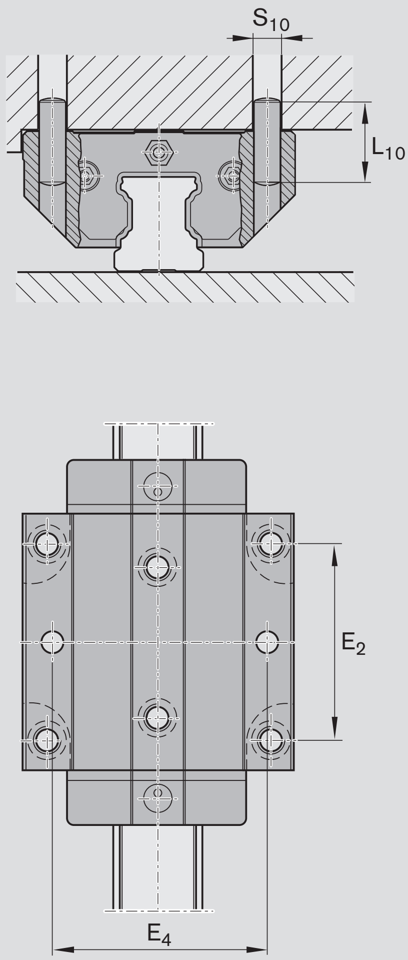
Note
- Rough-drilled holes made for production reasons may exist at the recommended pin hole positions on the runner block centerline ($Ø < S_{10}$). These may be bored open to accommodate the locating pins.

- 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!

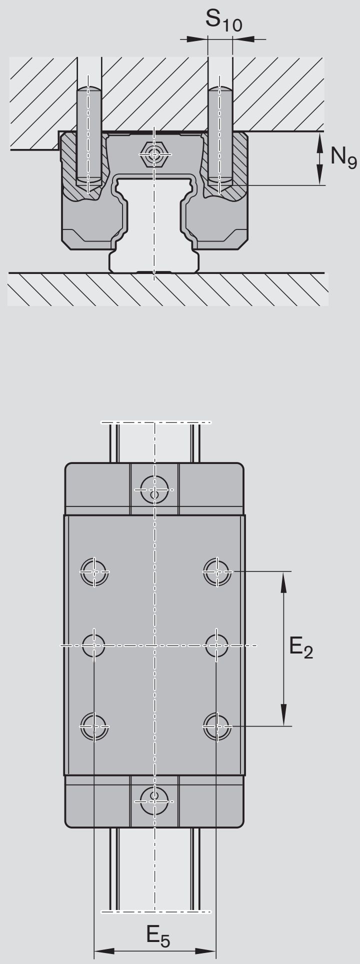
- Only prepare the pin holes after the installation is complete.

- 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 49 2)	32	24	7.5 6.5 2)	5
25	55 60 2)	35	32	9.0 7.0 2)	6
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

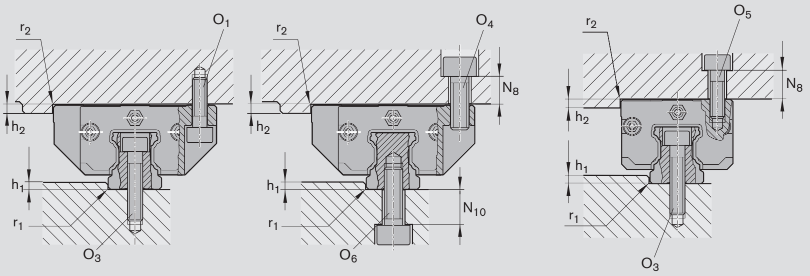
Ball runner blocks (flanged)
FKS, FKN

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	
	$h_{1\,min}$	$h_{1\,max}$	h_2	N_8	N_{10}	$r_{1\,max}$	$r_{2\,max}$	O_1 ISO 4762 2 pcs	O_4 ISO 4762 2 pcs	O_5 ISO 4762 2 pcs	O_3 ISO 4762	O_6 ISO 4762
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

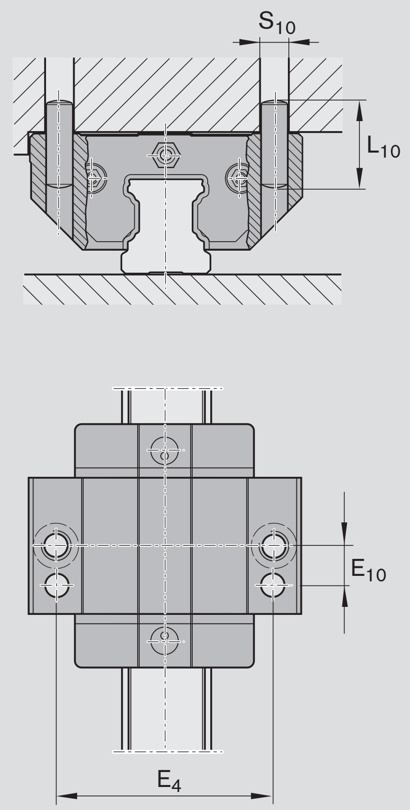
⚠ **If the recommended limits for permissible side loads are exceeded (see values for the individual runner block types), the runner block must be additionally fixed by means of locating pins**

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

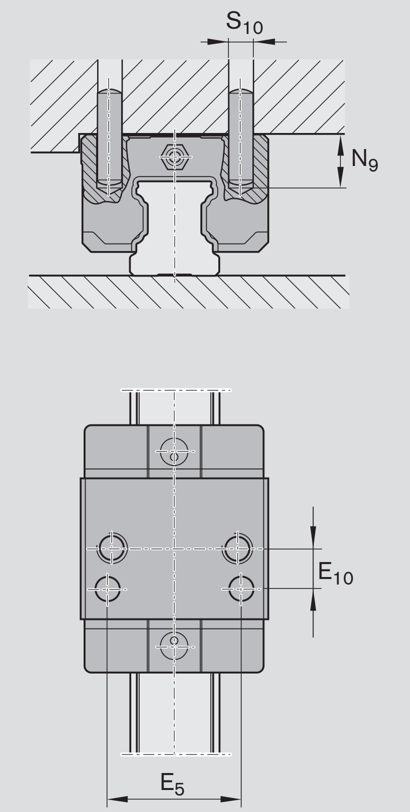
Possible pin types
- Taper pin (hardened) or
- Straight pin ISO 8734

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

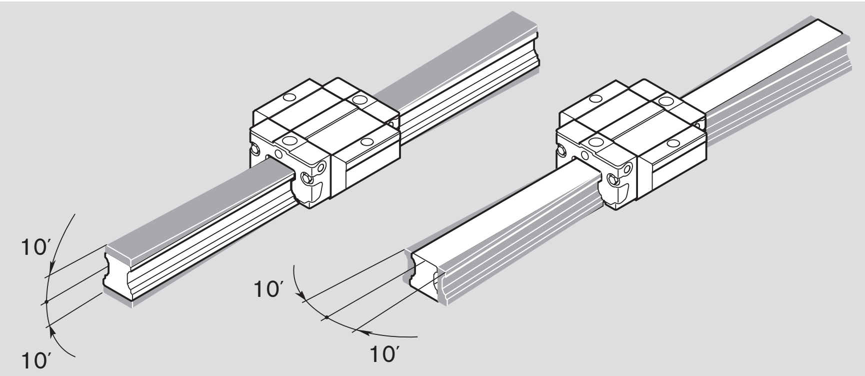


Size	Dimensions (mm)					
	E_4	E_5	E_{10}	L_{10} 1)	$N_{9\,max}$	S_{10} 1)
15	38	26	9	18	3.0	4
20	53 49 2)	32	10	24	3.5 2.0 2)	5
25	55 60 2)	35	11	32	7.0 5.0 2)	6
30	70	40	14	36	10.0	8
35	80	50	15	40	12.0	8

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

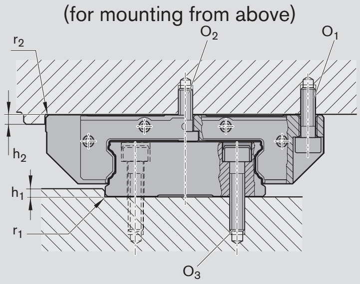
Note
The combinations shown here are examples. Basically, any ball runner block may be combined with any of the ball guide rail types offered.

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

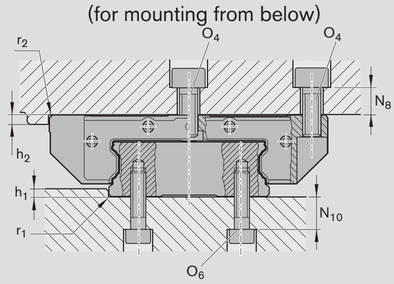
Guide rail with wide runner block

Ball runner blocks (flanged) BNS

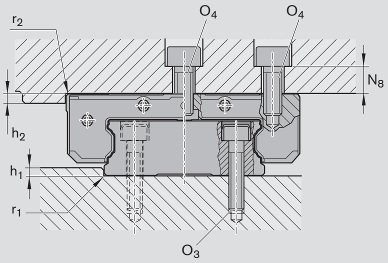
Ball guide rails
R1673, R1675, R1676
(for mounting from above)



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 O_1 ISO 4762 4 pcs	O_2 2) DIN 6912 2 pcs	O_4 1) 2) ISO 4762 6 pcs	Ball guide rail O_3 ISO 4762	O_6 ISO 4762
	$h_{1\,min}$	$h_{1\,max}$	h_2	N_8	N_8 3)	N_{10}	$r_{1\,max}$	$r_{2\,max}$					
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 O_1	O_2 5)	O_4	Ball guide rail 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 (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

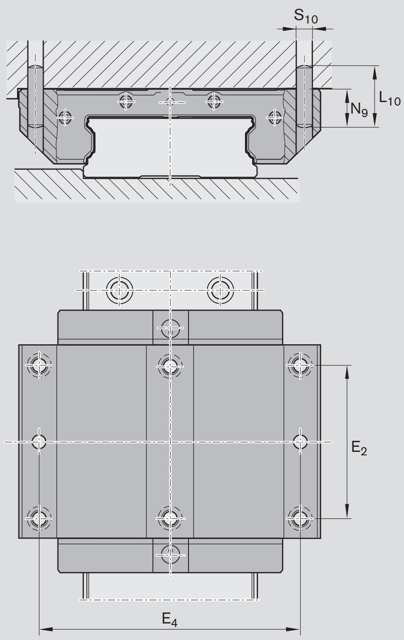
Note
- Rough-drilled holes made for production reasons may exist at the recommended pin hole positions on the runner block centerline (Ø < S_{10}). These may be bored open to accommodate the locating pins.

