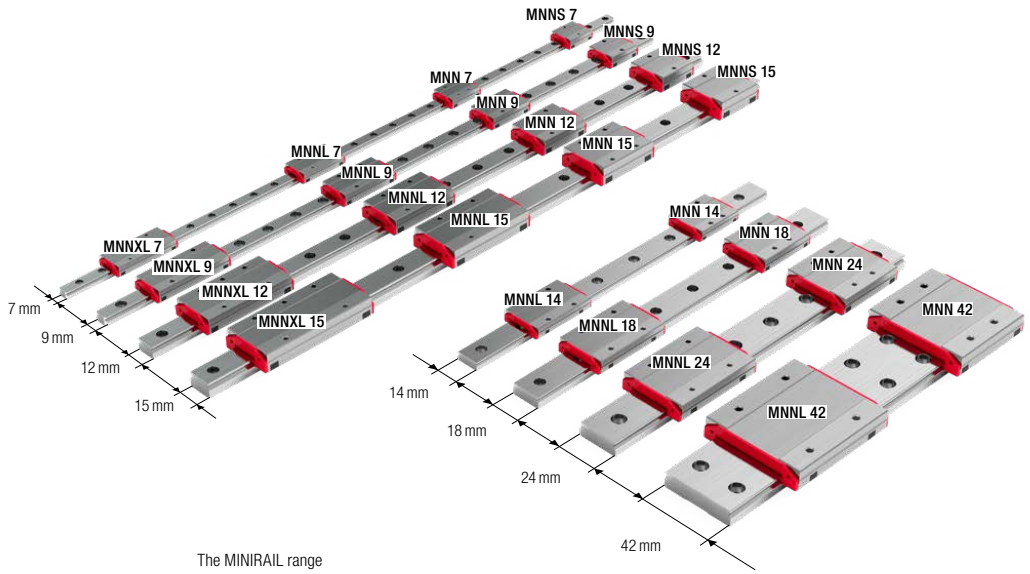
SCHNEEBERGER LINEAR TECHNOLOGY

7 MINIRAIL Product Overview

MINIRAIL are highly accurate miniature profiled linear guideways with ball bearings. Their precision, robustness, innovative design and strength are second to none.

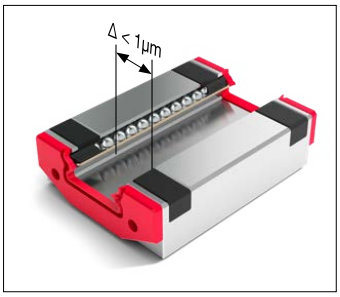
The range includes the standard rail widths of 7, 9, 12 and 15 as well as wider widths of 14, 18, 24 and 42. The carriages are available in four lengths: MNNS (short), MNN (standard), MNNL (long) and MNNXL (extra long).



The MINIRAIL range

7 MINIRAIL Product Overview

7.1 Product Characteristics

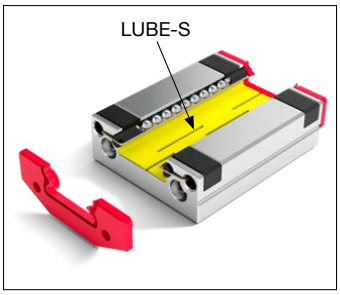


Carriage uniformity system

7.1.1 Carriage Interchangeability

Because the carriages are made to precisely the same size, they can be switched for other carriages at will (carriage uniformity system). This simplifies storage and maintenance considerably.

Note:
The MINISCALE PLUS carriages and guideways are always matched to each other and are therefore delivered as a set (carriage mounted on rails) - (see chapter 18.1).



