

MONORAIL

Profiled Linear Guideway

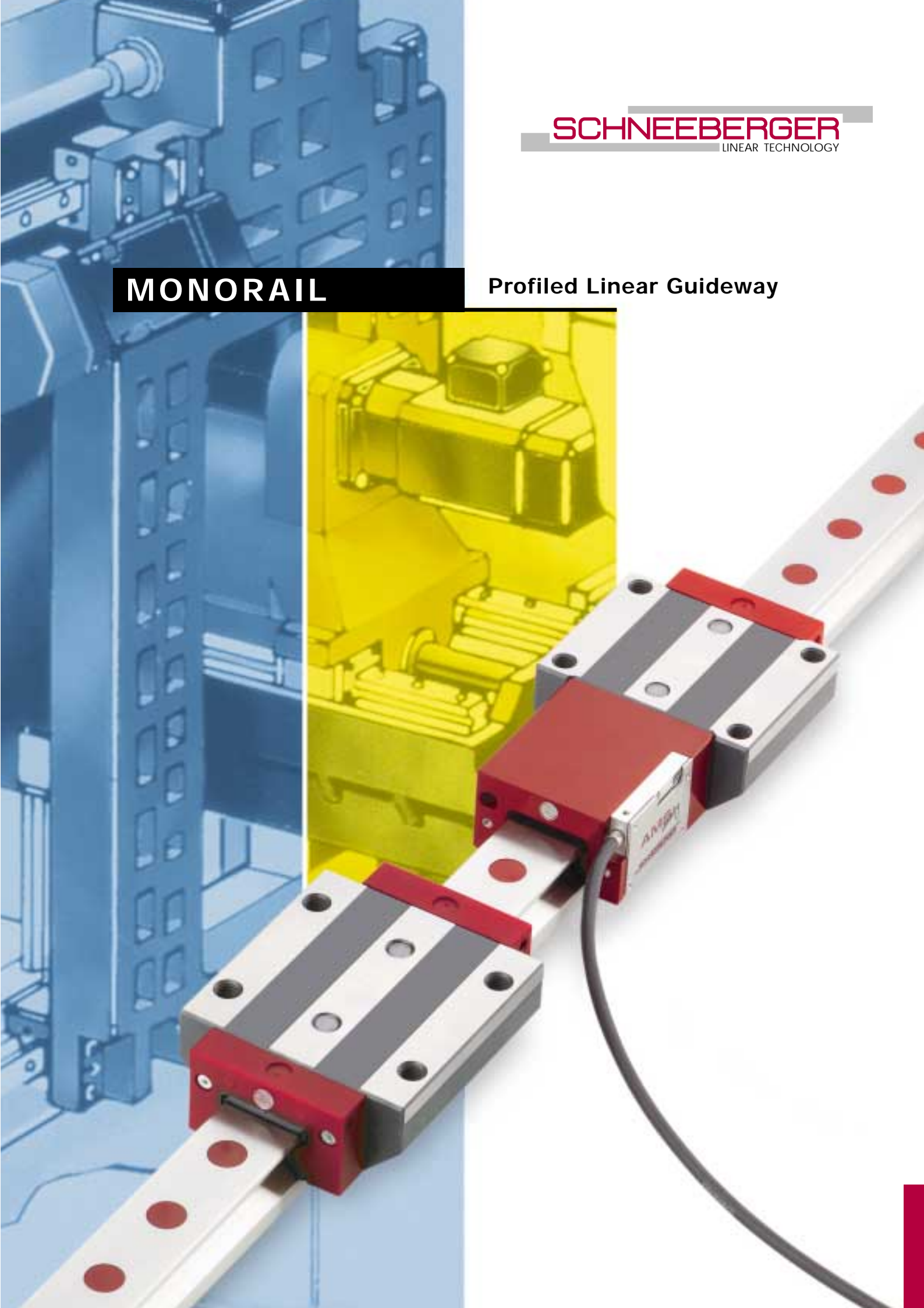


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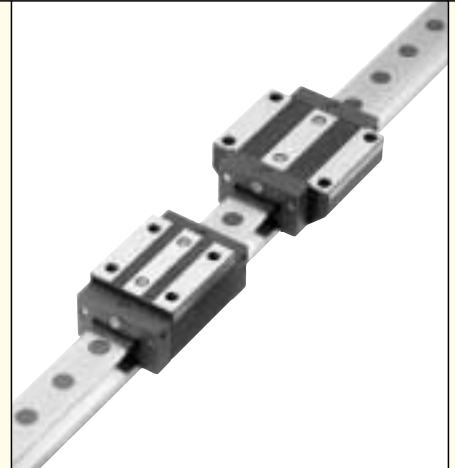
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Product Overview

1

1.1 Roller-MONORAIL MR

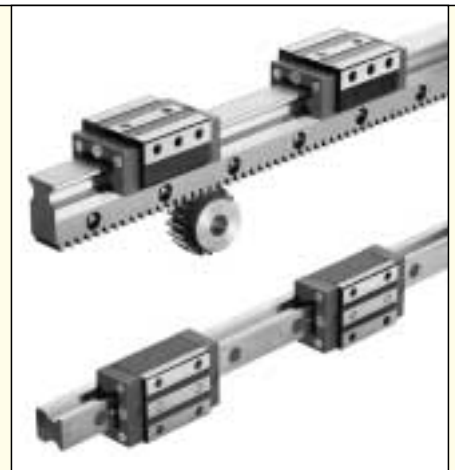
High rigidity, great dynamic and static load carrying capacity, outstanding running smoothness and the total enclosure of the carriage are the main features of the MONORAIL guideway. These properties result in higher machining rates while enhancing geometrical accuracy and surface quality of the machined workpieces. Our highly rigid MONORAIL provides improved vibration behavior, smaller vibration amplitudes and thus extends tool life. SCHNEEBERGER has systematically applied its many years of experience in the design, production and use of roller-type anti-friction guideways in the development of the MONORAIL. Consequently the MONORAIL is a cost-effective anti-friction guideway which meets the challenge presented by modern machine design.



1.2 Roller-MONORAIL MZ

In the handling and automation industry increasing use is being made of linear guiding systems with additional features. The ever increasing cost pressure and quality demands on handling and automation systems in industrial applications are satisfied by MONORAIL MZ:

- Extremely simple dimensioning and design of the connecting structure.
- Logical mounting of the guiderail and carriage systems.
- Optimal load-carrying capacity and service life based on the well-known MONORAIL machine guideway.
- Minimum servicing and maintenance as the design of the MONORAIL is conceived for industrial usage.
- Life and speed uncompromisingly match the user's requirements.



Types and Sizes

MRA, MRB, MRC, MRD
MR 25, 35, 45, 55, 65

Accessories

- Rail cover strip MAB
- Plastic plug MRK
- Brass plug MRS
- Steel plug MRZ
- NEW** ● Additional wiper ZCN, ZCV
- Metal wiper ASM
- Bellows FBM
- NEW** ● Lubrication Plate SPL
- Assembly rail MRM
- NEW** ● Brakes and Clamps

Available options

- Hard-chromed rails
- Hard-chromed carriages
- Through hardened rails
- Special hole spacings
- Additional alignment bores and threads

Types and Sizes

MRE
MZ 25, 35

Accessories

- NEW** ● Additional wiper ZCN, ZCV
- Metal wiper ASM
- NEW** ● Lubrication plate SPL
- Assembly rail MRM
- Standard pinion MZR

Available options

- Special rail length
- Other carriage types
- Helical rack version
- Special tooth pitch
- Rail without rack MO

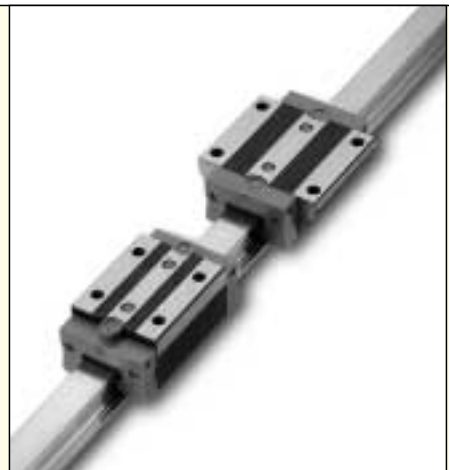
1.3 MONORAIL AMS

SCHNEEBERGER develops and produces integrated distance measuring systems for MONORAIL roller guideways. The technical level achieved sets standards with respect to economy, accuracy and reliability. The AMS (Advanced Measuring System) represents the current technical state of the art and is primarily utilized in machine tools. For various interfaces, powerful signal forming electronic systems are available from SCHNEEBERGER.



1.4 Ball-MONORAIL BM

Very good dynamic characteristics and high economy are the distinguishing features of the Schneeberger ball linear guideway MONORAIL BM. The novel design with few but optimally designed components, because the small number of transitions (joints) in the ball tracks makes outstanding running characteristics possible, which are distinguished by smooth running, little pulsation, low friction values and high travelling speeds. This robust linear guideway has a wide variety of possible applications and is an ideal complement to the roller guideway MR.



Types and Sizes

AMS_A (analog)
25, 35, 45, 55, 65

Accessories

- SMEa interpolation electronics
- Extension/connection cables

Types and Sizes

BMA, BMB, BMC, BMD
BM 15, 20, 25, 30, 35, 45

Accessories

- Rail cover strip BAB
 - Plastic plug BRK
 - Additional wipers ZBN/ZBV and ZBN-U/ZBV-U
 - Metal wipers ABM
 - Bellows FBB
 - Assembly rail MBM
 - Brakes and Clamps
- NEW**
- NEW**
- NEW**

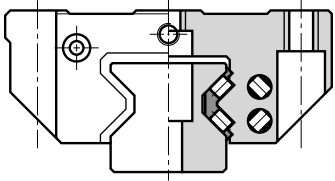
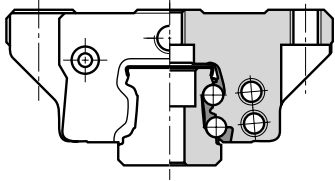
Available options

- Hard-chromed rails
- Hard-chromed carriage
- Special hole spacings
- Additional alignment bores and threads

MONORAIL-Fields of Application and Operating Conditions

MR			Accuracy classes		
			G0	G1	G2
BM			Fields of application		
			Measuring machines dressing units, special applications		
Preload classes					
V1		V2		V3	
Operating conditions					
Low-friction guideways for uniform loads, slight vibrations		For high rigidity, medium, changing loads and vibrations		For highest rigidity, high impact/shock loads and vibrations, strongly changing, high loads and torques	
Characteristics					

MONORAIL-Linear Guideways

Type	Roller MONORAIL MR	Ball MONORAIL BM
Design		
Technical characteristics	4 roller tracks in O-geometry, rollers with convex surface, completely sealed carriages, main dimensions in accordance with DIN 645-1, many versions and lubrication possibilities as well as numerous accessories for a broad application range	4 rows of balls with 2-point contact in O-geometry, optimized track geometry with a low number of transitions, small number of components, reduced maintenance as a result of integrated lubricant reservoirs, completely sealed carriages, trapezoidal-shaped rail section for a high rigidity and easier replacement of parts subject to wear, main dimensions in accordance with DIN 645-1
Loading capacity	●●●●	●●
Rigidity	●●●●	●●●
Accuracy	●●●●	●●●●
Service lifetime	●●●●	●●●
Running characteristics/pulsation	●●	●●●●
Friction characteristics	●●	●●●●
Admissible speed	●●●	●●●●
Easy installation and maintainance	●●●	●●●●
Requirements on accuracy and rigidity of the surrounding structure	●●	●●●
Integrated measuring system	yes	no
Integrated rack	yes	no
Main fields of application	Machine tools for high metal removal performance capacities and long service lifetimes, machines/installations with minimum assembly dimensions, CNC machining centers, CNC lathes, CNC grinding machines, EDM machines, injection molding machines	Machine tools for smaller and medium metal removal performance capacities, auxiliary axes, wood processing machines, sheet-metal processing machines, water-jet-/laser cutting installations, automatic punching/stamping machines, robotics, handling devices and automation technology, electronics and semiconductor technology, measuring technology, medical technology

●●●● = excellent

● = satisfactory

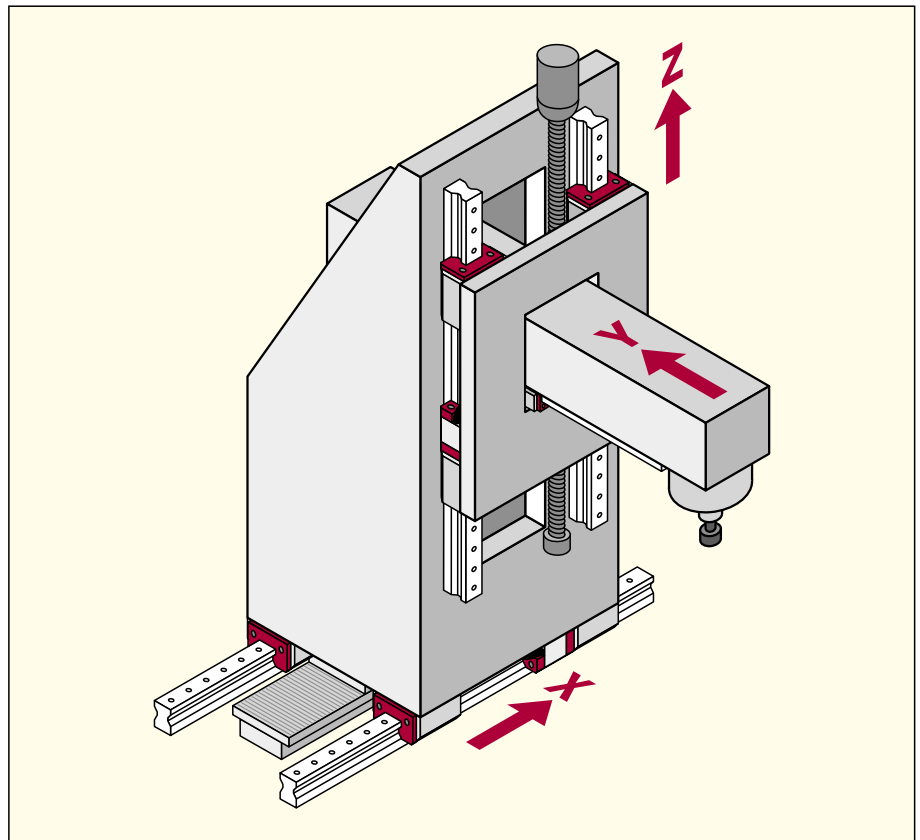
2.1 MONORAIL MR in a 3-axis drilling and milling machine with integrated distance measuring system AMS

The machine

The 3-axis drilling and milling machine in moving column construction is utilized in manufacturing systems for the production of series components. This construction is particularly adapted to short machining times and high speed. The Y- and Z-axes are driven with servomotors through balls screw drives, the X-axis with a linear motor. All axes are equipped with roller linear guideways MONORAIL MR with integrated magnetic distance measuring system AMS. The working space is $1400 \times 100 \times 200$ mm (X–Y–Z).

The requirements

Because the machine concept was a very compact design with high speed linear drive, the essential guideway criteria were high rigidity and small size. In addition, a solution for the integration of a high-resolution distance measuring system had to be found.



The SCHNEEBERGER solution

With the MONORAIL MR in this application, the advantages of a compact roller guideway in O-geometry, such as high rigidity and load-bearing capacity as well as static and dynamic precision with a minimum size, were realized. In the X-axis the size MRD 35 could be utilized despite the high attractive force of the linear motor. Because of the very restricted space conditions for the Y-axis, the described solution could only be achieved with the utilization of the compact size MR 25 and the integration of the magnetic scale into the guide rail.

The essential advantages

- Compact machine construction due to a reduced size of the guideways and the integrated distance measuring system
- Improved machine precision with high dynamics due to the high rigidity values of the roller guideway
- Reduced manufacturing and assembly effort because of the integration of the distance measuring system AMS into the guideway
- Operational stability of the distance measuring system by means of optimized mechanics and electronics, even though the linear drive was in close proximity
- High safety margins and long service lifetime due to the high load bearing capacity of the MONORAIL MR guideways
- Elimination of covers in the Y-axis by using guide carriages sealed on all sides

SCHNEEBERGER products utilized

X-axis	2 × MR 35-D2-1800-G1-V3
	1 × AMSA 35-1800-SI
Y-axis	2 × MR 25-C2-0350-G1-V3
	1 × AMSA 25-0350-SI
Z-axis	2 × MR 35-C2-0450-G1-V3
	1 × AMSA 35-0450-SI

2.2 MONORAIL MZ with integrated rack in a 3-axis profile/contour machining machine

The function

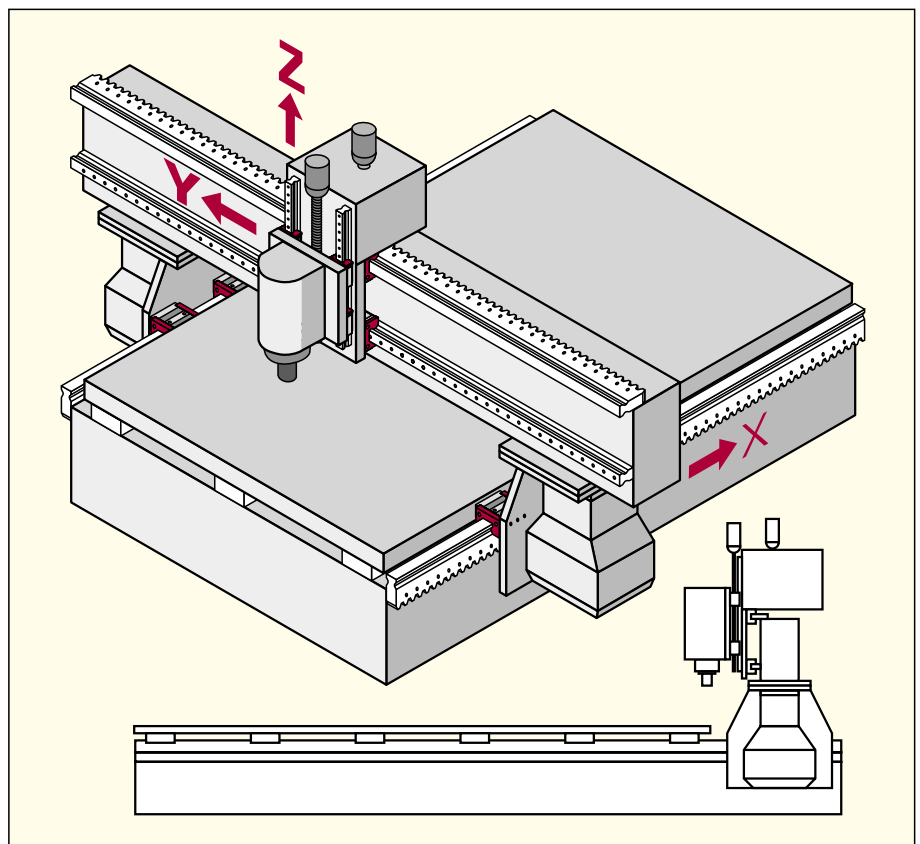
The 3-axis machine in gantry construction serves for profile / contour milling, drilling and the carving of materials such as wood or acrylic glass. Both the X-axis as well as the Y-axis are equipped with MONORAIL MZ roller guideways, whereby the drive is through the integrated rack. The Z-axis is equipped with two standard MONORAILs MR. Here the drive is a recirculating ball spindle.

The requirements

When developing this new robust generation of machines for heavy-duty applications, the increase of the cutting performance capacity and a high reliability of the machine were primary objectives. At the same time, the precision and the surface quality were also improved.

The SCHNEEBERGER solution

The high demands set could be fulfilled by the utilization of MONORAIL roller guideways MZ with integrated rack instead of the ball guideways with separate rack previously utilized. The SCHNEEBERGER product in an ideal manner combines the advantages of the roller guideway, such as a high load-bearing capacity and rigidity with the precision of the straight toothed MZ rack.



The essential advantages

- Space saving by utilizing the roller guideway size 25 (previously ball guideway size 35)
- Savings in time and cost by the elimination of machining – and aligning effort for the separate rack
- Higher positioning accuracy and repeatability by a defined pinion pre-loading of the precise MZ rack
- High cutting capacity
- Improved surface quality

SCHNEEBERGER products utilized

X-axis	2 × MZ 25-E2-5400-G3-V1
Y-axis	1 × MZ 25-E2-3350-G3-V1 and 1 × MR 25-C2-3350-X-G3-V1
Z-axis	2 × MR 25-C2-0510-X-G3-V1

2.3 MONORAIL BM in a 4-axis drilling and milling center for printed circuit boards

The machine

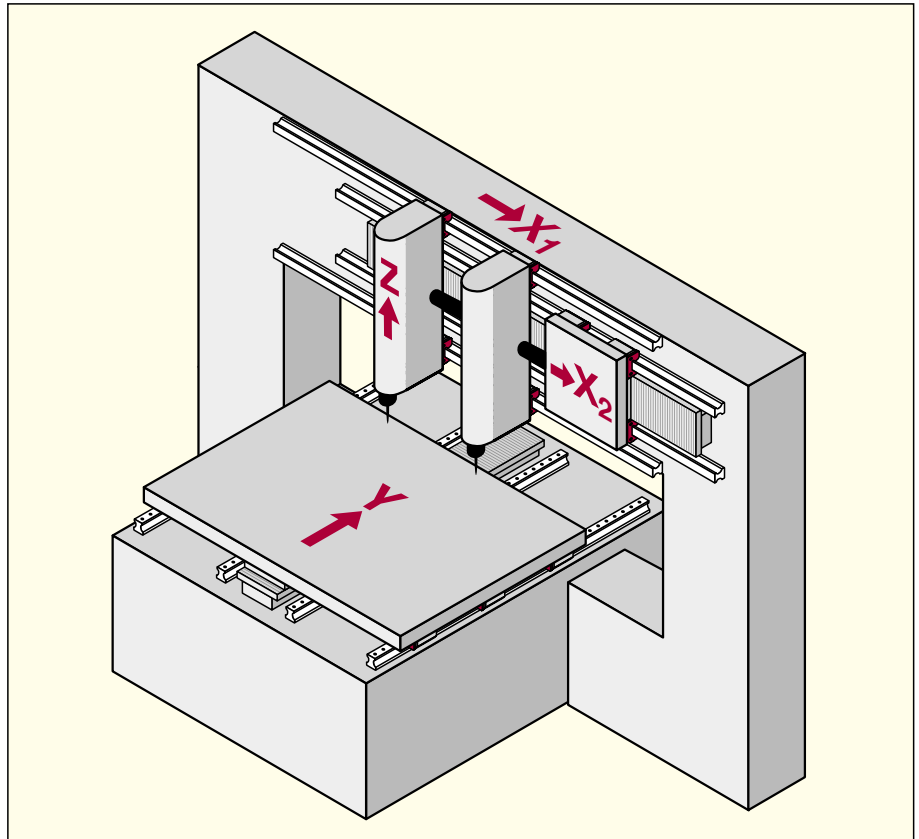
On the 4-axis drilling and milling center in gantry construction printed circuit boards are machined. Depending on the version, on the X1-axis there are up to 6 drilling heads, which are coupled to one another via connecting rods and are synchronously moved by means of a common linear motor. With this, several workpieces can be processed simultaneously. The drive itself is located on the separate X2-axis, which like the X1-axis is equipped with high-precision ball MONORAIL BM. The machine table (Y-axis) for moving the workpiece is also equipped with MONORAIL BM guideways and a linear drive. The tool feed in the Z-axis is effected using servomotors.

The requirements

The machine outlined set new standards in its class with respect to performance capacity, precision, high up-time and low maintenance requirements. For the guideways this meant high demands on the rigidity and running precision of the individual carriages, because, despite the high accuracy, the design utilized only one carriage per rail to support each drilling head.

The SCHNEEBERGER solution

The special requirements in this application are appropriately fulfilled by the SCHNEEBERGER ball guideway MONORAIL BM, due to its excellent running characteristics and its high economy. The comparatively high rigidity as well as the straightness of the guideways BM 25 is even improved in the X1- and X2-axes by the utilization of rails with a halved attachment hole spacing. In the Y-axis with the high magnet forces resulting from the linear drive, 4 rails are utilized because of the demanded low deflection (sag) of the table. Here too, thanks to its optimized load-bearing capacity, a ball guideway MONORAIL BM 35 is utilized.