- 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!

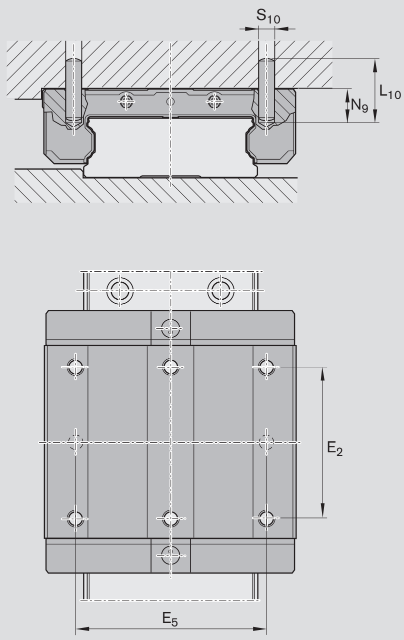
- Only prepare the pin holes after the installation is complete.

- 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

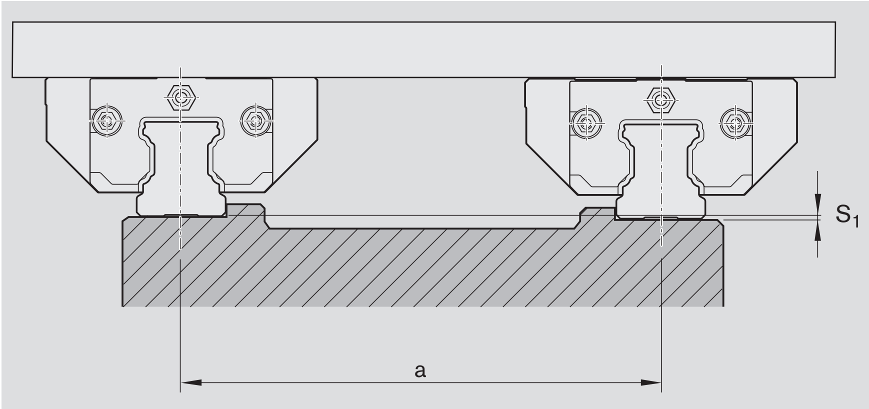
Installation Tolerances

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.

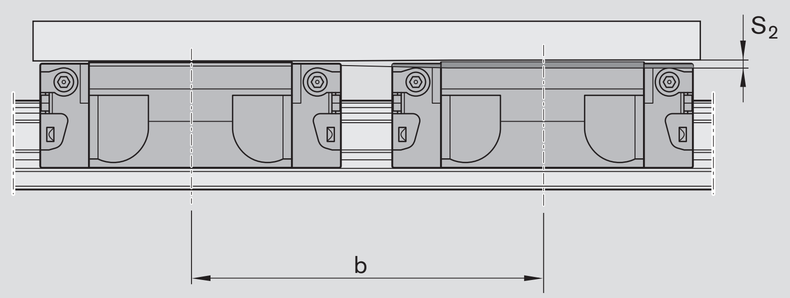
$$S_1 = a \cdot Y$$

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.

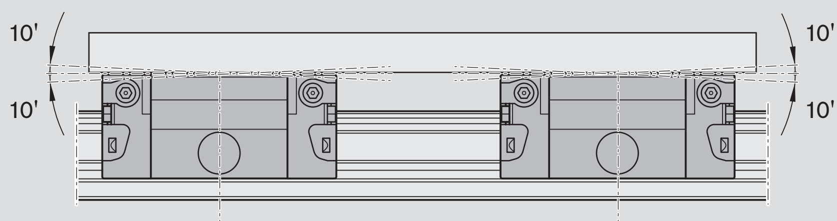
$$S_2 = b \cdot X$$

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

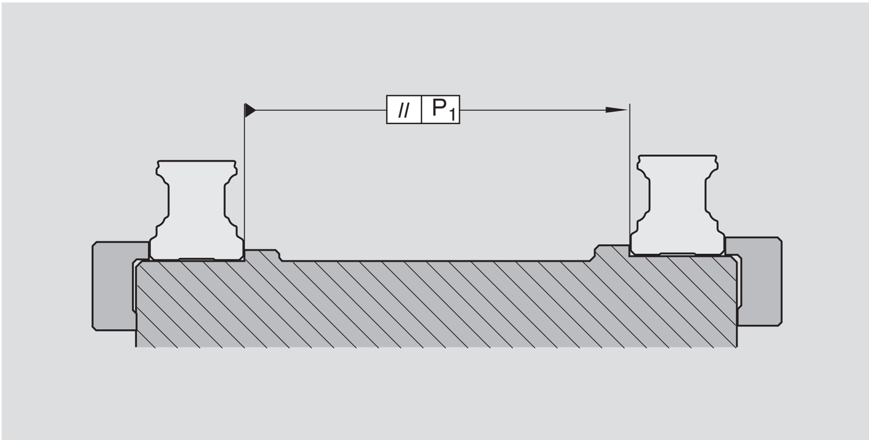
measured at the guide rails and at the runner blocks

The values for parallelism offset $\mathbf{P_1}$ apply to all ball runner blocks of the standard range.

The parallelism offset $\mathbf{P_1}$ causes a slight increase in preload on one side of the assembly.

Provided the parallelism offset $\mathbf{P_1}$ 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.

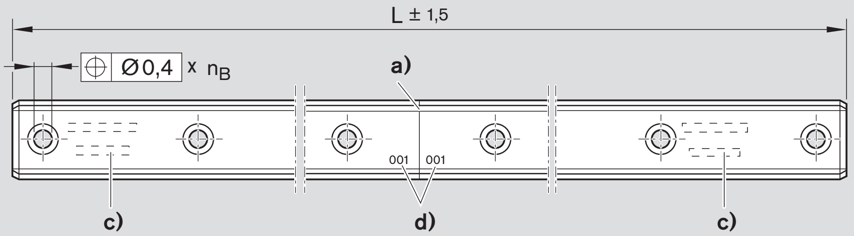
Preload classes
C0 = without preload
C1 = preload 2% C
C2 = preload 8% C
C3 = preload 13% C

Composite Ball Guide Rails

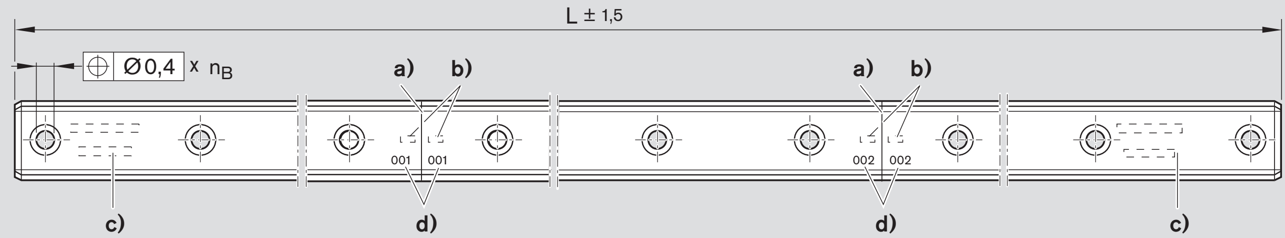
Notes on guide rails

– 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!

Notes on Lubrication

⚠ When using progressive feeder systems with grease lubricants, do not go below the minimum dosing quantity for relubrication as given in Table 9 ☞🗎 251.

⚠ We recommend applying initial lubrication with a manual grease gun before connecting the equipment to the centralized lubrication system.
When using a centralized lubrication system, it is essential that all lines and components in the circuit leading to the consumer (runner block) should be completely filled with lubricant and without any entrapped air bubbles. The pulse count can be calculated from the partial quantities and the piston distributor size.

- **For liquid grease, as per table 9 ☞🗎 251**
- **For oil lubrication, as per table 14 ☞🗎 255**

⚠ If other lubricants than those specified are used, this may lead to a reduction in the relubrication intervals, the achievable travel in short-stroke applications, and the load capacities. Possible chemical interactions between the plastic materials, lubricants and preservative oils must also be taken into account. In addition, the suitability of the lubricant for use in single-line centralized lubrication systems must be ensured.

⚠ Lubricant reservoirs, with or without pumps, must be equipped with stirrers to ensure that the lubricant will be replenished smoothly (avoidance of funneling effects in the reservoir).

⚠ Do not use greases containing solid particles (e.g., graphite or MoS_2)!

⚠ If initial lubrication is performed by the manufacturer, this may be done using grease or oil.
For subsequent relubrication, it is not possible to switch from grease to oil.

⚠ If the system is to be exposed to metalworking fluids, always apply 2 to 5 lubricant pulses at the beginning or when the system has been at a standstill for a longer period. When the system is in operation, 3 to 4 pulses per hour are recommended, irrespective of the distance traveled. If possible, apply lubricant while the system is in motion. Perform cleaning cycles.
(“Maintenance” ☞🗎 260)

⚠ If the application conditions involve dirt, vibrations, impacts, etc. we recommend shortening the relubrication intervals accordingly. Even under normal operating conditions, the system must be relubricated at the latest after 2 years due to aging of the grease.

If your application involves more demanding environmental requirements (such as clean room, vacuum, food industry applications, increased exposure to fluids or aggressive media, extreme temperatures), please consult us. Each application must be considered on its own merits in order to chose the most appropriate lubricant. Be sure to have all the information concerning your application at hand when contacting us.

Rexroth recommends using piston distributors from Vogel. These should be installed as close as possible to the lube ports of the runner blocks. Long lines and small line diameters should be avoided, and the lines should be laid on an upward slant.

A selection of possible lube fittings is given in the section “Accessories, Ball Runner Blocks” ☞🗎 170 (for more information, you should also consult the manufacturer of your lubrication system).

