SCHNEEBERGER
LINEAR TECHNOLOGY

MINIRAIL

The Miniature Guideway

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Table of Contents

MINIRAIL - the range of high-precision guideways

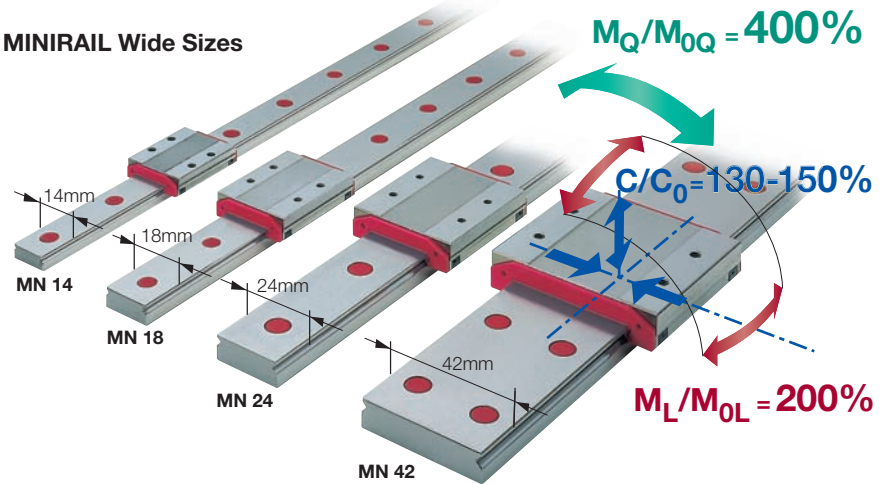**MINIRAIL – The 2-row miniature ball and rail guideway with high stability**
A quality product in accordance with the latest technological designs, consisting of a minimum number of components.

MINIRAIL
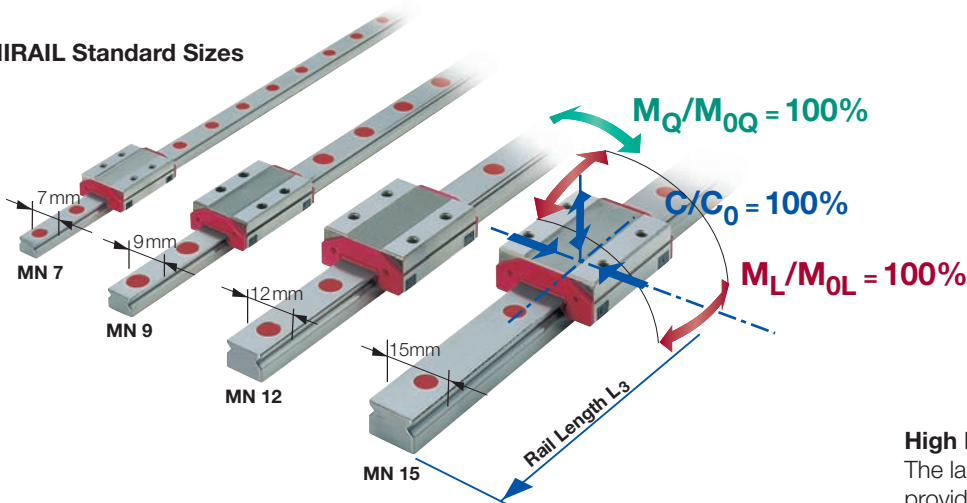**in 8 sizes according to DIN standards**
All installation and connection dimensions are in accordance with the DIN standard 645-2. The type designation of the individual products refers to the rail width in mm (e.g., MN 14 = rail width 14 mm). The design of the running tracks is based on the proprietary SCHNEEBERGER know-how. An interchangeability of rail and carriages exists within the MINIRAIL ranges.

MINIRAIL Wide Sizes

14mm
MN 14
18mm
MN 18
24mm
MN 24
42mm
MN 42

$M_Q/M_{0Q} = 400\%$
$C/C_0 = 130\text{-}150\%$
$M_L/M_{0L} = 200\%$

MINIRAIL Standard Sizes

7 mm
MN 7
9 mm
MN 9
12 mm
MN 12
15 mm
MN 15

Rail Length L_3

$M_Q/M_{0Q} = 100\%$
$C/C_0 = 100\%$
$M_L/M_{0L} = 100\%$

Rail Length L_3
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.

High Load Values and Torque
The large number of load-bearing balls provide the carriages with high permissible load values and torque. The MINIRAIL wide series in essence differ in the permissible transverse torque M_Q, which is up to 400% higher than that of the standard sizes.

Load-bearing values in accordance with the calculation DIN 636, part 2:
Co = static load
C = dynamic load (100 km)
Mo = static torque
M = dynamic torque (100 km)

