

**SCHNEEBERGER**  
LINEAR TECHNOLOGY



**MINIRAIL**  
The Miniature Guideway

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# 1 Product Overview

## MINIRAIL - the range of high-precision guideways

MINIRAIL represents the latest generation of miniature guideways for sophisticated applications. They are extremely robust, and their smooth running, precision, and reliability are demonstrated in every application.

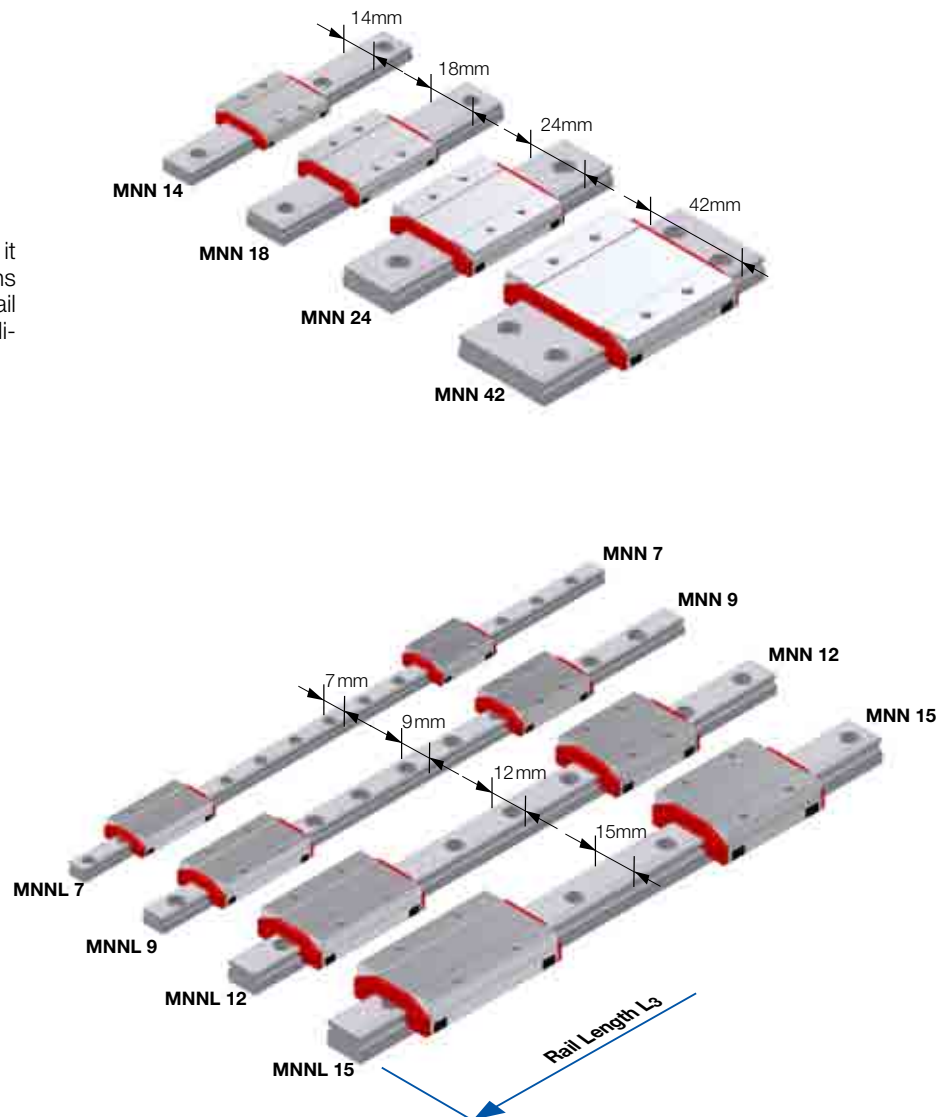
The **range** includes eight rail widths. Choose from three carriage sizes:

<b>Standard</b>	MNN 7	MNN 9	MNN 12	MNN 15
<b>Standard, long</b>	MNNL 7	MNNL 9	MNNL 12	MNNL 15
<b>Wide</b>	MNN 14	MNN 18	MNN 24	MNN 42

The design, material selection, and surface finish of the recirculation element and ball entry zone guarantee low pulsation and therefore a smooth ride.