LUBE-S long-term lubrication

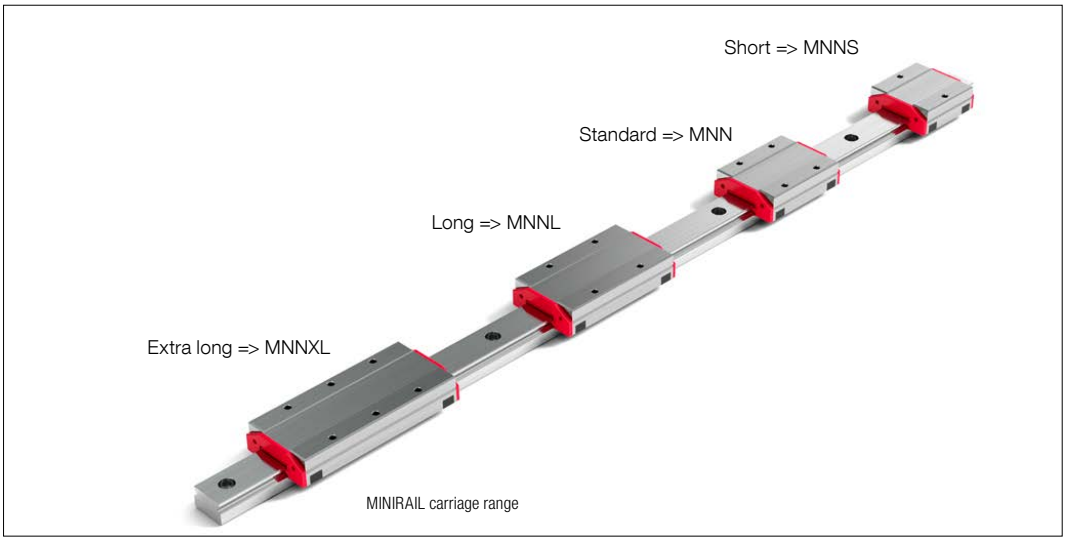
7.1.2 LUBE-S Long-term Lubrication from SCHNEEBERGER

The SCHNEEBERGER solution for long-term lubrication LUBE-S is described in detail in chapter 8.1. LUBE-S enables maintenance-free operation for up to 20,000 km, requires no extra space and is good for the environment and short stroke applications.

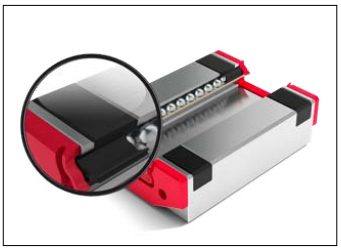
Note:
Guarantee only with lubricants tested and approved by SCHNEEBERGER.

7.1.3 The Carriage Range

The different carriage lengths from short to extra long, along with the corresponding load capacities, allow greater flexibility when designing axes of motion.



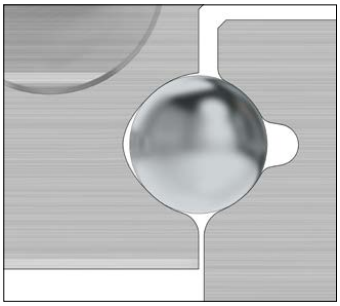
MINIRAIL carriage range



Enlargement of ball recirculation in the carriages

7.1.4 Speed and Acceleration

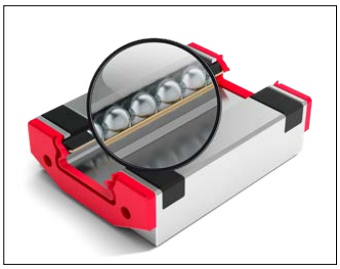
The innovative embedding of ball recirculation in the carriage allows speeds of up to 5 m/s and accelerations of up to 300 m/s^2.



Gothic arc profile of the guideway tracks

7.1.5 High Load Capacities

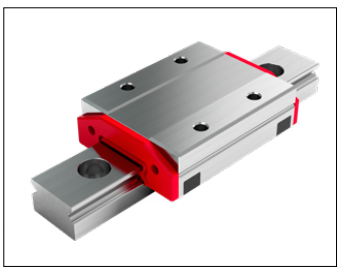
The Gothic arc profile of the guideway tracks allows high load capacities.



Retaining wire holding the balls in place

7.1.6 Simple Installation and Maintenance

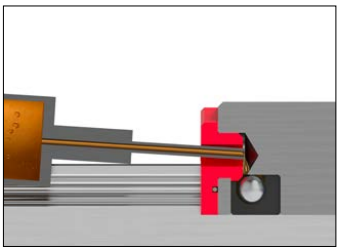
Whether a carriage is moving along the guideways or being prepared for installation, the ball bearings are always held in place by a retaining wire. This makes for easier handling and is a prerequisite for simple installation and replacement carriages.



Made of corrosion-resistant, through-hardened steel

7.1.7 Exceptional Robustness

Carriages and guideways are made of through-hardened stainless steel. They are therefore superbly suited for use in the most demanding of applications.



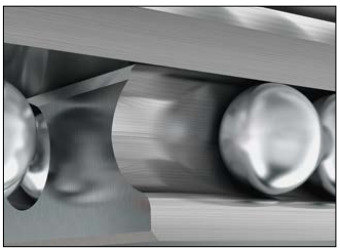
MINIRAIL lubrication with oil

7.1.8 Sophisticated Lubrication Concept

MINIRAIL are delivered unlubricated as standard, allowing you to decide on the optimal lubrication for the respective application (see chapter 7.2.12 «Lubricating MINIRAIL»).