## 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$_2$	ΔA / ΔB$_2$
G1, high-precision	±10 μm	7 μm
G3, precision	± 20 μm	15 μm
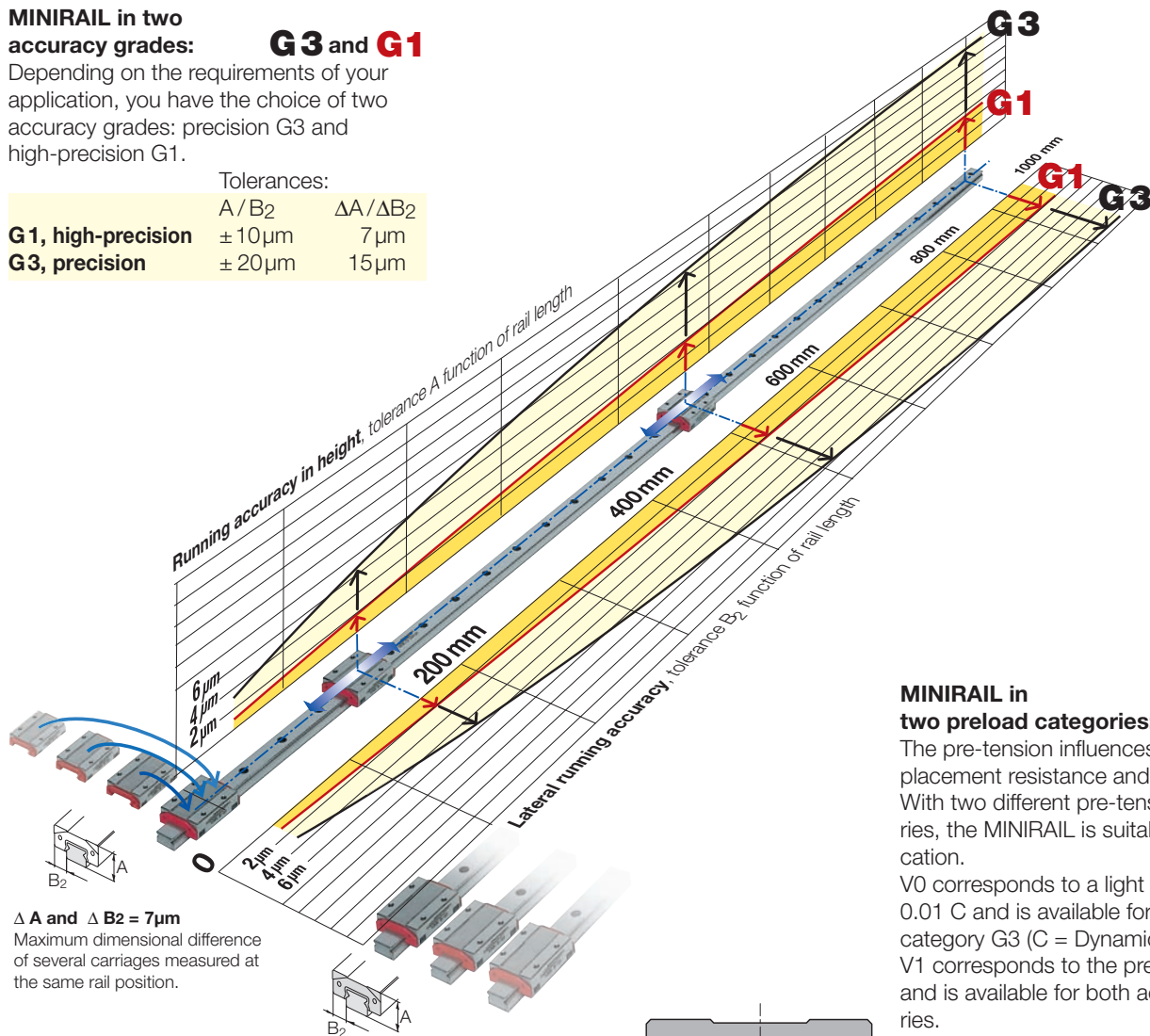
Δ **A and** Δ **B2 = 7μm**
Maximum dimensional difference of several carriages measured at the same rail position.

A and B$_2$ = ±10 μm
Maximum dimensional difference measured on several MINIRAIL-systems.

Δ < **1μm**
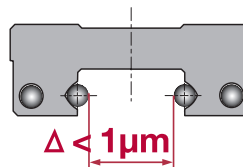
μm - Accuracy
Our manufacturing control of this precise dimension is decisive for the complete interchangeability of the rails from assembly to assembly and rail to rail.

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^2 • Incomparable

**High acceleration values
call for new solutions**

In the case of gearwheel or ball screw drives, the maximum speed was limited by the design of the linear guideway. In newer designs, the guideway is subjected to very high stresses as a result of the use of linear motors - the acceleration values have highly increased. Schneeberger's recirculation element (shown here) has been developed to withstand high stresses from demanding applications.

Optimized Material Selection

The ball recirculation devices are made out of a plastic material, which is capable of being subjected to high loads. The smooth running track surfaces are perfectly capable of accommodating the enormous centrifugal forces of the balls.
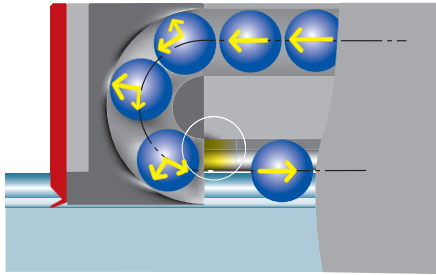
The Ball Entry Zone - A Decisive Point