The essential advantages

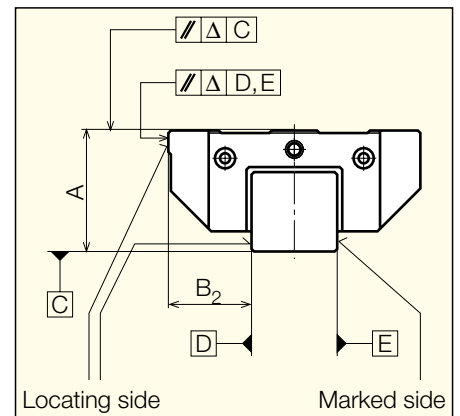
- High machine accuracy due to rigid guideways with optimized running characteristics, i. e., low and uniform friction, low pulsation and high running precision of the individual carriages
- Improved performance capacity, i. e., high speeds and accelerations due to the optimized track geometry and low mass
- Savings in space and weight with size BM 25 while retaining high load-bearing capacity and rigidity
- Robustness resulting from a small number of components and complete sealing
- Low maintenance effort due to the easy replacement of parts subject to wear on the rail and extended lubrication intervals

SCHNEEBERGER products utilized

X1-axis:	2 × BM 25-D2-3240-X-G0-V1
X2-axis (linear drive):	2 × BM 25-C2-1860-G0-V1
Y-axis:	4 × BM 25-C3-1560-G0-V1

3.1 Accuracy classes G0, G1, G2, G3

The four accuracy classes allow the user to select the configuration of MONORAIL guideways that best meets specific application-design requirements. The accuracy classes determine the dimensional tolerances and running accuracy of the carriages on the rails.

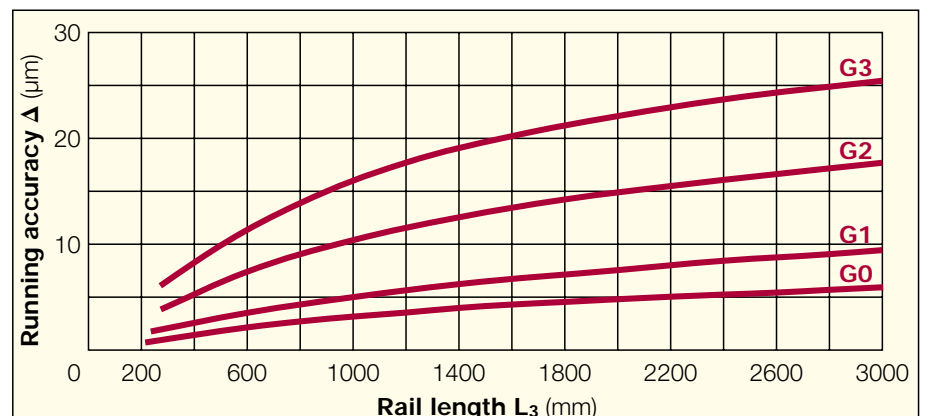


3.2 Dimensional tolerances

Accuracy-class	Tolerances * A and B ₂	1 rail ** Δ A and ΔB ₂	2 or more rails *** Δ A standard	*** Δ A matched
G0	± 5 μm	3 μm	10 μm	5 μm
G1	± 10 μm	5 μm	20 μm	7 μm
G2	± 20 μm	10 μm	40 μm	10 μm
G3	± 50 μm	25 μm	100 μm	25 μm

* Measured at the middle of the carriage.
 ** Dimension difference between two or more carriages of a rail measured at the middle of the carriage and at the same rail position.
 *** Dimension difference of the carriages when two or more rails are used side-by-side measured at the middle of the carriage and at the same rail position (state **-GP** matched when ordering).

3.3 Running accuracy Δ of the carriages on the rails



The running of the carriages within the limits of the tolerance can have a linear or wave-shaped course. The height of the tolerance is determined from the adjacent diagram in function of the rail length and the accuracy class. Example: L₃ = 2000 mm with G2 results in a permissible tolerance of 0.015 mm.

3.4 Preload classes V1, V2, V3

Preloading increases the rigidity of the guideway but also affects operational life and increases translation resistance. The MONORAIL system is available in various preload classes that correspond to the individual accuracy classes to address specific application requirements. The preload is dependent on the dynamic loading capacity C.

Preload class	Preload	Accuracy class
V1	$0.03 \cdot C$	G0, G1, G2, G3
V2	$0.08 \cdot C$	G0, G1, G2, G3
V3	$0.13 \cdot C$	G0, G1, G2, G3

3.5 Rails and carriage information

Rail lengths

Maximum length of single-piece rails L₃

Single-piece rails are manufactured in lengths according to the following chart. Longer rails consist of several pieces with butt joints. The joints are always in the middle of two attaching holes located.

Rail ends of part segments, which are joined together, are ground on the front side and have sharp edges. External rail ends and the ends of single-piece rails are cut on the end sides and deburred. Depending on the deburring process, the ends can manifest a black discoloration. This discoloration has no influence whatsoever on the quality.

Maximum length of single-piece rails L ₃ (lengths in mm)		15	20	25	30	35	45	55	65
Type	Hardening proc.								
MR	inductive through hardened			3000 2000		3000 2000		3000 1800	
BM	inductive through hardened	1500	1500	3000					
MZ	inductive			2400		2400			

Standard rails lengths

The standard rail lengths are

for MONORAIL MR and BM $L_3 = (n \cdot L_4 - 2 \text{ mm})$, for MONORAIL MZ $L_3 = n \cdot L_4$

Custom rail lengths

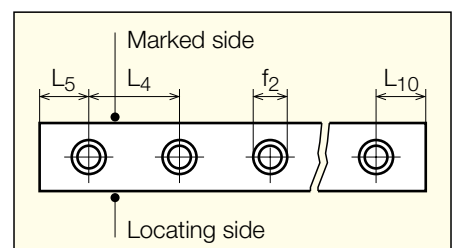
Rail lengths other than those standard rail lengths above are calculated according to the following formula:

$$L_3 = n \cdot L_4 + L_5 + L_{10} \text{ mm}$$

The following values should be maintained for hole pitch L₅ and L₁₀:

$$L_{5 \text{ max}}, L_{10 \text{ max}} = L_4 - \left(\frac{f_2}{2} + 1 \right) \text{ mm}$$

$$L_{5 \text{ min}}, L_{10 \text{ min}} = \frac{f_2}{2} + 1 \text{ mm}$$



*n = 3, 4, 5...

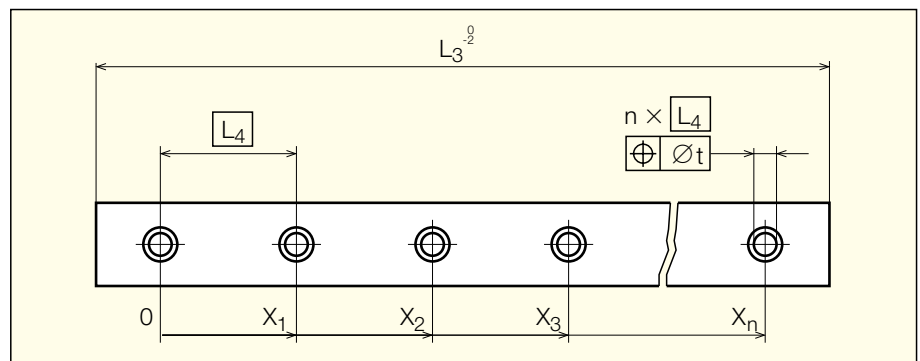
Tolerances for rail lengths and attaching holes

The length tolerance for single- and multi-piece rails is $L_3 \begin{smallmatrix} 0 \\ -2 \end{smallmatrix}$ mm

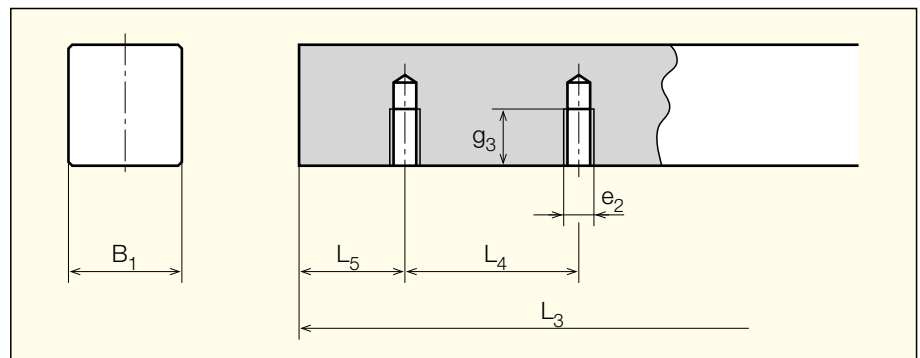
The position tolerance of the attaching holes in single- and multi-piece rails is:

Inductive hardened rails	BM 15–45, MR 25–65	
t (mm) according to DIN ISO 1101	0.4	

Through hardened rails	$X_n \leq 600$ mm	$X_n > 600$ mm
t (mm)	0.6	$0.001 \cdot X_n$



Rails with tapped attachment holes at the bottom



Size	15	20	25	30	35	45	55	65
e ₂ (mm)	M5	M6	M6	M8	M8	M12	M14	M16
g ₃ (mm)	8	10	12	15	15	19	22	25

See table in fig. 4.2/7.2 for all other dimensions
Ordering information see chapter 4.6/7.6



For MONORAIL BM in applications with high contamination the additional wipers ZBN-U/ ZBV-U are recommended.

Through hardened rails

MONORAIL-MR-rails can also be supplied in a through hardened version. This has advantages in the case of the following applications:

- Increased straightness requirements
- Utilization of the rail surface for supporting sheet metal covers
- Protection of the rail surface against scratches or scoring due to bombardment with metal chips

The maximum single piece length in this case is 1800 mm, for size MR 25 and MR 35 2000 mm. Furthermore, the positioning tolerances of the attachment holes have to be observed.

Hard-chromed rails and carriages

For applications requiring a special corrosion protection, e. g. in clean room or vacuum, because of a high relative humidity or an increased resistance against wear of the surfaces is required, MONORAIL rails and carriages can also be supplied in a hard-chromed version. The essential advantages of this coating applied by electro-plating are:

- Very good corrosion protection
- Very high resistance against wear and very high load bearing capacity of the surface
- Exceptional adhesive power and uniform distribution of the thickness of the coating
- Good sliding and therefore emergency running characteristics, because of the micro-pearl structure

It must be noted, that bores and threads and rolling elements are not chromium-plated. Carriages in hard-chromed version can only be supplied in preload classes **V2, V3**. When ordering, additionally include **-H** for chromed rails resp. **-HH**, if rails **and** carriages have to be chromed.

Special hole spacings L₄

Double or half hole spacing L₄: MONORAIL-MR-rails can on request (standard in the case of MZ) be supplied with double hole spacing L₄. It must be noted, that in this case the load bearing capacity is halved.

Also available for the MONORAIL BM for an increase of the rigidity and in order to improve the running accuracy are rails with a halved hole spacing (corresponds to MR standard L₄).

Ordering designation: -X-

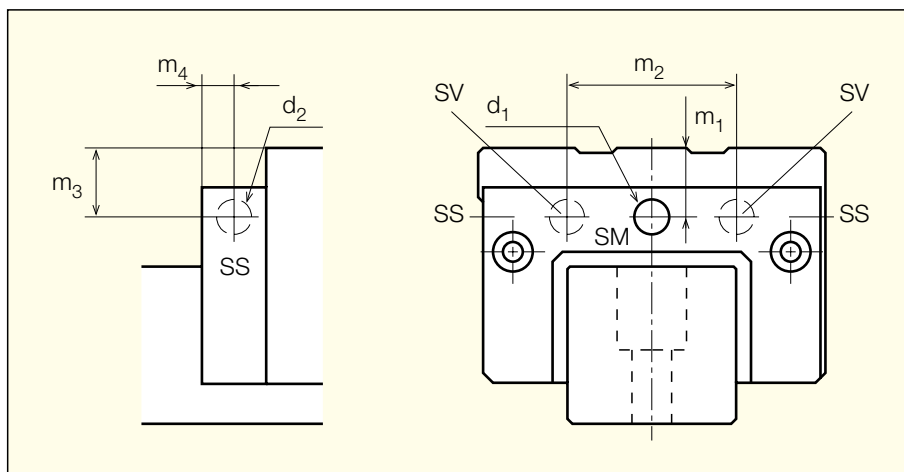
Other special hole spacings: If the hole spacing changes over the length of the rail, e.g., at the junction points in case of rails made out of several parts or if a special L₄ is required, then this has to be particularly mentioned in the order and a drawing included.

Ordering designation: -Y-

Additional alignment bores and threads

As an option, rails and carriages can be supplied with additional bores for alignment pins or with additional tapped bores. In such a case, when ordering it is imperative that a drawing is enclosed. For more detailed information, please contact your SCHNEEBERGER representative.

Connection thread in the front plate in front and on the side



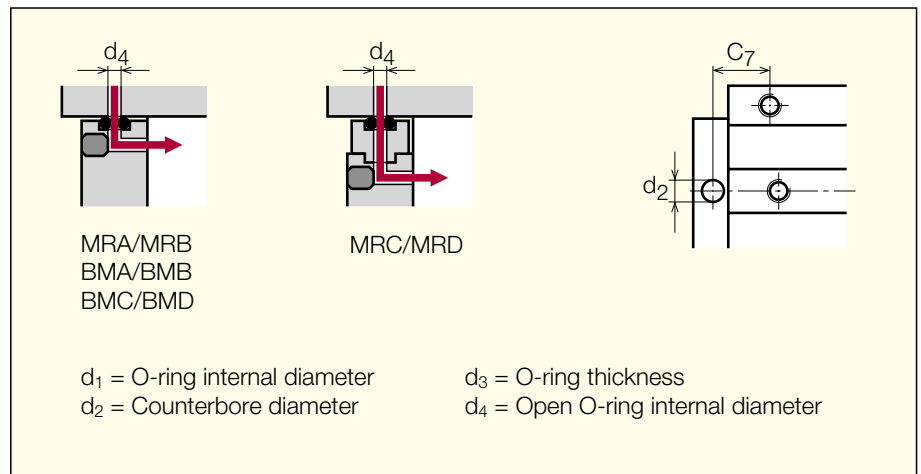
Type	Dimensions (mm)					
	m ₁	m ₂	m ₃	m ₄	d ₁	d ₂
MRA/B 25	5.5	–	–	–	M6	M6
MRC/D 25	9.5	–	–	–	M6	M6
MRA/B 35	7.0	32.0	7.0	6.5	M6	M6
MRC/D 35	14.0	–	14.0	–	M6	M6
MRA/B 45	8.0	40.0	8.0	7.5	M6	M6
MRC/D 45	18.0	–	18.0	–	M6	M6
MRA/B 55	9.0	50.0	9.0	8.5	M6	M6
MRC/D 55	19.0	–	19.0	–	M6	M6
MRB/D 65	13.0	64.0	13.0	12.5	M6	M6

Type	Dimensions (mm)					
	m ₁	m ₂	m ₃	m ₄	d ₁	d ₂
BMA 15	4.0	–	4.0	4.0	M3	M3
BMC 15	8.0	–	8.0	–	M3	M3
BMA/B/C/D 20	5.2	–	5.2	5.0	M6	M3
BMA/B 25	5.5	–	5.5	6.0	M6	M6
BMC/D 25	9.5	–	9.5	–	M6	M6
BMA/B 30	7.0	–	7.0	6.0	M6	M6
BMC/D 30	10.0	–	10.0	–	M6	M6
BMA/B 35	7.0	–	7.0	6.5	M6	M6
BMC/D 35	14.0	–	14.0	–	M6	M6
BMA/B 45	8.0	–	8.0	7.5	M6	M6
BMC/D 45	18.0	–	18.0	–	M6	M6

**Lubrication connection
from above**

If lubrication is required from above, the required location has to be indicated with the order. The necessary retrofitting work is carried out by SCHNEEBERGER.

Ordering information: From above: – SO



C_7 (mm)	MR 25	MR 35	MR 45	MR 55	MR 65
MRA	12.0	14.0	17.0	21.5	–
MRB	23.2	27.5	34.5	42.5	54.0
MRC	17.0	20.0	27.0	31.5	–
MRD	20.7	22.5	34.5	42.5	49.0
d_4	6.0	6.0	6.0	6.0	6.0
d_2	10.0	10.0	10.0	10.0	10.0

C_7 (mm)	BM 15	BM 20	BM 25	BM 30	BM 35	BM 45
BMA	8.0	10.5	13.2	14.5	14.5	17.0
BMB	–	18.5	22.7	25.5	27.25	32.75
BMC	10.0	12.5	18.2	20.5	20.5	27.0
BMD	–	13.5	20.2	21.5	22.25	32.75
d_4	4.0	6.0	8.0	8.0	8.0	8.0
d_2	8.0	10.0	12.0	12.0	12.0	12.0

Type	d_1	×	d_3
BM 15	4.48	×	1.78
BM 20, MR 25–65	6.75	×	1.78
BM 25–45	8.73	×	1.78

General information



- The lubrication connections are plastic threads. Therefore care must be taken when installing fittings.
- Any retrofitting work on the end plates for changing the lubrication connection should be carried out by SCHNEEBERGER. In case of rework by the customer, it is necessary to contact SCHNEEBERGER beforehand.
- Grease nipples as well as lubrication adapter pieces are not included on the carriages and have to be ordered separately.

Special installation orientations

In the case of a lubrication with grease, it is assured that all four tracks of the carriage are provided with lubricant, in all installation orientations.

Oil, however, has the tendency to follow the law of gravity and therefore to flow downwards, thus only to one side of the running track.

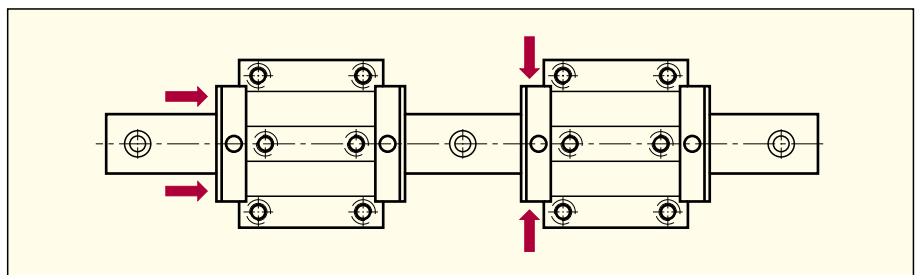
In the case of lubrication with oil and a horizontal or vertical installation, no special measures are needed. On the basis of the significantly reduced lubrication channel volumes, this is also applicable for an application rotated by 180 deg around the longitudinal axis of the rail. In case of a vertical installation, the lubrication connection has to be made in the upper front plate.

If, however, an **oil lubrication** and a different orientation (e. g., inclined by 10 deg to 90 deg around the longitudinal axis of the rail) is foreseen, then it has to be ensured, that all four tracks of the carriage are provided with sufficient lubricant. Depending on the type of guideway, this is achieved differently.

In the case of **MONORAIL MR 35–MR 65**, both sides of the rail can be lubricated independently from one another, this is implemented by a modification to the front plate and by using 2 lubrication connections in front or on the side.

Ordering information: Special: –ST

When ordering, the required connections have to be indicated on the order sheet. For lubricant quantities, refer to the chapter Lubrication with Oil.

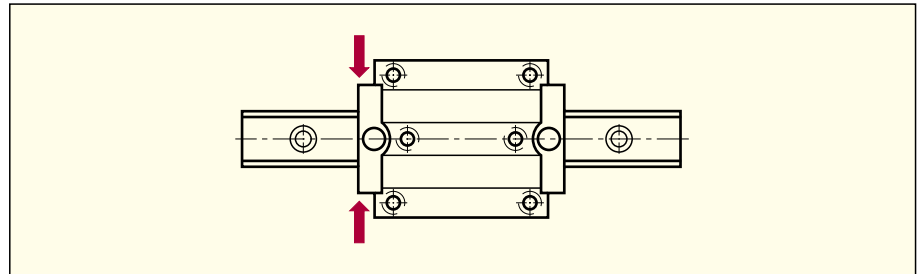


In the case of **MONORAIL MR 25** and **MONORAIL BM 15–45**, the lubricant distribution is effected both during the first lubrication as well as during subsequent lubrication by injecting the total required quantity of oil either with a single impulse or with several impulses in close sequence and while the carriage is in motion. For lubricant quantities, refer to the chapter Lubrication with Oil.

In the case of **MONORAIL BM 25–45**, both sides of the rail can be lubricated independently from one another, this is implemented by mounting a special front plate STB-ST on one carriage end and by using two lubrication connections on the side.

Ordering information: Special: –ST

When ordering, the required connections have to be indicated on the order sheet. For lubricant quantities, refer to the chapter Lubrication with Oil.



Short stroke – general lubrication remark

In the case of special installation orientations, the customer should include an installation drawing with the inquiry, to obtain a recommendation from SCHNEEBERGER regarding lubrication! In the case of a single lubrication connection per carriage, grease, or liquid grease, is preferred over oil.

In the case of a stroke smaller than $2 \times$ the carriage length, two lubrication connections are recommended, i. e., a lubrication from both ends.

If in the case of a **short stroke** the number of connections is doubled, then the total quantity of lubricant for subsequent lubrication nonetheless remains the same per carriage, i. e., the quantity per end is halved.

Lubrication with oil

For the lubrication using oil, SCHNEEBERGER recommends mineral oil CLP (DIN 51517) or HLP (DIN 51524) in the viscosity range of ISO VG32 to ISO VG100 in accordance with DIN 51519. Bed track oils CGLP up to ISO VG220 can also be used.

Initial lubrication prior to operation

Prior to operation, the carriages have to be filled with the indicated quantities for the first lubrication. In doing so, the total oil quantity should be injected in a single impulse or in several impulses in short succession while the carriage is being moved. The indicated quantities are applicable per carriage with one connection. If two connections per carriage are used, then the values have to be correspondingly halved.

In case of a special installation orientation or a short stroke, the lubrication guidelines in the corresponding chapters have to be followed.

Initial lubrication oil qty/carriage in cm ³	MR 25	MR 35	MR 45	MR 55	MR 65
Any installation orientation	0.95	0.55	0.70	0.90	1.20

Initial lubrication oil qty/carriage in cm ³	BM 15	BM 20	BM 25	BM 30	BM 35	BM 45
Any installation orientation	0.20	0.50	0.60	0.90	1.10	1.20

Subsequent lubrication intervals and quantities

The subsequent lubrication intervals depend on the load on the carriages and on external factors. As an indicative value, with a speed of $v \leq 1$ m/sec and a load ratio $C/P \geq 2$, the following interval for subsequent lubrication can be assumed:

Subsequent lubrication interval = 30 km

The lubrication quantity to be provided in accordance with this lubrication interval can be taken from the following table.

Applicable in case of a normal installation orientation is:

Table value:
pulse lubrication quantity × number of pulses per lubrication interval

Example: With $v = 0.2$ m/sec and 100% operating time, the lubrication interval of 30 000 m corresponds to approximately 40 operating hours. With a lubrication quantity requirement of 0.50 cm^3 in accordance with the table, a pulse oil quantity of 0.1 cm^3 every 8 hours follows.

In the case of a special installation orientation or short stroke, the lubrication information in the corresponding chapter has to be observed.

Subsequent lubrication oil qty per carriage in cm^3	MR 25	MR 35	MR 45	MR 55	MR 65
Normal installation orientation	0.15	0.25	0.35	0.50	0.70
Special installation orientation	0.95	0.55	0.70	0.90	1.20

Subsequent lubrication oil qty per carriage in cm^3	BM 15	BM 20	BM 25	BM 30	BM 35	BM 45
Norm. inst. orientation	0.07	0.17	0.20	0.30	0.35	0.40
Spec. inst. orientation	0.14	0.34	0.40	0.60	0.70	0.80

Remarks

The values indicated above are only guideline values. An accurate determination of the quantities and intervals can only be determined under real operating conditions. It is recommended to lubricate at least $1 \times$ per month and after a longer machine shut-down prior to putting it into operation again. In the case of unfavorable conditions, loads, climate, ambient conditions, a more frequent lubrication is necessary.

Lubrication with grease



SCHNEEBERGER recommends KP2K grease in accordance with DIN 51825.

Attention:

During greasing the carriage should be moved several times over a distance corresponding to at least 3 times its length.