If other consumers are connected to the single-line centralized lubrication system, the weakest link in the chain will determine the lubrication cycle time.

The product specifications and safety data sheet for Dynalub can be found at www.boschrexroth.de/brl

Lubrication

Lubrication using a grease gun or a progressive feeder system

Grease type

We recommend using **Dynalub 510** with the following properties:

- High performance lithium soap grease, consistency class NLGI 2 as per DIN 51818 (KP2K-20 per DIN 51825)
- Good water resistance
- Corrosion protection
- Temperature range: –20 to +80 °C

Under conventional environmental conditions this ground-fiber, homogeneous grease is ideally suited for the lubrication of linear elements:

- At loads of up to 50% C
- For short-stroke applications > 1 mm
- For the permissible speed range of Ball Rail Systems

The product specifications and safety data sheet for Dynalub can be found at www.boschrexroth.de/brl

⚠ **Refer to the Notes on Lubrication!** ☞ **244**

Part numbers for Dynalub 510:

- R3416 037 00 (cartridge 400 g)
- R3416 035 00 (hobbock 25 kg)

⚠ **Ball runner blocks must never be put into operation without initial lubrication.**

If they are pre-lubricated before shipment, no initial lubrication by the user is required.

Rexroth Ball Rail Systems are coated with anti-corrosion oil prior to shipment.

Initial lubrication of the runner blocks (basic lubrication)

Stroke ≥ 2 · runner block length B_1 (normal stroke)

- Install and lubricate one lube fitting per runner block, at **either** of the two end caps!

Initial lubrication is applied in three partial quantities as specified in Table 1:

1. Grease the runner block with the first partial quantity as per Table 1, pressing it in slowly with the help of a grease gun.
2. Slide runner block back and forth over 3 · runner block length B_1 for three full cycles.
3. Repeat steps 1. and 2. two more times.
4. Make sure there is a visible film of grease on the guide rail.

Size	Initial lubrication (normal stroke)				
	Part number (not pre-lubricated)		Part number (pre-lubricated)		
	R16.. ... 10 R16.. ... 11 R16.. ... 60	R20.. ... 04/0Z R20.. ... 05 R20.. ... 06/0Y R20.. ... 07	R16.. ... 20/2Z R16.. ... 21 R16.. ... 22/2Y R16.. ... 23	R20.. ... 30/3Z R20.. ... 31 R20.. ... 32/3Y R20.. ... 33 R20.. ... 90	R16.. ... 70/7Z R16.. ... 71 R16.. ... 72/7Y R16.. ... 73
	Partial quantity (cm^3)				
15	0.4 (3x)		Pre-lubricated with Dynalub 510 before shipment		
20	0.7 (3x)				
25	1.4 (3x)				
30	2.2 (3x)				
35	2.2 (3x)				
45	4.7 (3x)				
55	9.4 (3x)		–		
65	15.4 (3x)				
20/40	1.0 (3x)		Pre-lubricated with Dynalub 510 before shipment		
25/70	1.4 (3x)				
35/90	2.7 (3x)		–		

Table 1

Stroke < 2 · runner block length B_1 (short stroke)

- Install and lubricate two lube fittings per runner block, one on **each** of the two end caps!

Initial lubrication is applied to each fitting in three partial quantities as specified in Table 2:

1. Grease each fitting on the runner block with the first partial quantity as per Table 2, pressing it in slowly with the help of a grease gun.
2. Slide runner block back and forth over 3 · runner block length B_1 for three full cycles.
3. Repeat steps 1. and 2. two more times.
4. Make sure there is a visible film of grease on the guide rail.

Size	Initial lubrication (short stroke)				
	Part number (not pre-lubricated)		Part number (pre-lubricated)		
	R16.. ... 10 R16.. ... 11 R16.. ... 60	R20.. ... 04/0Z R20.. ... 05 R20.. ... 06/0Y R20.. ... 07	R16.. ... 20/2Z R16.. ... 21 R16.. ... 22/2Y R16.. ... 23	R20.. ... 30/3Z R20.. ... 31 R20.. ... 32/3Y R20.. ... 33 R20.. ... 90	R16.. ... 70/7Z R16.. ... 71 R16.. ... 72/7Y R16.. ... 73
	Partial quantity per port (cm^3)				
	left	right			
15	0.4 (3x)	0.4 (3x)	Pre-lubricated with Dynalub 510 before shipment		
20	0.7 (3x)	0.7 (3x)			
25	1.4 (3x)	1.4 (3x)			
30	2.2 (3x)	2.2 (3x)			
35	2.2 (3x)	2.2 (3x)			
45	4.7 (3x)	4.7 (3x)			
55	9.4 (3x)	9.4 (3x)	–		
65	15.4 (3x)	15.4 (3x)			
20/40	1.0 (3x)	1.0 (3x)	Pre-lubricated with Dynalub 510 before shipment		
25/70	1.4 (3x)	1.4 (3x)			
35/90	2.7 (3x)	2.7 (3x)	–		

Table 2

Lubrication and Maintenance

Lubrication

Lubrication using a grease gun or a progressive feeder system (continued)

Relubrication of runner blocks

Stroke ≥ 2 · runner block length B_1 (normal stroke)

- When the relubrication interval according to Graph 1 or 2 ☞🗎 247 has been reached, add the relubrication quantity according to Table 3.

⚠ **Refer to the Notes on Lubrication! ☞🗎 244**

Size	Relubrication (normal stroke)				
	Part number		Part number		
	R16.. ... 10 R16.. ... 11 R16.. ... 60	R20.. ... 04/0Z R20.. ... 05 R20.. ... 06/0Y R20.. ... 07	R16.. ... 20/2Z R16.. ... 21 R16.. ... 22/2Y R16.. ... 23	R20.. ... 30/3Z R20.. ... 31 R20.. ... 32/3Y R20.. ... 33 R20.. ... 90	R16.. ... 70/7Z R16.. ... 71 R16.. ... 72/7Y R16.. ... 73
	Partial quantity (cm^3)		Partial quantity (cm^3)		
15	0.4 (1x)		0.4 (2x)		
20	0.7 (1x)		0.7 (2x)		
25	1.4 (1x)		1.4 (2x)		
30	2.2 (1x)		2.2 (2x)		
35	2.2 (1x)		2.2 (2x)		
45	4.7 (1x)		4.7 (2x)		
55	9.4 (1x)		–		
65	15.4 (1x)				
20/40	1.0 (1x)		1.0 (2x)		
25/70	1.4 (1x)		1.4 (2x)		
35/90	2.7 (1x)		–		

Table 3

Stroke < 2 · runner block length B_1 (short stroke)

- When the relubrication interval according to Graph 1 or 2 ☞🗎 247 has been reached, add the relubrication quantity **per** lube port according to Table 4.
- At each lubrication cycle the runner block should be traversed back and forth through a lubricating stroke of 3 · runner block length B_1. In any case, the lubricating stroke must never be shorter than the runner block length B_1.

⚠ **Refer to the Notes on Lubrication! ☞🗎 244**

Size	Relubrication (short stroke)				
	Part number		Part number		
	R16.. ... 10 R16.. ... 11 R16.. ... 60	R20.. ... 04/0Z R20.. ... 05 R20.. ... 06/0Y R20.. ... 07	R16.. ... 20/2Z R16.. ... 21 R16.. ... 22/2Y R16.. ... 23	R20.. ... 30/3Z R20.. ... 31 R20.. ... 32/3Y R20.. ... 33 R20.. ... 90	R16.. ... 70/7Z R16.. ... 71 R16.. ... 72/7Y R16.. ... 73
	Partial quantity per port (cm^3)		Partial quantity per port (cm^3)		
	left	right		left	right
15	0.4 (1x)	0.4 (1x)		0.4 (2x)	0.4 (2x)
20	0.7 (1x)	0.7 (1x)		0.7 (2x)	0.7 (2x)
25	1.4 (1x)	1.4 (1x)		1.4 (2x)	1.4 (2x)
30	2.2 (1x)	2.2 (1x)		2.2 (2x)	2.2 (2x)
35	2.2 (1x)	2.2 (1x)		2.2 (2x)	2.2 (2x)
45	4.7 (1x)	4.7 (1x)		4.7 (2x)	4.7 (2x)
55	9.4 (1x)	9.4 (1x)	–		
65	15.4 (1x)	15.4 (1x)			
20/40	1.0 (1x)	1.0 (1x)		1.0 (2x)	1.0 (2x)
25/70	1.4 (1x)	1.4 (1x)		1.4 (2x)	1.4 (2x)
35/90	2.7 (1x)	2.7 (1x)	–		

Table 4

Load-dependent relubrication intervals for grease lubrication using grease guns or progressive feeder systems ("dry axes")

The following conditions apply:
- Grease lubricant Dynalub 510 or alternatively Castrol Longtime PD 2
- No exposure to metalworking fluids
- Standard seals
- Ambient temperature: T = 20 - 30 °C

Key to graphs

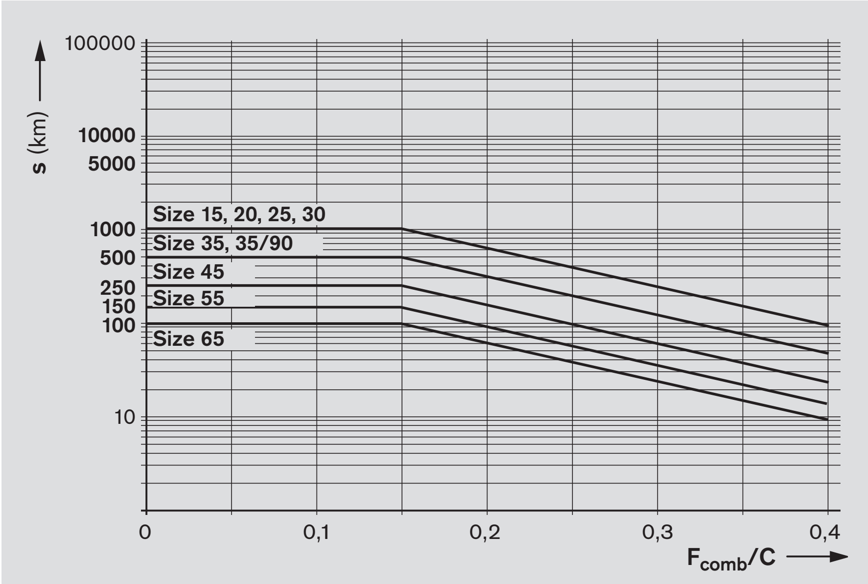
C	=	dynamic load capacity	(N)
F_{comb}	=	combined equivalent dynamic load on bearing	(N)
F_{comb}/C	=	load ratio	(–)
s	=	relubrication interval expressed as travel	(km)

Definition of F_{comb}/C

The load ratio F_{comb}/C is the quotient of the equivalent dynamic load on the bearing at the combined load on the bearing F_{comb} (taking account of the internal preload force F_{pr}) divided by the dynamic load capacity C ☞ 8 – 9.