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 of the ball recirculation system. The initial lubrication is applied at Schneeberger.
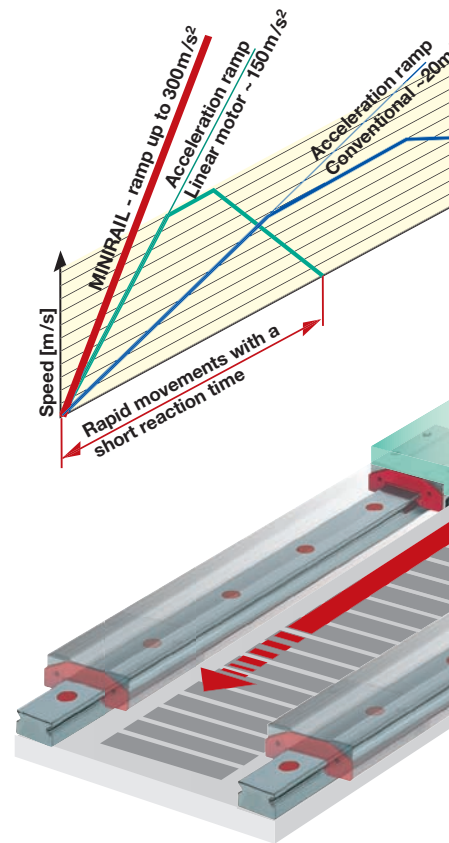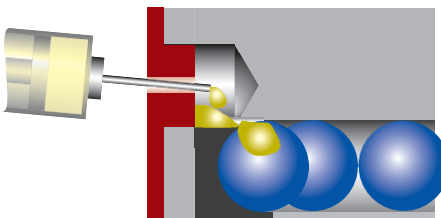
smoothness • Durable precision

Displacement force (N)

Stroke [mm]

Time [s]

Smoothness and Displacement Force
Running quietness and displacement force are important characteristic features of the ball guideway. The MINIRAIL carriages are interchangeable.
When the displacement powers are to lie within a determined tolerance (possible only on request), rails and wagons are paired and delivered as a set from the factory.

Carriages without 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.

Carefully Contoured Front Plates
To obtain quietness and extended life, rail and carriage assemblies require clean running surfaces - even under unfavorable conditions. Our MINIRAIL carriages are equipped with rail-wiping, contoured front plates.
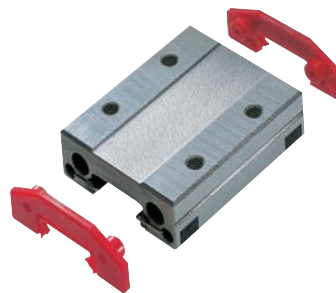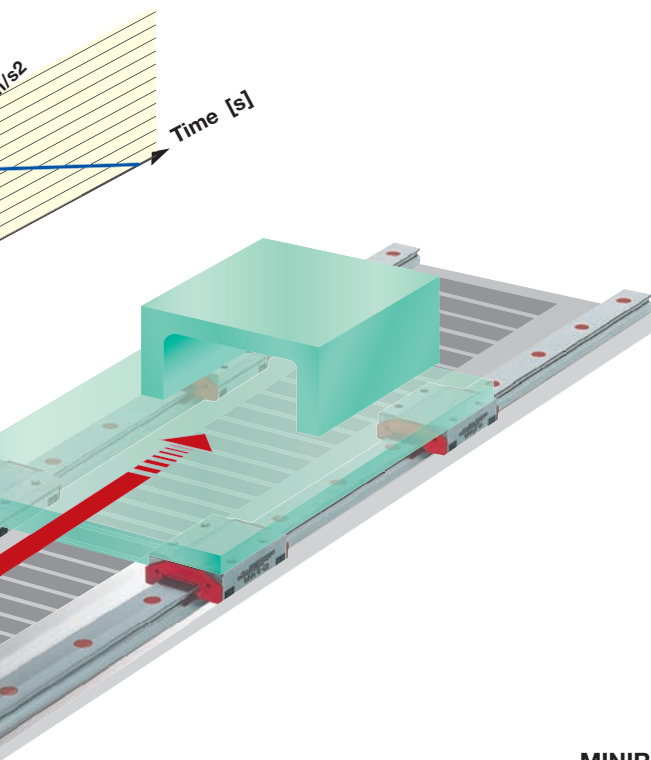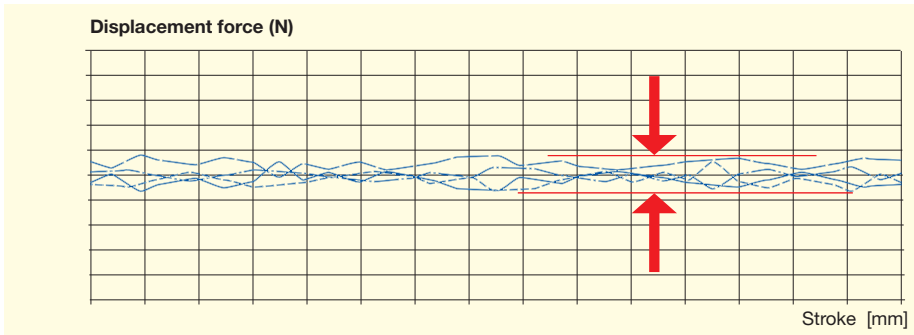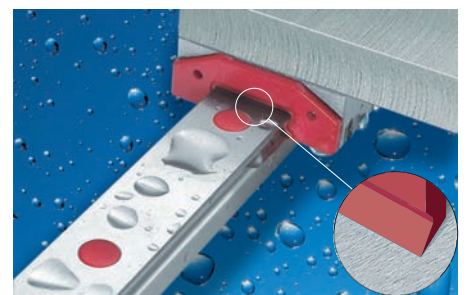
MINIRAIL rails and carriages
All rails and carriages are manufactured from corrosion-resistant, through-hardened steel and are suitable for utilization in the most diverse applications, such as clean room conditions.