Initial greasing prior to operation

After the installation of the MONORAIL guideway, an initial greasing of the carriages has to take place. This also applies if the mounting of lubrication plates is additionally foreseen. The quantities indicated are applicable per carriage.

Initial greasing grease qty per carriage in g	MR 25	MR 35	MR 45	MR 55	MR 65
MRA/MRC	1.8	2.8	5.0	8.0	–
MRB/MRD	2.1	3.5	6.3	10.1	18.0

Initial greasing grease qty per carriage in g	BM 15	BM 20	BM 25	BM 30	BM 35	BM 45
BMA/BMC	0.8	1.6	2.7	4.3	6.3	12.0
BMB/BMD	–	2.0	3.3	5.2	7.7	14.8

Subsequent lubrication intervals and quantities

The subsequent lubrication intervals depend on the load on the carriages and on external factors. As an indicative value, with a speed of $v \leq 1$ m/sec and a load ratio $C/P \geq 2$, the following interval for subsequent lubrication can be assumed:

Subsequent lubrication interval = $C/P \cdot 100$ km
--

The quantity of grease to be provided in accordance with this interval can be taken from the following table.

Subsequent lubrication grease qty per carriage in g	MR 25	MR 35	MR 45	MR 55	MR 65
MRA/MRC	0.4	1.0	2.0	3.0	–
MRB/MRD	0.5	1.2	2.3	3.8	7.0

Subsequent lubrication grease qty per carriage in g	BM 15	BM 20	BM 25	BM 30	BM 35	BM 45
BMA/BMC	0.3	0.6	1.0	1.6	2.4	4.7
BMB/BMD	–	0.8	1.3	2.0	3.0	5.8

Remarks

The values indicated above are only guideline values. An accurate determination of the quantities and intervals can only be determined under real operating conditions. It is recommended to lubricate at least every 3 months. In the case of unfavorable conditions, loads, climate, ambient conditions, a more frequent lubrication is necessary.

NEW
Lubrication plate SPL

The lubrication plate is utilized in such applications, where long lubrication intervals are demanded. It enables an automatic and uniform supplying of the roller elements with lubricating oil over a long period of time. In order to achieve maximum travelling distances without any re-lubrication, the lubrication plates are always installed in pairs – i. e., one lubrication plate per carriage end and respectively installed in front of the front plates.

Installation positions

The SPL guarantees an assured supply of lubricant in all installation positions.

Delivered condition

General

The SPL is on principle delivered ready for installation, i.e., filled with oil. The lubrication connections for re-lubrication at the front in the centre (-SM) as well as on the narrow sides (-SS) are respectively closed off with a threaded pin, respectively a screw.

Delivery installed on the carriage

In the case of delivery together with a MONORAIL system or individual carriages, respectively two lubrication plates are installed on the carriage at the works. The carriages are in addition filled with a roller bearing grease (lithium based saponified grease on a mineral oil basis). A lubricating nipple for refilling the SPL is supplied loose.

Delivery as accessory / Individual component

In case of delivery of the SPL for retro-fitting, these are supplied in pairs ready for installation, i. e., filled with oil. A lubricating nipple for replenishing as well as the corresponding fixing screws DIN 7984 are enclosed in a separate plastic bag.

First oil fill

The SPL ex works SCHNEEBERGER Höfen/Enz is filled with oil type KLÜBER Lamora D 220 and therefore immediately ready for use.

First oil fill	MR 25	MR 35	MR 45	MR 55	MR 65
qty per lubrication plate in cm ³	3.1	8.4	15.6	26.8	61.0

Refilling interval and quantity

The refilling of the lubrication plates should take place in dependence of the load as well as of the other application conditions of the guideways. As a guideline value, the following refilling intervals can be assumed:

Refilling interval				
MR 25	MR 35	MR 45	MR 55	MR 65
2500 km		5000 km		

Remarks

The values indicated above are only guideline values. An accurate determination of the time intervals can only be established under actual operating conditions. In case of unfavourable conditions, loads, climate, environment, a more frequent refilling is necessary. Independent of the distance travelled, a refilling is necessary after a maximum of **12 months** of operation.

For the refilling of the lubrication plates, oil type **KLÜBER Lamora D 220** has to be utilized. In case of refilling with other lubricants, the SCHNEEBERGER will assume no liability whatsoever.

The oil quantity for the above indicated refilling intervals can be taken from the following table.

Refilling	MR 25	MR 35	MR 45	MR 55	MR 65
qty per lubrication plate in cm ³	2.2	6.0	11.0	19.0	43.0

The SPL is refilled through one of the three lubricating bores described above at the front in the middle or on the side. A lubricating nipple, which is supplied as an accessory, serves for filling the oil.

General remarks



- When lubrication plates are retro-fitted, on principle the carriages in addition have to be filled with grease. For the recommended lubricant quantities, please refer to the section on lubrication with grease
- In case of applications, in which coolant can come into contact with the MONORAIL guideways, additional wipers ZCN/ZCV have to be installed in front of every lubrication plate, refer to installation instructions SPL.

Service lifetime lubrication

The lubricant forms a protective film between the roller element and the track and prevents metallic contact. Therefore the lubrication protects against wear and corrosion.

Grease lubrication, frequently also referred to as service lifetime lubrication, is considered as a form of minimum quantity lubrication.

During the operation of MONORAIL guideways loss of lubricant takes place. In addition, the grease ages because of the diffusion of oil out of the carrier substance. These circumstances call for subsequent lubrication. The subsequent lubrication quantities and intervals have to be determined under operating conditions.

Depending on the application, i.e., corresponding to the loading ratio C/P, the stroke of the carriage and ambient influences, the useful service lifetime of the grease can amount to between some hundreds of hours and several years.



SCHNEEBERGER cannot guarantee, that with a single lubrication, the calculated service lifetime of the MONORAIL guideways will be achieved!

Without any subsequent lubrication, the service lifetime of the MONORAIL guideway will depend on the useful service lifetime of the grease!

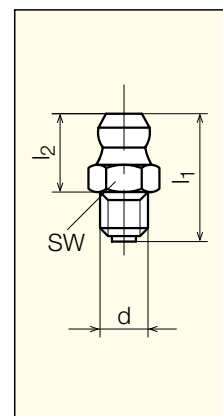
Accessories

Greasing nipple

Hydraulic-type lubricating nipple, straight according to DIN 71412

Type	d	l ₁	l ₂	SW
SN 6	M6	16	10.5	7

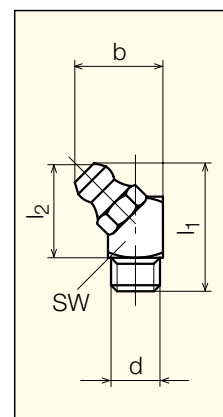
- Application:
- BM 20-45
 - MR 25-65



Hydraulic-type lubricating nipple, 45 deg according to DIN 71412

Type	d	l ₁	l ₂	b	SW
SN 6-45	M6	21	15.5	15	9

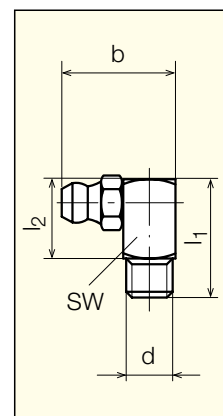
- Application:
- BM 20-45
 - MR 25-65



Hydraulic-type lubricating nipple, 90 deg according to DIN 71412

Type	d	l ₁	l ₂	b	SW
SN 6-90	M6	18	12.5	19	9

- Application:
- BM 20-45
 - MR 25-65



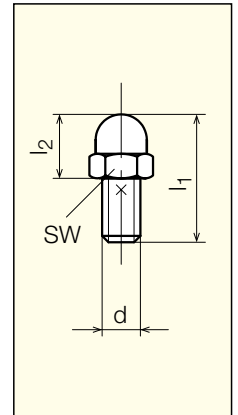
All dimensions in mm

Lubrication adapter M 3

Type	d	l ₁	l ₂	SW
SN 3	M3	10	5	4

Application:

- BM 15
- BM 20 only laterally



Lubrication adapter

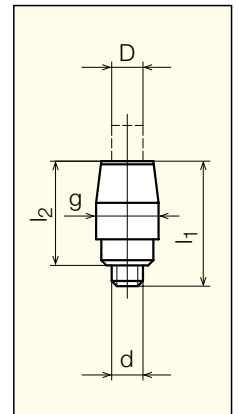
Straight screw-in connection M 3

For tubing with ext. diameter \varnothing D = 3 mm

Type	d	g	l ₁	l ₂
SA 3-D 3	M3	\varnothing 6	12	9.5

Application:

- BM 15
- BM 20 only laterally



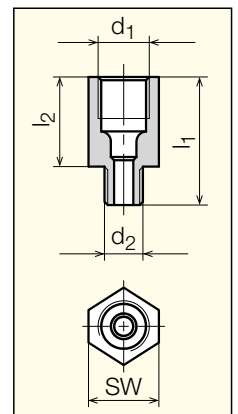
Adapter with hexagon insert bit

For tubing with ext. diameter \varnothing = 4 mm

Type	d ₁	d ₂	l ₁	l ₂	SW
SA 6-6KT-G1/8	G1/8*	M6	20	14	12
SA 6-6KT-M 8	M8x1**	M6	20	14	11

Application:

- BM 30–45
- MR 35–65



* G1/8 = 1/8" BSP thread (not 1/8" NPT)

** Counterbore in accordance with DIN 2367 for screwed pipe connections without soldering

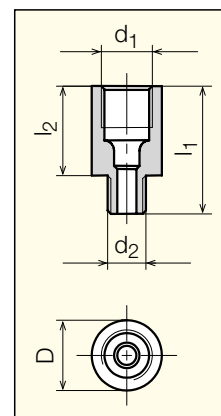
Adapter, external round

For tubing with ext. diameter $\varnothing = 4 \text{ mm}$

Type	d_1	d_2	l_1	l_2	D
SA 6-RD-M 8	M8×1*	M6	20	14	10

Application:

- BM 20–45
- MR 25–65



Banjo fittings

For tubing with ext. diameter $\varnothing =$

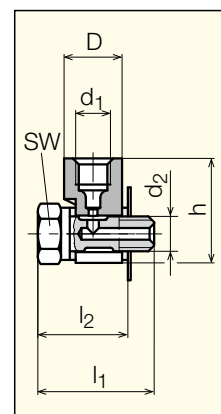
SV 6-M 6 2.5 mm

SV 6-M 8 4 mm

Type	d_1	d_2	l_1	l_2	h	D	SW
SV 6-M 6	M6×0.75*	M6	22	16	18	10	9
SV 6-M 8	M8×1*	M6	22	15.5	22	10	9

Application:

- BM 20–45
- MR 25–65



3.7 General data

Permissible speeds and accelerations

General applications under normal operating conditions:

	MR	BM
Speeds up to	3 m/s	5 m/s
Acceleration up to	50 m/s ²	100 m/s ²

Higher values are permissible. These depend on the carriage type, lubrication, installation orientation, preload and loading. The approval of a SCHNEEBERGER representative should be obtained in such cases.

Permissible operating temperatures

MONORAIL guideways can be used at operating temperatures between -40°C and $+80^\circ\text{C}$. Short-term temperatures up to $+120^\circ\text{C}$ are permissible. Does not apply to bellows.

Materials

SCHNEEBERGER rails, carriages and rolling elements are made from hardened and ground bearing steel as standard. The rails are induction-hardened and the carriages are through-hardened. Plastic components are injection-molded using POM, PAPA and TPU.

* Counterbore in accordance with DIN 2367 for screwed pipe connections without soldering

4.1 Product features

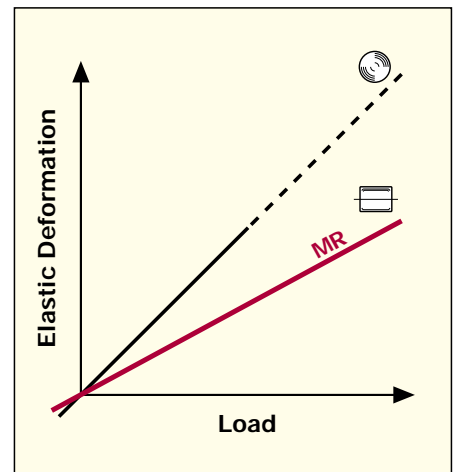


High rigidity, great dynamic and static load carrying capacity, outstanding running smoothness and the total enclosure of the carriage are the main features of the MONORAIL guideway. These properties result in higher machining rates while enhancing geometrical accuracy and surface quality of the machined workpieces. Our highly rigid MONORAIL provides improved vibration behavior, smaller vibration amplitudes and thus extends tool life.

SCHNEEBERGER has systematically applied its many years of experience in the design, production and use of roller-type anti-friction guideways in the development of the MONORAIL. Consequently the MONORAIL is a cost-effective anti-friction guideway which meets the challenge presented by modern machine design.

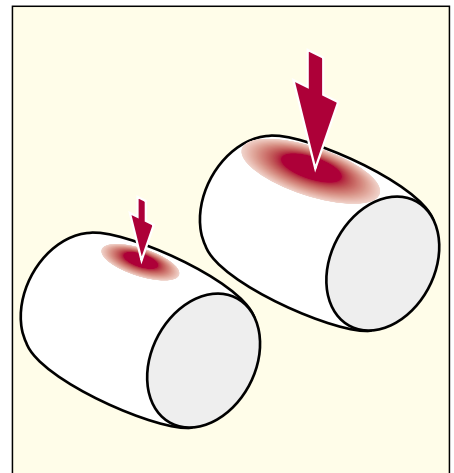
Rigidity

Linear guideways have a significant effect on the overall rigidity of a machine tool. The proven high rigidity of the MONORAIL is achieved by using rollers as rolling elements and by the optimization of the cross section of the carriage and the rail.



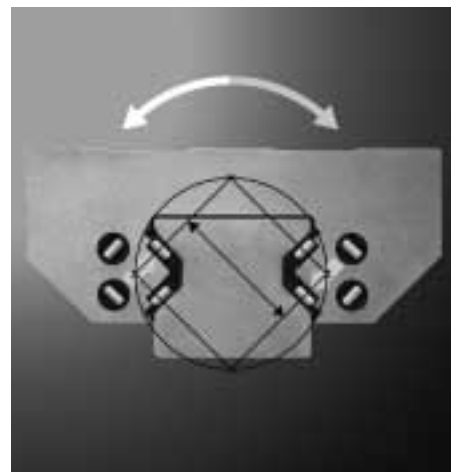
Load carrying capacity

In contrast to the circular-arch ball guideway, the roller guideway has a flat and noticeably larger contact area. This results in a substantially higher load carrying capacity and lower wear together with minimum rolling friction.



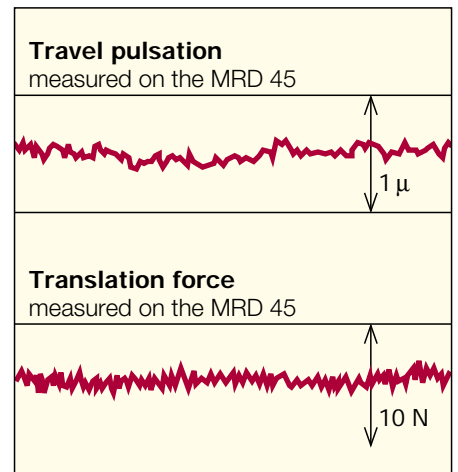
O-Geometry

The chosen O-arrangement of the rollers causes the force vectors to intersect outside, far from the rail center, allowing heavy loading by moments and forces acting in all directions.



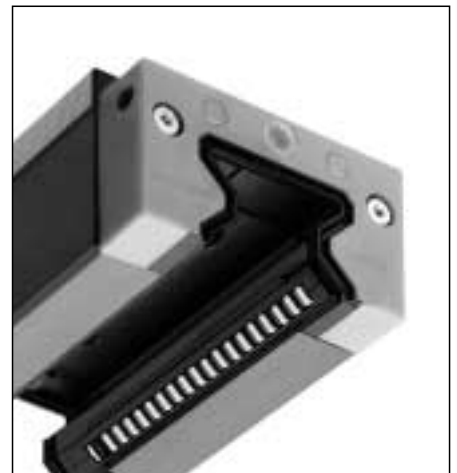
Running smoothness

The running smoothness of the MONORAIL is the result of the optimized geometry of the roller tracks. Minimized guideway travel pulsation and a uniform translation force are extremely important in demanding machining applications.



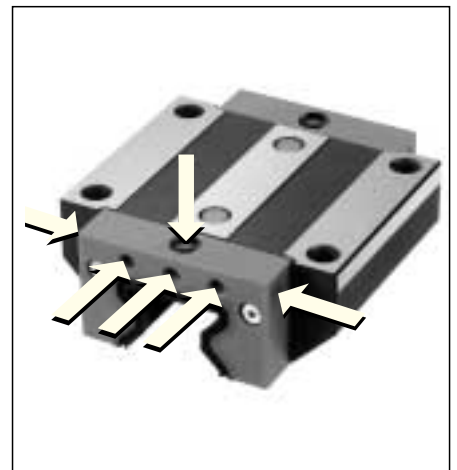
Wipers

Integral wipers that totally enclose the MONORAIL carriage protect the rollers and track surfaces from contamination. The double-lipped wipers minimize lubricant loss. Lubrication can be systematically fed into the roller recirculation zones regardless of installation orientation.

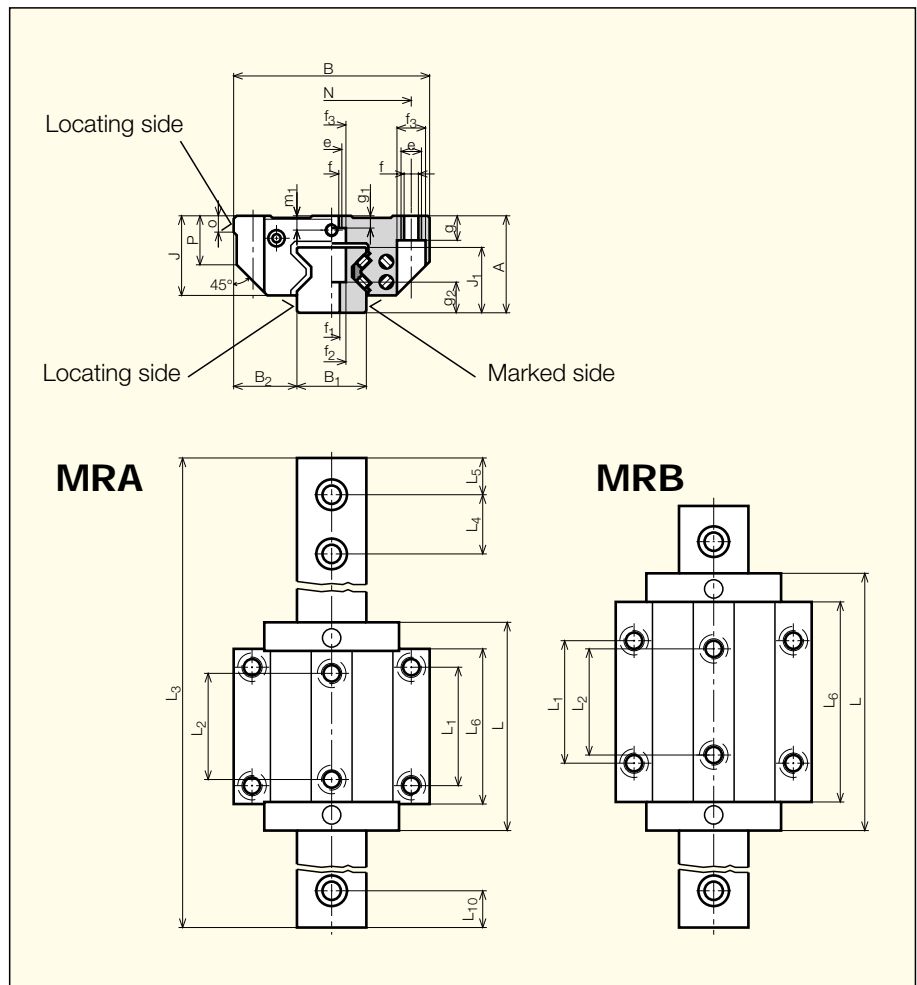


Versatile lubrication possibilities

The carriages can be lubricated through various lubrication connections (from the front, either side or above). The geometry of the lubrication channels, combined with efficient sealing, reduces lubricant consumption. This provides both economic and environmental benefits.



4.2 Dimension tables, loading capacities MONORAIL MR
Carriage types MRA and MRB

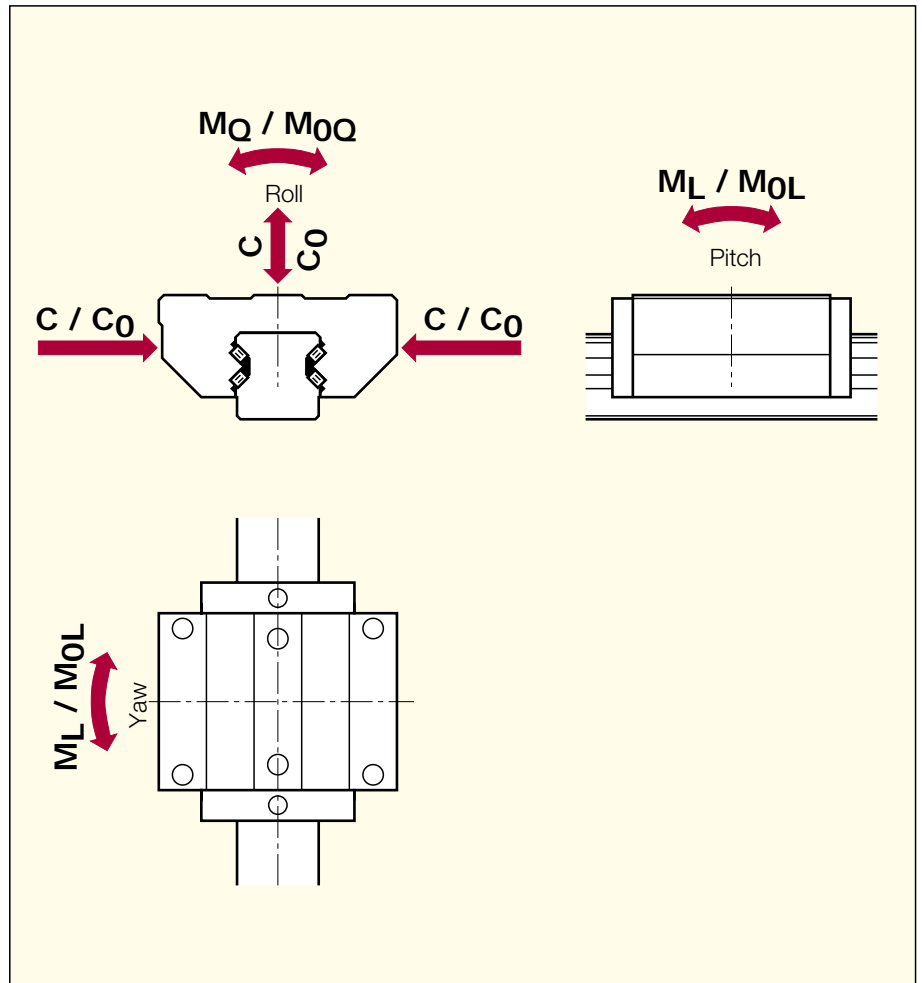


Drawings in dxf or dwg format are available on www.schneeberger.com in section Services.