Each wiper on the carriages features two lubrication holes so that the left and right ball recirculation pathways can be lubricated with oil separately. This ensures that the tracks of the carriage can be supplied with lubricant independent of their installation orientation.

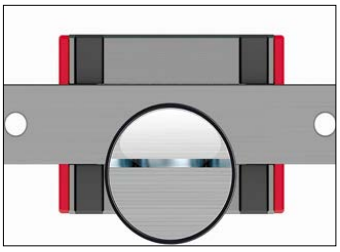
Also consider the long-term lubrication option LUBE-S in chapter 8.1.



Polished run-ins

7.1.9 Excellent Running Properties

The ball recirculation, transitions and run-ins on the carriages are designed for consistent redirection of the ball bearings. They ensure optimal containment of the enormous centrifugal forces involved with minimal friction.

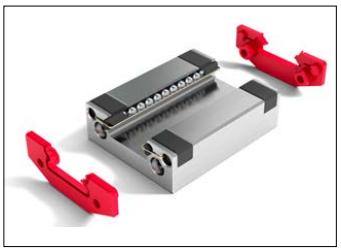


Small clearances between carriages and guideways

7.1.10 Maximum Protection from Contamination

The ultra-precise manufacturing of the carriages and guideways ensures minimal clearance between them. This prevents the migration of dirt particles into carriages.

7 MINIRAIL Product Overview



Detachable wipers

The carriages are fitted with profiled wipers as standard. They are snap-fitted into place and can therefore be easily replaced. Alternative variants (for example low-friction or clearance wipers) are described in chapter 9.2.

Plastic plugs for sealing

In order to prevent the accumulation of dirt, the attachment holes in the guideways can be sealed with plastic plugs (see chapter 9.1).

7 MINIRAIL Product Overview

7.2 Technical Information and Alternative Variants

7.2.1 MINIRAIL Performance Parameters

Max. acceleration	300 m/s²
Max. speed	5 m/s
Preload classes	V0 slightly play up to 0.01 C (C = dynamic load capacity)
	V1 Preload 0 to 0.03 C (C = dynamic load capacity)
Accuracy classes	G1 and G3
Materials	
- guideways, carriages, ball bearings	Stainless steel, through-hardened
- wiper [2]	TPC
- ball recirculation	POM
Areas of application	
- temperature range [1]	-40 °C to +80 °C (-40 °F to +176 °F)
- vacuum [2]	vacuum (max. 10^{-7} mbar)
- humidity	10 % – 70 % (non-condensing)
- cleanroom	Cleanroom class ISO 7 or ISO 6 (in accordance with ISO 14644-1)

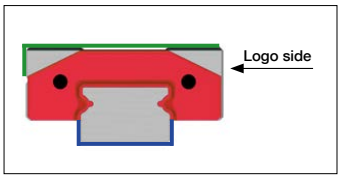
[1] Depending on the load, temperatures of up to +150 °C (+302 °F) are possible with modified ball recirculation made of PEEK (on request). The standard lubricant covers a temperature range from -20 °C to +100 °C. SCHNEEBERGER also accepts requests for lubricants for other temperatures.

[2] For use in high vacuum, the wipers on the carriages must be removed. MINIRAIL with modified ball recirculation made of PEEK can also be operated in a vacuum (up to 10^{-9} mbar) on request. Use in a vacuum requires a special lubricant available from SCHNEEBERGER. So that no air remains trapped in the blind holes, the fastening screws must be vented.

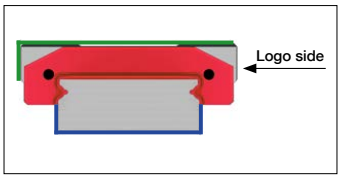
7.2.2 Reference and Supporting Surfaces

The reference and supporting surfaces of carriages and guideways are designated as follows.

Standard sizes 7, 9, 12 and 15



Wider widths 14, 18, 24 and 42



Carriage reference and supporting surfaces
Guideway reference and supporting surfaces

The polished reference side of the carriage is opposite the carriage side with the company logo / type designation.
Either side of the guideway can be used as a reference side.