SCHNEEBERGER - MINIRAIL is synonymous for reliability, competence and perfection in
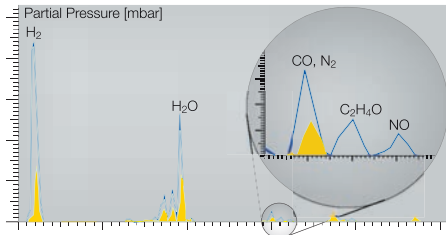
Vacuum capacity
MINIRAIL can be operated in high vacuum without any wiper (max. 10^{-7} mbar). Wipers are not suitable for operation in vacuum.

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.

**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 a prerequisite for quickly changing the carriages.

MINIRAIL - Protective Rail
MINIRAIL - carriages are shipped on a protective rail, in order to prevent any impairment by dirt or debris.

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all types of designs - all over the world.

Competent Application Engineering for a Longer Service Life
During your design phase, Schneeberger's competent engineers will assist you in the selection of a suitable product. With the optimal product selection and installation, the running characteristics of the MINIRAIL become effective and provide a long service life.
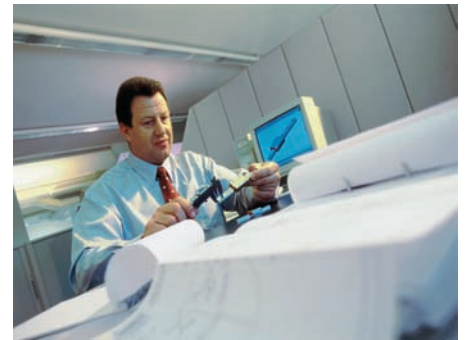
Clamping Element for Safety Purposes
The clamping element has been developed especially for Schneeberger's MINIRAIL. In normal operation, the clamping element is maintained in an open position by compressed air, and in the case of an electric power failure, the spring-force blocks all movement for operational safety.
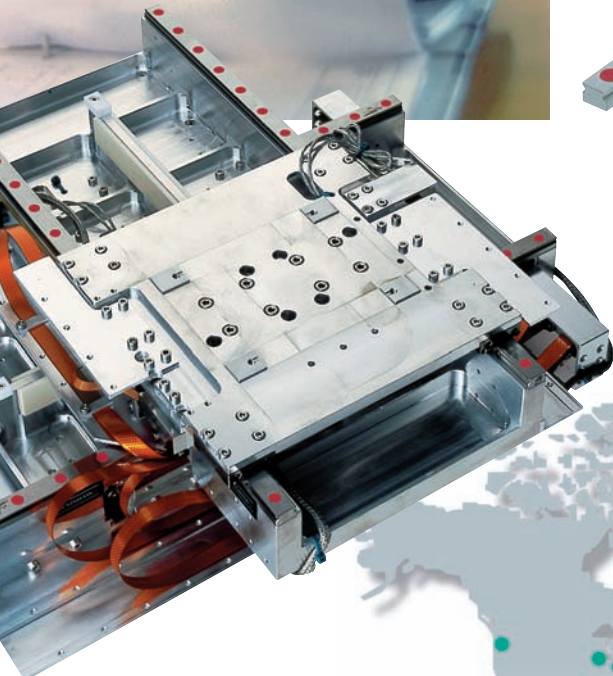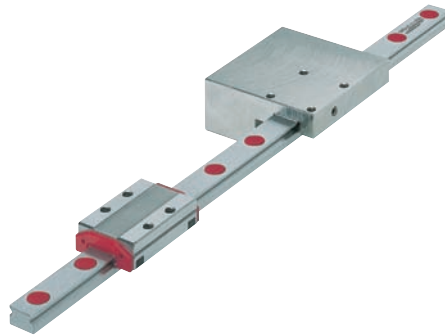
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With an extensive network of SCHNEEBERGER branch companies and exclusive representatives, we keep in contact with our customers all over the world.
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www.schneeberger.com