### Rail Length L<sub>3</sub>

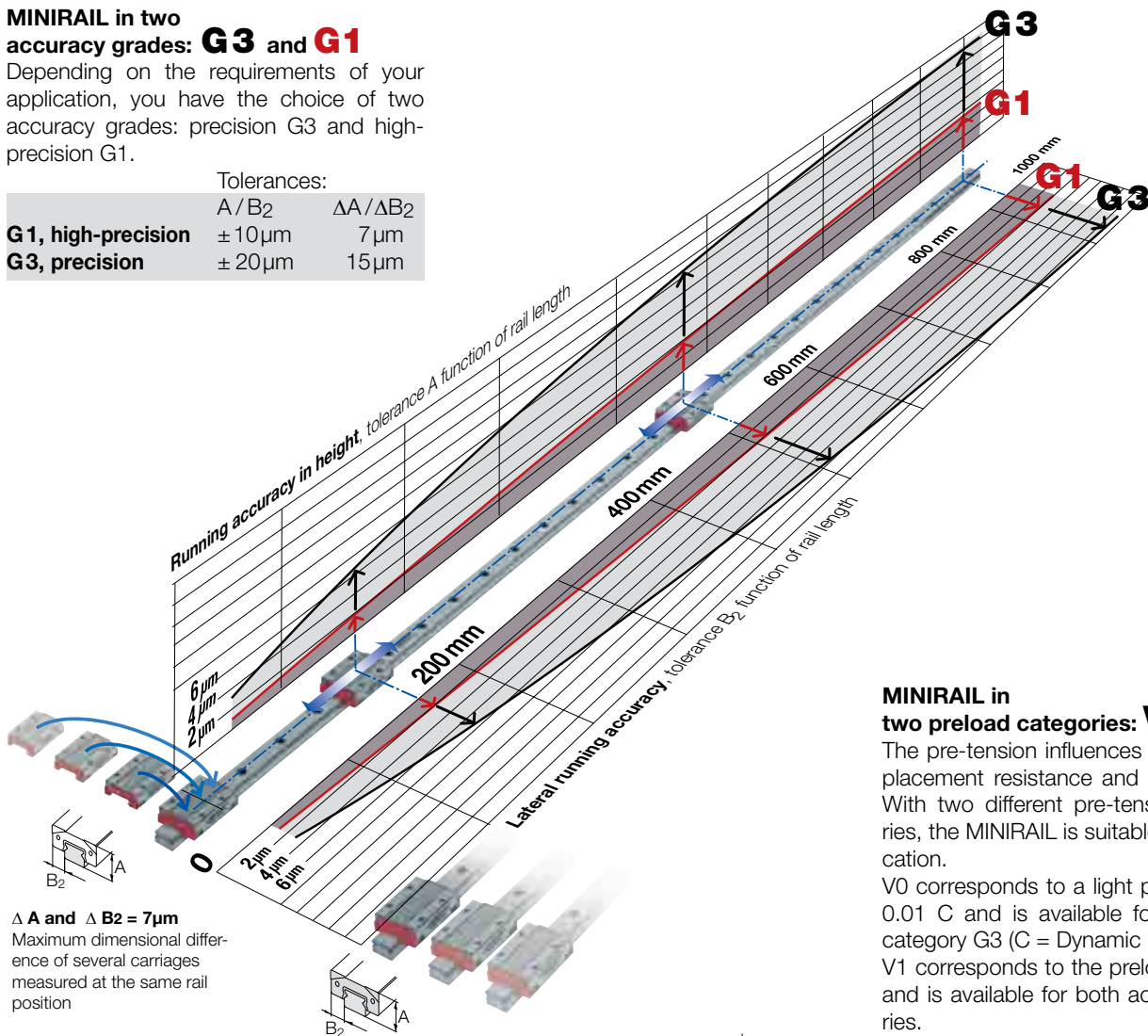
Our manufacturing know-how makes it possible to produce precision rail lengths up to 980 mm, depending on the rail size. For custom applications, intermediate lengths are available.



**MINIRAIL in two accuracy grades: G3 and G1**

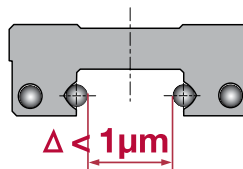
Depending on the requirements of your application, you have the choice of two accuracy grades: precision G3 and high-precision G1.

	Tolerances:	
	A/B <sub>2</sub>	ΔA/ΔB <sub>2</sub>
<b>G1, high-precision</b>	±10 μm	7 μm
<b>G3, precision</b>	±20 μm	15 μm



**Δ A and Δ B<sub>2</sub> = 7 μm**  
Maximum dimensional difference of several carriages measured at the same rail position

**A and B<sub>2</sub> = ±10 μm**  
Maximum dimensional difference measured on several MINIRAIL systems



**μm - accuracy**

Our manufacturing control of this precise dimension is decisive for the complete interchangeability of the carriages.

**MINIRAIL in two preload categories: V0 and V1**

The pre-tension influences the rigidity, displacement resistance and service lifetime. With two different pre-tensioning categories, the MINIRAIL is suitable for your application.

V0 corresponds to a light preload of up to 0.01 C and is available for the accuracy category G3 (C = Dynamic load).

V1 corresponds to the preload 0 to 0.03 C and is available for both accuracy categories.

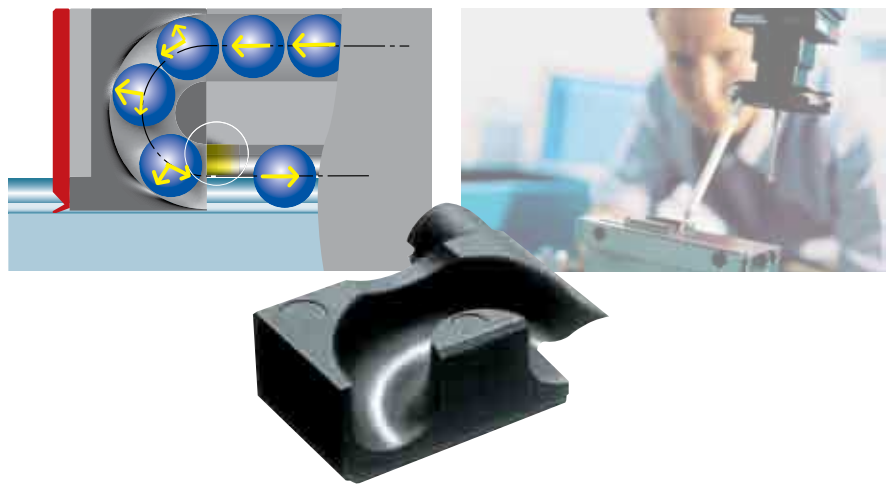
**MINIRAIL Carriage interchangeability guarantee**

The carriages are manufactured with high precision and are completely interchangeable. This makes a high degree of flexibility with respect to operations planning, stocking and assembly. As a result of the interchangeability, additional carriages can be installed onto an existing rail.