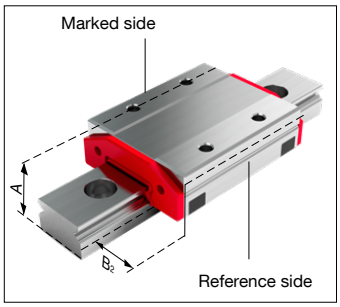
7.2.3 Accuracy Classes

MINIRAIL carriages and guide rails are made to a high precision independently of each other. The carriages are interchangeable. This means that any carriage of the same size and accuracy class can be used on the guide rails without influencing the preload class.

MINISCALE PLUS carriages and guide rails are also made to a high precision. Due to the integrated linear encoder, the carriage and guideway are matched together and therefore can only be changed as a set.

Both G1 and G3 accuracy classes offer a precise MINIRAIL range suited to the application-specific needs of the customer. The accuracy classes determine the size tolerances and the running accuracy of the carriages on the guideways:
High accuracy G1
Standard accuracy G3

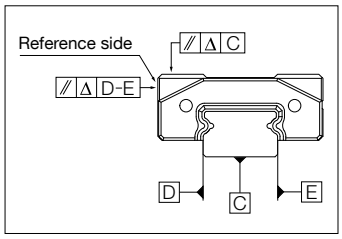
Note:
MINIRAIL are available in accuracy classes G1 and G3
MINISCALE PLUS are always delivered in accuracy class G1.

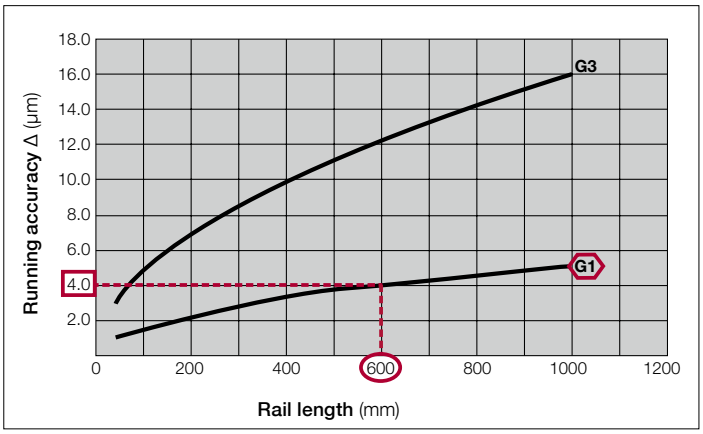


	Tolerances	
	A and B_2	ΔA and ΔB_2
Accuracy class G1	+/- 10 µm	7 µm
Accuracy class G3	+/- 20 µm	15 µm
	Measured relative to carriage centre	Difference in measurement between several carriages on the same position on the rails
	For the measurements mentioned above, the guideway is mounted on a flat surface. Measurement is taken from the middle of the carriage. Since the measurement is stable, it is based on the midpoint of the two supporting surfaces	

7.2.4 Running Accuracy

In terms of tolerances, the running of the carriage on a guideway can take on either a linear or wave-like shape. The maximum permissible deviation is limited by the accuracy class of the guideway. As shown on the following diagram, the tolerance is determined by the rail length and by accuracy class G1 or G3.





Example according to the diagram:
A rail length of 600 mm and accuracy class G1 results in a maximum permissible deviation of 4.0 µm

The parallelism deviations result from the manufacturing tolerances of the guide rails. The upper diagram shows the maximum parallelism deviation Δ (µm) in operation, depending on the guide rail length. A prerequisite for validity is an ideal installation of the respective guideway.

7.2.5 Preload Classes

The preload classes are defined as a fraction of the dynamic load capacity C (see chapter 17). The amount of preload is generally based on the intended use of the guideways.

An increased preload …
… increases the rigidity
… increases the displacement resistance
… reduces the service life

Preload class	Preload	corresponding accuracy class
V0	slightly play up to 0.01 • C	G3
V1	0 to 0.03 • C	G1 or G3

7.2.6 Push Force

The push force of the carriage is influenced by the preload class, the lubricant and the wipers used.

The carriages can be delivered with a defined push force on request (see chapter 8.3).