Type	Dimensions (mm)																		
	A	B	B ₁ * ±0.05	B ₂	J	J ₁	L**	L ₁	L ₂	L ₄	L ₅ / L ₁₀	L ₆	N	e	f	f ₁	f ₂	f ₃	
MRA 25 MRB 25	36	70	23	23.5	29.5	24.5	81 103.4	45	40	30	14	60 79.4	57	M 8	6.8	7	11	11	
MRA 35 MRB 35	48	100	34	33	40	32	109 136	62	52	40	19	80 103	82	M10	8.5	9	15	15	
MRA 45 MRB 45	60	120	45	37.5	50	40	137.5 172.5	80	60	52.5	25	104 135	100	M12	10.5	14	20	18	
MRA 55 MRB 55	70	140	53	43.5	57	48	163.5 205.5	95	70	60	29	120 162	116	M14	12.5	16	24	20	
MRB 65	90	170	63	53.5	76	58	251	110	82	75	36.5	201	142	M16	14.5	18	26	23	

* Lower tolerances on request

** When using additional wipers, metal wipers and lubrication plates, the total length L is increasing, see chapter 4.5.

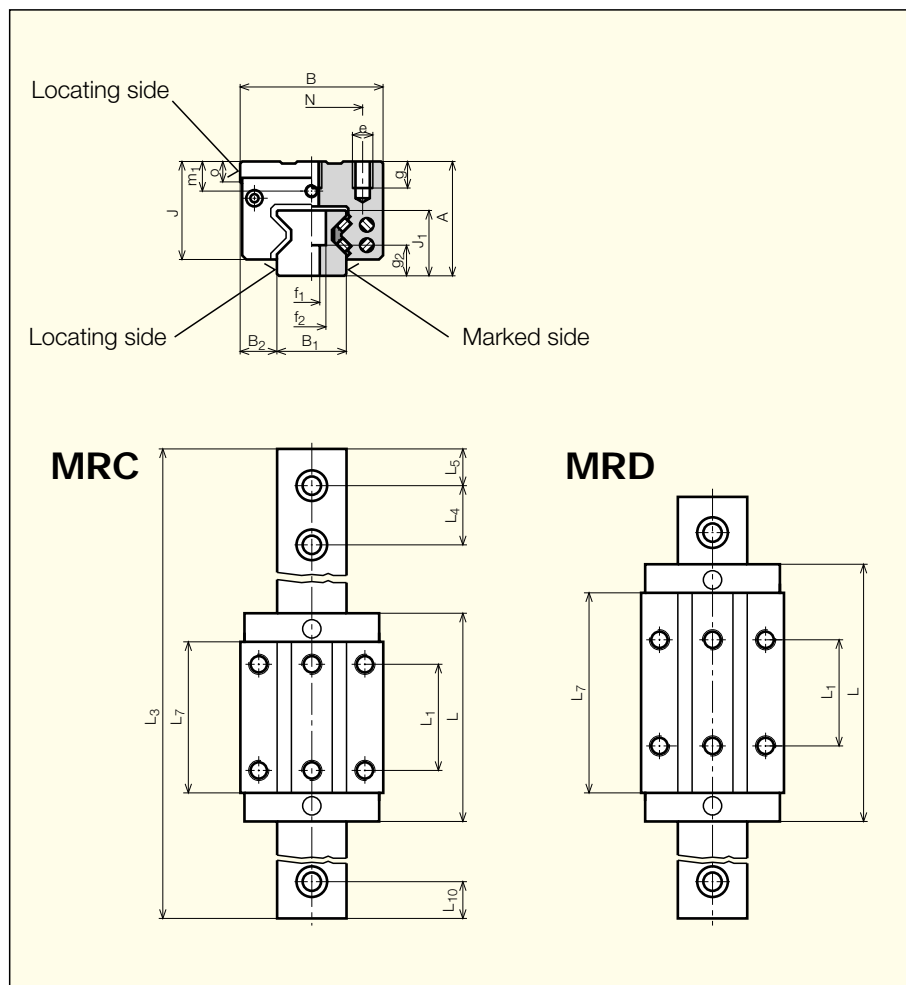


Roller Ø	g	g ₁	g ₂	m ₁	o	P
3.2	9	6.5	13	5.5	7.5	17.5
4.5	12	10	15	7	8	23
5	15	11	21	8	10	30.5
6	18	13.5	26	9	12	34.5
7	23	19	32	13	15	51

Loading capacities		Moments				Weights	
C ₀ (N)	C (N)	M _{0Q} (Nm)	M _{0L} (Nm)	M _Q (Nm)	M _L (Nm)	Carriage (kg)	Rail (kg/m)
49 800	27 700	733	476	408	265	0.7	3.4
70 300	39 100	1 035	936	576	521	1.0	6.8
93 400	52 000	2 008	1 189	1 118	662	1.6	10.7
128 500	71 500	2 762	2 214	1 537	1 232	2.1	15.2
167 500	93 400	4 621	2 790	2 577	1 556	3.1	22.2
229 500	127 800	6 333	5 161	3 527	2 874	4.1	
237 000	131 900	7 771	4 738	4 325	2 637	5.2	
324 000	180 500	10 624	8 745	5 919	4 872	7.0	
530 000	295 000	20 912	17 930	11 640	9 980	13.2	

C₀ = Static loading capacity
 C = Dynamic loading capacity (100 km)
 M₀ = Static moment capacity
 M = Dynamic moment capacity (100 km)

4.3 Dimension tables, loading capacities MONORAIL MR
Carriage types MRC and MRD

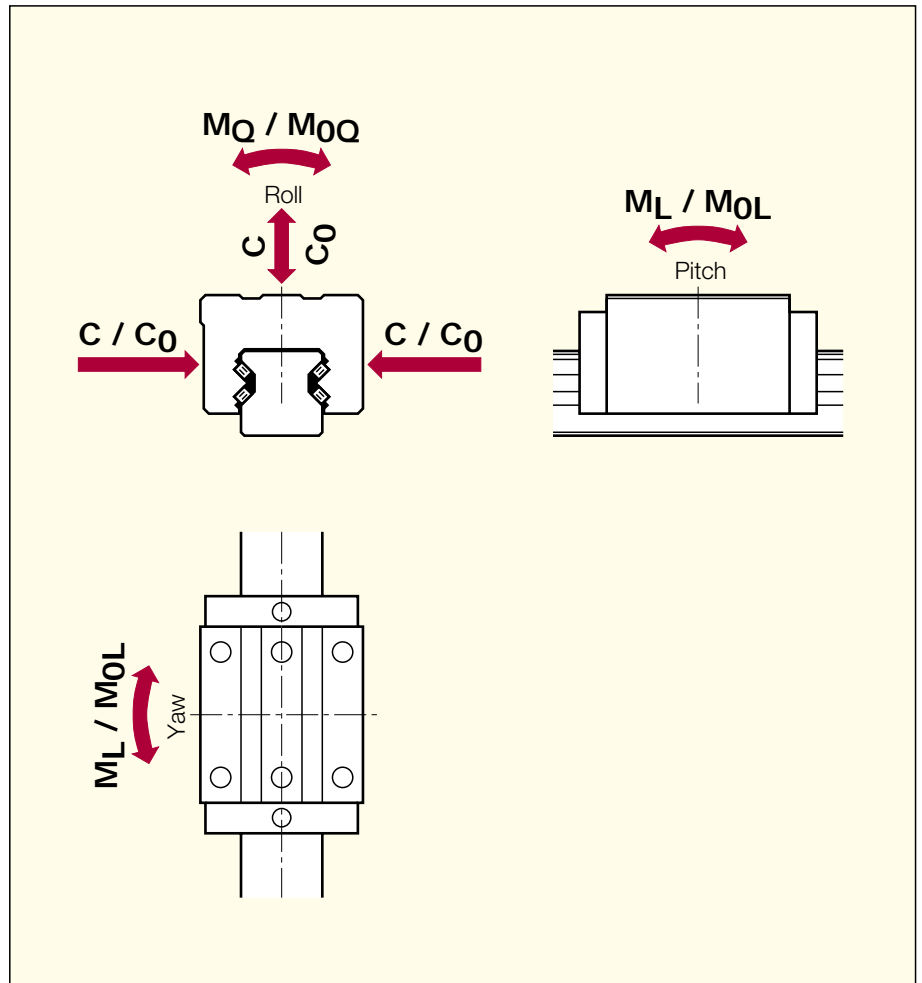


Drawings in dxf or dwg format are available on www.schneeberger.com in section Services.

Type	Dimensions (mm)														
	A	B	B ₁ * ±0.05	B ₂	J	J ₁	L**	L ₁	L ₄	L ₅ / L ₁₀	L ₇	N	e	f ₁	f ₂
MRC 25 MRD 25	40	48	23	12.5	33.5	24.5	81 103.4	35 50	30	14	57 79.4	35	M 6	7	11
MRC 35 MRD 35	55	70	34	18	47	32	109 136	50 72	40	19	76 103	50	M 8	9	15
MRC 45 MRD 45	70	86	45	20.5	60	40	137.5 172.5	60 80	52.5	25	100 135	60	M 10	14	20
MRC 55 MRD 55	80	100	53	23.5	67	48	163.5 205.5	75 95	60	29	120 162	75	M 12	16	24
MRD 65	90	126	63	31.5	76	58	251	120	75	36.5	201	76	M 16	18	26

* Lower tolerances on request

** When using additional wipers, metal wipers and lubrication plates, the total length L is increasing, see chapter 4.5.



Roller Ø	g	g ₂	m ₁	o
3.2	9	13	9.5	7.5
4.5	12	15	14	8
5	18	21	18	10
6	19	26	19	12
7	20	32	13	15

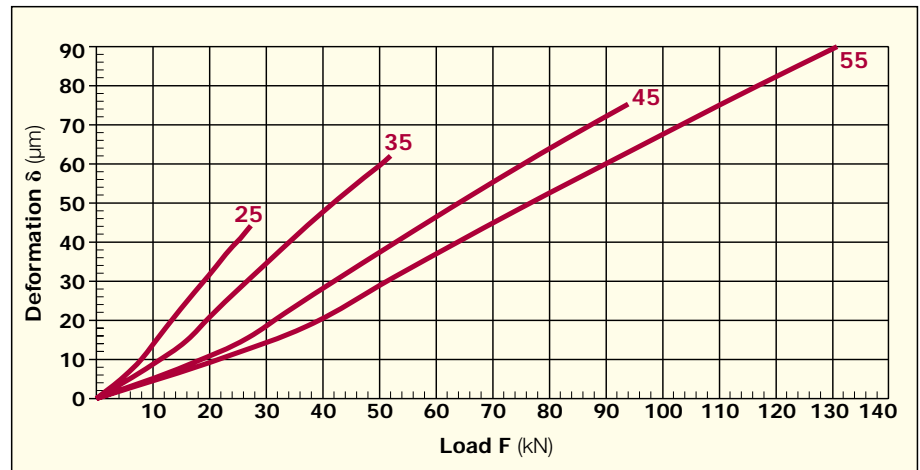
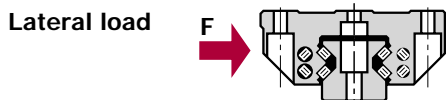
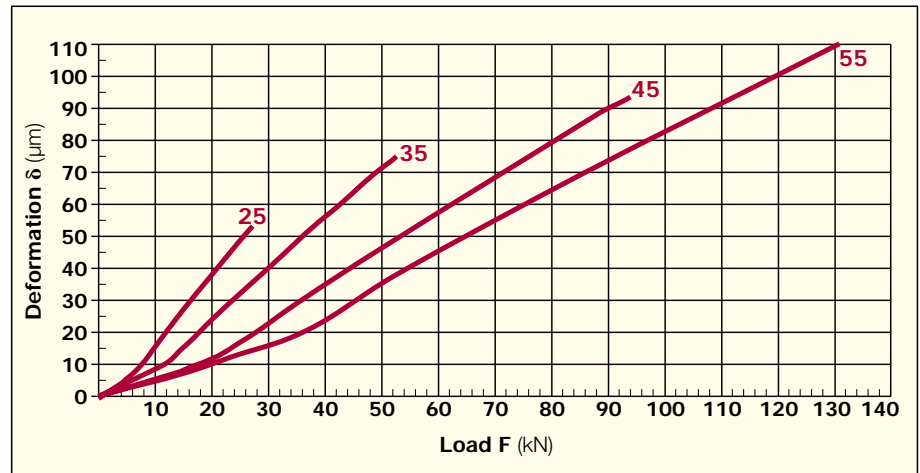
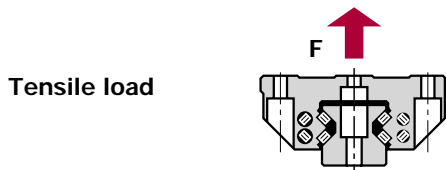
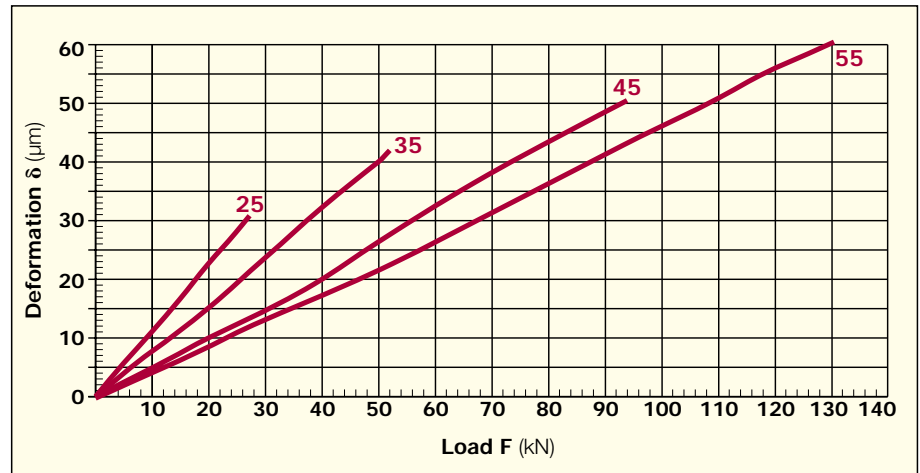
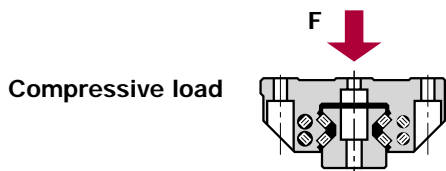
Loading capacities		Moments				Weights	
C ₀ (N)	C (N)	M _{0Q} (Nm)	M _{0L} (Nm)	M _Q (Nm)	M _L (Nm)	Carriage (kg)	Rail (kg/m)
49 800	27 700	733	476	408	265	0.6	3.4
70 300	39 100	1 035	936	576	521	0.85	3.4
93 400	52 000	2 008	1 189	1 118	662	1.35	6.8
128 500	71 500	2 762	2 214	1 537	1 232	1.9	6.8
167 500	93 400	4 621	2 790	2 577	1 556	3.0	10.7
229 500	127 800	6 333	5 161	3 527	2 874	4.1	10.7
237 000	131 900	7 771	4 738	4 325	2 637	4.5	15.2
324 000	180 500	10 624	8 745	5 919	4 872	6.1	15.2
530 000	295 000	20 912	17 930	11 640	9 980	10.3	22.2

C₀ = Static loading capacity
 C = Dynamic loading capacity (100 km)
 M₀ = Static moment capacity
 M = Dynamic moment capacity (100 km)

4.4 Rigidity

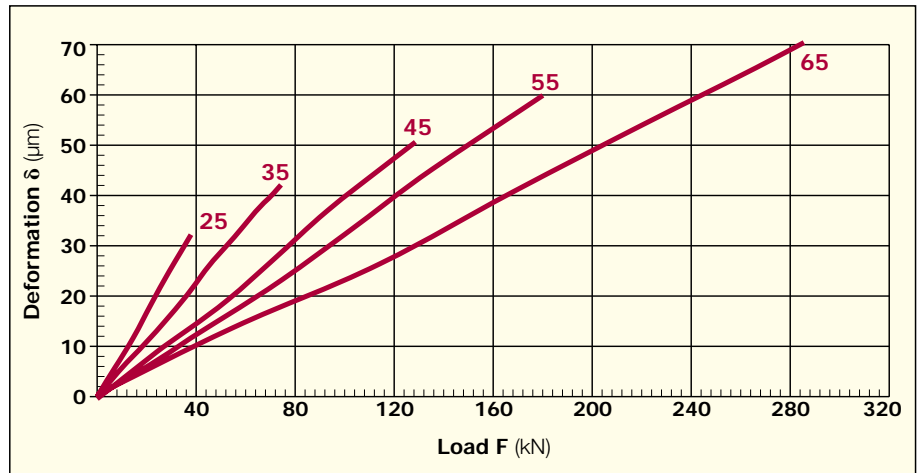
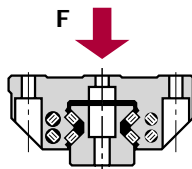
MRA 25, 35, 45, 55
MRC 25, 35, 45, 55

The diagrams correspond to preload class V3

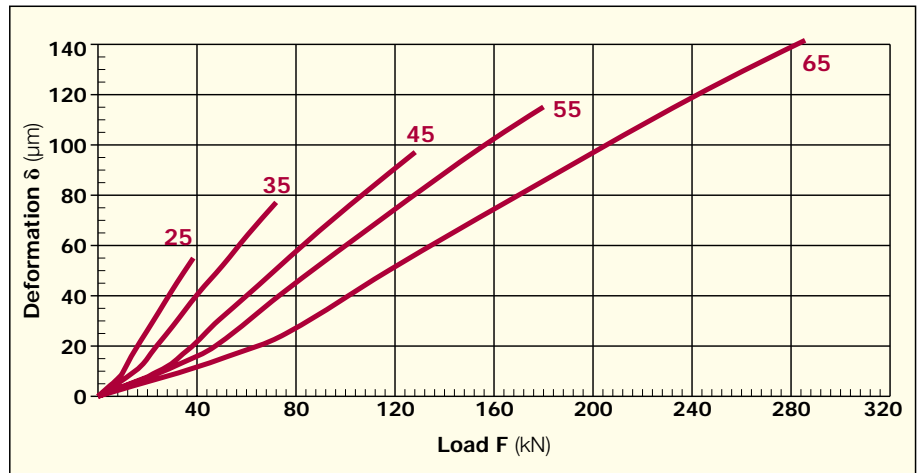
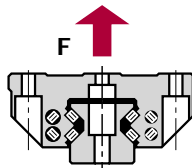


MRB 25, 35, 45, 55, 65
MRD 25, 35, 45, 55, 65

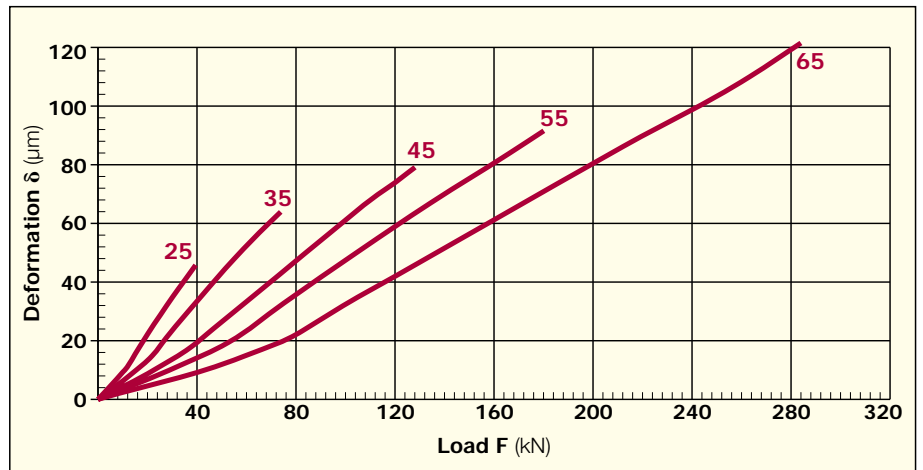
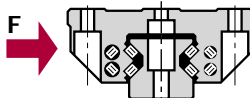
Compressive load



Tensile load



Lateral load



4.5 Accessories – must be ordered separately

Rail cover strip MAB

With the rail cover strip made of stainless spring steel a smooth rail surface is achieved, which enables the wipers to function optimally. The rail cover strip can be utilized in several pieces, i. e., without any limitation to the length of the rail and it is easy to install. As a result of the self-centering shape and the V-shaped ends, a lifting-off or shifting of the strip in any installation position is impossible. The maximum length of one piece amounts to 3 m.



NEW
Rail cover strip MAC
Pre-information

The new SCHNEEBERGER rail cover strip MAC combines technical functionality with easy handling and a corresponding aesthetic appearance. It provides the following advantages:

- Reliable functioning in all installation orientations due to a secure anchoring in a special groove.
- Utilization of the rail surface as reference surface through the edge zones remaining free.
- Protection of the wipers during the installation process by means of the rail bores being relocated inside the groove.
- Maximum one-piece cover strip length 6 m, applications using several pieces of cover strips can be implemented without any problem.

Your SCHNEEBERGER representative will inform you about the availability of this product.



Plastic plug MRK

Instead of the rail cover strip, plastic plugs can be used to close the rail attachment holes.



Brass plug MRS

Brass plugs are applicable for enhanced requirements regarding surface quality.



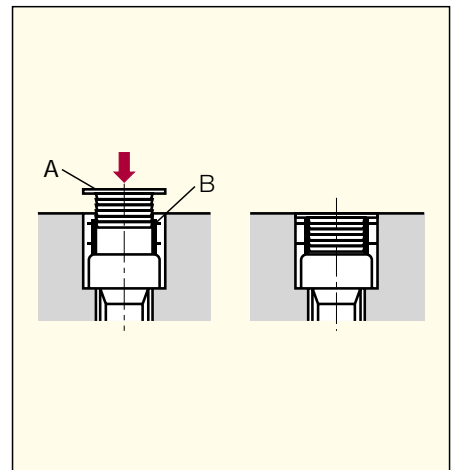
Two-piece steel plug MRZ

The two-piece steel plug, made of stainless steel, is ideal for applications where plastic or brass plugs are inadequate, i. e. in open chip areas. This plug guarantees leakproof sealing of the screw head space.



MRZ function: The seal ring (B) loosely fits into the counterbore. The tapered plug (A) expands the ring when inserted. The plug in its mounted position is flush with the rail and provides a smooth running surface for optimum wiper function and life.

Mounting tools are available. See ordering information in chapter 4.6.



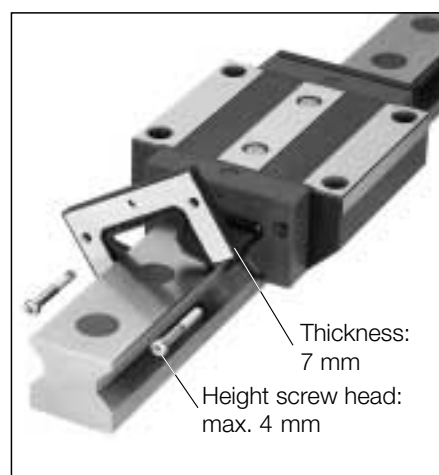
NEW

Additional wipers ZCN, ZCV
replace ZAN/ZAV available from
autumn 2000

The ZCN and ZCV wipers provide effective additional protection of the guideways in heavily contaminated environments.

The new generation of additional wipers can be mounted directly over the rail cross section due to their flexibility. Two versions are available:

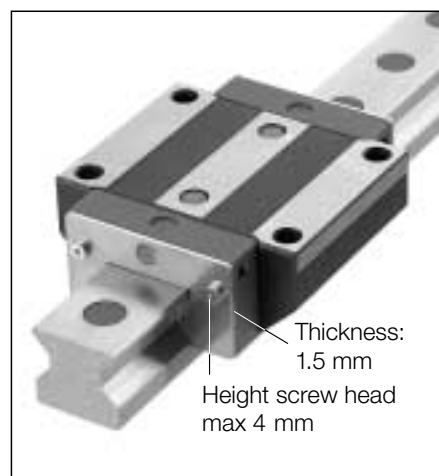
- ZCN made of NBR (Nitrile)
 - ZCV made of Viton® (Fluoro-elastomer)
- for applications with aggressive coolants
These wipers ZCN/ZCV can also be used in combination with the metal wiper ASM.



Metal wiper ASM

The metal wipers ASM serve for the protection of the sealing lips of carriages and additional wipers against hot metal chips. Large and loose dirt particles are pushed away and because of the large radial gap to the rail cannot get jammed. Metal wipers must not be utilized on rails with the measuring system AMS.

The metal wipers are ideally utilized in combination with additional wipers ZCN/ZCV.