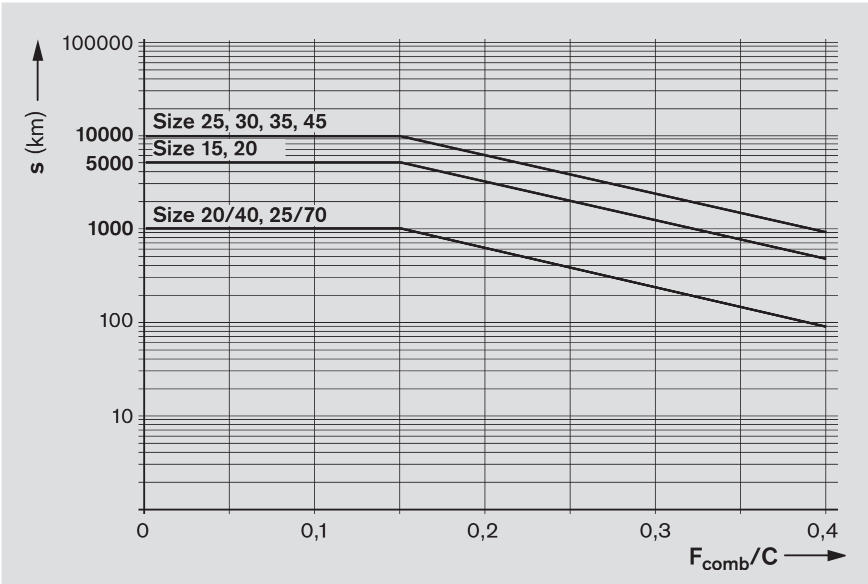
Please consult us regarding the relubrication intervals in the following cases:
- exposure to metalworking fluids
- use of double-lipped seals (DS)
- use of standard seals (SS) in combination with end seals or FKM seals or seal kits

⚠ **Refer to the Notes on Lubrication!** ☞ 244



Graph 1

Part number		
R16.. ... 10	R16.. ... 11	R16.. ... 60



Graph 2

Part number				
R20.. ... 04	R16.. ... 20	R20.. ... 30	R16.. ... 70	R20.. ... 90
R20.. ... 05	R16.. ... 21	R20.. ... 31	R16.. ... 71	
R20.. ... 06	R16.. ... 22	R20.. ... 32	R16.. ... 72	
R20.. ... 07	R16.. ... 23	R20.. ... 33	R16.. ... 73	

Lubrication and Maintenance

Lubrication

Liquid grease lubrication via single-line piston distributor systems

Liquid grease

We recommend using **Dynalub 520** with the following properties:

- High performance lithium soap grease, consistency class NLGI 00 as per DIN 51818 (GP00K-20 per DIN 51826)
- Good water resistance
- Corrosion protection
- Temperature range: –20 to +80 °C

Under conventional environmental conditions this ground-fiber, homogeneous grease is ideally suited for the lubrication of linear elements:

- In single-line centralized lubrication systems
- At loads of up to 50% C
- For short-stroke applications > 1 mm
- For the permissible speed range of Ball Rail Systems
- For miniature versions

The product specifications and safety data sheet for Dynalub can be found at www.boschrexroth.de/brl

⚠ **Refer to the Notes on Lubrication!** ☞ 244

Part numbers for Dynalub 520:

- R3416 043 00 (cartridge 400 g)
- R3416 042 00 (bucket 5 kg)

⚠ **Ball runner blocks must never be put into operation without initial lubrication.**

If they are pre-lubricated before shipment, no initial lubrication by the user is required.

Rexroth Ball Rail Systems are coated with anti-corrosion oil prior to shipment.

Initial lubrication of the runner blocks (basic lubrication)

Stroke ≥ 2 · runner block length B_1 (normal stroke)

- Install and lubricate one lube fitting per runner block, at **either** of the two end caps!

Initial lubrication is applied in three partial quantities as specified in Table 5:

1. Grease the runner block with the first partial quantity as per Table 5, pressing it in slowly with the help of a grease gun.
2. Slide runner block back and forth over 3 · runner block length B_1 for three full cycles.
3. Repeat steps 1. and 2. two more times.
4. Make sure there is a visible film of grease on the guide rail.

Size	Initial lubrication (normal stroke)				
	Part number (not pre-lubricated)		Part number (pre-lubricated)		
	R16.. ... 10 R16.. ... 11 R16.. ... 60	R20.. ... 04/0Z R20.. ... 05 R20.. ... 06/0Y R20.. ... 07	R16.. ... 20/2Z R16.. ... 21 R16.. ... 22/2Y R16.. ... 23	R20.. ... 30/3Z R20.. ... 31 R20.. ... 32/3Y R20.. ... 33 R20.. ... 90	R16.. ... 70/7Z R16.. ... 71 R16.. ... 72/7Y R16.. ... 73
	Partial quantity (cm^3)				
15	0.4 (3x)		Pre-lubricated with Dynalub 510 before shipment		
20	0.7 (3x)				
25	1.4 (3x)				
30	2.2 (3x)				
35	2.2 (3x)				
45	4.7 (3x)				
55	9.4 (3x)		–		
65	15.4 (3x)				
20/40	1.0 (3x)		Pre-lubricated with Dynalub 510 before shipment		
25/70	1.4 (3x)				
35/90	2.7 (3x)		–		

Table 5

Stroke < 2 · runner block length B_1 (short stroke)

- Install and lubricate two lube fittings per runner block, one on **each** of the two end caps!

Initial lubrication is applied to each fitting in three partial quantities as specified in Table 6:

1. Grease each fitting on the runner block with the first partial quantity as per Table 6, pressing it in slowly with the help of a grease gun.
2. Slide runner block back and forth over 3 · runner block length B_1 for three full cycles.
3. Repeat steps 1. and 2. two more times.
4. Make sure there is a visible film of grease on the guide rail.

Size	Initial lubrication (short stroke)				
	Part number (not pre-lubricated)		Part number (pre-lubricated)		
	R16.. ... 10 R16.. ... 11 R16.. ... 60	R20.. ... 04/0Z R20.. ... 05 R20.. ... 06/0Y R20.. ... 07	R16.. ... 20/2Z R16.. ... 21 R16.. ... 22/2Y R16.. ... 23	R20.. ... 30/3Z R20.. ... 31 R20.. ... 32/3Y R20.. ... 33 R20.. ... 90	R16.. ... 70/7Z R16.. ... 71 R16.. ... 72/7Y R16.. ... 73
	Partial quantity per port (cm^3)				
	left	right			
15	0.4 (3x)	0.4 (3x)	Pre-lubricated with Dynalub 510 before shipment		
20	0.7 (3x)	0.7 (3x)			
25	1.4 (3x)	1.4 (3x)			
30	2.2 (3x)	2.2 (3x)			
35	2.2 (3x)	2.2 (3x)			
45	4.7 (3x)	4.7 (3x)			
55	9.4 (3x)	9.4 (3x)	–		
65	15.4 (3x)	15.4 (3x)			
20/40	1.0 (3x)	1.0 (3x)	Pre-lubricated with Dynalub 510 before shipment		
25/70	1.4 (3x)	1.4 (3x)			
35/90	2.7 (3x)	2.7 (3x)	–		

Table 6

Relubrication of runner blocks

Stroke ≥ 2 · runner block length B_1 (normal stroke)

- When the relubrication interval according to Graph 3 or 4 ☞🗎 250 has been reached, add the relubrication quantity according to Table 7.

Note

The required pulse count is the quotient (as a whole number) of the minimum relubrication quantity according to Table 7 and the smallest permissible piston distributor size (i.e. the minimum pulse quantity) according to Table 9 ☞🗎 251. The smallest permissible piston distributor size also depends on the mounting orientation.
The lubricant cycle time can then be obtained by dividing the relubrication interval ☞🗎 250 by the calculated pulse count (see design example ☞🗎 256).

⚠ **Refer to the Notes on Lubrication!** ☞🗎 **244**

Size	Relubrication (normal stroke)				
	Part number		Part number		
	R16.. ... 10 R16.. ... 11 R16.. ... 60	R20.. ... 04/0Z R20.. ... 05 R20.. ... 06/0Y R20.. ... 07	R16.. ... 20/2Z R16.. ... 21 R16.. ... 22/2Y R16.. ... 23	R20.. ... 30/3Z R20.. ... 31 R20.. ... 32/3Y R20.. ... 33 R20.. ... 90	R16.. ... 70/7Z R16.. ... 71 R16.. ... 72/7Y R16.. ... 73
		Partial quantity (cm³)			Partial quantity (cm³)
15		0.4 (1x)			0.4 (2x)
20		0.7 (1x)			0.7 (2x)
25		1.4 (1x)			1.4 (2x)
30		2.2 (1x)			2.2 (2x)
35		2.2 (1x)			2.2 (2x)
45		4.7 (1x)			4.7 (2x)
55		9.4 (1x)		–	
65		15.4 (1x)			
20/40		1.0 (1x)			1.0 (2x)
25/70		1.4 (1x)			1.4 (2x)
35/90		2.7 (1x)		–	

Table 7

Stroke < 2 · runner block length B_1 (short stroke)

- When the relubrication interval according to Graph 3 or 4 ☞🗎 250 has been reached, add the relubrication quantity **per** lube port according to Table 8.
- – Calculate the required pulse count and lubricant cycle time in the same way as for relubrication (normal stroke).
- At each lubrication cycle the runner block should be traversed back and forth through a lubricating stroke of 3 · runner block length B_1. In any case, the lubricating stroke must never be shorter than the runner block length B_1.