Technical Data
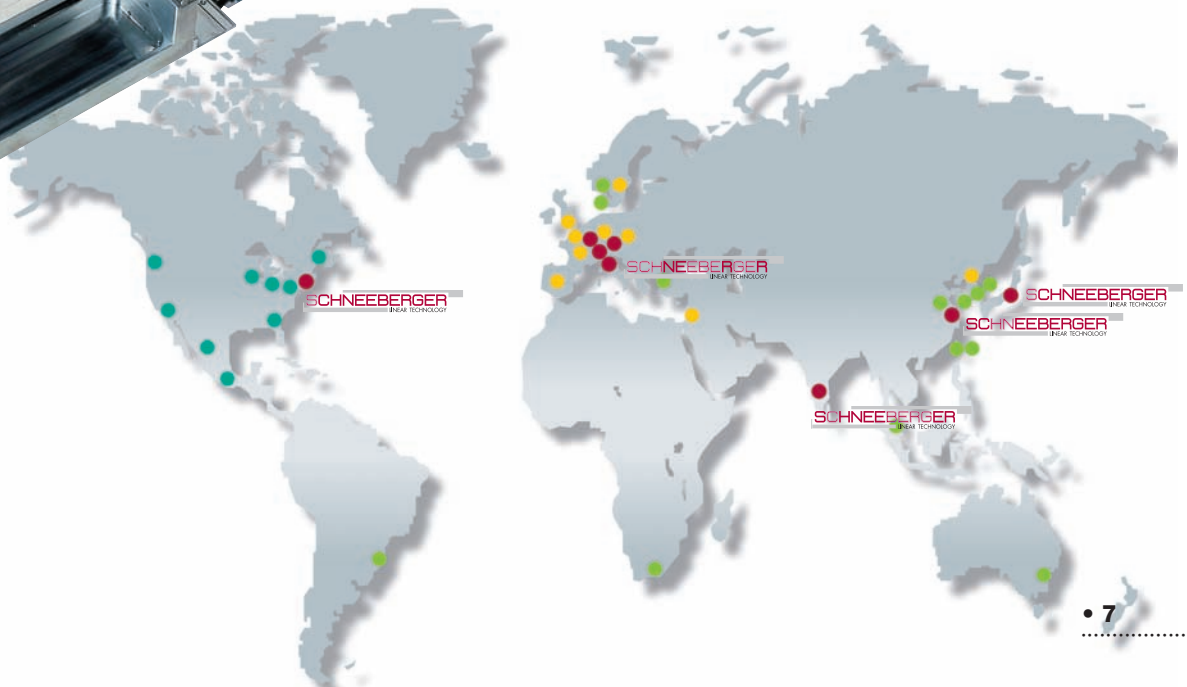
2.1 Accuracy classes

The MINIRAIL guideways are available in two accuracy classes.

Accuracy class	Tolerances [1] A and B_2	[2] Δ A and ΔB_2
G1	± 10 µm	7 µm
G3	± 20 µm	15 µm

[1] Measuring referring to the center of the carriage
[2] 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

Locating side   Marked side
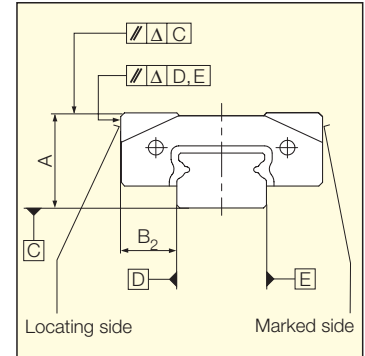
2.2 Running accuracy
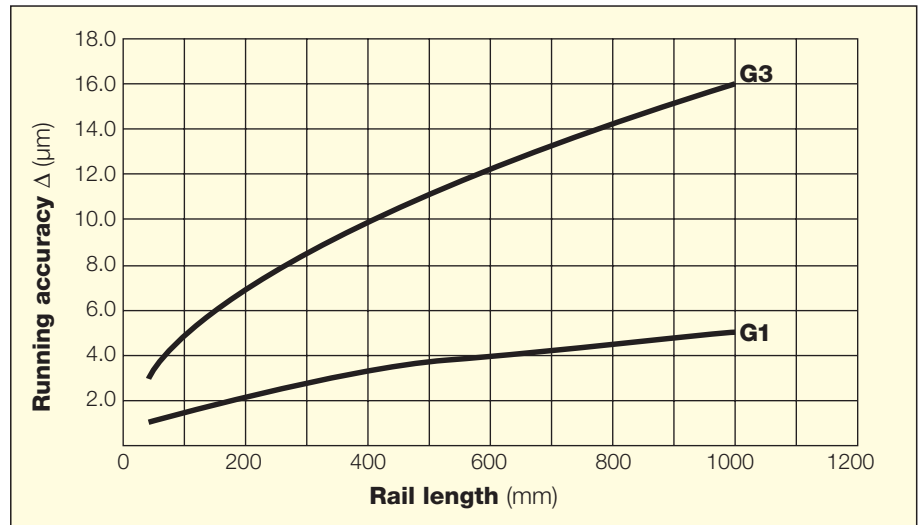
2.3 Preload classes V0, V1

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
V0	near clearance to 0.01 · C	G3
V1	0 to 0.03 · C	G1, G3

C = Dynamic loading capacity (see chapter 3.1 and 3.2)

2.4   Rail information

Rail lengths
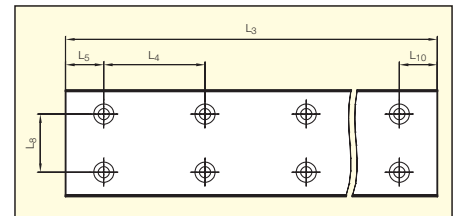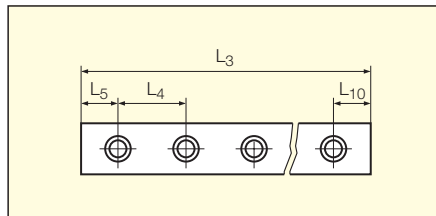
Standard rail lengths L_3 (length in mm)

Size	L_4	L_5, L_{10}	L_8	L_3	Max L_3
7	15	5	–	40, 55, 70, 85, …, 760	760
9	20	7.5	–	55, 75, 95, 115, …, 935	935
12	25	10	–	70, 95, 120, 145, …, 945	945
15	40	15	–	70, 110, 150, 190, …, 950	950
14	30	10	–	80, 110, 140, 170, …, 740	770
18	30	10	–	80, 110, 140, 170, …, 950	950
24	40	15	–	110, 150, 190, 230, …, 950	950
42	40	15	23	110. 150. 190, 230, …, 950	950

Custom rail lengths

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

$$L_3 = (n-1) \cdot L_4 + L_5 + L_{10} \qquad n = 3, 4, 5\dots \text{ (n = number of attaching holes)}$$