Bellows FBM

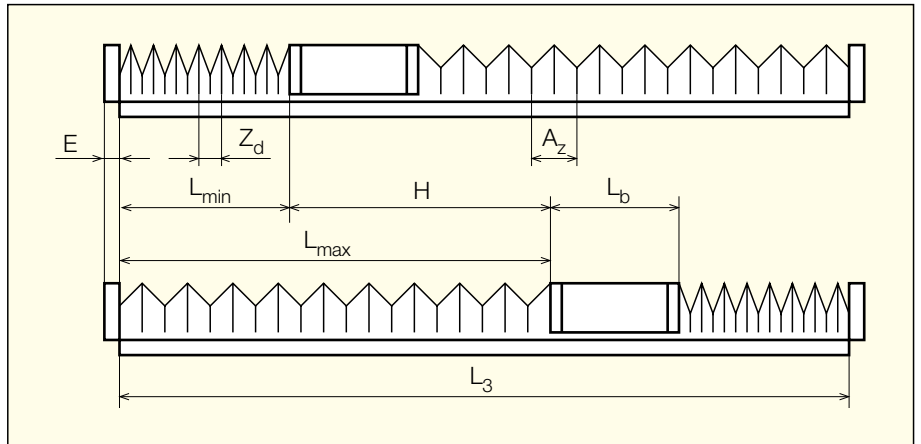
A standard bellows is available for all MONORAIL sizes. The bellows covers the entire length of the rail. The cross section is matched to the particular carriage size. The outside dimensions of the carriages are not exceeded by the bellows. The bellows is mainly used to provide additional protection against dust and splashed water. Installation is simple and requires little time. Retrofitting is only possible with induction heat treated rails since the rail ends have to be drilled for the attachment of the end plate EPL. The bellows is made of a synthetic fabric coated on both sides with polyurethane.

The ZPL adapter plate is required to attach the bellows to the carriage. The adapter plate is screwed to the front plate of the carriage. The EPL end plate can be screwed to the end face of the rail. The bellows is fastened with two rivets each to the adapter plate and front plate.

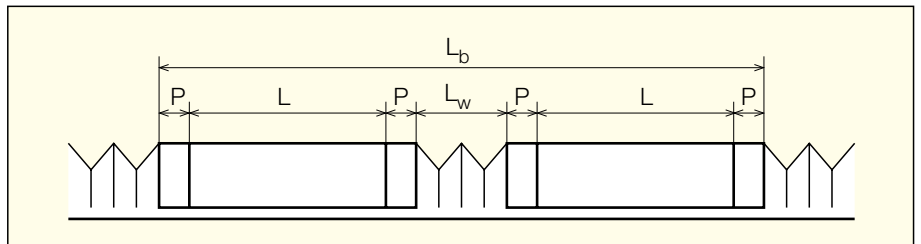
The required adapter and end plates, the attaching screws and rivets are supplied with the order of a complete bellows.

Bellows length calculation

$$L_b = L + 2 \cdot P$$



$$L_b = 2 \cdot (L + 2 \cdot P) + L_w$$



$$L_{min} = n \cdot Z_d + 10$$

$$L_{max} = H + L_{min}$$

$$n = \frac{H}{A_z - Z_d} \quad \text{Round up to whole number}$$

- A_z : Extension per fold
- E : End plate thickness
- H : Travel distance
- L : Carriage length (chapter 4.2 or 4.3)
- L_b : Total length with adapter plates
- L_3 : Rail length
- L_{max} : Extended length of bellows
- L_{min} : Closed length of bellows
- L_w : Clearance between two carriages
- n : Number of folds per bellows
- P : Adapter plate thickness
- Z_d : Closed distance per fold

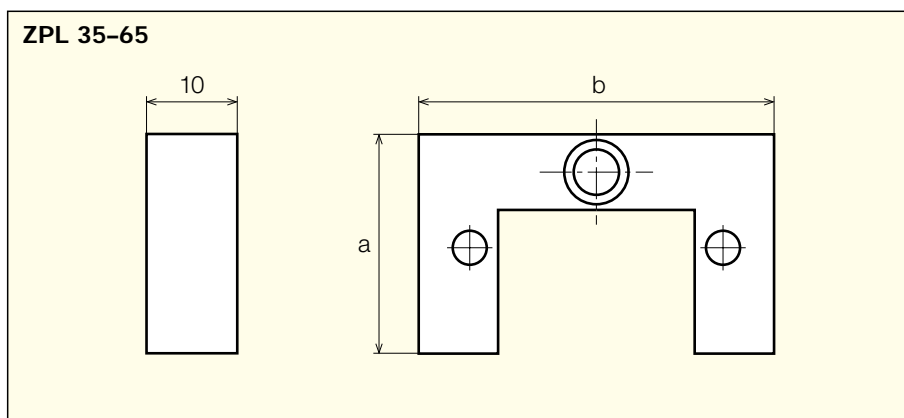
Size	FBM 25	FBM 35	FBM 45	FBM 55	FBM 65
Dimensions in mm					
A_z	13	20	22	28	35
Z_d	2.5	2.5	2.5	2.5	2.5
E	8	8	8	8	8
P	12	12	12	12	12

Rail length calculation

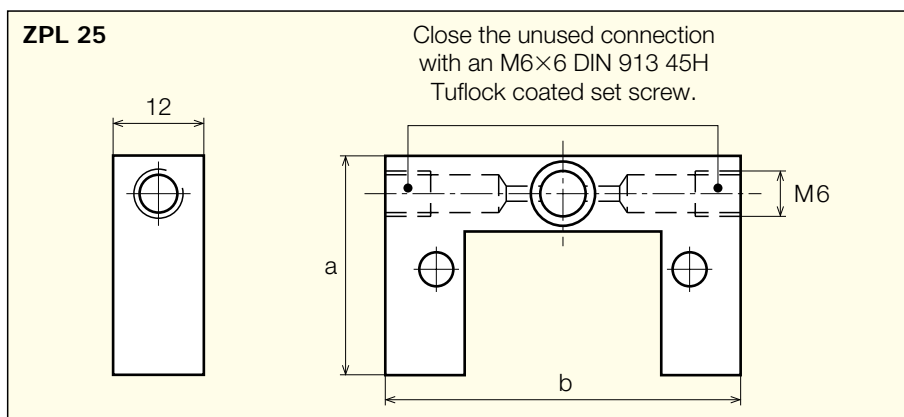
$$L_3 = L_{min} + L_{max} + L_b$$

Adapter plate ZPL

The adapter plate is used for attaching the bellows to the carriage. The adapter plate is made of black-anodized aluminum. A special fastening screw is supplied with the adapter plate.



The adapter plate size 25 is used for attaching the bellows and also for the connection of a lateral lubrication.



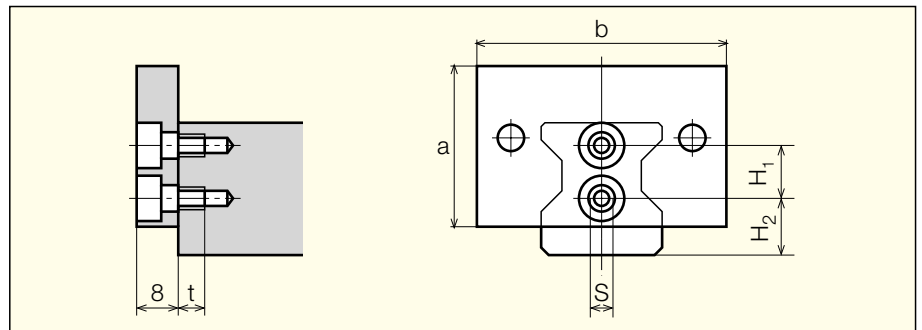
Size	ZPL 25	ZPL 35	ZPL 45	ZPL 55	ZPL 65
Dimension in mm					
a	29	39.5	49.5	56.5	75.5
b	47	68	84	98	123

End plate EPL

The end plate is used to attach the bellows to the end of the rail. The attaching holes can be drilled in the rail if the bellows is to be retrofitted.

The end plate is made of black-anodized aluminum and must be ordered separately if required. Both attaching screws are supplied with the end plate.

The external dimensions of the endplate correspond to the front plate, the bellows and the adapter plate.



Size	EPL 25	EPL 35	EPL 45	EPL 55	EPL 65
Dimension in mm					
a	30	40	50	57	76
b	47	68	84	98	123
H ₁	10	12	15	20	22
H ₂	10.5	14	17	20	25
Sxt	M4×5	M4×5	M6×8.5	M6×8.5	M6×8.5

NEW Lubrication plate SPL

The new lubrication plate SPL thanks to its integrated oil reservoir makes possible an automatic and uniform supply of lubricating oil to the roller elements over a long period of time. As a result, the investment – and operating costs can be significantly reduced. The advantages are:

- Assured supply of lubricant in any installation position
- Long lubrication intervals of up to 5000 km, resp. 12 months
- Can be refilled, in this context refer to chapter 3.6 Lubrication
- Cost saving due to the elimination of a central lubrication system
- Low burden on the environment because of the minimal consumption of lubricant

For maximum travelling distances without re-lubrication, the lubrication plates are always utilized in pairs. The lubrication plates have the same dimensions as the front plates of the carriages and are installed in front of these. Retro-fitting is possible. In case of applications, where coolant can



come into contact with the guideways, additional wipers ZCN/ZCV have to be foreseen.

Assembly rail MRM

The assembly rail is required when the carriage must be removed from the rail and then reinstalled (chapter 9) during the installation of the MONORAIL. It is advisable to leave the assembly rail in the carriage to protect the rollers against contamination. If necessary, the two internal screws for fastening the carriage can be tightened through the two holes in the assembly rail. The assembly rail is made of plastic and available in two lengths, for standard carriages and for carriages with lubrication plates.



Front plate STP – spare part

The red front plates at the end sides of the MONORAIL carriages have two essential functions:

- Supply of lubricant and
- sealing the MONORAIL carriages.

Through several integrated lubrication connections, refer to chapter 4.6 Ordering Information, with the help of a lubricating nipple or by connection to a lubricating line lubricant can be supplied to the carriages, refer to chapter 3.6 Lubrication. Lubricating channels inside the front plate distribute the lubricant and guide it to the roller bodies.

The integrated double-lip cross wipers seal the carriage at the ends and with this prevent the ingress of dirt and the loss of lubricant. Because the cross wipers are subject to wear, the front plates have to be examined regularly and if necessary re-



placed, also refer to chapter 10, Precautionary Measures.

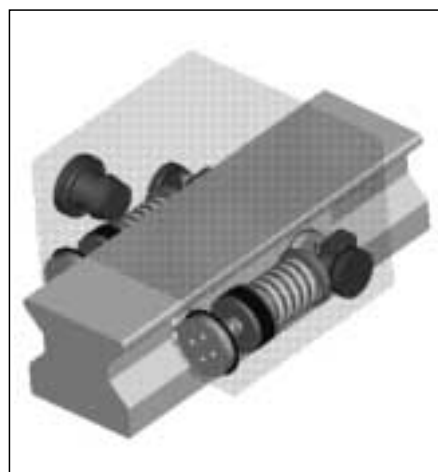
NEW Brakes and clamps

SCHNEEBERGER for the most diverse application cases offers clamping – and braking elements for the roller guideway MONORAIL MR. The various alternatives can be utilized for applications like the securing of a position of linear axes, the clamping of machine tables and right to the application of a controllable counter-force in case of chip-removing processes.

Available are manual, pneumatic- and hydraulic-actuated products.

Versions opening when pressure is applied are optimally suitable for securing vertical axes or linear motor axes in case of an electric power failure.

For more detailed information, please contact your SCHNEEBERGER representative.



4.6 Ordering information MR

When custom MONORAIL MR versions are required, additional information is needed to ensure the correct execution of the order. This has to be marked on the supplementary order sheet:

- Type, accuracy class, preload in the event of different carriage types on a rail
- Additional wipers
- Locating sides of carriages and rails
- Position of lubrication connections or additional lubrication plates
- Installation orientation and type of lubrication

For orders with more than two rails, butt joint rails or rails with more than two carriages per rail a separate drawing is required, on which as well the lengths of all sections of multi-section rails and rail cover strips are indicated.

Guideway MONORAIL MR

	—	MR	35	-C2	-0948	-A	-U	-D	-39	-29	-X	-G1	-V3	-GP	-SO	-A	-HH
Quantity																	
Guideway type	MR																
Size	25, 35, 45, 55, 65																
Carriage type	A, B, C, D																
Carriage qty	1, 2, ...																
Rail length L_3 (in mm).	State the total length for multi-section rails ground together.																
AMS-measuring system*	A Rail with integrated scale**																
Rail version*	U Rails with tapped attachment holes at the bottom** B Rail for cover strip MAB																
Enhanced straightness*	D Rail through hardened																
Starting hole pitch L_5 (in mm)																	
End hole pitch L_{10} (in mm)																	
Rail hole pitch L_4 special*	X doubled hole pitch (as BM) Y L_4 not standard or not uniform (drawing required)																
Accuracy class	G0, G1, G2, G3																
Preload class	V1, V2, V3																
Matched*	GP																
Lubrication connection not standard*	SO above																
Position has to be indicated on supplementary sheet	SS lateral (not size 25) SV front laterally (not size 25) ST special, 2 connections per carriage (not size 25)																
Carriages with parallel locating sides*	A carriage width $B_A = (B-0.2) \pm 0.05$ mm																
Hard-chroming*	H only rails hard-chromed HH rails and carriages hard-chromed																

* Optional specifications

For the measuring system AMS size 25, the specification rail execution **U is compulsory

Accessories MONORAIL MR – to be ordered separately

Rail cover strip

			—	MAB	35	-0948
Quantity						
Type	MAB (Steel cover strip)					
Size	25, 35, 45, 55, 65					
Rail length L₃						

Plugs

			—	MRK	35	
Quantity						
Type	MRK (plastic) MRS (brass) MRZ (steel, two piece)					
Size	25, 35, 45, 55, 65					

Mounting tool for two piece steel plug MRZ

			—	MWH	35	
Quantity						
Type	MWH	Sliding block with insertion tool				
	MZH	Hydraulic cylinder (for all sizes)				
Size	25, 35, 45, 55, 65 (no specification for MZH)					

Additional wipers

			—	ZCN	35	
Quantity						
Type	ZCN (NBR) ZCV (Viton)					
Size	25, 35, 45, 55, 65					

Metal wipers

			—	ASM	35	
Quantity						
Type	ASM not allowed with AMS rail					
Size	25, 35, 45, 55, 65					

Bellows

		—	FBM	35	-24	-EZ
Quantity						
Type	FBM					
Size	25, 35, 45, 55, 65					
Number of folds						
Version	without specification EZ ZZ	bellow only, without attachment plates with 1 endplate (EPL) and 1 adapter plate (ZPL) – For mounting to rail ends with 2 adapter plates – For mounting between two carriages				

Attachment plates for bellow

		—	ZPL	35	
Quantity					
Type	ZPL EPL	Adapter plate End plate	Included at order of a complete bellow		
Size	25, 35, 45, 55, 65				

Lubrication plate

		—	SPL	35	-MR
Quantity	only pair orders				
Type	SPL				
Size	25, 35, 45, 55, 65				
Version	MR	Roller guideway MONORAIL MR/MZ			

Assembly rail

		—	MRM	35	-SPL
Quantity					
Type	MRM				
Size	25, 35, 45, 55, 65				
Version	no indication SPL	Standard version Long version for carriages with lubrication plate SPL			

Front plate (Spare part)

		—	STP	35	-SO
Quantity					
Type	STP				
Size	25, 35, 45, 55, 65				
Lubrication connection	no indication G 1/8 SO-AB SO-CD SS* SV* ST*	Standard, M6 center front G 1/8 center front (not size 25, 35) from above, carriage type MRA/MRB from above, carriage type MRC/MRD lateral (not size 25) front lateral (not size 25) special, 2 × connections per carriage (not size 25)			

* Order with indication of lubrication connection positions required.

Supplementary sheet for MR 25-65/Arrangement of carriages and accessories

Customer, Address

Machine, axis

Drawing No. Customer

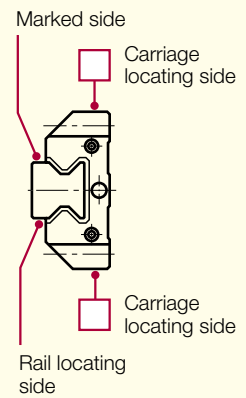
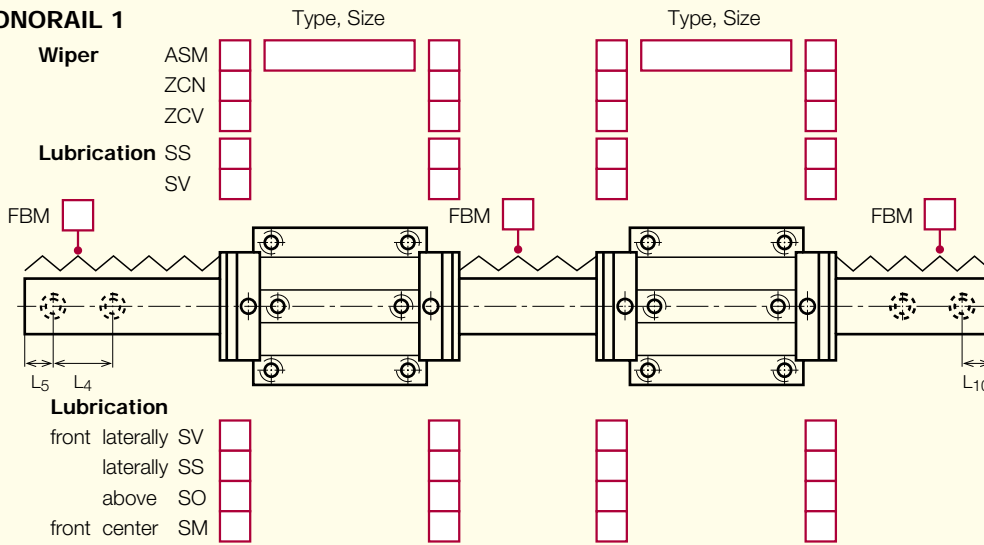
SCHNEEBERGER rep.

Drawing No. SCHNEEBERGER

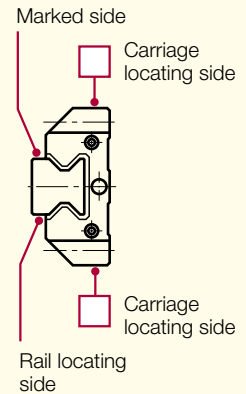
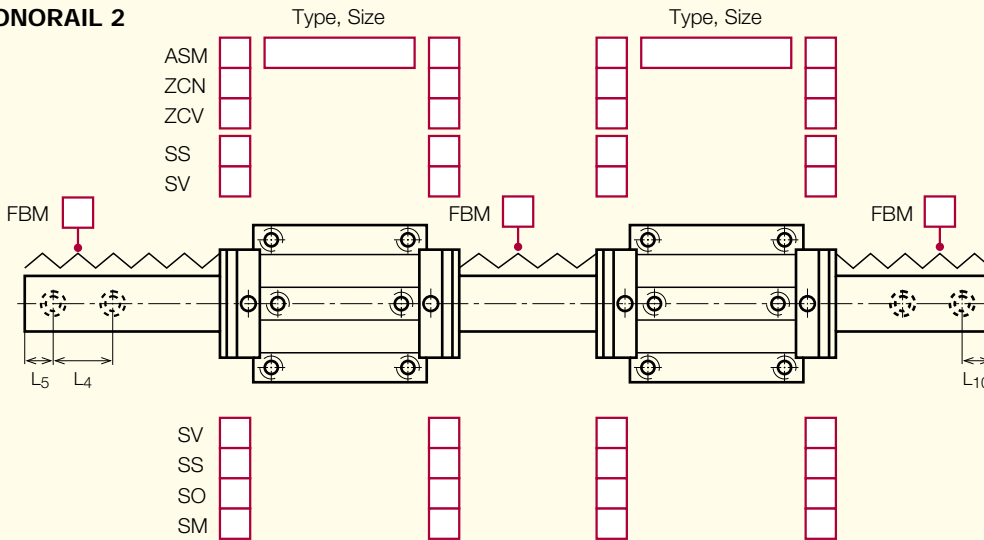
Ordering information MONORAIL 1

Ordering information MONORAIL 2

MONORAIL 1



MONORAIL 2



Mounting position

- standard (horizontal/vertical)
- special: turned ___° on longitudinal axis of the rail (Two connections per carriage are recommended with oil, sizes 35-65)

Lubrication Accessories

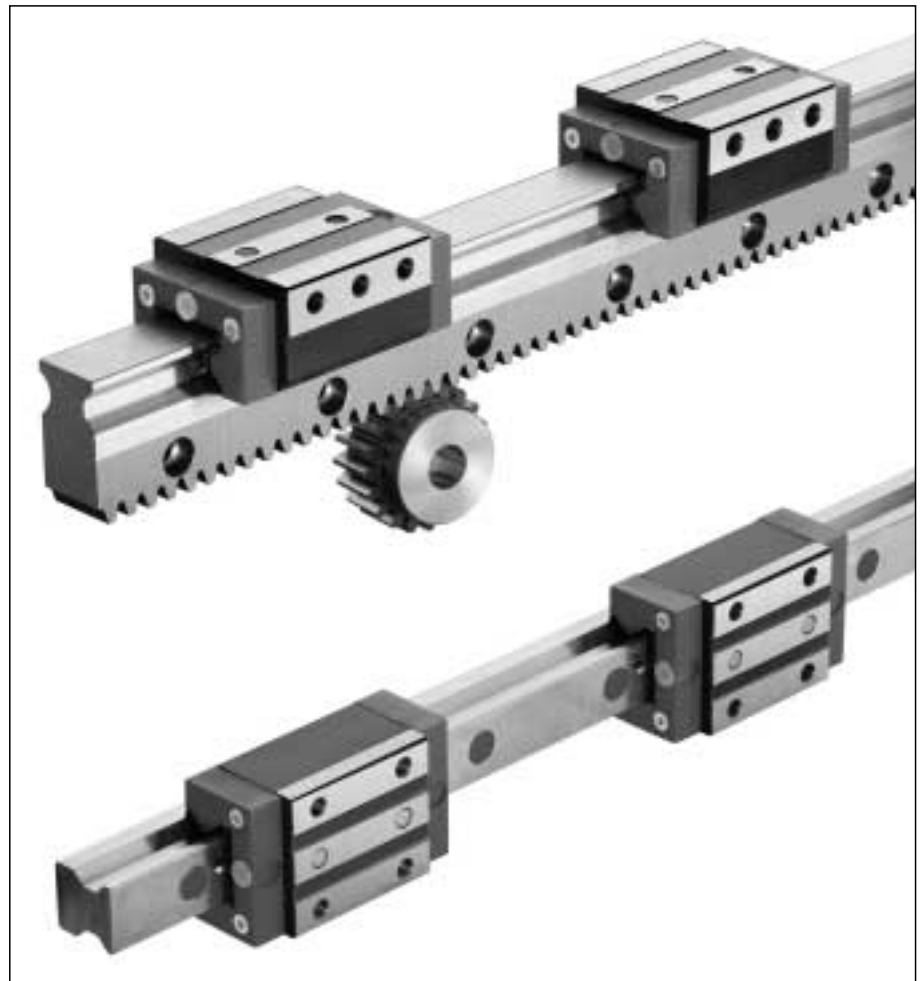
- Lubrication plate
- Lubricating nipples mounted

Attach

- from above
- from bottom (-U-)

Rail covering

- MRK
- MRS
- MRZ
- MAB



5.1 Product features

In the handling and automation industry increasing use is being made of linear guiding systems with additional features. The ever increasing cost pressure and quality demands on handling and automation systems in industrial applications are satisfied by SCHNEEBERGER MONORAIL MZ. The **MZ**, with integrated rack, offers the following decisive advantages:

- Extremely simple dimensioning and design of the connecting structure.
- Logical mounting of the guiderail and carriage systems.
- Optimal load-carrying capacity and service life based on the well-known MONORAIL machine guideway.
- Minimum servicing and maintenance as the design of the MONORAIL is conceived for industrial usage.
- Life and speed uncompromisingly match the user's requirements.