⚠ **Refer to the Notes on Lubrication!** ☞🗎 **244**

Size	Relubrication (short stroke)				
	Part number		Part number		
	R16.. ... 10 R16.. ... 11 R16.. ... 60	R20.. ... 04/0Z R20.. ... 05 R20.. ... 06/0Y R20.. ... 07	R16.. ... 20/2Z R16.. ... 21 R16.. ... 22/2Y R16.. ... 23	R20.. ... 30/3Z R20.. ... 31 R20.. ... 32/3Y R20.. ... 33 R20.. ... 90	R16.. ... 70/7Z R16.. ... 71 R16.. ... 72/7Y R16.. ... 73
	Partial quantity per port (cm³)		Partial quantity per port (cm³)		
	left	right	left		right
15	0.4 (1x)	0.4 (1x)	0.4 (2x)		0.4 (2x)
20	0.7 (1x)	0.7 (1x)	0.7 (2x)		0.7 (2x)
25	1.4 (1x)	1.4 (1x)	1.4 (2x)		1.4 (2x)
30	2.2 (1x)	2.2 (1x)	2.2 (2x)		2.2 (2x)
35	2.2 (1x)	2.2 (1x)	2.2 (2x)		2.2 (2x)
45	4.7 (1x)	4.7 (1x)	4.7 (2x)		4.7 (2x)
55	9.4 (1x)	9.4 (1x)		–	
65	15.4 (1x)	15.4 (1x)			
20/40	1.0 (1x)	1.0 (1x)	1.0 (2x)		1.0 (2x)
25/70	1.4 (1x)	1.4 (1x)	1.4 (2x)		1.4 (2x)
35/90	2.7 (1x)	2.7 (1x)		–	

Table 8

Lubrication and Maintenance

Lubrication

Liquid grease lubrication via single-line piston distributor systems (continued)

Load-dependent relubrication intervals for liquid grease lubrication via single-line piston distributor systems ("dry axes")

The following conditions apply:
- Liquid grease Dynalub 520 or alternatively Castrol Longtime PD 00
- No exposure to metalworking fluids
- Standard seals
- Ambient temperature: T = 20 - 30 °C

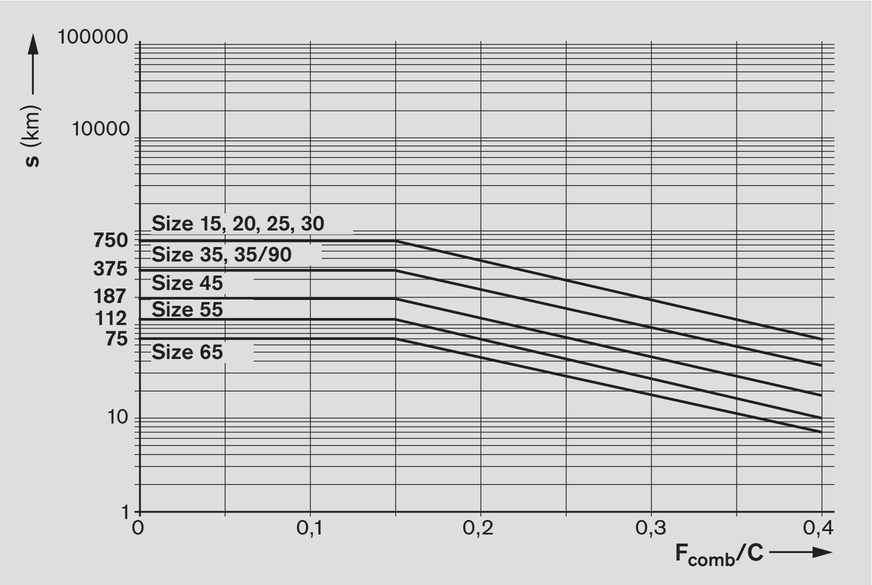
Key to graphs

C	=	dynamic load capacity	(N)
F_{comb}	=	combined equivalent dynamic load on bearing	(N)
F_{comb}/C	=	load ratio	(–)
s	=	relubrication interval expressed as travel	(km)

Definition of F_{comb}/C
The load ratio F_{comb}/C is the quotient of the equivalent dynamic load on the bearing at the combined load on the bearing F_{comb} (taking account of the internal preload force F_{pr}) divided by the dynamic load capacity C ☞ 8 - 9.

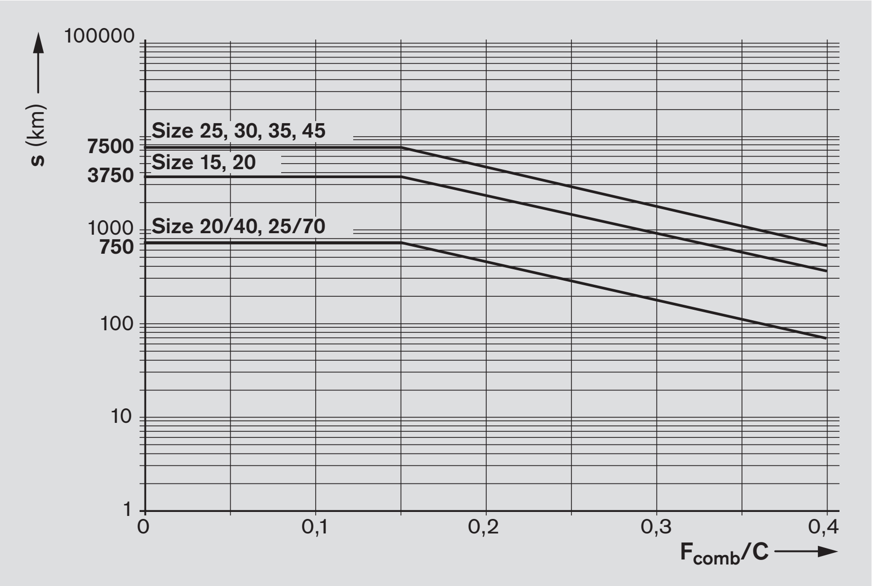
Please consult us regarding the relubrication intervals in the following cases:
- exposure to metalworking fluids
- use of double-lipped seals (DS)
- use of standard seals (SS) in combination with end seals or FKM seals or seal kits

⚠ **Refer to the Notes on Lubrication!** ☞ **244**



Graph 3

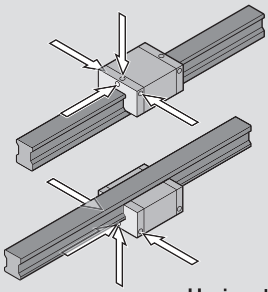
Part number		
R16.. ... 10	R16.. ... 11	R16.. ... 60



Graph 4

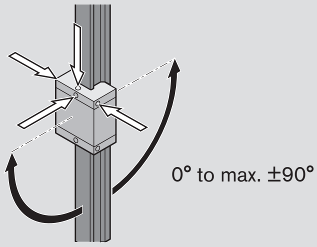
Part number				
R20.. ... 04	R16.. ... 20	R20.. ... 30	R16.. ... 70	R20.. ... 90
R20.. ... 05	R16.. ... 21	R20.. ... 31	R16.. ... 71	
R20.. ... 06	R16.. ... 22	R20.. ... 32	R16.. ... 72	
R20.. ... 07	R16.. ... 23	R20.. ... 33	R16.. ... 73	

Mounting orientation I – normal stroke
Horizontal
1 lube port at **either** of the two end caps



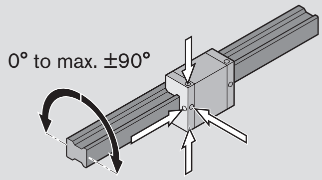
Horizontal, top-down
Same port

Mounting orientation II – normal stroke
Vertical to inclined horizontal
1 lube port at top end cap



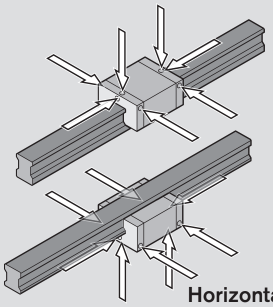
Vertical to inclined horizontal, top-down
Same port

Mounting orientation III – normal stroke
Wall mounting
1 lube port at **either** of the two end caps



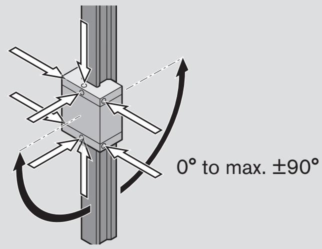
Same port

Mounting orientation IV – short stroke
Horizontal
2 lube ports, one on **each** of the two end caps



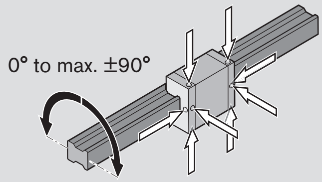
Horizontal, top-down
Same ports

Mounting orientation V – short stroke
Vertical to inclined horizontal
2 lube ports, one on **each** of the two end caps (top and bottom)



Vertical to inclined horizontal, top-down
Same ports

Mounting orientation VI – short stroke
Wall mounting
2 lube ports, one on **each** of the two end caps



Same ports

Smallest permissible piston distributor sizes for liquid grease lubrication through single-line centralized systems1)

Ball runner blocks					Smallest permissible piston distributor size (≙ minimum pulse quantity) per lube port (cm³) for liquid grease, NLGI class 00										
Part number				Mounting orientations	Size 15	20	25	30	35	45	55	65	20/40	25/70	35/90
R16.. ... 10				Horizontal I, IV	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
R16.. ... 11				Vertical II, V											
R16.. ... 60				Wall mount. III, VI											
R20.. ... 04	R16.. ... 20	R20.. ... 30	R16.. ... 70	Horizontal I, IV	0.03	0.03	0.03	0.06	010	0.10	-		0.03	0.03	-
R20.. ... 0Z	R16.. ... 2Z	R20.. ... 3Z	R16.. ... 7Z	Vertical II, V											
R20.. ... 05	R16.. ... 21	R20.. ... 31	R16.. ... 71	Wall mount. III, VI		0.06	0.06	0.10	0.20	0.20			0.06	0.06	
R20.. ... 06	R16.. ... 22	R20.. ... 32	R16.. ... 72												
R20.. ... 0Y	R16.. ... 2Y	R20.. ... 3Y	R16.. ... 7Y												
R20.. ... 07	R16.. ... 23	R20.. ... 33	R16.. ... 73												
		R20.. ... 90													

Table 9

1) The following conditions apply:
- Liquid grease Dynalub 520 (or alternatively Castrol Longtime PD 00) and piston distributors from Vogel
- Lube ducts must be filled
- Ambient temperature T = 20 - 30 °C

Lubrication and Maintenance

Lubrication

Oil lubrication via single-line piston distributor systems

Oil lubricant
We recommend using **Shell Tonna S 220** with the following properties:
- Special demulsifying oil CLP or CGLP as per DIN 51517-3 for machine bed tracks and tool guides
- A blend of highly refined mineral oils and additives
- Can be used even when mixed with significant quantities of metalworking fluids

⚠ **Refer to the Notes on Lubrication!** **☞ 244**

⚠ **Ball runner blocks must never be put into operation without initial lubrication.**

If they are pre-lubricated before shipment, no initial lubrication by the user is required.