## MINIRAIL – Perfection to the last detail for the latest requirements of the technology

### High accelerations of up to 300 m/s<sup>2</sup>

The recirculation element plays a crucial role in withstanding the constantly increasing acceleration values. For this reason, SCHNEEBERGER uses a plastic material that is capable of enduring very high loads. The ingenious shape and the smooth surfaces of the recirculation element are designed with high levels of centrifugal force in mind.



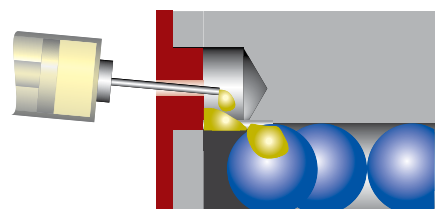
### The ball entry zone - a decisive Point

The precise fine grinding of the ball entry position on the running track is crucial to the operational quietness and service life, especially in the case of carriages with preload. Here we have indeed produced our best work.



### Direct lubrication

Two lubrication bores in each front plates allow the direct lubrication on the ball recirculation system.



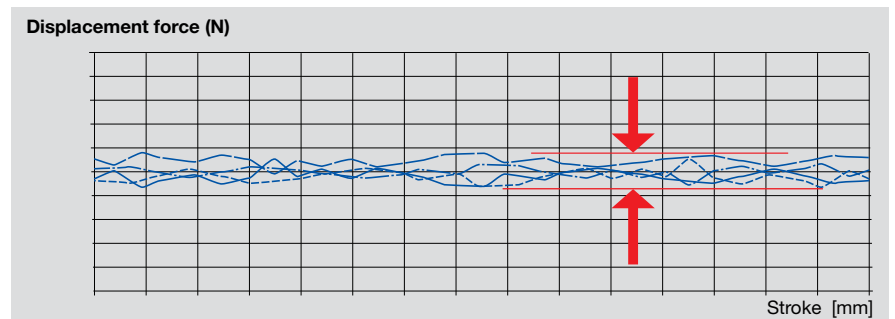
**MINIRAIL rails and carriages**

All rails and carriages are manufactured from corrosion-resistant, through-hardened steel and are suitable for utilization in the most diverse applications.



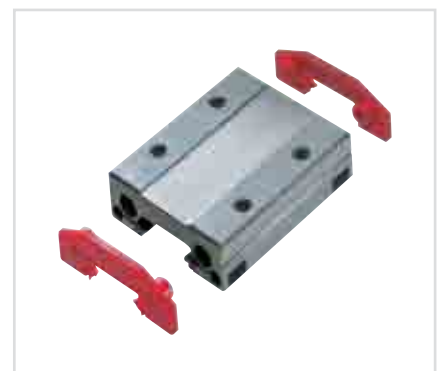
**High smoothness and low displacement force**

Running quietness and displacement force are important characteristic features of the ball guideway. When the displacement powers are to lie within a given tolerance (only on request), rails and wagons are paired and delivered as a set from the factory.



**The front plates**

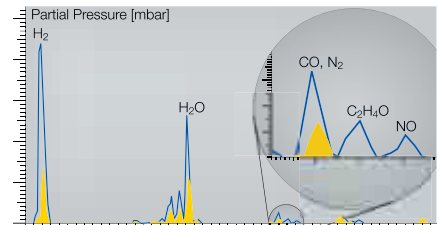
To obtain quietness and extended life, rail and carriage assemblies require clean running surfaces - even under unfavorable conditions. Therefore our MINIRAIL carriages are equipped with rail-wiping, contoured front plates. Should the protective - and wiping function of the front plates not be required, the front plates can be removed easily. As a result, the displacement resistance is reduced significantly.



## MINIRAIL is synonymous for reliability and perfection

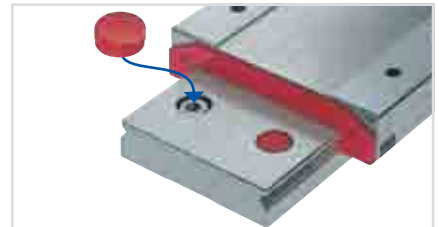
### Vacuum capacity

MINIRAIL can be operated in high vacuum without any wiper (max.  $10^{-7}$  mbar).



### Perfection with plastic plugs

Plastic plugs in the rail mounting holes prevent the accumulation of any dirt.



### Protective packaging

Carriages and rails are packed carefully and ready for installation. In the process MINI-RAIL carriages are shipped on a protective rail, in order to prevent any impairment by dirt or debris.



### Competent engineering

During your design phase competent engineers will assist you in the selection of a suitable product.

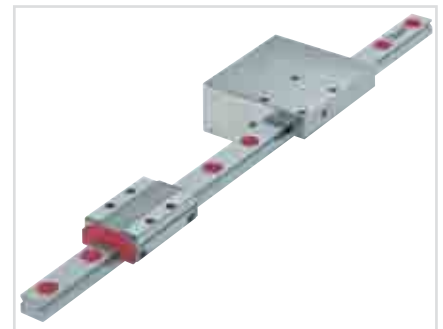
**Ball Retention device for easy handling**

If a carriage is removed from the rail or is being prepared for installation, the balls are always retained in the carriage by a special ball retaining device. This makes handling significantly easier and is prerequisite for quickly changing the carriages.



**Clamping element for safety purposes**

The clamping element has been developed especially for MINIRAIL. In normal operation, the clamping element is maintained in an open position by compressed air, and in the case of an electric power failure, the spring-force blocks all movement for operational safety.