5.2 Dimension table, loading capacities MONORAIL MZ with carriage type MRE

Standard version

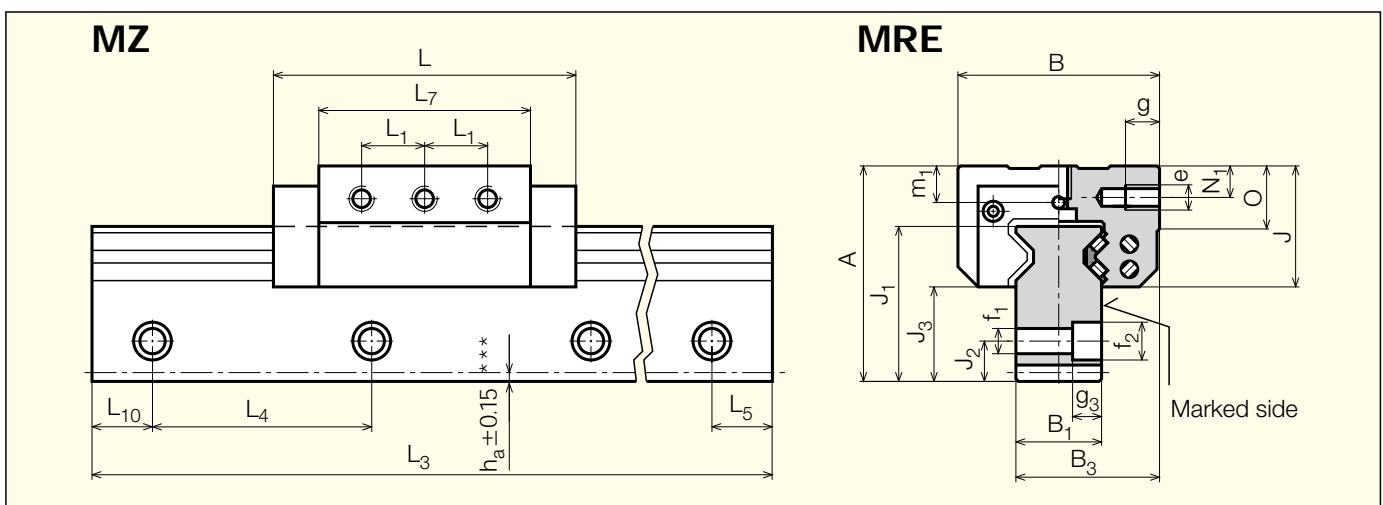
- MONORAIL carriage and track of the rail are hardened
- MONORAIL rails can be mounted continuously
- Rack Teeth cut straight (as per DIN 867)
Pressure angle 20°
Milled to quality 8, unhardened
Maximum accumulated pitch error for single unit rails: ± 0.06 mm per 1000 mm
- The running accuracy Δ of the carriages on the rail corresponds to accuracy class G3
- The preload class of the carriages corresponds to V1

Version MO

- Rail cross section same as MZ but without rack

On request

- Besides carriage type MRE, carriage types MRA, MRB, MRC and MRD can also be used
- Helical rack (single piece rails only)
- Special tooth pitch
- Rails of special length, maximum single piece rail length $L_3 = 2400$ mm



Type	Dimensions (mm)															
	Linear pitch	A	B	B ₁ * ±0.05	B ₂	B ₃	J	J ₁	J ₂	J ₃	L**	L ₁	L ₃	L ₄	L ₅ / L ₁₀	L ₇
MZ/MRE 25	7.5	60	57	23	–	40	33.5	44.5	11.5	26.5	81	17.5	1500	60	30	57
MR-X/MRC 25	–	40	48	23	12.5	–	33.5	24.5	–	–	81	35	1500	60	30	57
MZ/MRE 35	10.0	85	76	34	–	55	47	62	17	38	109	25	1520	80	40	76
MR-X/MRC 35	–	55	70	34	18	–	47	32	–	–	109	50	1520	80	40	76

* Lower tolerances on request

** When using additional wipers, metal wipers and lubrication plates, the total length L is increasing, see chapter 4.5.

*** Dimension $h_a \triangleq$ Module m, see chapter 5.4.

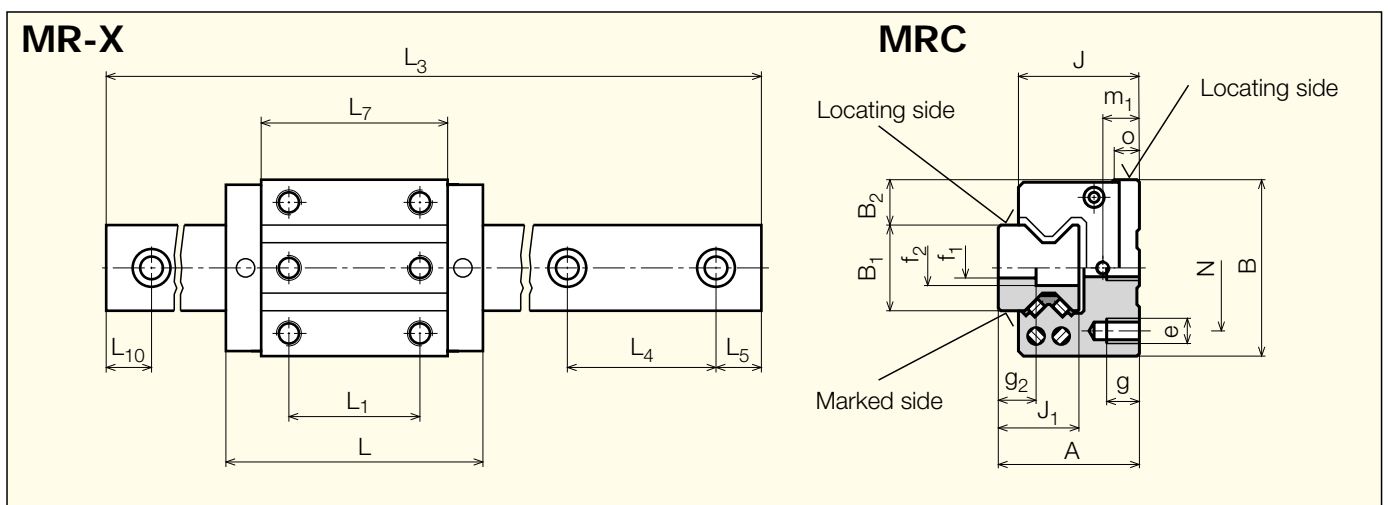
5.3 Dimension table, loading capacities MONORAIL MR-X with carriage type MRC

Standard version

- MONORAIL-rail with double hole spacing L_4
- The running accuracy Δ of the carriages on the rail corresponds to accuracy class G3
- The preload class of the carriages corresponds to V1

On request

- Also carriage types MRA, MRB, MRD and MRE can be used



N	N ₁	e	f ₁	f ₂	g	g ₂	g ₃	m ₁	o	Roller Ø	Loading capacities* C _o (N)	C (N)	Max. rack load (N)	Weights Carriage (kg)	Rail (kg/m)
–	7.5	M6	7	11	10	–	7	9.5	15	3.2	24 900	13 850	1800	0.75	7.0
35	–	M6	7	11	9	13	–	9.5	7.5	3.2	24 900	13 850	1800	0.6	3.4
–	11	M8	9	15	12	–	9	14	22	4.5	46 700	26 000	2500	1.6	14.8
50	–	M8	9	15	12	15	–	14	8	4.5	46 700	26 000	2500	1.35	6.8

*Loading capacities reduced according to hole pitch

C = dynamic loading capacity (100 km)
C_o = static loading capacity

5.4 Accessories

For MONORAIL MZ the following accessories are available, see also chapter 4.5:

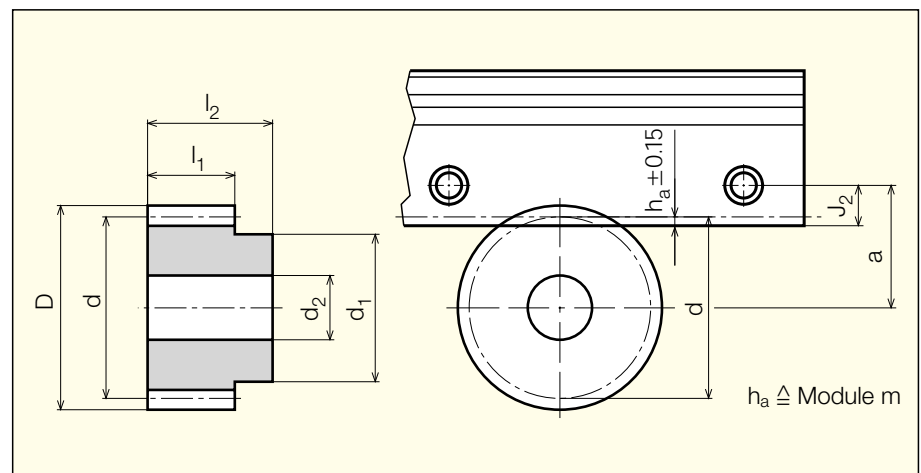
- Additional wipers ZCN/ZCV
- Metal wiper ASM
- Lubrication plate SPL
- Mounting rail MRM

Standard accessories

For the parallel rail MR-X the same accessories are available as for the standard MONORAIL MR.

Standard pinion MZR

- Tothing hardened and ground
- Quality 6 f 24 according to DIN 3962/3963/3967
- Straight bore for customized fitting to the motor shaft



	Reference circle $\varnothing d$	Module m	No of Teeth z	Pitch p	Dimensions (mm)						Weight in kg
					a	D	d ₁	d ₂	l ₁	l ₂	
MZR 25	47.75	2.3873	20	7.5	33.0	52.52	40	15 h7	19.5	30	0.34
MZR 35	63.66	3.1831	20	10	45.7	70.02	50	15 h7	29.5	43	0.88

all dimensions in mm

$$\text{Module } m = \frac{p}{\pi}$$

$$\text{Reference circle } \varnothing d = m \cdot z$$



Attention:

- For systems with multi-section rails, a pinion with spring pre-load must be used due to the ± 0.15 mm tolerance of the dimension h_a .
- When mounting multi-section rails, the rail joints have to be adjusted according to section 9.6 of this catalog (Handling the rails).

5.5 Ordering information MZ

When custom MONORAIL MZ versions are required, additional information is needed to ensure the correct execution of the order. This has to be marked on the supplementary order sheet:

- Type, accuracy class, preload in the event of different carriage types on a rail
- Additional wipers
- Locating sides of carriages and rail
- Position of lubrication connections or additional lubrication plates
- Installation orientation and type of lubrication

In the case of more than 2 rails, butt joint rails or in the case of more than two carriages per rail, a separate drawing is required, on which as well the lengths of all sections of multi-section rails are indicated.

Guideway MONORAIL MZ

	—	MZ	35	-E2	-0950	-30	-20	-Y	-G3	-V1	-SO	-A
Quantity												
Guideway type		MZ MO										
Size		25, 35										
Carriage type		E (A, B, C, D)										
Carriage quantity		1, 2, ...										
Rail length L₃ (in mm).												
Starting hole pitch L₅ (in mm)												
End hole pitch L₁₀ (in mm)												
Hole pitch L₄ special*		X Y										
Accuracy class		G3										
Preload class		V1										
Lubrication connection not standard*												
Position has to be indicated on supplementary sheet												
Carriages with parallel locating sides*												

Order information for parallel guideway see chapter 4.6 MONORAIL MR

*Optional specifications

Supplementary sheet for MZ/MO 25-35/Arrangement of carriages and accessories

Customer, Address

Machine, axis

Drawing No. Customer

SCHNEEBERGER-rep.

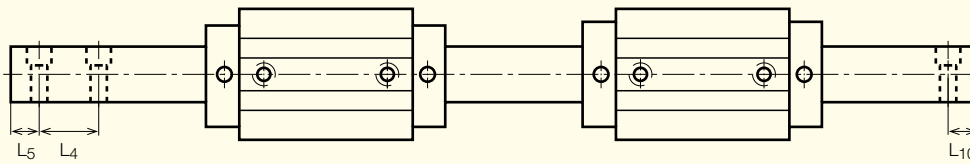
Drawing No. SCHNEEBERGER

Ordering information MONORAIL MZ/MO

Ordering information MONORAIL MR-X

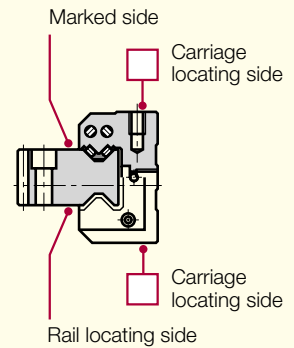
MONORAIL MZ/MO

	Type, Size	Type, Size
Wiper	ASM <input type="checkbox"/>	<input type="checkbox"/>
	ZCN <input type="checkbox"/>	<input type="checkbox"/>
	ZCV <input type="checkbox"/>	<input type="checkbox"/>
Lubrication	SS <input type="checkbox"/>	<input type="checkbox"/>
	SV <input type="checkbox"/>	<input type="checkbox"/>



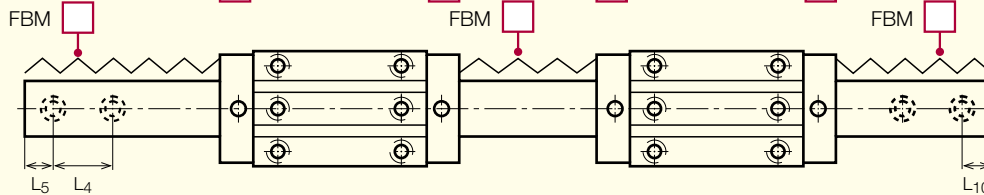
Lubrication

front laterally	SV <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
laterally	SS <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
above	SO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
front center	SM <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

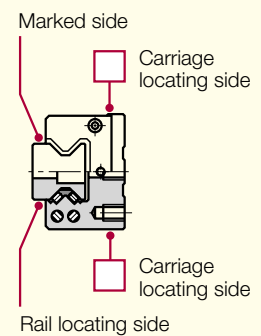


MONORAIL MR-X

	Type, Size	Type, Size
Wiper	ASM <input type="checkbox"/>	<input type="checkbox"/>
	ZCN <input type="checkbox"/>	<input type="checkbox"/>
	ZCV <input type="checkbox"/>	<input type="checkbox"/>
Lubrication	SS <input type="checkbox"/>	<input type="checkbox"/>
	SV <input type="checkbox"/>	<input type="checkbox"/>



SV <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
SS <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
SO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
SM <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



Mounting position

- standard (horizontal/vertical)
- special: turned ___° on longitudinal axis of the rail
(Two connections per carriage are recommended with oil, size 35)

Lubrication Accessories

- Lubrication plate SPL
- Lubrication nipple mounted

Attach MR-X

- from above
- from bottom (-U-)

Rail covering MR-X

- MRK MRZ
- MRS MAB



6.1 Product features

SCHNEEBERGER develops and produces integrated distance measuring systems for MONORAIL roller guideways.

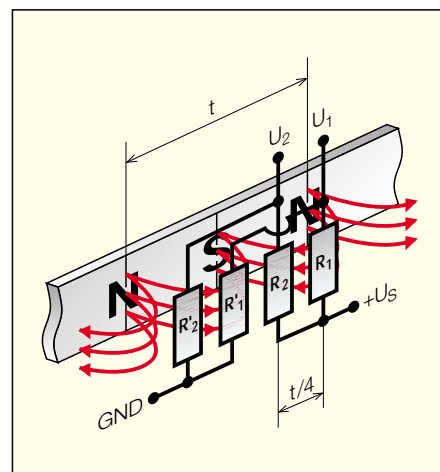
The technical level achieved sets standards with respect to economy, accuracy and reliability.

The AMS (Advanced Measuring System) represents the current technical state of the art and is primarily utilized in machine tools.

For various interfaces, powerful signal forming electronic systems are available from SCHNEEBERGER.

Reliable scanning technique

The measuring system is based on a magnetoresistive sensor which scans the magnetic grating «t» of the scale. A relative motion between the scale and the sensor in the measuring direction causes periodic changes of resistance in response to changes in the magnetic flux vector. In order to identify the relatively small resistance changes and to compensate for temperature-related signal changes, several sensor elements are configured in a bridge.



The new scanning electronic readhead

The system operates without requiring maintenance. The design of the scanning unit of the measuring head has been optimized to achieve the highest reliability.

- The single piece titanium scanning glider is prepared with a special finish selected for its wear resistance and its sliding characteristics.
- The newly developed MONORAIL AMS_A sensor chip was designed utilizing state of the art semiconductor technology. As a result, a significant increase in the reliability and signal quality has been achieved.
- The signals of the MONORAIL AMS_A are compatible with current NC control systems and technology. Either $1V_{pp}$ or $11\mu A_{pp}$ output signals are available. For control systems requiring a TTL input, an external electronic interpolation system (SMEa) is available.



Insensitive to contamination

For normal machine operating conditions this integrated measuring system is insensitive to oil, grease and coolant contamination. In especially dirty operating environments additional standard wipers ZAN/ZAV are recommended.



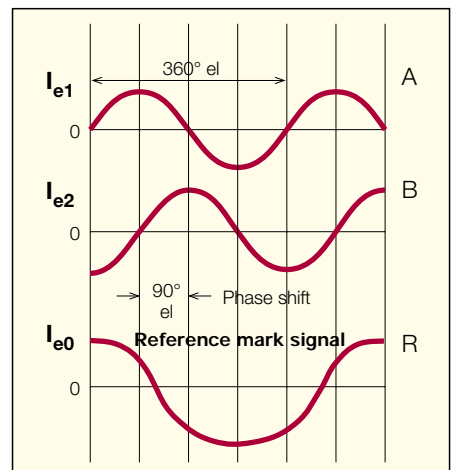
Precise measuring standard

The magnetic grating and the reference marks are applied to a hard magnetic material rigidly connected to the rail. This material's thermal behavior corresponds to that of steel and gray iron. In the measuring direction, the scale increments consist of consecutive north and south poles. The high coercive field strength of the scale material guarantees the magnetization of the poles. The measuring standard is applied as the final step.



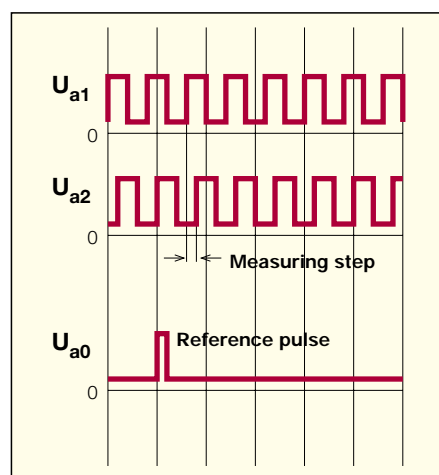
Scanning signals

The scanning signals consist of two sinusoidal signals and a reference mark. The signals are phase-shifted to each other by 90°. The signal period 360° corresponds to the grating period «t» of the scale.



Digital interpolation electronics SMEa

The analog current signals of the scanning head are amplified and sent to a digital signal processor. This calculates the present position and from it the number of measuring steps covered. These are output as quadrature TTL signals. With an interpolation factor of 100, using edge detection, a measuring step of $1\mu\text{m}$ is achieved. The interpolation electronics is available in two versions: voltage and current.



6.2 Technical data

MONORAIL AMS_A

Measuring standard	Hard-magnetic North/South gratings
Signal period	400 μm (= grating period t)
Accuracy class	$\pm 5\ \mu\text{m}/\text{m}$ at 20° C
Reference marks	every 50 mm
Measuring step	1 μm with SMEa, interpolation to 0.2 μm possible
Repeatability	± 1 measuring step
Interpolation error	$\pm 1\ \mu\text{m}$
Max. traversing speed	3 m/s
Output signals	sinusoidal, 90° phase-shifted current signals i_{e1} , i_{e2} : 7 to 16 μA_{pp} (1 k Ω load) voltage signals A, B: 0.6 to 1.2 V_{pp} (120 Ω load)
Reference signal	current signals i_{e0} : approx. 5.5 μA (usable component) voltage signals R: approx. 0.5 V (usable component)
Electrical connections	current signals 9 pins, voltage signals 12 pins cable 3 m with connector (standard) cable 0.3 m with mounting base and flange (optional)
Power supply	5 V $\pm 5\%$ /50 mA
Protection (DIN 40050)	IP 64
Operating temperature	0 to 50° C
Max. rail length L_3	3000 mm

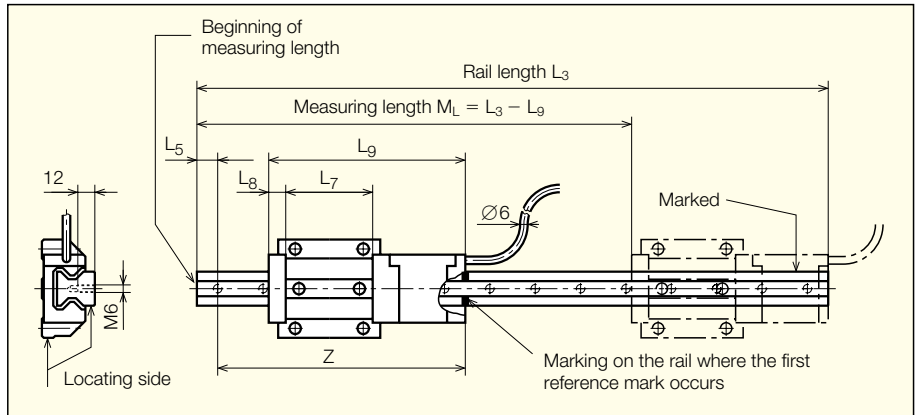
Measuring electronic SMEa

A detailed brochure is available for download at www.schneeberger.com in section Products/Measuring systems or contact your SCHNEEBERGER partner.

6.3 Dimensions

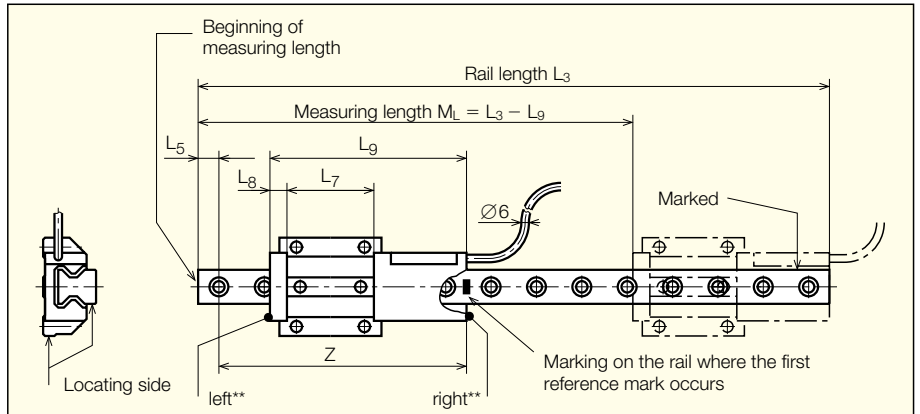
AMS_A 25

Z	L ₇	L ₈	L ₉	L ₉ *
±1.5	MRA/ MRC	MRB/ MRD	MRA/ MRC	MRB/ MRD
25	203	57	79.4	12
Z = Distance to first reference mark Further reference marks are spaced at 50 mm over measuring length L ₃ , L ₅ see chapter 4.2 and 4.3				

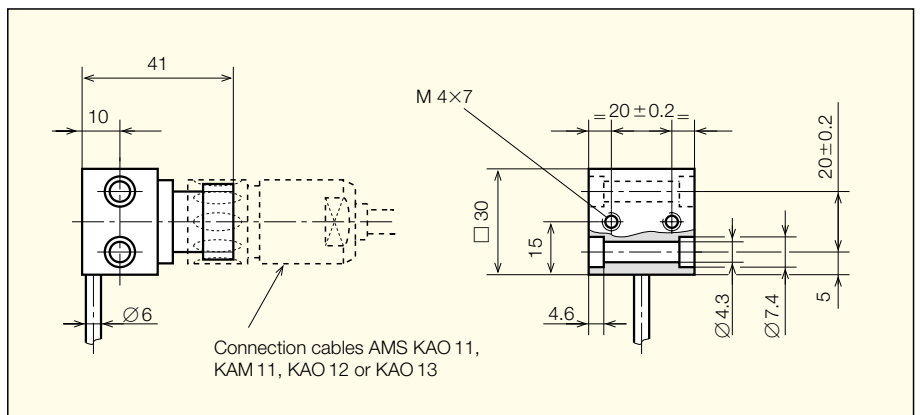


AMS_A 35, 45, 55, 65

Z	L ₇	L ₈	L ₉	L ₉ *
±1.5	MRA/ MRC	MRB/ MRD	MRA/ MRC	MRB/ MRD
35	227	76	103	16.5
45	243	100	135	19
55	277	120	162	22
65	344	-	201	25
Z = Distance to first reference mark Further reference marks are spaced at 50 mm over measuring length L ₃ , L ₅ see chapter 4.2 and 4.3				

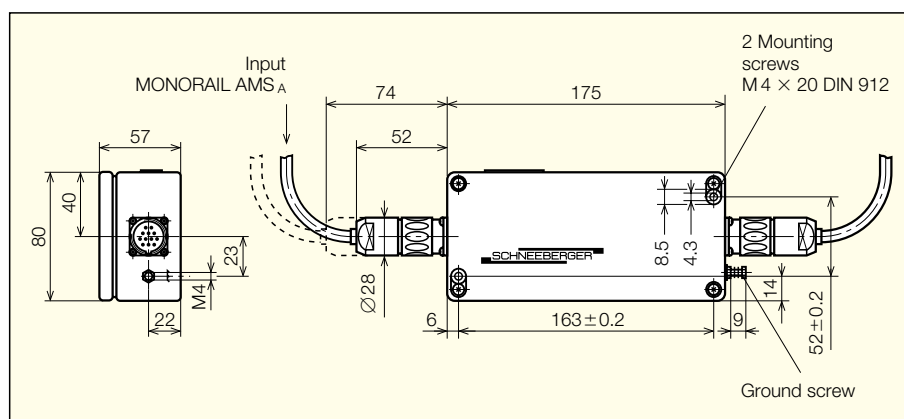


Mounting base with flange socket (male)



* When using additional wipers, the total length L₉ is increasing, see chapter 4.5.
** Only for orders of additional wipers AMS-LI and AMS-RE

Dimensions SMEa / Cable connections



6.4 Ordering information MONORAIL MR with AMS

Orders for MONORAIL MR with AMS versions require additional information to ensure the correct execution of the order. Mark on the supplementary sheet:

- Position of scanning unit (ev. add special drawing)
- Type, accuracy class, preload in the event of different carriage types on a rail
- Additional wipers
- Locating sides of carriages and rails
- Position of the lubrication connections
- Installation orientation and type of lubrication

For orders with more than two rails, butt joint rails, rails with more than two carriages per rail or a different position of the scanning head as indicated in the supplementary sheet a separate drawing is required.