7.2.7 Friction and Smoothness

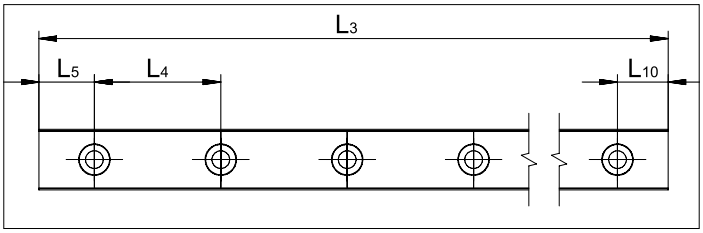
SCHNEEBERGER places high emphasis on running smoothness during the manufacturing process. Transitions, run-ins and run-outs and the quality of the plastics are given top priority. This also applies in respect of the rolling elements used, which must satisfy the most stringent quality demands. Under normal operating conditions, a coefficient of friction of 0.005 can be expected (without wipers).

7.2.8 Carriage Uniformity System

The MINIRAIL carriages are interchangeable within preload and accuracy classes. With this in mind, guideways and carriages are packaged separately (see chapter 18.1). This simplifies interchangeability and storage.

7.2.9 Rail Length and Hole Spacings

Sizes	L_4	L_5 and L_{10}	Rail lengths L_3 ...	... max.
7	15	5	40, 55, 70, 85 ...	...1005
9	20	7.5	55, 75, 95, 115 ...	...1000
12	25	10	70, 95, 120, 145 ...	...1000
15	40	15	70, 110, 150, 190 ...	... 995
14	30	10	80, 110, 140, 170 ...	... 985
18	30	10	80, 110, 140, 170 ...	... 985
24	40	15	110, 150, 190, 230 ...	... 995
42	40	15	110, 150, 190, 230 ...	... 990



L_3	= standard rail lengths in mm
L_4, L_5, L_{10}	= standard hole spacings in mm

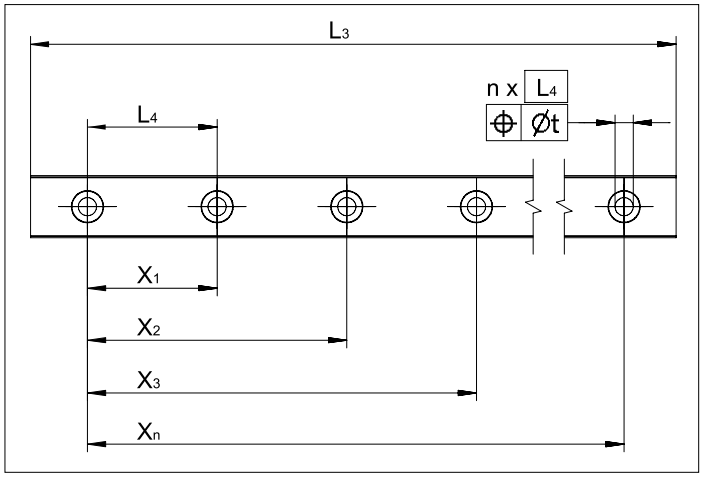
Calculating rail lengths that do not correspond to the standard

Individual rail lengths can be calculated with the following formula (up to a maximum rail length according to the above table):

$L_3 = (n-1) \bullet L_4 + L_5 + L_{10}$

L_3	= rail length in mm
L_4, L_5, L_{10}	= individual hole spacing in mm
L_4	= standard hole spacings in mm
n	= number of attachment holes

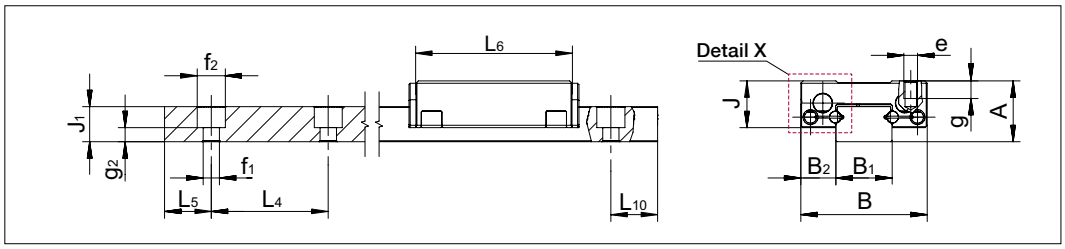
Position tolerance of the attachment holes and tolerances of the rail length



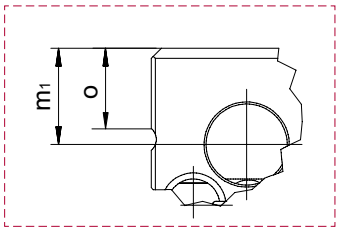
L_3 = rail length in mm
L_4 = hole spacing in mm
n = number of attachment holes
t = position tolerance in mm