Rexroth Ball Rail Systems are coated with anti-corrosion oil prior to shipment.

Initial lubrication of the runner blocks (basic lubrication)

Stroke ≥ 2 · runner block length B_1 (normal stroke)
- Install and lubricate one lube fitting per runner block, at **either** of the two end caps!

Initial lubrication is applied in two partial quantities as specified in Table 10:
1. Apply the first of the oil quantities as specified in Table 10 to the runner block.
2. Slide runner block back and forth over 3 · runner block length B_1 for three full cycles.
3. Repeat steps 1. and 2. two more times.
4. Make sure there is a visible film of lubricant on the guide rail.

Size	Initial lubrication (normal stroke)				
	Part number (not pre-lubricated)		Part number (pre-lubricated)		
	R16.. ... 10 R16.. ... 11 R16.. ... 60	R20.. ... 04/0Z R20.. ... 05 R20.. ... 06/0Y R20.. ... 07	R16.. ... 20/2Z R16.. ... 21 R16.. ... 22/2Y R16.. ... 23	R20.. ... 30/3Z R20.. ... 31 R20.. ... 32/3Y R20.. ... 33 R20.. ... 90	R16.. ... 70/7Z R16.. ... 71 R16.. ... 72/7Y R16.. ... 73
	Partial quantity (cm^3)				
15	0.4 (2x)		Pre-lubricated with Dynalub 510 before shipment		
20	0.7 (2x)				
25	1.0 (2x)				
30	1.1 (2x)				
35	1.2 (2x)				
45	2.2 (2x)				
55	3.6 (2x)		–		
65	6.0 (2x)				
20/40	0.7 (2x)		Pre-lubricated with Dynalub 510 before shipment		
25/70	1.1 (2x)				
35/90	1.8 (2x)		–		

Table 10

Stroke < 2 · runner block length B_1 (short stroke)
- Install and lubricate two lube fittings per runner block, one on **each** of the two end caps!

Initial lubrication is applied to each fitting in two partial quantities as specified in Table 11:
1. Apply the first of the oil quantities as specified in Table 11 to each fitting of the runner block.
2. Slide runner block back and forth over 3 · runner block length B_1 for three full cycles.
3. Repeat steps 1. and 2. two more times.
4. Make sure there is a visible film of lubricant on the guide rail.

Size	Initial lubrication (short stroke)				
	Part number (not pre-lubricated)		Part number (pre-lubricated)		
	R16.. ... 10 R16.. ... 11 R16.. ... 60	R20.. ... 04/0Z R20.. ... 05 R20.. ... 06/0Y R20.. ... 07	R16.. ... 20/2Z R16.. ... 21 R16.. ... 22/2Y R16.. ... 23	R20.. ... 30/3Z R20.. ... 31 R20.. ... 32/3Y R20.. ... 33 R20.. ... 90	R16.. ... 70/7Z R16.. ... 71 R16.. ... 72/7Y R16.. ... 73
	Partial quantity per port (cm^3)				
	left	**right**			
15	0.4 (2x)	0.4 (2x)	Pre-lubricated with Dynalub 510 before shipment		
20	0.7 (2x)	0.7 (2x)			
25	1.0 (2x)	1.0 (2x)			
30	1.1 (2x)	1.1 (2x)			
35	1.2 (2x)	1.2 (2x)			
45	2.2 (2x)	2.2 (2x)			
55	3.6 (2x)	3.6 (2x)	–		
65	6.0 (2x)	6.0 (2x)			
20/40	0.7 (2x)	0.7 (2x)	Pre-lubricated with Dynalub 510 before shipment		
25/70	1.1 (2x)	1.1 (2x)			
35/90	1.8 (2x)	1.8 (2x)	–		

Table 11

Relubrication of runner blocks

Stroke ≥ 2 · runner block length B_1 (normal stroke)

- When the relubrication interval according to Graph 5 or 6 ☞ 254 has been reached, add the relubrication quantity according to Table 12.

Note

The required pulse count is the quotient (as a whole number) of the minimum relubrication quantity according to Table 12 and the smallest permissible piston distributor size (i.e. the minimum pulse quantity) according to Table 14 ☞ 255.
The smallest permissible piston distributor size also depends on the mounting orientation.
The lubricant cycle time can then be obtained by dividing the relubrication interval ☞ 254 by the calculated pulse count (see design example ☞ 256).

⚠ **Refer to the Notes on Lubrication! ☞ 244**

Size	Relubrication (normal stroke)				
	Part number		Part number		
	R16.. ... 10 R16.. ... 11 R16.. ... 60	R20.. ... 04/0Z R20.. ... 05 R20.. ... 06/0Y R20.. ... 07	R16.. ... 20/2Z R16.. ... 21 R16.. ... 22/2Y R16.. ... 23	R20.. ... 30/3Z R20.. ... 31 R20.. ... 32/3Y R20.. ... 33 R20.. ... 90	R16.. ... 70/7Z R16.. ... 71 R16.. ... 72/7Y R16.. ... 73
	Partial quantity (cm^3)		**Partial quantity** (cm^3)		
15	0.4 (1x)		0.4 (1x)		
20	0.7 (1x)		0.7 (1x)		
25	1.0 (1x)		1.0 (1x)		
30	1.1 (1x)		1.1 (1x)		
35	1.2 (1x)		1.2 (1x)		
45	2.2 (1x)		2.2 (1x)		
55	3.6 (1x)		–		
65	6.0 (1x)		–		
20/40	0.7 (1x)		0.7 (1x)		
25/70	1.1 (1x)		1.1 (1x)		
35/90	1.8 (1x)		–		

Table 12

Stroke < 2 · runner block length B_1 (short stroke)

- When the relubrication interval according to Graph 5 or 6 ☞ 254 has been reached, add the relubrication quantity **per** lube port according to Table 13.
  - Calculate the required pulse count and lubricant cycle time in the same way as for relubrication (normal stroke).
- At each lubrication cycle the runner block should be traversed back and forth through a lubricating stroke of 3 · runner block length B_1. In any case, the lubricating stroke must never be shorter than the runner block length B_1.

⚠ **Refer to the Notes on Lubrication! ☞ 244**

Size	Relubrication (short stroke)				
	Part number		Part number		
	R16.. ... 10 R16.. ... 11 R16.. ... 60	R20.. ... 04/0Z R20.. ... 05 R20.. ... 06/0Y R20.. ... 07	R16.. ... 20/2Z R16.. ... 21 R16.. ... 22/2Y R16.. ... 23	R20.. ... 30/3Z R20.. ... 31 R20.. ... 32/3Y R20.. ... 33 R20.. ... 90	R16.. ... 70/7Z R16.. ... 71 R16.. ... 72/7Y R16.. ... 73
	Partial quantity per port (cm^3)		**Partial quantity per port** (cm^3)		
	left	**right**	**left**	**right**	
15	0.4 (1x)	0.4 (1x)	0.4 (1x)	0.4 (1x)	
20	0.7 (1x)	0.7 (1x)	0.7 (1x)	0.7 (1x)	
25	1.0 (1x)	1.0 (1x)	1.0 (1x)	1.0 (1x)	
30	1.1 (1x)	1.1 (1x)	1.1 (1x)	1.1 (1x)	
35	1.2 (1x)	1.2 (1x)	1.2 (1x)	1.2 (1x)	
45	2.2 (1x)	2.2 (1x)	2.2 (1x)	2.2 (1x)	
55	3.6 (1x)	3.6 (1x)	–		
65	6.0 (1x)	6.0 (1x)	–		
20/40	0.7 (1x)	0.7 (1x)	0.7 (1x)	0.7 (1x)	
25/70	1.1 (1x)	1.1 (1x)	1.1 (1x)	1.1 (1x)	
35/90	1.8 (1x)	1.8 (1x)	–		

Table 13

Lubrication and Maintenance

Lubrication

Oil lubrication via single-line piston distributor systems (continued)

Load-dependent relubrication intervals for oil lubrication via single-line piston distributor systems ("dry axes")

The following conditions apply:
- Lube oil Shell Tonna S 220
- No exposure to metalworking fluids
- Standard seals
- Ambient temperature:
  T = 20 – 30 °C

Key to graphs

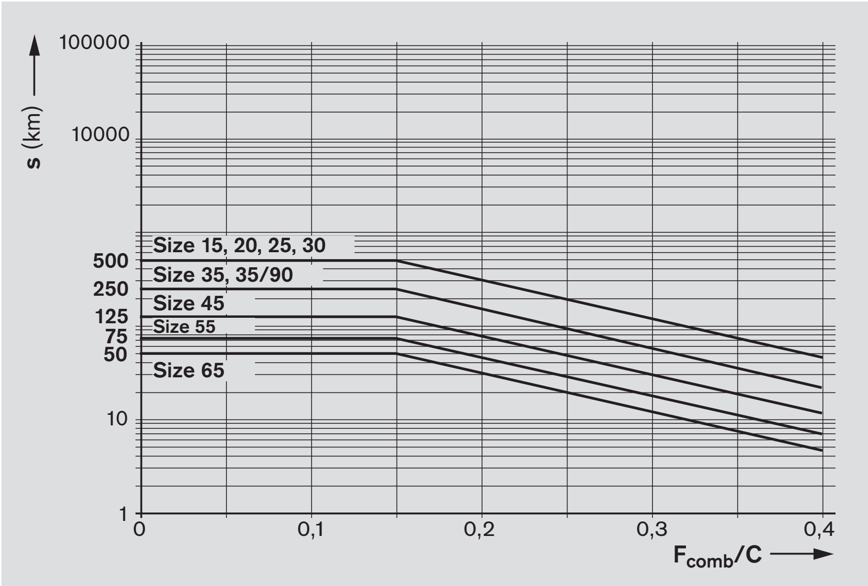
C	=	dynamic load capacity	(N)
F_{comb}	=	combined equivalent dynamic load on bearing	(N)
F_{comb}/C	=	load ratio	(–)
s	=	relubrication interval expressed as travel	(km)

Definition of F_{comb}/C

The load ratio F_{comb}/C is the quotient of the equivalent dynamic load on the bearing at the combined load on the bearing F_{comb} (taking account of the internal preload force F_{pr}) divided by the dynamic load capacity C ☞ 8 – 9.