Guideway MONORAIL MR

Order information see chapter 4.6 for MONORAIL MR. The guideway with the integrated measuring system has to be indicated with an **A** in the ordering designation, for size 25 additionally with an **U** for rails with tapped attachment holes at the bottom.

Delivery content

The measuring system AMS contains, according to the following order designation, the scale on the rail, the scanning head and its housing. Other accessories have to be ordered separately.

Measuring system AMS

		—	AMSA	35	-0948	-S	-I
Quantity							
Type	AMS_A analog						
Size	25, 35, 45, 55, 65						
Length of measuring system in mm (max. 3000 mm, according to max. single piece rails)							
Electrical connection	S	Cable 3 m with connector					
	M	Cable 0.3 m with mounting base and flange socket					
Output signal	U	Voltage output					
	I	Current output					

Accessories AMS – to be ordered separately

Interpolation electronics

		—	SMEA	-I	-P	-S	
Quantity							
Type	SME_a						
Interface	U	Voltage input					
	I	Current input					
Voltage supply	P	Type with «power sense»					
	D	«DC-DC converter»					
Configuration	S	Standard configuration					
	K	Custom configuration of interpolation rate, signal edge separation, reference pulse width					

Extension/Connection cables

		—	KAO 10	-5
Quantity				
Type	KAO 10 KAO 11 KAO 12 KAO 13 KAO 14	KAM 10 KAM 11		
Length in m 1, 3, 5, 10, 15, 20 (Longer lengths on request)				

Scanning head (in case of replacement)

		—	SMA	35	-S	-I
Quantity						
Type	SMA	analog				
Size	25, 35 (also for sizes 45, 55), 65					
Electrical connection	S	Cable 3 m with connector				
	M	Cable 0.3 m with mounting base and flange socket				
Output signal	U	Voltage interface				
	I	Current interface				

Housing for scanning head

		—	AMS-GEH	-35
Quantity				
Type	AMS-GEH			
Size	25, 35, 45, 55, 65	Size 25 without lubrication connection		

Additional wipers

		—	ZAN	35	-AMS
Quantity					
Type	ZAN (NBR)				
	ZAV (Viton)				
Size	25, 35, 45, 55, 65				
Version	AMS*	for AMS-rail (only size 25)			
	AMS-LI*	for AMS-rail, left version (only size 35)			
	AMS-RE*	for AMS-rail, right version (only size 35)			
	AMS-GEH*	for AMS-housing			

Front plate (spare part)

		—	STP	25	-AMS
Quantity					
Type	STP				
Size	25, 35				
Version	AMS*	for AMS rail (size 25 only)			
	AMS-LI*	for AMS rail, left version (size 35 only)			
	AMS-RE*	for AMS rail, right version (size 35 only)			
Lubrication connection	no indication	Standard, M6 center front			
	SO-AB	from above, carriage type MRA/MRB			
	SO-CD	from above, carriage type MRC/MRD			
	SS**	lateral (size 35 only)			
	SV**	front lateral (size 35 only)			
	ST**	special, 2 × connections per carriage (size 35 only)			

* Special geometry of the sealing lips on the side of the magnetic scale, see also chapter 6.3

** Order with indication of lubrication connection positions required

Supplementary sheet for MR 25–65 with AMS/Arrangement of carriages and accessories

Customer, Address

Machine, axis

Drawing No. Customer

SCHNEEBERGER-rep.

Drawing No. SCHNEEBERGER

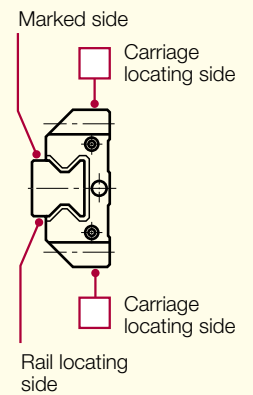
Ordering information MONORAIL 1

Ordering information MONORAIL 2

MONORAIL 1

	Type, Size	Type, Size
Wiper	ZAN <input type="checkbox"/> <input type="checkbox"/> ZAN <input type="checkbox"/>	ZAN <input type="checkbox"/> <input type="checkbox"/> ZAN <input type="checkbox"/>
	ZAV <input type="checkbox"/> <input type="checkbox"/> ZAV <input type="checkbox"/>	ZAV <input type="checkbox"/> <input type="checkbox"/> ZAV <input type="checkbox"/>
Lubrication	SS <input type="checkbox"/> <input type="checkbox"/> SS <input type="checkbox"/> <input type="checkbox"/>	SS <input type="checkbox"/> <input type="checkbox"/> SS <input type="checkbox"/> <input type="checkbox"/>
	SV <input type="checkbox"/> <input type="checkbox"/> SV <input type="checkbox"/> <input type="checkbox"/>	SV <input type="checkbox"/> <input type="checkbox"/> SV <input type="checkbox"/> <input type="checkbox"/>

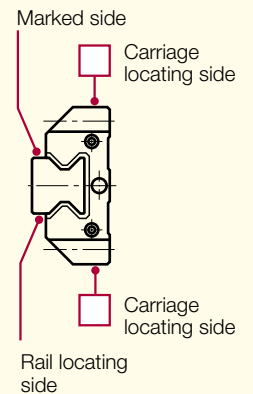
Lubrication	front laterally SV <input type="checkbox"/>	front laterally SV <input type="checkbox"/>
	laterally SS <input type="checkbox"/>	laterally SS <input type="checkbox"/>
	above SO <input type="checkbox"/>	above SO <input type="checkbox"/>
	front center SM <input type="checkbox"/>	front center SM <input type="checkbox"/>



MONORAIL 2

	Type, Size	Type, Size
ASM <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>
ZAN <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>
ZAV <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>
SS <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>
SV <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>

SV <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
SS <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
SO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
SM <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



Mounting position

- standard (horizontal/vertical)
- special: turned ___° on longitudinal axis of the rail (Two connections per carriage are recommended with oil, size 35–65)

Lubrication/Accessories

- Lubricating nipples mounted

Attach

- from above
- from bottom (-U-)

Rail covering

- MRK MRZ
- MRS MAB

MONORAIL BM - the ball type linear guideway.

Ball-MONORAIL BM

There is know-how inside *



High loads and moments

- Stiffness against roll moments
- O-Geometry

Enhanced run-out accuracy

- Optimized geometry of carriage and rail

Simple and fast maintenance

- Exchangeability of wear parts on the rail
- Small number of parts

Less carriage pulsation

- Unique run-in-area

* MONORAIL BM - know-how, to your advantage.

SCHNEEBERGER
LINEAR TECHNOLOGY

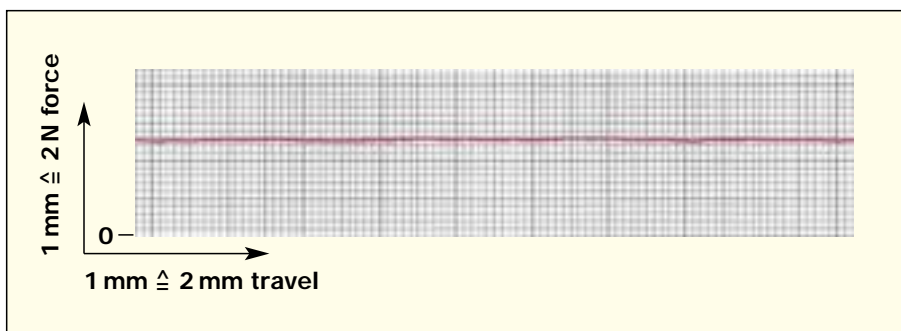
7.1 Product features



Very good dynamic characteristics and high economy are the distinguishing features of the Schneberger ball type linear guideway MONORAIL BM. The novel design with few but optimally designed components, because the small number of transitions (joints) in the ball tracks makes outstanding running characteristics possible, which are distinguished by smooth running, little pulsation, low friction values and high travelling speeds. By means of the trapeze-shaped rail cross-section, a high rigidity of the guideway has been achieved and simultaneously the maintenance effort required significantly reduced, because parts subject to wear can be replaced without having to dismantle the guideway. The complete sealing of the carriages guarantees a high reliability in conjunction with a long service life. This robust guideway is therefore suitable for many and diverse applications and represents an ideal complement to the roller guideway MR.

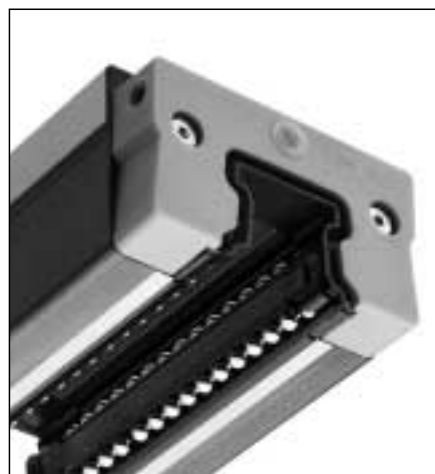
Unique running characteristics

Special attention was focused on the run-in area of the balls from the unloaded to the loaded zone. This area was geometrically balanced in such a manner, that very smooth operation, minimum travel pulsation, pitch movement and noise, was achieved, in both low and high speed movements.



Completely sealed

The double-lip cross wiper seals as well as the additionally sealed gaps between the front plate and the steel body ensure an exceedingly effective seal and therefore a significant increase of the service life. The operational safety and reliability of the wiper seals is even more enhanced by the smooth rail surface when using the standard rail cover strip.

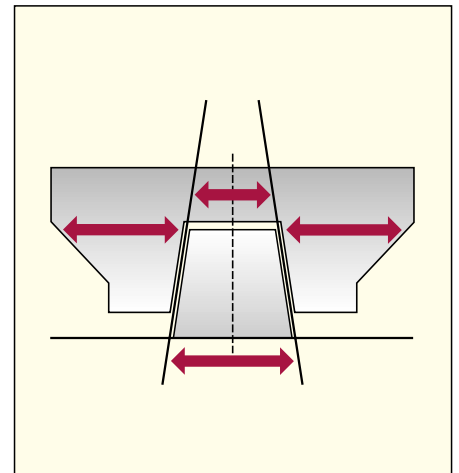


Balls retained

The robust construction is also clearly evident by the fact that the balls are securely held in the tracks of the carriage at all times. Therefore an assembly rail for installing or removing the carriage is not required, if carefully executed.

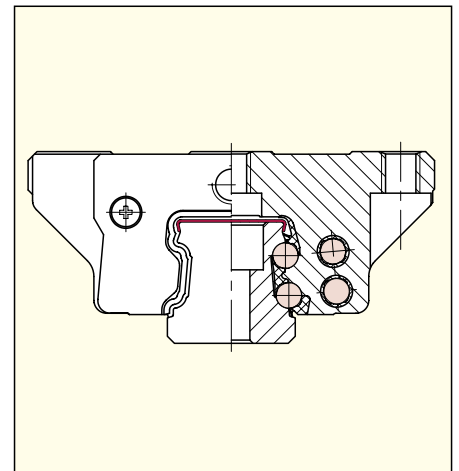
Optimized rail and carriage cross sections

Because of the trapezoidal rail profile, it was possible to optimize the carriage cross sections for the highest possible rigidity. This rail profile enables easier servicing because the front plate, standard and additional wipers can be replaced without removing the carriage from the rail.



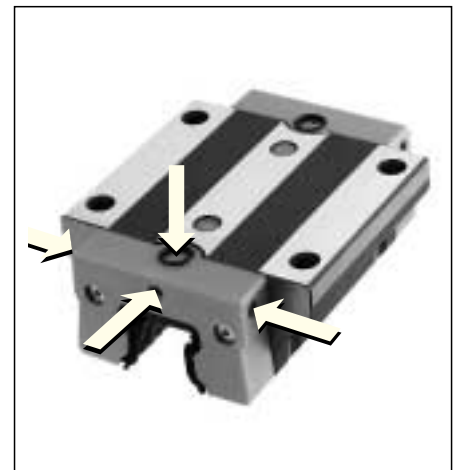
The highest precision with high rigidity

The MONORAIL BM is a modern, 4-row ball guideway. The balls make contact with each track at only two points, even under pre-load. As a result, the friction is reduced to a minimum and quiet, smooth running is achieved. Due to the selected ball arrangement, this guideway has a high load bearing capacity, equal in any direction. Consequently, the MONORAIL BM can be used in a broad range of applications. The precision of the guideway corresponds to the high SCHNEEBERGER accuracy standard. Additional central mounting holes particularly when wide carriages are used yields an increased rigidity under tensile load.



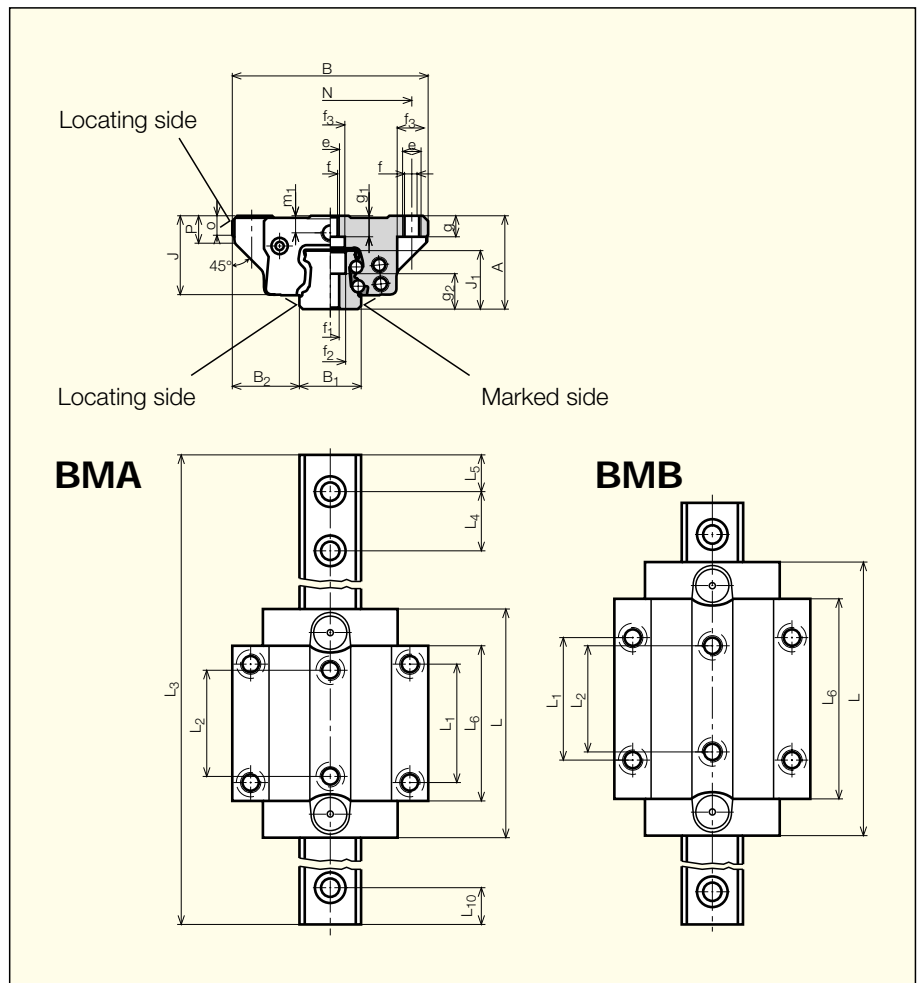
Versatile lubrication possibilities

The carriages can be lubricated through various lubrication connections (from the front, either side or above). The geometry of the lubrication channels, combined with efficient sealing, reduces lubricant consumption. This provides both economic and environmental benefits.



**7.2 Dimension table,
loading capacities
MONORAIL BM**

Carriage types BMA and BMB

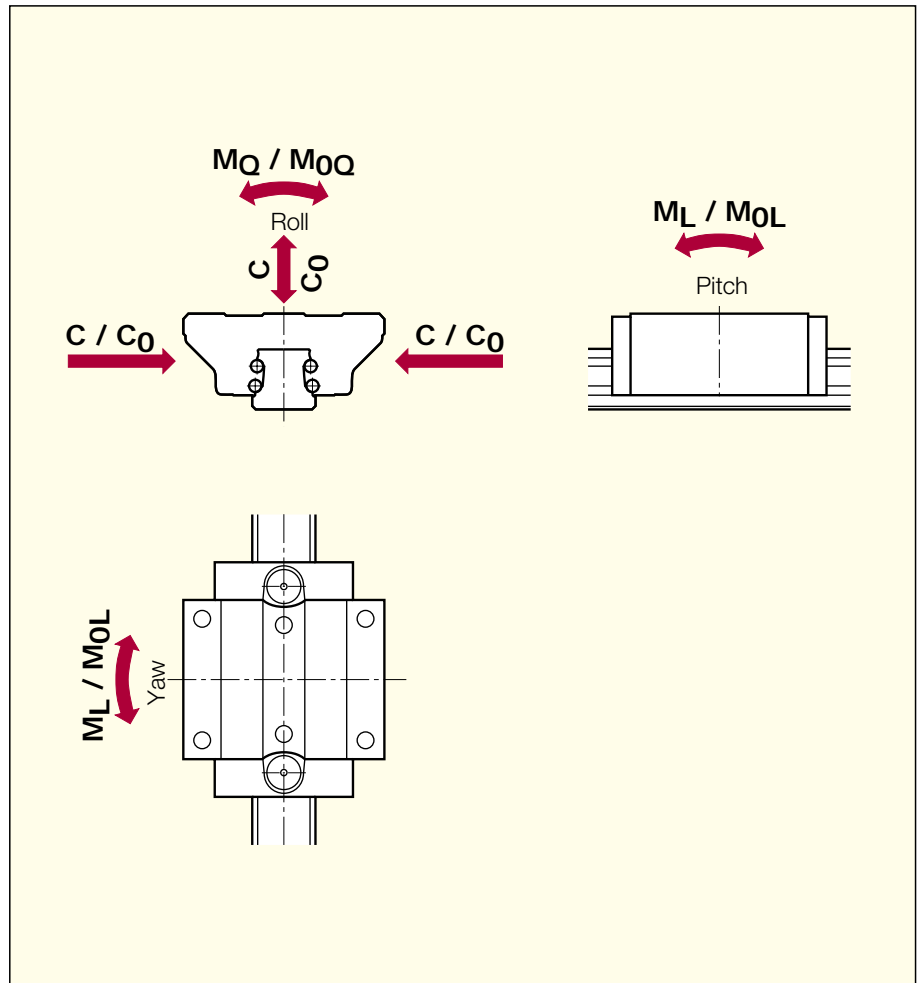


Drawings in dxf or dwg format are available on www.schneeberger.com in section Services.

Type	Dimensions (mm)																	
	A	B	B ₁ *	B ₂	J	J ₁	L**	L ₁	L ₂	L ₄	L ₅ / L ₁₀	L ₆	N	e	f	f ₁	f ₂	f ₃
BMA 15	24	47	15	16	20.2	15.7	59.8	30	26	60	29	42.8	38	M 5	4.4	4.5	8	7.5
BMA 20	30	63	20	21.5	25.5	19	75.5	40	35	60	29	53.5	53	M 6	5.4	5.8	10	9.5
BMB 20							91.5					69.5						
BMA 25	36	70	23	23.5	30.5	22.7	89.3	45	40	60	29	64.3	57	M 8	6.8	7	11	11
BMB 25							108.3					83.3						
BMA 30	42	90	28	31	35.9	26	103	52	44	80	39	75	72	M10	8.5	9	15	15
BMB 30							125					97						
BMA 35	48	100	34	33	41	29.5	118	62	52	80	39	86	82	M10	8.5	9	15	15
BMB 35							143.5					111.5						
BMA 45	60	120	45	37.5	50.8	37	145	80	60	105	51.5	107	100	M12	10.5	14	20	18
BMB 45							176.5					138.5						

* Lower tolerances on request

** When using additional wipers and metal wipers, the total length L is increasing, see chapter 7.5.



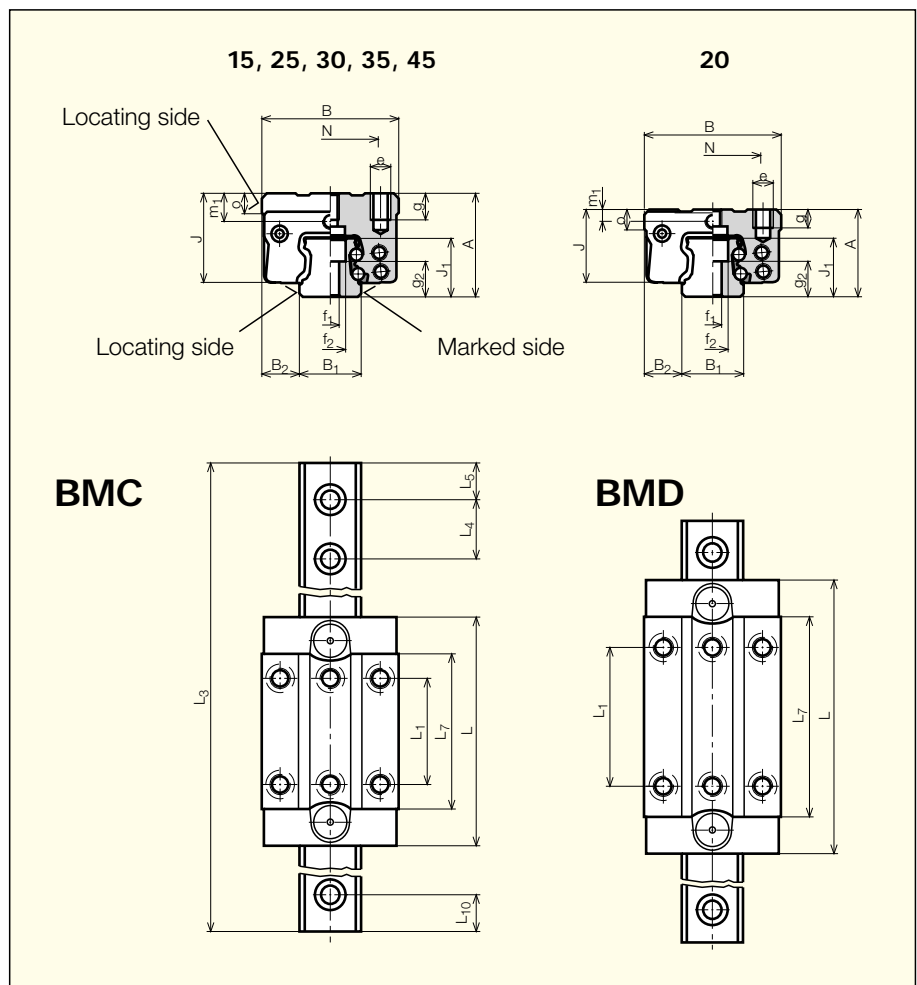
ball	\varnothing	g	g_1	g_2	m_1	o	P
3.2	7	4.5	9.5	4	7	7	
4.0	8	6.5	11.5	5.2	8	8	
4.8	9	8	14	5.5	7	11	
5.6	12	10	14.5	7	8	12	
6.4	12	12	18	7	8	14	
7.9	15	15	22	8	10	17.5	