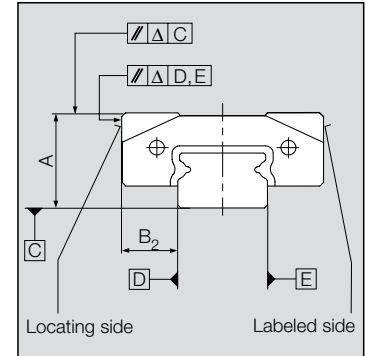
## 2 Technical Data

### 2.1 Accuracy classes

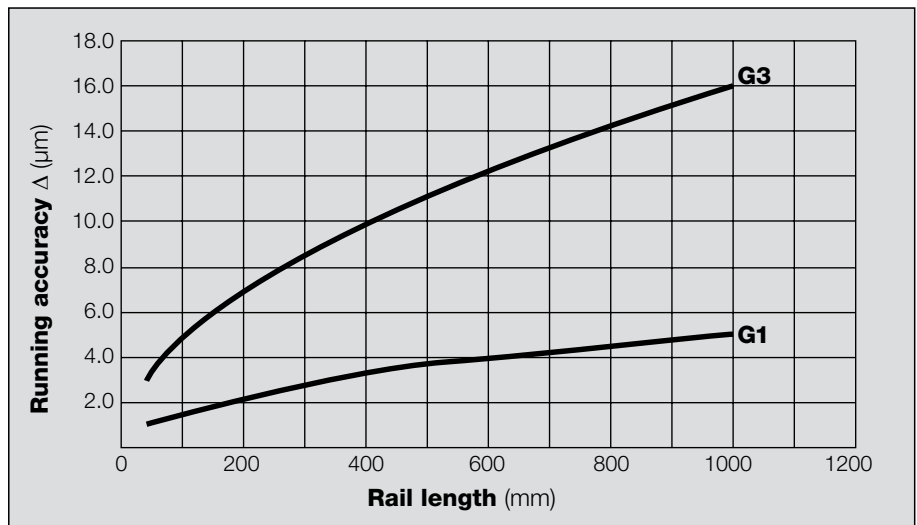
The MINIRAIL guideways are available in two accuracy classes.

Accuracy class	Tolerances	
	<sup>1</sup> A and B <sub>2</sub>	<sup>2</sup> Δ A and ΔB <sub>2</sub>
<b>G1</b>	± 10 μm	7 μm
<b>G3</b>	± 20 μm	15 μm

<sup>1</sup> Measuring referring to the center of the carriage  
<sup>2</sup> Dimension differences between two or more carriages measured at the middle of each carriage (mean value of both supports) and at the same rail position



### 2.2 Running accuracy



### 2.3 Preload classes V0, V1

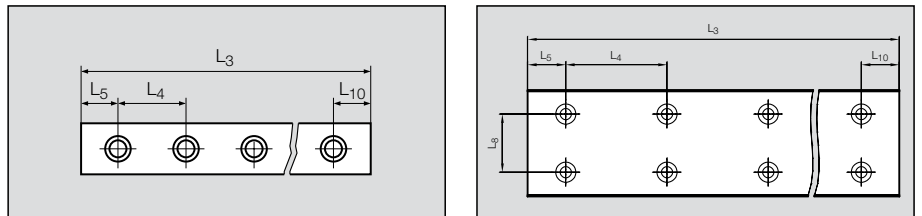
Preloading increases the rigidity of the guideway but also affects operational life and increases translation resistance. The MINIRAIL system is available in two preload classes to address specific application requirements. The rail up to determines the preload classes.

Preload class	Preload	Accuracy class
<b>V0</b>	near clearance to 0.01 · C	G3
<b>V1</b>	0 to 0.03 · C	G1, G3

C = Dynamic loading capacity (see chapter 3.1)

## 2.4 Design of rail

### Rail lengths



Standard rail lengths $L_3$ (length in mm)					
Size	$L_4$	$L_5, L_{10}$	$L_8$	$L_3$	Max $L_3$
<b>7</b>	15	5	–	40, 55, 70, 85, ...	1000
<b>9</b>	20	7.5	–	55, 75, 95, 115, ...	995
<b>12</b>	25	10	–	70, 95, 120, 145, ...	995
<b>15</b>	40	15	–	70, 110, 150, 190, ...	990
<b>14</b>	30	10	–	80, 110, 140, 170, ...	980
<b>18</b>	30	10	–	80, 110, 140, 170, ...	980
<b>24</b>	40	15	–	110, 150, 190, 230, ...	990
<b>42</b>	40	15	23	110, 150, 190, 230, ...	990

### Custom rail lengths

Other rail lengths are available up to the maximum rail lengths above and are calculated according to the following formula:

$$L_3 = (n-1) \cdot L_4 + L_5 + L_{10} \quad n = \text{number of fixing holes}$$

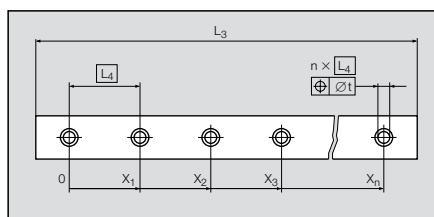
The following minimum and maximum values should be maintained for the starting hole pitch  $L_5$  and the end hole pitch  $L_{10}$ .

Minimum and maximum starting and end hole pitch $L_5, L_{10}$ (lengths in mm)								
Size	<b>7</b>	<b>9</b>	<b>12</b>	<b>15</b>	<b>14</b>	<b>18</b>	<b>24</b>	<b>42</b>
<b><math>L_5, L_{10}</math> minimum</b>	4	5	5	5	5	5	6	6
<b><math>L_5, L_{10}</math> maximum</b>	11	15	20	35	25	25	34	34

### Tolerances for rail lengths and fixing holes

The position tolerance of the attaching holes and the length tolerance is:

Rail	$L_3, X_n \leq 300 \text{ mm}$	$L_3, X_n > 300 \text{ mm}$
<b>t (mm)</b>	0.3	$0.001 \cdot X_n$
<b><math>L_3</math></b>	$\pm 0.3$	$\pm 0.001 \cdot L_3$



## 2.5 Lubrication

The front plates include two lubrication holes to allow independent lubrication for the right and left side of the carriage.