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	7	9	12	15	14	18	24	42
L_5, L_{10} minimum	4	5	5	5	5	5	6	6
L_5, L_{10} maximum	11	15	20	35	25	25	34	34

Tolerances for rail lengths and attaching holes

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

Rail	L_3, $X_n \leq 300$ mm	L_3, X_n 300 mm
t (mm)	0.3	$0.001 \cdot X_n$
L_3	± 0.3	$\pm 0.001 \cdot L_3$
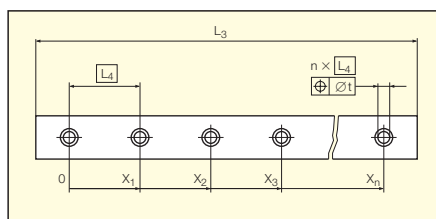
2.5	Lubrication	The front plates include two lubrication holes to allow independent lubrication for the right and left side of the carriage.

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. The required re-lubrication intervals as well as a lubrication prior to operation depend on the application and the operating conditions.
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.

Basic lubrication with grease

Initial lubrication and re-lubrication according to table.

Basic lubrication with grease per carriage in cm³							
MNN 7	**MNN 9**	**MNN 12**	**MNN 15**	**MNN 14**	**MNN 18**	**MNN 24**	**MNN 42**
0.04	0.09	0.15	0.25	0.05	0.11	0.20	0.33

Basic lubrication with oil

Initial lubrication and re-lubrication until oil escapes.

Re-lubrication:

Recommended values:
The basic lubrication is sufficient for 3000 km of travel, based on the follwoing factors:
load ratio C/P = 10
speed = 1 m/s
stroke = 150 mm

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Technical Data

2.6   General data

**Permissible speeds
and accelerations**

General applications under normal operating conditions:

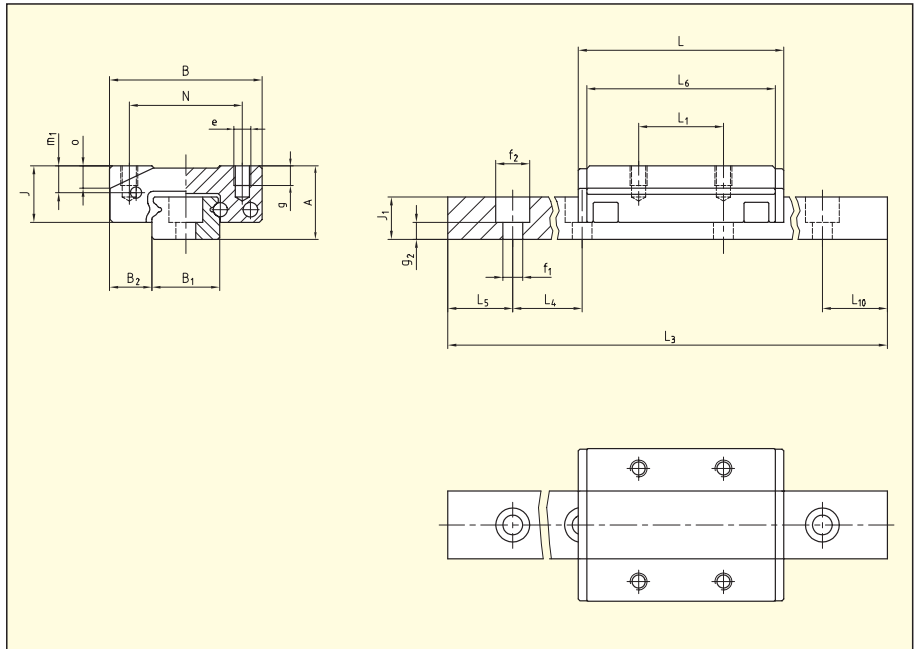| Speeds up to	5 m/s
Accelerations up to	300 m/s^2

**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.

• 11

**3.1 Dimension table, loading capacities
Sizes 7, 9, 12, 15**

Type	Dimensions (mm)																			
	A	B	B_1	B_2	J	J_1	L	L_1	L_4	L_5/L_{10}	L_6	N	e	f_1	f_2	g	g_2	m_1	o
MN 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
MN 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
MN 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
MN 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

Type	Loading capacities		Moments				Weights Carriage Rail	
	C_0 (N)	C (N)	M_{0Q} (Nm)	M_{0L} (Nm)	M_Q (Nm)	M_L (Nm)	(g)	(g/m)
MN 7	1560	925	5.6	4.3	3.3	2.5	12.8	216.3
MN 9	2770	1690	12.9	10.2	7.9	6.2	23.9	308.8
MN 12	3900	2510	23.8	16.3	15.3	10.4	47.4	597.9
MN 15	5620	3680	42.7	28.1	27.9	18.4	81.4	995.5
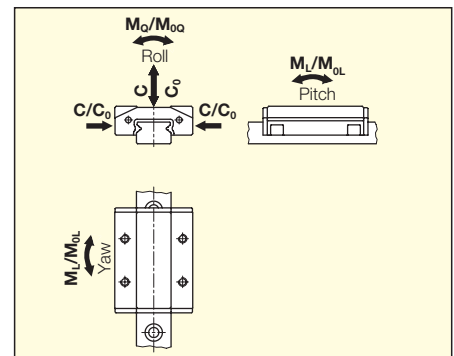
Loading capacities are calculated values, based on DIN 636-2
C_0 = static loading capacity
C = dynamic loading capacity (100 km)
M_0 = static moment
M = dynamic moment (100 km)