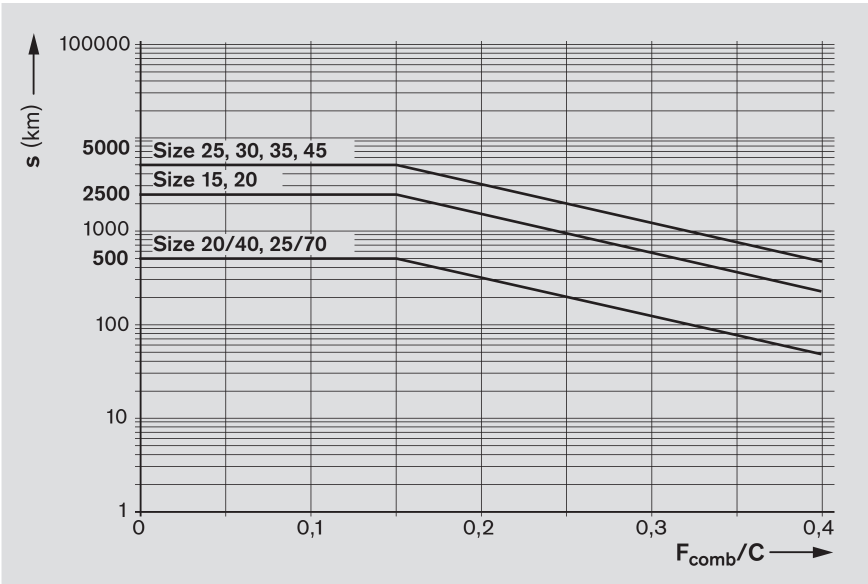
Please consult us regarding the relubrication intervals in the following cases:
- exposure to metalworking fluids
- use of double-lipped seals (DS)
- use of standard seals (SS) in combination with end seals or FKM seals or seal kits

⚠ **Refer to the Notes on Lubrication!** **☞ 244**



Graph 5

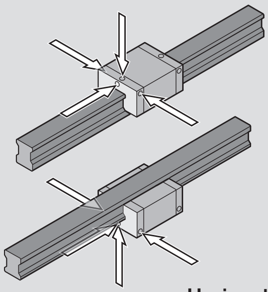
Part number		
R16.. ... 10	R16.. ... 11	R16.. ... 60



Graph 6

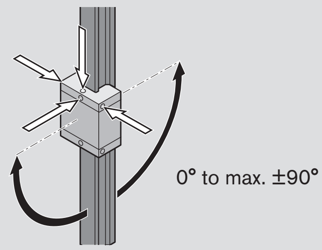
Part number				
R20.. ... 04	R16.. ... 20	R20.. ... 30	R16.. ... 70	R20.. ... 90
R20.. ... 05	R16.. ... 21	R20.. ... 31	R16.. ... 71	
R20.. ... 06	R16.. ... 22	R20.. ... 32	R16.. ... 72	
R20.. ... 07	R16.. ... 23	R20.. ... 33	R16.. ... 73	

Mounting orientation I – normal stroke
Horizontal
1 lube port at **either** of the two end caps



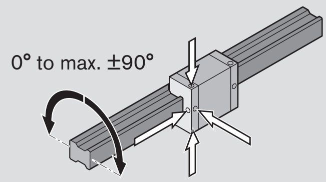
Horizontal, top-down
Same port

Mounting orientation II – normal stroke
Vertical to inclined horizontal
1 lube port at top end cap



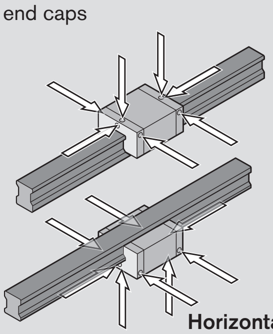
Vertical to inclined horizontal, top-down
Same port

Mounting orientation III – normal stroke
Wall mounting
1 lube port at **either** of the two end caps



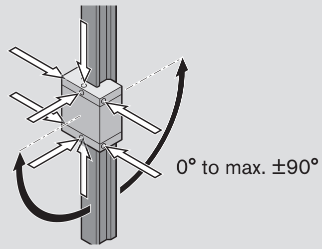
Same port

Mounting orientation IV – short stroke
Horizontal
2 lube ports, one on **each** of the two end caps



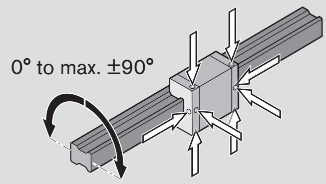
Horizontal, top-down
Same ports

Mounting orientation V – short stroke
Vertical to inclined horizontal
2 lube ports, one on **each** of the two end caps (top and bottom)



Vertical to inclined horizontal, top-down
Same ports

Mounting orientation VI – short stroke
Wall mounting
2 lube ports, one on **each** of the two end caps



Same ports

Smallest permissible piston distributor sizes for oil lubrication via single-line centralized systems[1)]

Ball runner blocks					Smallest permissible piston distributor size (≙ minimum pulse quantity) per lube port (cm³) at oil viscosity 220 m²/s										
Part number				Mounting orientations	Size 15	20	25	30	35	45	55	65	20/40	25/70	35/90
R16.. ... 10				Horizontal I, IV											
R16.. ... 11				Vertical II, V	0.60	0.60	0.60	0.60	0.60	0.60	1.50	1.50	0.30	0.30	0.60
R16.. ... 60				Wall mount. III, VI											
R20.. ... 04	R16.. ... 20	R20.. ... 30	R16.. ... 70	Horizontal I, IV		0.03	0.03	0.06	0.10	0.10			0.03	0.03	
R20.. ... 0Z	R16.. ... 2Z	R20.. ... 3Z	R16.. ... 7Z	Vertical II, V	0.03						-				-
R20.. ... 05	R16.. ... 21	R20.. ... 31	R16.. ... 71	Wall mount. III, VI		0.06	0.06	0.10	0.16	0.16			0.06	0.06	
R20.. ... 06	R16.. ... 22	R20.. ... 32	R16.. ... 72												
R20.. ... 0Y	R16.. ... 2Y	R20.. ... 3Y	R16.. ... 7Y												
R20.. ... 07	R16.. ... 23	R20.. ... 33	R16.. ... 73												
		R20.. ... 90													

Table 14

1) The following conditions apply:
- Lube oil Shell Tonna S 220 using piston distributors from Vogel
- Lube ducts must be filled
- Ambient temperature T = 20 - 30 °C

Lubrication

Design example for lubrication of a typical 2-axis application with centralized lubrication

X-axis

Component or parameter	Given data
Ball runner block	Size 35; 4 blocks; C = 41,900 N; part numbers: R1651 323 20 (☞🗎 36)
Ball guide rail	Size 35; 2 rails; L = 1,500 mm; part numbers: R1605 333 61 (☞🗎 122)
Combined equivalent dynamic load on bearing	F_{comb} = 12,570 N (per runner block) taking into account the preload (in this case C2 = 8% C)
Stroke	500 mm
Average linear speed	v_m = 1 m/s
Temperature	20 - 30 °C
Mounting orientation	Horizontal
Lubrication	Single-line centralized lubrication system for all axes with liquid grease Dynalub 520
Exposure to contaminants	No exposure to fluids, chips, dust

Design variables	Design input (per runner block)	Information sources
1. Normal or short-stroke?	Normal stroke: Stroke ≥ 2 · runner block length B_1 500 mm ≥ 2 · 77 mm 500 mm ≥ 154 mm i.e. normal stroke	– Normal stroke formula ☞🗎 248, runner block length B_1 ☞🗎 37
2. Initial lubrication quantity	1 lube port, initial lubrication quantity: pre-lubricated with Dynalub 510 before shipment	– Initial lubrication quantity from Table 5 ☞🗎 248
3. Relubrication quantity	1 lube port, relubrication quantity: 2.2 cm³ (2x)	– Relubrication quantity from Table 7 ☞🗎 249
4. Mounting orientation	Mounting orientation 1 – normal stroke (horizontal)	– Mounting orientation from overview ☞🗎 251
5. Piston distributor size	Permissible piston distributor size: 0.1 cm³	– Piston distributor size from Table 9 ☞🗎 251, for size 35, mounting orientation I (horizontal)
6. Pulse count	$\text{Pulse count} = \frac{2 \cdot 2.2\ \text{cm}^3}{0.1\ \text{cm}^3} = 44$	– $\text{Pulse count} = \frac{\text{number} \cdot \text{relubrication quantity}}{\text{perm. piston distributor size}}$
7. Load ratio	$\text{Load ratio} = \frac{12{,}570\ \text{N}}{41{,}900\ \text{N}} = 0.3$	– Load ratio = F_{comb}/C F_{comb} and C from given data
8. Relubrication interval	Relubrication interval: 1,800 km	– Relubrication interval from Graph 4 ☞🗎 250: Curve size 35 at load ratio 0.3
9. Lubrication cycle	$\text{Lubrication cycle} = \frac{1{,}800\ \text{km}}{44} = 41\ \text{km}$	– $\text{Lube cycle} = \frac{\text{relubrication interval}}{\text{pulse count}}$

Interim result (X-axis)

For the X-axis, a minimum quantity of 0.1 cm³ Dynalub 520 must be supplied to each runner block every 41 km.