This ensures that all tracks of the carriage are provided with lubricant, in all installation orientations.

At delivery the carriages are slightly oiled. Prior to operation the carriages must be lubricated!

Subsequent lubrication depends upon environmental conditions as well as the nature and type of the load. Guarantees regarding subsequent lubrication intervals can only be provided through the user's own tests and experience. In all cases, the recommendations provided by the lubricant manufacturer must be followed.

For lubrication with oil, SCHNEEBERGER recommends mineral oil CLP (DIN 51517) or HLP (DIN 51524) in the viscosity range of ISO VG32 to ISO VG150 in accordance with DIN 51519.

For lubrication with grease, SCHNEEBERGER recommends grease KP2K or KP1K in accordance with DIN 51825.

A re-lubrication set with an appropriate oil can be ordered at SCHNEEBERGER with the ordering code MNW.



### Lubrication with grease

During the lubrication the carriages have to be moved on the rail in order to distribute the lubricant.

Quantity of grease in cm <sup>3</sup>							
<b>MNN 7</b>	<b>MNN 9</b>	<b>MNN12</b>	<b>MNN 15</b>	<b>MNN 14</b>	<b>MNN 18</b>	<b>MNN 24</b>	<b>MNN 42</b>
0.04	0.09	0.015	0.025	0.05	0.11	0.20	0.33
<b>MNNL 7</b>	<b>MNNL 9</b>	<b>MNNL 12</b>	<b>MNNL 15</b>				
0.05	0.11	0.20	0.35				

### Lubrication with oil

During the lubrication the carriages have to be moved on the rail in order to distribute the lubricant.

### Re-lubrication

#### Guideline values based on the following assumption:

- Load ratio C/P\* = 10
  - Speed of 1 m/s
  - Stroke of 150 mm
- Re-lubrication interval = 3000 km

\*C = dynamic loading capacity / P = equivalent force

**2.6 General data**

**Permissible speeds and accelerations**

General applications under normal operating conditions:

Speeds up to	5 m/s
Accelerations up to	300 m/s <sup>2</sup>

**Permissible operating temperatures**

MINIRAIL guideways can be used at operating temperatures between -40°C and +80°C. Short term temperatures up to +120°C are permissible.

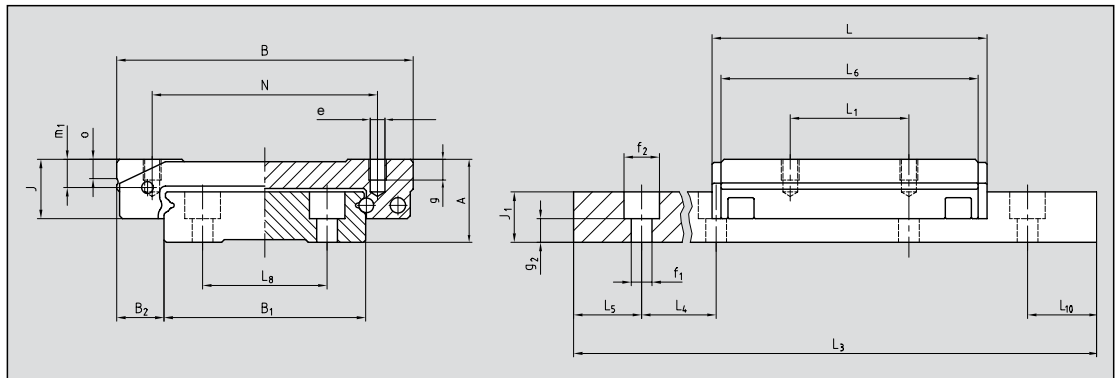
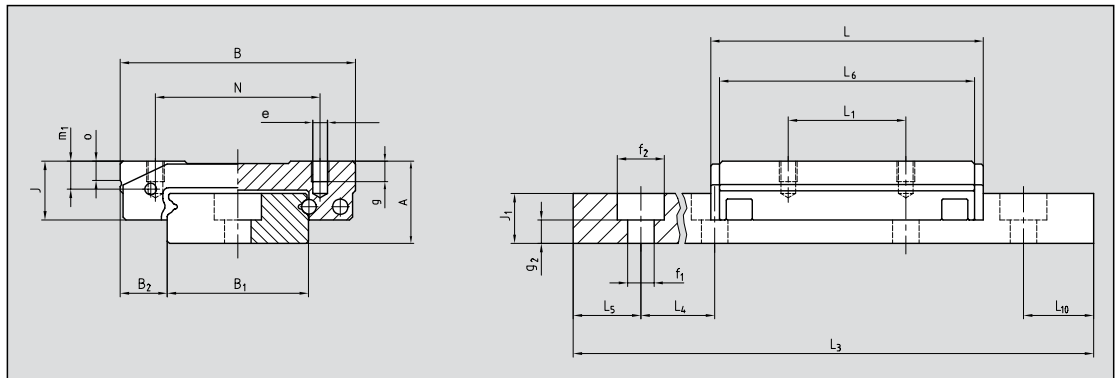
**Materials**

All steel parts are made from through hardened stainless steel. Plastic components are injection-molded using POM and TPE.