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3.2 Dimension table, loading capacities Sizes 14, 18, 24, 42

Type	Dimensions (mm)																				
	A	B	B_1	B_2	J	J_1	L	L_1	L_4	L_5/L_{10}	L_6	L_8	N	e	f_1	f_2	g	g_2	m_1	o
MN 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	12	30	18	6	8.5	7	40	12	30	10	37	–	21	M3	3.5	6	3	2.5	4.3	3.1
MN 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	16	60	42	9	12	9.5	55.7	20	40	15	52.7	23	45	M4	4.5	8	4.5	5	5.5	4.9

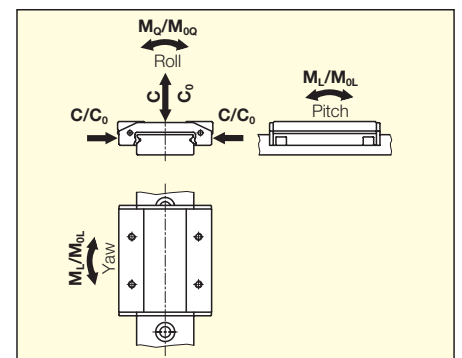| Type	Loading capacities		Moments				Weights	
	C_0 (N)	C (N)	M_{0Q} (Nm)	M_{0L} (Nm)	M_Q (Nm)	M_L (Nm)	Carriage (g)	Rail (g/m)
MN 14	2340	1230	16.6	9.3	8.7	4.9	25	518.3
MN 18	3880	2140	35.5	19.4	19.6	10.7	47	914.6
MN 24	5630	3240	68.2	32.9	39.2	18.9	84	1473.0
MN 42	8110	4750	171.2	56.8	100.3	33.3	169	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)

3.3 Accessories – must be ordered separately

Plastic plugs MNK

Plastic plugs can be used to close the rail attachment holes.
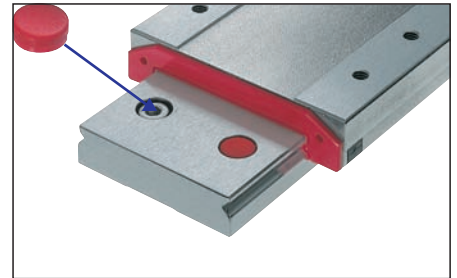
MINIRAIL Type	Plastic plugs Type	Plastic plugs can be combined with attaching screws of type		
		DIN 912	DIN 7984	ISO 7380
MN 7	MNK 4	–	–	x
MN 9	MNK 6	–	x	x
MN 12	MNK 6	x	x	x
MN 15	MNK 6	x	x	x
MN 14	MNK 6	–	x	x
MN 18	MNK 6	x	x	x
MN 24	MNK 8	–	x	x
MN 42	MNK 8	–	x	x

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!
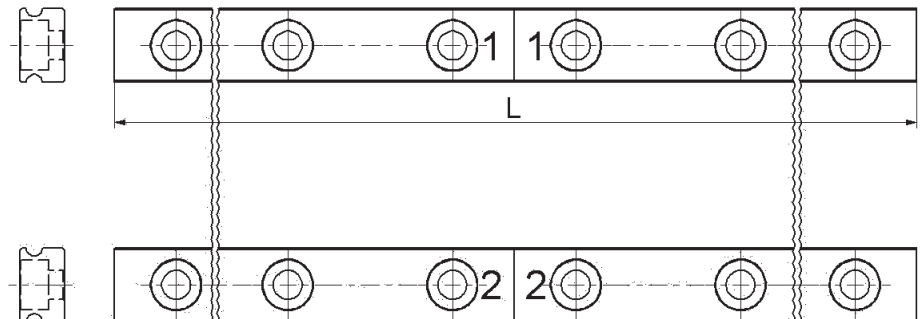
3.4   Ordering information MINIRAIL

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

Carriage MINIRAIL MNN

			__	MNN	9	- G1

Quantity		
Carriage type	**MNN**	
Size	**7, 9, 12, 15, 14, 18, 24, 42**	
Accuracy class	**G1, G3**	

Guideway MINIRAIL MN

		__	MN	9	-155	-7.5	-7.5	- G1	-V1	ZG

Quantity		
Guideway type	**MN**	
Size	**7, 9, 12, 15, 14, 18, 24, 42**	
Rail length	L_3 (in mm)	
Starting hole pitch	L_5 (in mm)*	
End hole pitch	L_{10} (in mm)*	
Accuracy class	**G1, G3**	
Preload class	**V0, V1**	
Ground together		

* Indicate only if special pitch

Accessories MINIRAIL MN

Re-lubrication set

		__	MNW

Quantity		
Type	**MNW**	

Plastic plugs MNK

		__	MNK	6

Quantity		
Type	**MNK**	
Size	**4, 6, 8**	

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 ist done as follows:

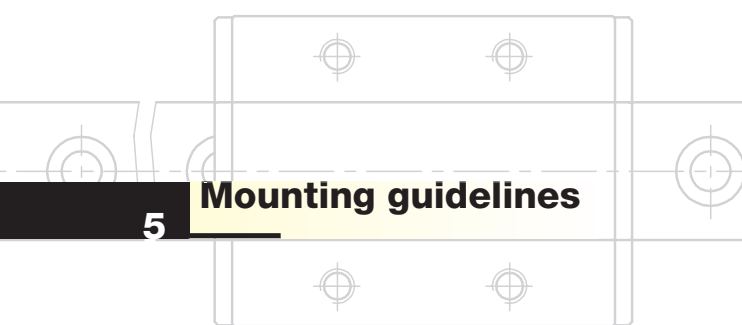$$C_{50} = 1.26 \cdot C_{100}$$

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

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

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⁻¹)
v_m = average traversing speed (m/min)

5.1 Tightening torques for rails and carriages

**Tightening torques for fastening screws DIN 912, μ 0,125 (12,9) and DIN 912, μ 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_2 the friction coefficient μ 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.