	$L_3 \leq 300$ mm	$L_3 > 300$ mm
Position tolerance t of the attachment hole	0.3	0.001 • Xn
Tolerance of the rail length L_3	±0.3	±0.001 • L_3

7.2.10 Dimension Tables, Load Capacities and Moment Loads for Standard Sized MINIRAIL



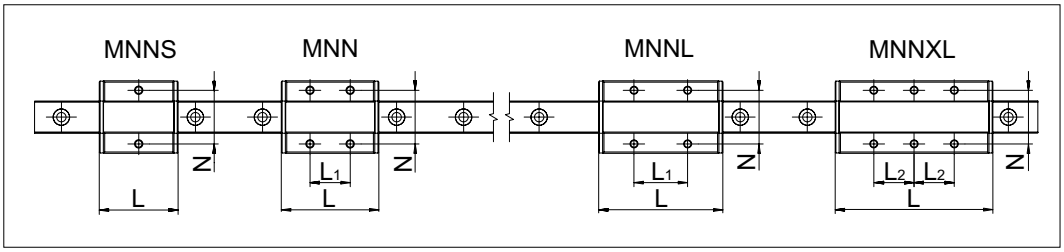
Detail X

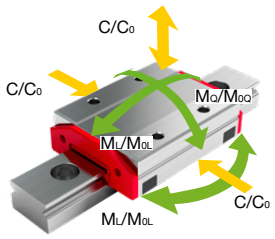


		Name	Standard size 7					Standard size 9				
			Guideway	MNNS	MNN	MNNL	MNNXL	Guideway	MNNS	MNN	MNNL	MNNXL
Dimensions (mm)	A	System height		8					10			
	B	System width		17					20			
	B_1	Rail width	7					9				
	B_2	Distance between reference surfaces		5					5.5			
	J	Carriage height		6.5					8			
	J_1	Rail height	4.5					5.5				
	L	Carriage length with wipers		18.6	24.6	32.1	41.1		22	32	40	50
	L_1	Longitudinal spacing of attachment holes		-	8	13	20		-	10	16	26
	L_2	Longitudinal spacing of attachment holes		-	-	-	10		-	-	-	13
	L_4	Spacing of attachment holes	15					20				
	L_5/L_{10}	Position of first and last attachment hole	5					7.5				
	L_6	Carriage length (steel body)		16.1	22.1	29.6	38.6		19	29	37	47
	N	Lateral attachment hole spacing		12					15			
	e	Thread		M2					M3			
	f_1	Hole diameter	2.4					3.5				
	f_2	Countersink diameter	4.2					6				
	g	Thread depth		2.5					3			
	g_2	Step drilling height	2.2					2				
	m_1	Position of lubrication holes		3.1					3.8			
	o	Reference face height		2.5					3.1			
Load capacity (N)	C_0	Static load capacity		935	1560	2340	3275		1385	2770	3880	5270
	C	Dynamic load capacity (≙ C_{100})		645	925	1230	1550		1040	1690	2140	2645
Torque (Nm)	M_{0Q}	Permissible lateral static torque		3.4	5.6	8.4	11.8		6.5	12.9	18.1	24.5
	M_{0L}	Permissible longitudinal static torque		1.6	4.3	9.3	18		2.8	10.2	19.4	35.1
	M_Q	Permissible lateral dynamic torque		2.3	3.3	4.4	5.6		4.8	7.9	9.9	12.3
	M_L	Permissible longitudinal dynamic torque		1.1	2.5	4.9	8.5		2.1	6.2	10.7	17.6
Weights guideway (g/m), carriage (g)			216	9	13	18	23	309	16	24	31	40