### 3.1 Dimension table, loading capacities

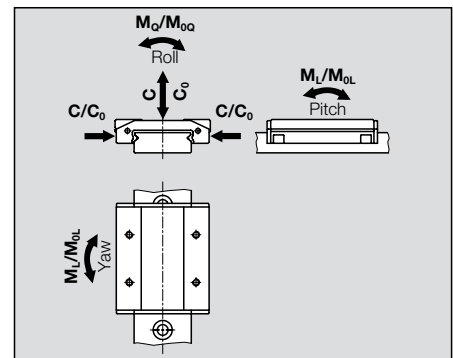
Type		Dimensions (mm)																			
Rail	Carriage	A	B	B <sub>1</sub>	B <sub>2</sub>	J	J <sub>1</sub>	L	L <sub>1</sub>	L <sub>4</sub>	L <sub>5</sub> / L <sub>10</sub>	L <sub>6</sub>	L <sub>8</sub>	N	e	f <sub>1</sub>	f <sub>2</sub>	g	g <sub>2</sub>	m <sub>1</sub>	o
MN 7	MNN 7	8	17	7	5	6.5	4.5	24.6	8	15	5	22.1	-	12	M2	2.4	4.2	2.5	2.2	3.1	2.5
	MNNL 7							32.1	13			29.6									
MN 9	MNN 9	10	20	9	5.5	8	5.5	32	10	20	7.5	29	-	15	M3	3.5	6	3	2	3.8	3.1
	MNNL 9							40	16			37									
MN 12	MNN 12	13	27	12	7.5	10	7.5	36.4	15	25	10	33.4	-	20	M3	3.5	6	3.5	3	4.75	3.9
	MNNL 12							46.4	20			43.4									
MN 15	MNN 15	16	32	15	8.5	12	9.5	43.7	20	40	15	40.7	-	25	M3	3.5	6	4	5	5.55	4.9
	MNNL 15							58.7	25			55.7									
MN 14	MNN 14	9	25	14	5.5	6.8	5.2	32.1	10	30	10	29.6	-	19	M3	3.5	6	2.8	2	3.3	2.2
MN 18	MNN 18	12	30	18	6	8.5	7	40	12			37						-	21	M3	3
MN 24	MNN 24	14	40	24	8	10	8.5	46.4	15	40	15	43.4	-	28	M3	4.5	8	3.5	4	4.75	3.9
MN 42	MNN 42	16	60	42	9	12	9.5	55.7	20			52.7						23	45	M4	4.5

Type		Loading capacities		Moments				Weights	
Rail	Carriage	Co (N)	C (N)	M <sub>00</sub> (Nm)	M <sub>0L</sub> (Nm)	M <sub>0</sub> (Nm)	M <sub>L</sub> (Nm)	Carriage (g)	Rail (g/m)
MN 7	MNN 7	1560	925	5.6	4.3	3.3	2.5	12.8	216.3
	MNNL 7	2340	1230	8.4	9.3	4.4	4.9	18	216.3
MN 9	MNN 9	2770	1690	12.9	10.2	7.9	6.2	23.9	308.8
	MNNL 9	3880	2140	18.1	19.4	9.9	10.7	31	308.8
MN 12	MNN 12	3900	2510	23.8	16.3	15.3	10.4	47.4	597.9
	MNNL 12	5630	3240	34.4	32.9	19.8	18.9	63	597.9
MN 15	MNN 15	5620	3680	42.7	28.1	27.9	18.4	81.4	995.5
	MNNL 15	8740	5000	66.4	65.5	38.1	37.6	114	995.5
MN 14	MNN 14	2340	1230	16.6	9.3	8.7	4.9	25	518.3
MN 18	MNN 18	3880	2140	35.5	19.4	19.6	10.7	47	914.6
MN 24	MNN 24	5630	3240	68.2	32.9	39.2	18.9	84	1473.0
MN 42	MNN 42	8110	4750	171.2	56.8	100.3	33.3	169	2828.4



Loading capacities are calculated values, based on DIN 636-2

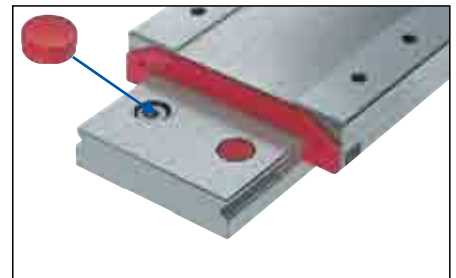
- $C_0$  = static loading capacity
- $C$  = dynamic loading capacity (100 km)
- $M_0$  = static moment
- $M$  = dynamic moment (100 km)



### 3.2 Accessories

#### Plastic plugs

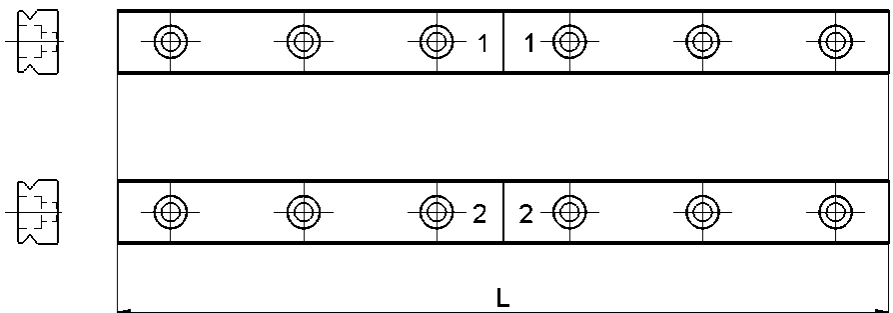
Plastic plugs can be used to close the rail attachment holes.