Mounting guidelines

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.
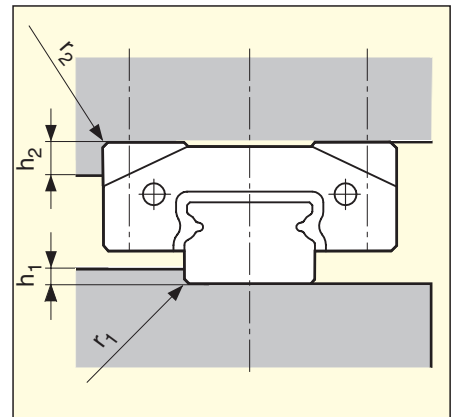
Size	h_1	$r_{1\ max}$	$r_{2\ max}$	h_2
7	1.2	0.2	0.3	2.5
9	1.5	0.3	0.4	3
12	2.5	0.4	0.4	4
15	3.5	0.5	0.5	5
14	1.8	0.2	0.4	2
18	3	0.3	0.5	3
24	3.5	0.4	0.5	4
42	3.5	0.5	0.6	5

## 5.3 Configuration of assembly surfaces

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

The surface quality of the supporting structure has no direct influence on the operational and run-out behavior. A roughness average ratio of R_a 0.4 to 1.6 µm 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).
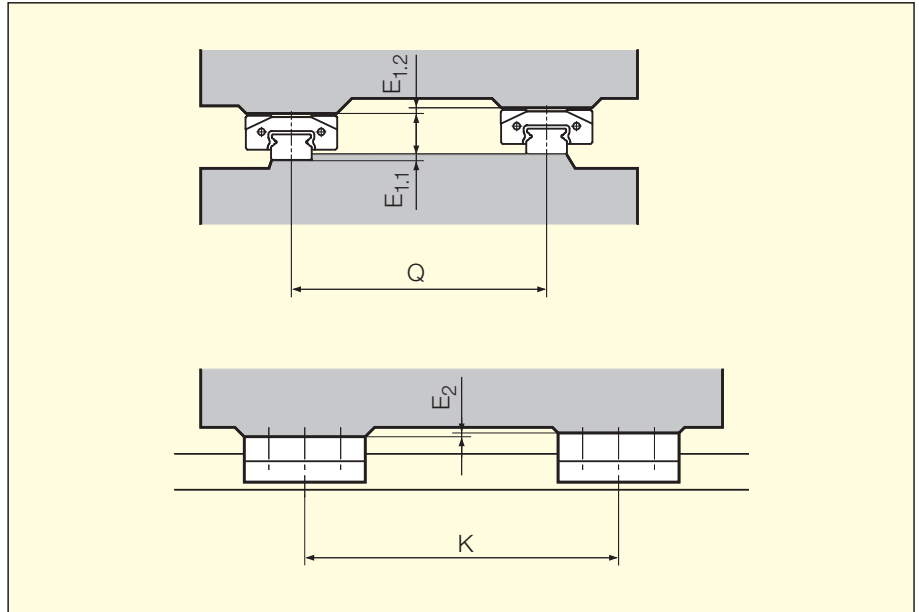
	MNN	V0	V1
$E_1 = E_{1.1} + E_{1.2}$	7, 9, 12, 15	0.00025 Q	0.00015 Q
E_2	7, 9, 12, 15	0.00005 K	0.00005 K
$E_1 = E_{1.1} + E_{1.2}$	14, 18, 24, 42	0.00013 Q	0.00008 Q
E_2	14, 18, 24, 42	0.00004 K	0.00004 K

Example of calculation

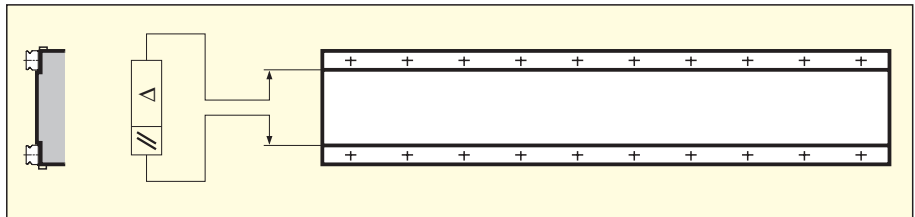| Nominal:	Type	MNN 12
	Preload class	V1
	Gap Q	120 mm

Target: Admissible height difference E_1

Calculation: 0.00015 x 120 mm = <u>0.018 mm</u>

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

Mounting guidelines

• **19**

| 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**
V0	0.003	0.005	0.008	0.01
V1	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** at menu DOWNLOAD or be ordered from SCHNEEBERGER.

As delivered condition

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

Transportation and intermediate storage

The MINIRAIL guideways 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 guideways in their original packaging.
• Protect the guideways against impacts and dampness/humidity.