SCHNEEBERGER LINEAR TECHNOLOGY

7 MINIRAIL Product Overview

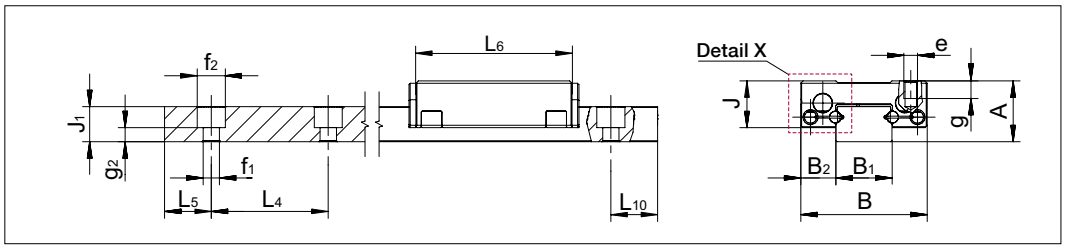




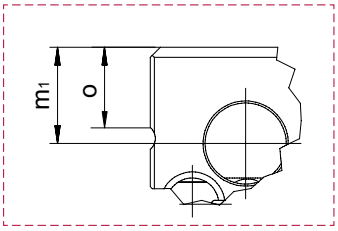
		Name	Standard size 12					Standard size 15				
			Guideway	MNNS	MNN	MNNL	MNNXL	Guideway	MNNS	MNN	MNNL	MNNXL
Dimensions (mm)	A	System height		13					16			
	B	System width		27					32			
	B_1	Rail width	12					15				
	B_2	Distance between reference surfaces		7.5					8.5			
	J	Carriage height		10					12			
	J_1	Rail height	7.5					9.5				
	L	Carriage length with wipers		23.9	36.4	46.4	58.9		31.7	43.7	58.7	73.7
	L_1	Longitudinal spacing of attachment holes		-	15	20	30		-	20	25	40
	L_2	Longitudinal spacing of attachment holes		-	-	-	15		-	-	-	20
	L_4	Spacing of attachment holes	25					40				
	L_5/L_{10}	Position of first and last attachment hole	10					15				
	L_6	Carriage length (steel body)		20.9	33.4	43.4	55.9		28.7	40.7	55.7	70.7
	N	Lateral attachment hole spacing		20					25			
	e	Thread		M3					M3			
	f_1	Hole diameter	3.5					3.5				
	f_2	Countersink diameter	6					6				
	g	Thread depth		3.5					4			
	g_2	Step drilling height	3					5				
	m_1	Position of lubrication holes		4.75					5.55			
	o	Reference face height		3.9					4.9			
Load capacity (N)	C_0	Static load capacity		1735	3900	5630	7800		3120	5620	8740	11855
	C	Dynamic load capacity (≙ C_{100})		1420	2510	3240	4070		2435	3680	5000	6200
Torque (Nm)	M_{QQ}	Permissible lateral static torque		10.6	23.8	34.4	47.6		23.7	42.7	66.4	90.1
	M_{QL}	Permissible longitudinal static torque		3.6	16.3	32.9	61.8		9.4	28.1	65.5	118.6
	M_Q	Permissible lateral dynamic torque		8.7	15.3	19.8	24.8		18.5	27.9	38.1	47.1
	M_L	Permissible longitudinal dynamic torque		3	10.4	18.9	32.2		7.3	18.4	37.6	62
Weights guideway (g/m), carriage (g)			598	29	47	63	81	996	56	81	114	146