MINIRAIL Type	Plastic plugs Type	Plastic plugs can be combined with attaching screws of type		
		DIN 912	DIN 7984	DIN 7380
MN 7	MNK 4	-	-	X
MN 9	MNK 6	-	X	X
MN 12	MNK 6	X	X	X
MN 15	MNK 6	X	X	X
MN 14	MNK 6	-	X	X
MN 18	MNK 6	X	X	X
MN 24	MNK 8	-	X	X
MN 42	MNK 8	-	X	X

#### Multi-section rails (ZG)

Should the desired overall length of the rail exceed the maximum length specified in the brochure, some rails can be ground together. The offset between the individual guide rails should not exceed 0.002 mm. When assembling the guideways, the numbering at the junction must be observed.



### 3.3 Ordering information MINIRAIL

The MINIRAIL carriage and rail must be ordered as separate items.

#### Carriage

	—	MNN	9	-G1
Quantity				
Carriage type	<b>MNN</b>	<b>MNNL</b>		
Size	<b>7, 9, 12, 15, 14, 18, 24, 42</b>		<b>7, 9, 12, 15</b>	
Accuracy class	<b>G1, G3</b>		<b>G1, G3</b>	

#### Rail

	—	MN	9	-155	-7.5	-7.5	-G1	-V1	-ZG
Quantity									
Rail type	<b>MN</b>								
Size	<b>7, 9, 12, 15, 14, 18, 24, 42</b>								
Rail length	<b>L<sub>3</sub></b> (in mm)								
Starting hole pitch	<b>L<sub>5</sub></b> (in mm)*								
End hole pitch	<b>L<sub>10</sub></b> (in mm)*								
Accuracy class	<b>G1, G3</b>								
Preload class	<b>V0, V1</b>								
Ground together									

\* Indicate only if special pitch

#### Accessories

##### Re-lubrication set

	—	MNW
Quantity		
Type	<b>MNW</b>	

##### Plastic plugs

	—	MNK	6
Quantity			
Type	<b>MNK</b>		
Size	<b>4, 6, 8</b>		



### 4.1 Dynamic loading capacity C

The loading capacity values for anti-friction guideways are based on the principles specified by the ISO for calculation of rolling-contact bearings (DIN ISO 281).

Dynamic loading capacity is the loading which results in a nominal operational life corresponding to a translation distance of 100 000 m (100 km) provided that the loading due to mass and direction is unchanged and the line of influence acts vertically on the rolling-contact bearing unit.

#### Comparison of loading

Other suppliers often indicate their loading capacities for a translation distance of 50 000 m (50 km). These values according to JIS standard are above the values according to DIN ISO. The recalculation of the loading capacities is done as follows:

$$C_{50} = 1.26 \cdot C_{100}$$

#### Operational life calculation

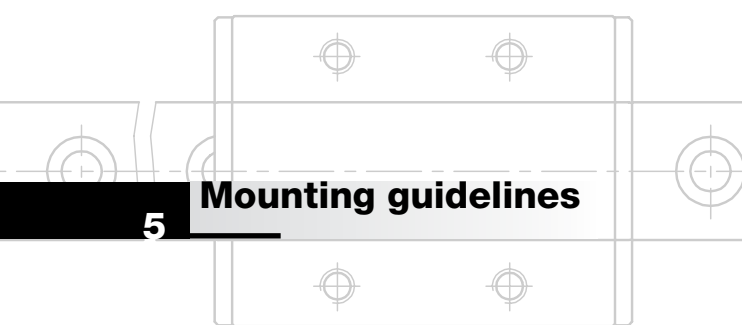
The nominal calculated operational life L for the equivalent force P and a dynamic loading capacity C is:

$$L = (C/P)^3 \cdot 10^5 \text{ m} \quad L = \text{nominal life (m)}$$

#### Operational life calculation in hours

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

$L_h$  = nominal life (h)  
 $s$  = stroke length (m)  
 $n$  = stroke frequency (min<sup>-1</sup>)  
 $v_m$  = average traversing speed (m/min)



## 5.1 Tightening torques for rails and carriages

### Tightening torques for fastening screws DIN 912, $\mu$ 0,125 (12,9) and DIN 912, $\mu$ 0,2 (A2-70)

Strength-class	max. tightening torques [Nm]		
	M2	M3	M4
12.9	0.6	2.1	5.0
A2-70	0.3	1.1	2.6

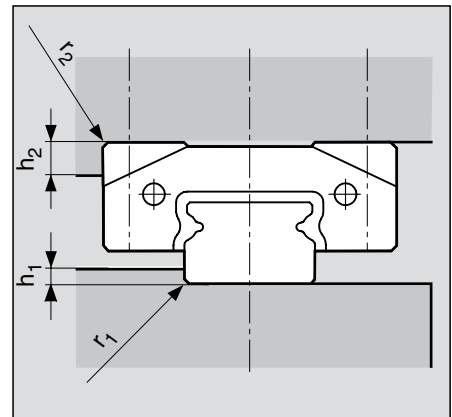
#### Notes

When the screws are greased with grease containing MoS<sub>2</sub> the friction coefficient  $\mu$  can be reduced by as much as half. As the tightening torques required to reach the maximum permissible tightening force depend on the friction coefficient, they must be reduced accordingly. The values can be obtained from the screw manufacturer's information or from the specialist literature. If necessary, carry out tests to determine the actual friction coefficient.

Refer to the screw manufacturer's information. This is always binding.

**5.2 Configuration of the lateral locating sides**

The corners between the support and locating surfaces of the surrounding structure are normally provided with a relief groove. However, if no relief groove is provided, then the dimensions tabulated below must be maintained.