Y-axis

Component or parameter	Given data
Ball runner block	Size 25; 4 blocks; C = 22,800 N; part numbers: R1651 223 20 (☞ 36)
Ball guide rail	Size 25; 2 rails; L = 1,000 mm; part numbers: R1605 232 31 (☞ 122)
Combined equivalent dynamic load on bearing	F_{comb} = 3,420 N (per runner block) taking into account the preload (in this case C2 = 8% C)
Stroke	50 mm (short stroke)
Average linear speed	v_m = 1 m/s
Temperature	20 - 30 °C
Mounting orientation	Vertical
Lubrication	Single-line centralized lubrication system for all axes with liquid grease Dynalub 520
Exposure to contaminants	No exposure to fluids, chips, dust

Design variables	Design input (per runner block)	Information sources
1. Normal or short-stroke?	Normal stroke: Stroke ≥ 2 · runner block length B_1 50 mm ≥ 2 · 57.8 mm 50 mm < 115.6 mm i.e. short stroke	– Normal stroke formula ☞ 248, runner block length B_1 ☞ 37
2. Initial lubrication quantity	2 lube ports, initial lubrication quantity per lube port: pre-lubricated with Dynalub 510 before shipment	– Initial lubrication quantity from Table 6 ☞ 248
3. Relubrication quantity	2 lube ports, relubrication quantity per port: 1.4 cm³ (2x)	– Relubrication quantity from Table 8 ☞ 249
4. Mounting orientation	Mounting orientation V – short stroke (vertical to inclined horizontal)	Mounting orientation from overview ☞ 251
5. Piston distributor size	Permissible piston distributor size: 0.03 cm³	– Piston distributor size from Table 9 ☞ 249, for size 25, mounting orientation V (vertical to inclined horizontal)
6. Pulse count	$\text{Pulse count} = \frac{2 \cdot 1.4\ \text{cm}^3}{0.03\ \text{cm}^3} = 94$	– $\text{Pulse count} = \frac{\text{number} \cdot \text{relubrication quantity}}{\text{perm. piston distributor size}}$
7. Load ratio	$\text{Load ratio} = \frac{3{,}420\ \text{N}}{22{,}800\ \text{N}} = 0.15$	– Load ratio = F_{comb}/C F_{comb} and C from given data
8. Relubrication interval	Relubrication interval: 7,500 km	– Relubrication interval from Graph 4 ☞ 250: Curve size 25 at load ratio 0.15
9. Lubrication cycle	$\text{Lubrication cycle} = \frac{7{,}500\ \text{km}}{94} = 80\ \text{km}$	– $\text{Lube cycle} = \frac{\text{relubrication interval}}{\text{pulse count}}$
Interim result (Y-axis)	For the Y-axis, a minimum quantity of 0.03 cm³ Dynalub 520 must be supplied per runner block and per port every 80 km.	
End result (two-axis lubrication)	Since both the axes in this example are supplied by a single-line centralized lubrication system, the X-axis with its smaller lube cycle (41 km) determines the overall cycle of the system, i.e. the Y-axis will also be lubricated every 41 km.	**The number of ports and the minimum lubricant quantities determined for each axis remain the same.**

Lubrication and Maintenance

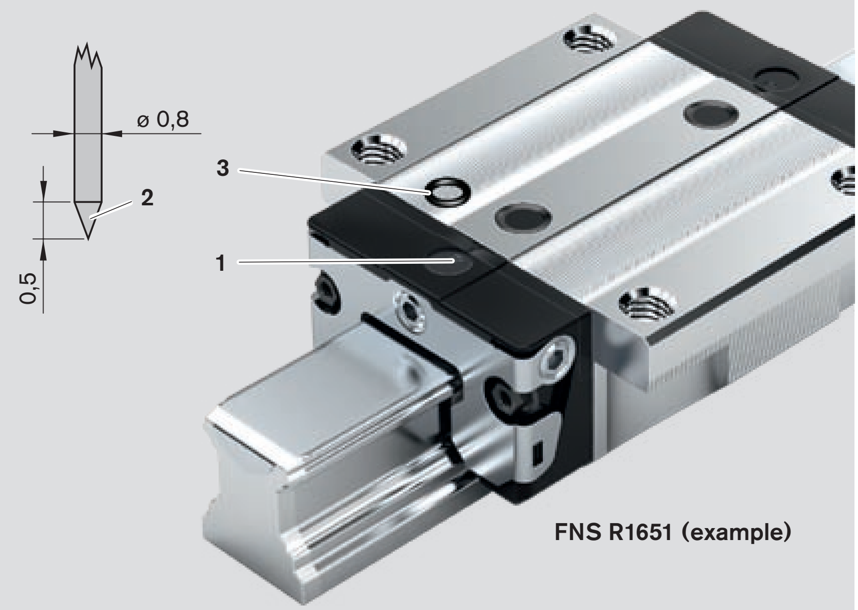
Lubrication

Lubrication from above

Lubrication from above without lube adapter
For all ball runner blocks prepared for lubrication from above.
(Exceptions: Ball runner blocks, high, SNH R1621 and SLH R1624)

⚠ **In the O-ring recess there is a further pre-formed small recess (1). Do not use a drill to open this. Risk of contamination!**

1. Heat up a pointed metal punch (2) with diameter of 0.8 mm.
2. Carefully punch through the recess (1) to open the lube hole. Do not exceed the permissible depth T_{max} as specified in the table!
3. Insert O-ring (3) in the recess (O-ring is **not** supplied with the runner block. Accessories for Ball Runner Blocks ☞🗎 171).

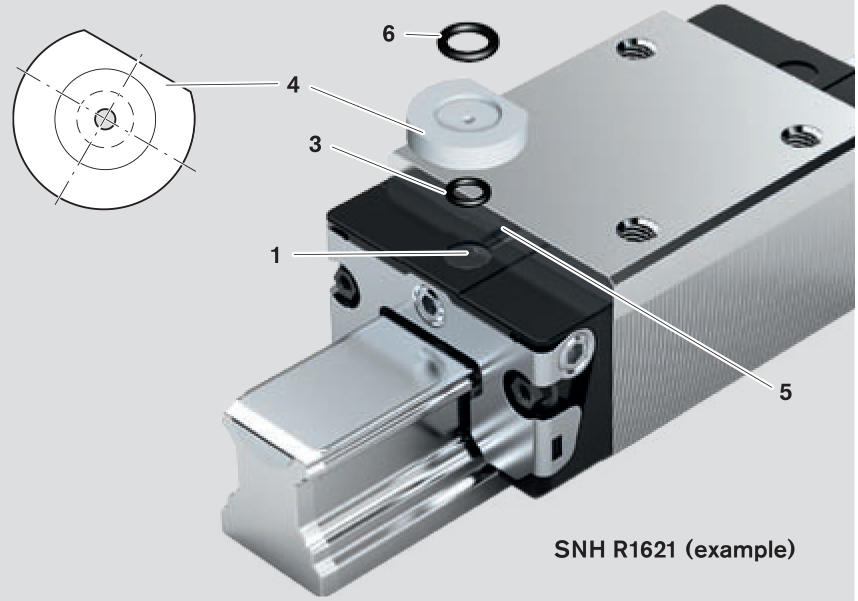


FNS R1651 (example)

Lubrication from above with lube adapter
(Accessories for Ball Runner Blocks ☞🗎 159)
A lube adapter is needed for high runner blocks, if lubrication is to be performed through the carriage.

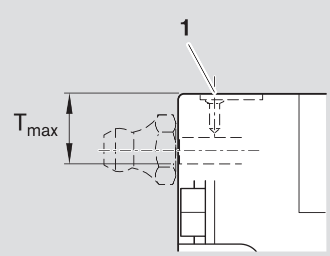
⚠ **In the O-ring recess there is a further pre-formed small recess (1). Do not use a drill to open this. Risk of contamination!**

1. Heat up a pointed metal punch (2) with diameter of 0.8 mm.
2. Carefully punch through the recess (1) to open the lube hole. Do not exceed the permissible depth T_{max} as specified in the table!
3. Insert O-ring (3) in the recess (O-ring is supplied with the lube adapter).
4. Insert the lube adapter at a slant into the recess and press the straight side (4) against the steel part (5). Use grease to fix the adapter in place.
5. Place O-ring (6) in the lube adapter (O-ring is supplied with the lube adapter).



SNH R1621 (example)

Size	Lube hole at top: Maximum permissible depth for punching open T_{max} (mm)	
	Ball runner block standard height/ high	Ball runner block low profile
15	3.6	–
20	3.9	4.4
25	3.3	4.9
30	6.6	–
35	7.5	–
45	8.8	–
20/40	4.0	–
25/70	2.1	–
35/90	7.9	–

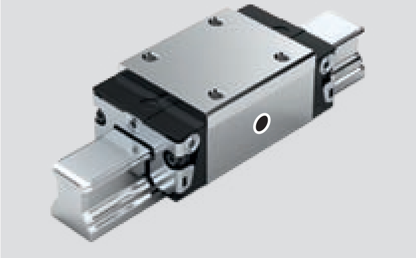


Special lube ports

On request, special lube ports can be provided in the ball runner block body for lubrication from above (A) or from the side (B).

A

B



Recommended grease lubricants

Manufacturer	Name	Specification NLGI grade	Part number 400 g cartridge
Bosch Rexroth	Dynalub 510	2	R3416 037 00
	Dynalub 520	00	R3416 043 00

Maintenance

Cleaning cycle

Dirt can settle and encrust on guide rails, especially when these are not enclosed.

To ensure that seals and cover strips retain their functionality, this dirt must be removed at regular intervals.

It is advisable to perform at least one full cleaning cycle over the entire installed rail length at least twice a day, but at the latest every 8 hours.

Before shutting down the machine, always perform a cleaning cycle.

Shorten the maintenance intervals for systems exposed to metalworking fluids.

Checking accessories

All accessories used for scraping or wiping the guide rails must be checked at regular intervals.

In environments with heavy contamination, it is advisable to replace all the parts directly exposed to such contamination.

We recommend checking the accessories at least once a year.