7 MINIRAIL Product Overview

7.2.11 Dimension Tables, Load Capacities, and Moment Loads, for Wider Width MINIRAIL



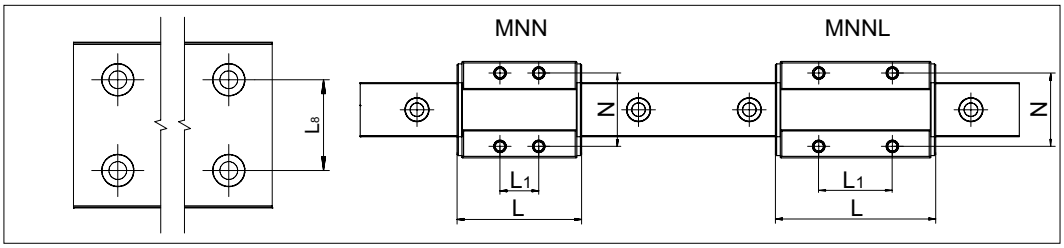
Detail X

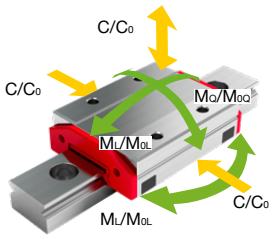


		Name	Wider width 14			Wider width 18		
			Guideway	MNN	MNNL	Guideway	MNN	MNNL
Dimensions (mm)	A	System height		9			12	
	B	System width		25			30	
	B_1	Rail width	14			18		
	B_2	Distance between reference surfaces		5.5			6	
	J	Carriage height		6.8			8.5	
	J_1	Rail height	5.2			7		
	L	Carriage length with wipers		32.1	41.1		40	50
	L_1	Longitudinal spacing of attachment holes		10	19		12	24
	L_2	Longitudinal spacing of attachment holes		-	-		-	-
	L_4	Spacing of attachment holes	30			30		
	L_5/L_{10}	Position of first and last attachment hole	10			10		
	L_6	Carriage length (steel body)		29.6	38.6		37	47
	L_8	Lateral attachment hole spacing	-			-		
	N	Lateral attachment hole spacing		19			21	
	e	Thread		M3			M3	
	f_1	Hole diameter	3.5			3.5		
	f_2	Countersink diameter	6			6		
	g	Thread depth		2.8			3	
	g_2	Step drilling height	2			2.5		
	m_1	Position of lubrication holes		3.3			4.3	
	o	Reference face height		2.2			3.1	
Load capacity (N)	C_0	Static load capacity		2340	3275		3880	5270
	C	Dynamic load capacity (≙ C_{100})		1230	1550		2140	2645
Torque (Nm)	M_{0Q}	Permissible lateral static torque		16.6	23.3		35.5	48.2
	M_{0L}	Permissible longitudinal static torque		9.3	18		19.4	35.1
	M_Q	Permissible lateral dynamic torque		8.7	11		19.6	24.2
	M_L	Permissible longitudinal dynamic torque		4.9	8.5		10.7	17.6
Weights guideway (g/m), carriage (g)			518	25	33	915	47	60

SCHNEEBERGER LINEAR TECHNOLOGY

7 MINIRAIL Product Overview





		Name	Wider width 24			Wider width 42		
			Guideway	MNN	MNNL	Guideway	MNN	MNNL
Dimensions (mm)	A	System height		14			16	
	B	System width		40			60	
	B_1	Rail width	24			42		
	B_2	Distance between reference surfaces		8			9	
	J	Carriage height		10			12	
	J_1	Rail height	8.5			9.5		
	L	Carriage length with wipers		46.4	58.9		55.7	73.7
	L_1	Longitudinal spacing of attachment holes		15	28		20	35
	L_2	Longitudinal spacing of attachment holes		-	-		-	-
	L_4	Spacing of attachment holes	40			40		
	L_5/L_{10}	Position of first and last attachment hole	15			15		
	L_6	Carriage length (steel body)		43.4	55.9		52.7	70.7
	L_8	Lateral attachment hole spacing	-			23		
	N	Lateral attachment hole spacing		28			45	
	e	Thread		M3			M4	
	f_1	Hole diameter	4.5			4.5		
	f_2	Countersink diameter	8			8		
	g	Thread depth		3.5			4.5	
	g_2	Step drilling height	4			5		
	m_1	Position of lubrication holes		4.75			5.5	
	o	Reference face height		3.9			4.9	
Load capacity (N)	C_0	Static load capacity		5630	7800		8110	11855
	C	Dynamic load capacity (≙ C_{100})		3240	4070		4750	6200
Torque (Nm)	M_{QQ}	Permissible lateral static torque		68.2	94.4		171.2	250.2
	M_{QL}	Permissible longitudinal static torque		32.9	61.8		56.8	118.6
	M_Q	Permissible lateral dynamic torque		39.2	49.3		100.3	130.8
	M_L	Permissible longitudinal dynamic torque		18.9	32.2		33.3	62
Weights guideway (g/m), carriage (g)			1476	84	109	2828	169	231

7.2.12 Lubrication

General
Choice of lubricant is an important consideration and must therefore be defined during the development phase of the machine or application. From experience, choosing the lubricant after the design is finalized leads to significant difficulties later on. A carefully thought out lubrication concept is therefore a feature of a state-of-the-art and well-planned design.

Parameters to be taken into account in selecting the lubricant include:

- Operating conditions (Speed, acceleration, stroke, load, installation orientation)
- External influences (Temperature, aggressive media or radiation, contamination, humidity, vacuum, cleanroom)
- Relubrication (Period of time, amount, compatibility)
- Compatibility (With other lubricants, with corrosion protection and with integrated materials such as plastic)

Technical and economic considerations determine the lubricant used.

The guideways should be kept free of cutting oils or water-soluble coolants and lubricants as they thin or wash off the lubricant. In addition, coolants tend to become sticky as they dry out. Lubricants with solid additives are not suitable.

Long-term lubrication
The long-term lubrication LUBE-S from SCHNEEBERGER is covered in chapter 8.1.

Custom lubricants
Specific lubricants are used for specific purposes. For example lubricants for use in vacuums, cleanrooms, for high or low temperatures, for high speeds or high-frequency strokes. SCHNEEBERGER can supply the guideways with the appropriate lubricant for all of these applications.

Additional important information about lubricants is available in chapter 16.3.3.