Size	$h_1$	$r_1$ max	$r_2$ max	$h_2$
<b>7</b>	1.2	0.2	0.3	2.5
<b>9</b>	1.5	0.3	0.4	3
<b>12</b>	2.5	0.4	0.4	4
<b>15</b>	3.5	0.5	0.5	5
<b>14</b>	1.8	0.2	0.4	2
<b>18</b>	3	0.3	0.5	3
<b>24</b>	3.5	0.4	0.5	4
<b>42</b>	3.5	0.5	0.6	5

**5.3 Configuration of assembly surfaces**

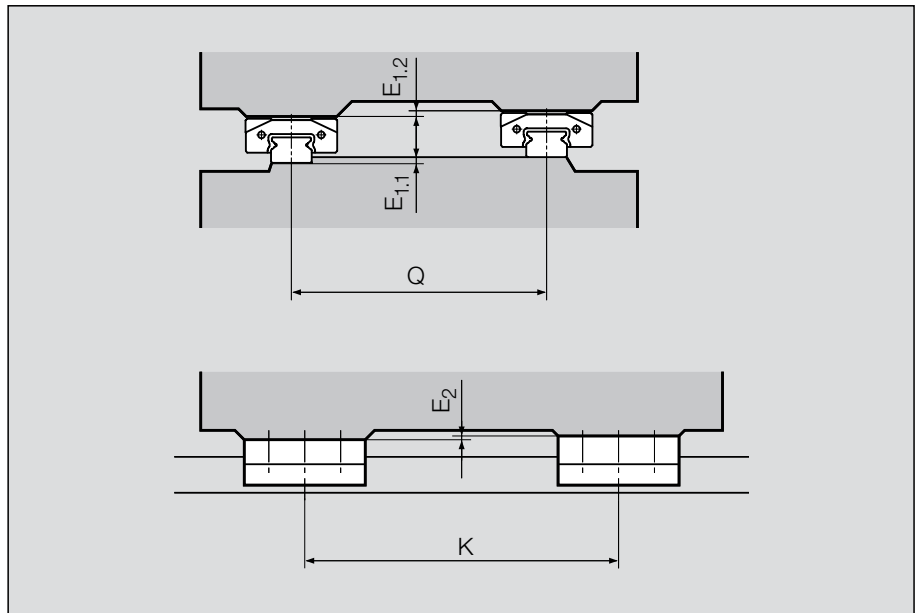
MINIRAIL advantages can only be achieved when mounted to a rigid, accurately machined structure.

A roughness average ratio of  $R_a$  0.4 to 1.6  $\mu\text{m}$  is recommended for support and locating surfaces.

Inaccuracies of the attachment surfaces are partially compensated by the elastic deformation of the MINIRAIL. However, they may affect overall accuracy, running behavior and operational life.

**5.4 Geometrical and position accuracy of the support surfaces**

Permissible height deviation (use values in mm for the calculation)



	<b>MNN</b>	<b>VO</b>	<b>V1</b>
<b>E1 = E1.1 + E1.2</b>	7, 9, 12, 15	0.00025 Q	0.00015 Q
<b>E2</b>	7, 9, 12, 15	0.00005 K	0.00005 K
<b>E1 = E1.1 + E1.2</b>	14, 18, 24, 42	0.00013 Q	0.00008 Q
<b>E2</b>	14, 18, 24, 42	0.00004 K	0.00004 K

	<b>MNNL</b>	<b>VO</b>	<b>V1</b>
<b>E2</b>	7, 9, 12, 15	0.00004 K	0.00004 K

**Example of calculation**

Nominal: Type MNN 12  
 Preload class V1  
 Gap Q 120 mm

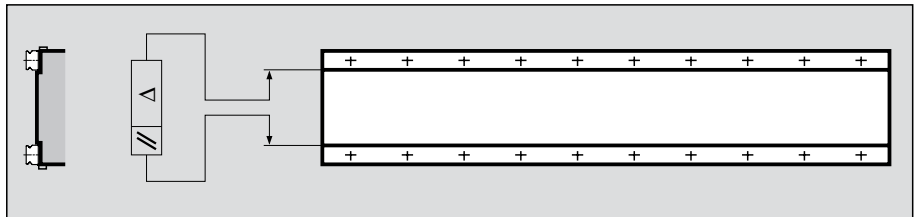
Target: Admissible height difference  $E_1$

Calculation:  $0.00015 \times 120 \text{ mm} = \underline{0.018 \text{ mm}}$

Result: The difference of  $E_{1.1}$  plus  $E_{1.2}$  ( $= E_1$ ) must not exceed 0.0180 mm.

### 5.5 Parallelism tolerances of the locating surfaces

Permissible tolerances for the parallelism



Tolerances for preload class (mm)				
	7 / 14	9 / 18	12 / 24	15 / 42
<b>V0</b>	0.003	0.005	0.008	0.01
<b>V1</b>	0.002	0.003	0.004	0.005

### 5.6 Various

#### Mounting instructions

The installation of the MINIRAIL guideways is described in detail in the separate **Mounting Instructions MINIRAIL** and can be downloaded from [www.schneeberger.com](http://www.schneeberger.com) at menu DOWNLOADS.

#### As delivered condition

MINIRAIL are delivered in protective packaging. The carriages are mounted on a plastic rail and slightly oiled for immediate operation.



#### Transportation and intermediate storage

MINIRAIL are highly precise components, which have to be treated with care. As a protection against damage, the following instructions should be followed:

- Always store and transport MINIRAIL in their original packaging.
- Protect the guideways against impacts and dampness/humidity.

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