Loading capacities		Moments				Weight	
C_0	C	M_{0Q}	M_{0L}	M_Q	M_L	Carriage (kg)	Rail (kg/m)
(N)	(N)	(Nm)	(Nm)	(Nm)	(Nm)		
19 600	9 000	181	146	83	67	0.3	1.4
31 400	14 400	373	292	171	134	0.5	2.2
41 100	17 400	490	495	206	208	0.6	
46 100	21 100	631	513	289	235	0.7	3.0
60 300	25 500	825	863	349	365	0.9	
63 700	29 200	1 084	829	497	380	1.2	4.3
83 300	35 300	1 414	1 390	599	589	1.5	
84 400	38 700	1 566	1 252	718	574	1.8	5.4
110 300	46 700	2 048	2 104	867	891	2.3	
134 800	61 900	3 193	2 498	1 466	1 147	3.3	8.8
176 300	74 700	4 175	4 199	1 769	1 779	4.2	

C_0 = Static loading capacity
 C = Dynamic loading capacity (100 km)
 M_0 = Static moment capacity
 M = Dynamic moment capacity (100 km)

**7.3 Dimension table,
loading capacities
MONORAIL BM**

Carriage types BMC and BMD

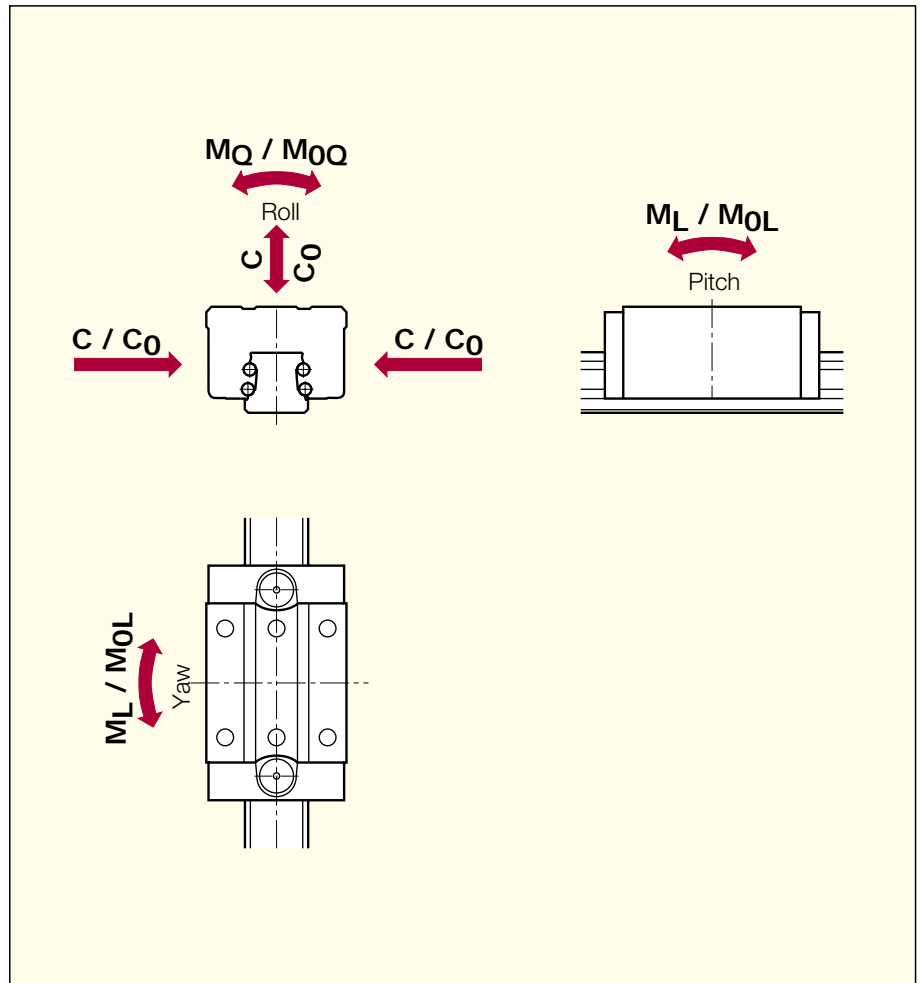


Drawings in dxf or dwg format are available on www.schneeberger.com in section Services.

Type	Dimensions (mm)													
	A	B +0.4 0	B ₁ * ±0.05	B ₂	J	J ₁	L**	L ₁	L ₄	L ₅ / L ₁₀	L ₇	N	e	f ₁
BMC 15	28	34	15	9.5	24.2	15.7	59.8	26	60	29	42.8	26	M 4	4.5
BMC 20	30	44	20	12	25.5	19	75.5	36	60	29	53.5	32	M 5	5.8
BMD 20							91.5	50			69.5			
BMC 25	40	48	23	12.5	34.5	22.7	89.3	35	60	29	64.3	35	M 6	7
BMD 25							108.3	50			83.3			
BMC 30	45	60	28	16	38.9	26	103	40	80	39	75	40	M 8	9
BMD 30							125	60			97			
BMC 35	55	70	34	18	48	29.5	118	50	80	39	86	50	M 8	9
BMD 35							143.5	72			111.5			
BMC 45	70	86	45	20.5	60.8	37	145	60	105	51.5	107	60	M 10	14
BMD 45							176.5	80			138.5			

* Lower tolerances on request

** When using additional wipers and metal wipers, the total length L is increasing, see chapter 7.4.



f_2	ball \varnothing	g	g_2	m_1	o
8	3.2	6	9.5	8	6
10	4.0	7	11.5	5.2	6
11	4.8	9	14	9.5	11
15	5.6	11	14.5	10	11
15	6.4	12	18	14	15
20	7.9	18	22	18	19

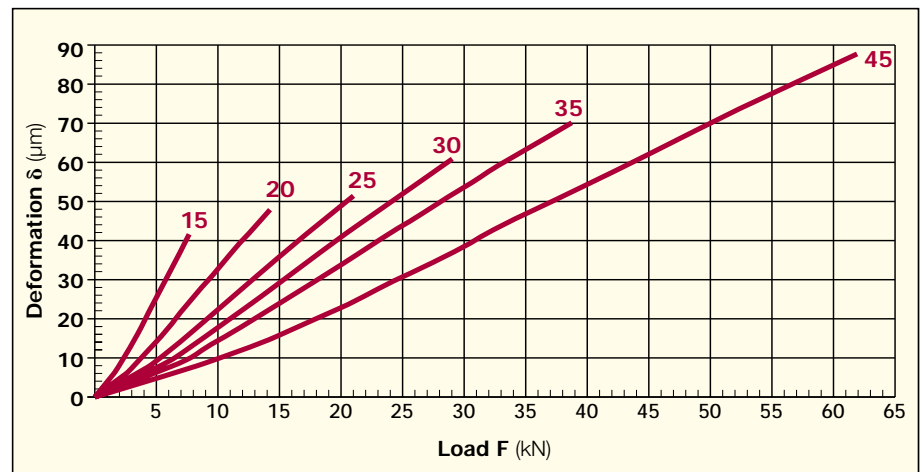
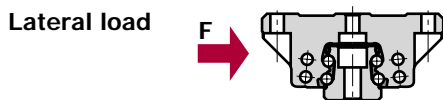
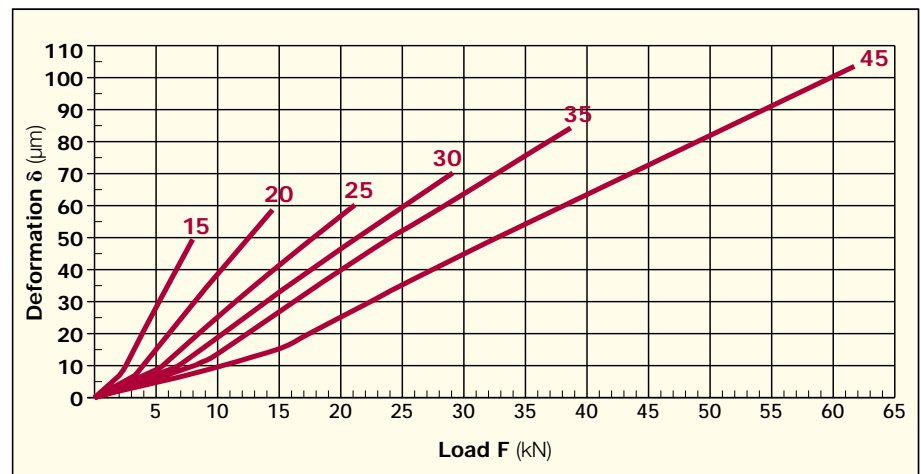
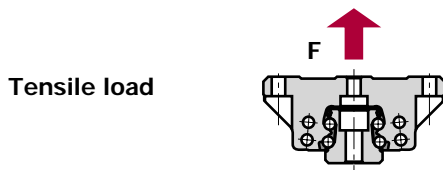
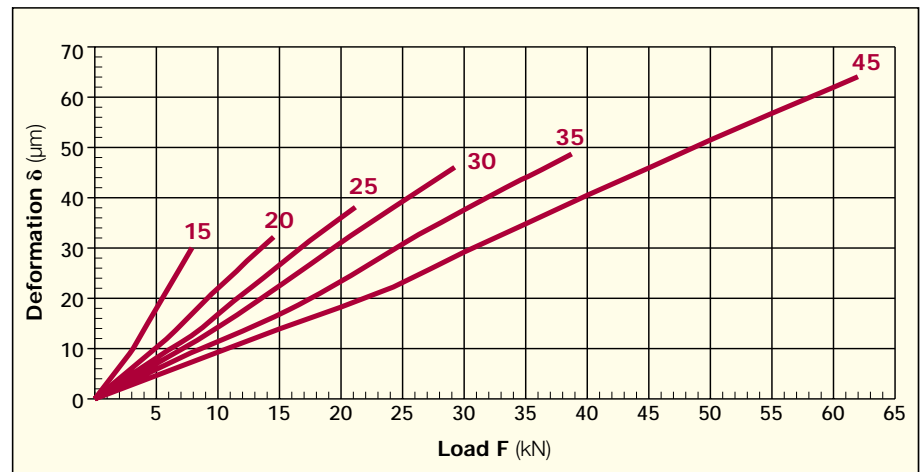
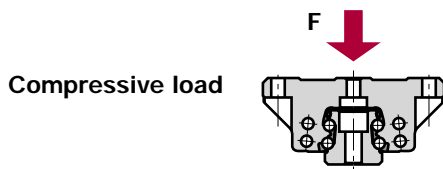
Loading capacities		Moments				Weight	
C_0 (N)	C (N)	M_{0Q} (Nm)	M_{0L} (Nm)	M_Q (Nm)	M_L (Nm)	Carriage (kg)	Rail (kg/m)
19 600	9 000	181	146	83	67	0.3	1.4
31 400	14 400	373	292	171	134	0.4	2.2
41 100	17 400	490	495	206	208	0.5	3.0
46 100	21 100	631	513	289	235	0.7	3.0
60 300	25 500	825	863	349	365	0.8	3.0
63 700	29 200	1 084	829	497	380	1.0	4.3
83 300	35 300	1 414	1 390	599	589	1.3	4.3
84 400	38 700	1 566	1 252	718	574	1.8	5.4
110 300	46 700	2 048	2 104	867	891	2.3	5.4
134 800	61 900	3 193	2 498	1 466	1 147	3.4	8.8
176 300	74 700	4 175	4 199	1 769	1 779	4.3	8.8

C_0 = Static loading capacity
 C = Dynamic loading capacity (100 km)
 M_0 = Static moment capacity
 M = Dynamic moment capacity (100 km)

7.4 Rigidity

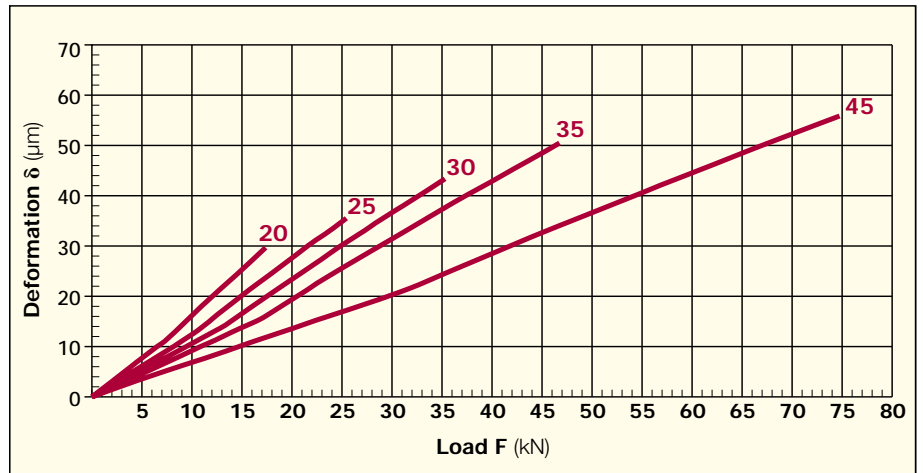
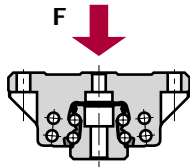
BMA 15, 20, 25, 30, 35, 45
 BMC 15, 20, 25, 30, 35, 45

The diagrams correspond to preload class V3

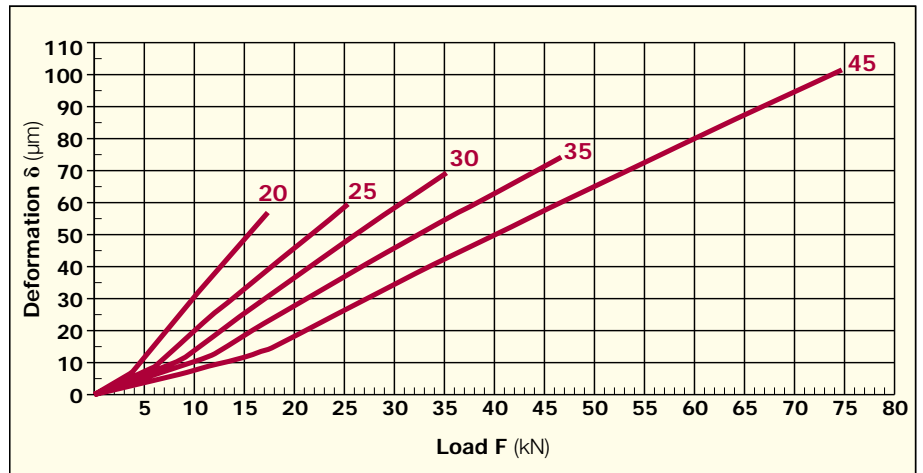
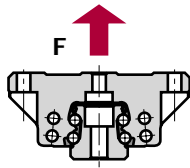


BMB 20, 25, 30, 35, 45
BMD 20, 25, 30, 35, 45

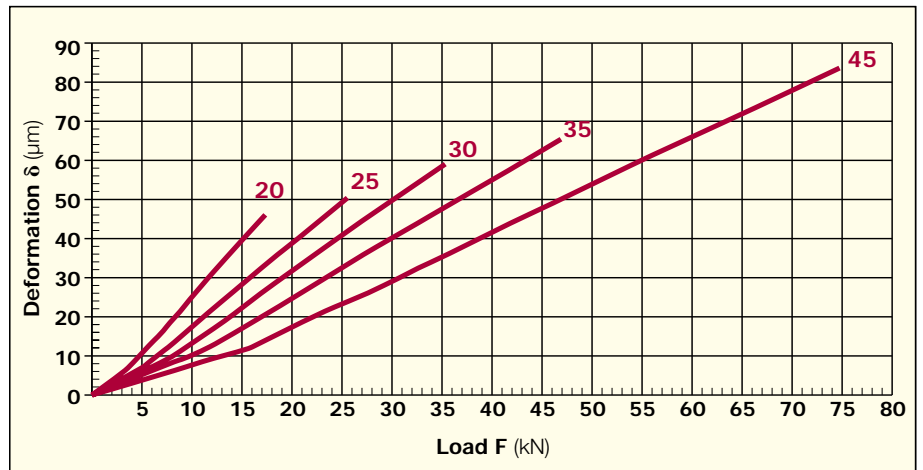
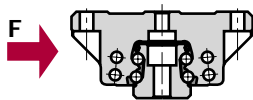
Compressive load



Tensile load



Lateral load



7.5 Accessories – to be ordered separately

Rail cover strip BAB

With the rail cover strip (stainless steel), a smooth sealing surface is achieved, which optimizes wiper function. The cover strip is easily installed and can be supplied in several pieces. The cover is secured by a full-surface adhesive tape which prevents liquids from seeping under the strip and potentially causing corrosion. In addition, the adhesive prevents the strip from separating from the rail in any installation orientation. The rail cover strip is always 5 mm shorter than the total length of the rail.



Plastic plug BRK



Plastic plugs can be utilized instead of the rail cover strip for closing off the rail attachment holes.

When utilizing them it must be noted, that the rails in their standard version have a chamfer of $0.5 \times 45^\circ$, so that with the plastic plugs ring-shaped gaps result.

For applications in environments with strong contamination with dirt therefore the rail cover strip BAB has to be preferred. When plastic plugs are utilized, they have to be used in conjunction with additional wipers ZBN-U/ZBV-U.

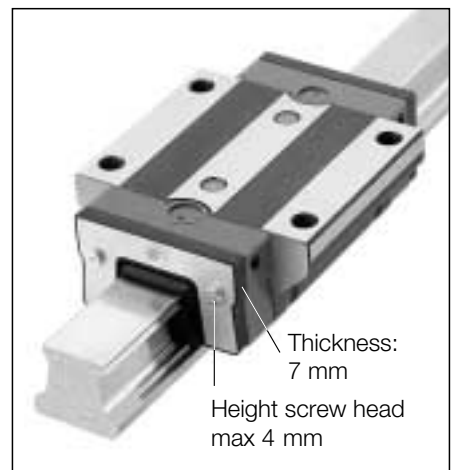


Additional wipers ZBN/ZBV

The ZBN and ZBV wipers provide effective additional protection of the rails in highly contaminated surroundings. Two versions are available:

- ZBN made of NBR (Nitrile)
- ZBV made of VITON® (Fluoro-elastomer)

The wipers ZBN/ZBV can also be used in combination with the metal wiper ABM.

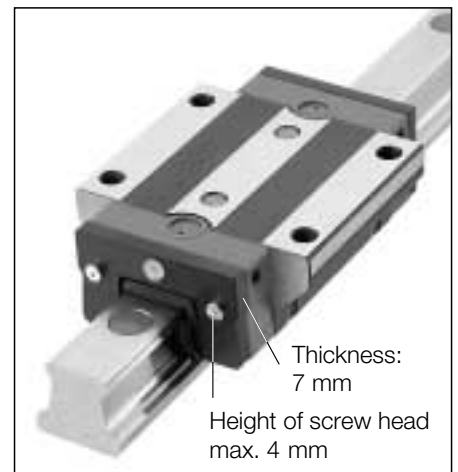


**Additional wipers
ZBN-U/ZBV-U**

For rails without cover strip, such as rails attached from the bottom or with plastic plugs, exists a special type with adapted sealing lips geometry and black-anodized support. Two versions are available:

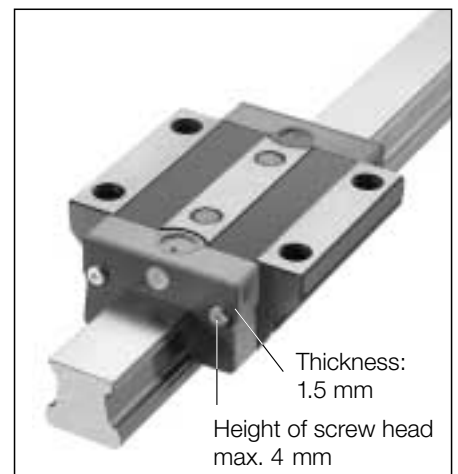
- ZBN-U made of NBR (Nitrile)
- ZBV-U made of VITON® (Fluoro-elastomer) for applications with aggressive coolants

The wipers ZBN-U/ZBV-U can also be used in combination with the metal wiper ABM.



Metal wiper ABM

The metal wipers ABM serve for the protection of the sealing lips of carriages and additional wipers against hot metal chips. Large and loose dirt particles are pushed away and because of the large radial gap to the rail cannot get jammed. The metal wipers are ideally utilized in combination with additional wipers ZBN/ZBV.



Bellows FBB

A standard bellows is available for MONORAIL sizes BM 20–BM 45. The bellows covers the entire length of the rail and is mainly used to provide additional protection against dust and splashed water.

The bellows is made of a synthetic fabric coated on both sides with polyurethane. Installation is simple and requires little time. The ZPB adapter plate is required to attach the bellows to the carriage. The adapter plate is screwed to the front plate of the carriage. The EPL end plate can be screwed to the end face of the rail. The bellows is fastened with two rivets each to the adapter plate and front plate.

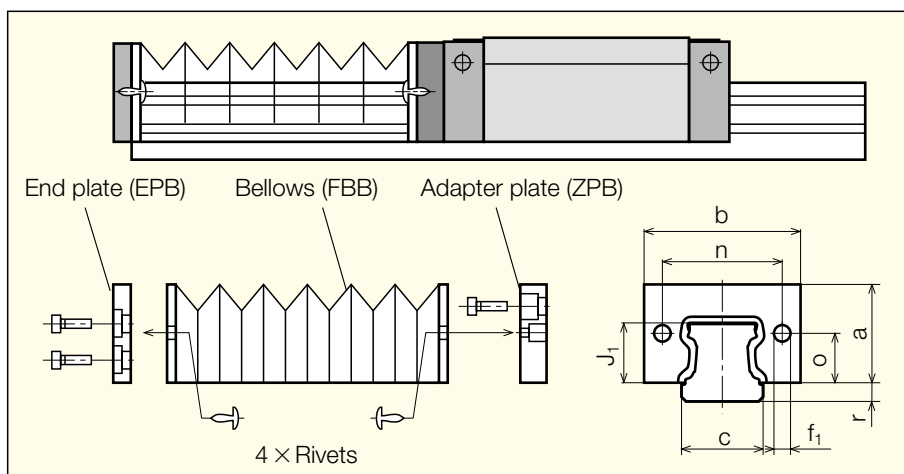
The required adapter and end plates, the attaching screws and rivets are supplied with the order of a complete bellows.

Outside dimensions

The outside dimensions of the bellows and adapter plates conform to those of the respective front plates.

Adapter plate ZPB

The adapter plate is used for attaching the bellows to the carriage and is made of black-anodized aluminum.

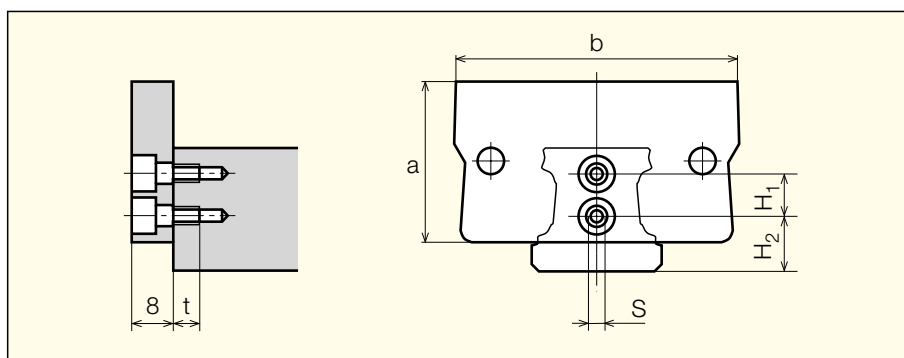


Size	FBB 20	FBB 25	FBB 30	FBB 35	FBB 45
Dimension in mm					
a	25	30	35	39.5	50
b	43	47	58.5	68	84
c	20	23	28	34	45
n	32	34	42	53	67
o	12.5	14	17.5	20	25.5
J ₁	14.8	17.5	20.2	22.3	28.1
r	4.5	5.5	6.1	7.0	9.2
f ₁	4.5	4.5	4.5	4.5	4.5

End plate EPB

The end plate is used to attach the bellows at the end of the rail and is made of red-anodized aluminum.

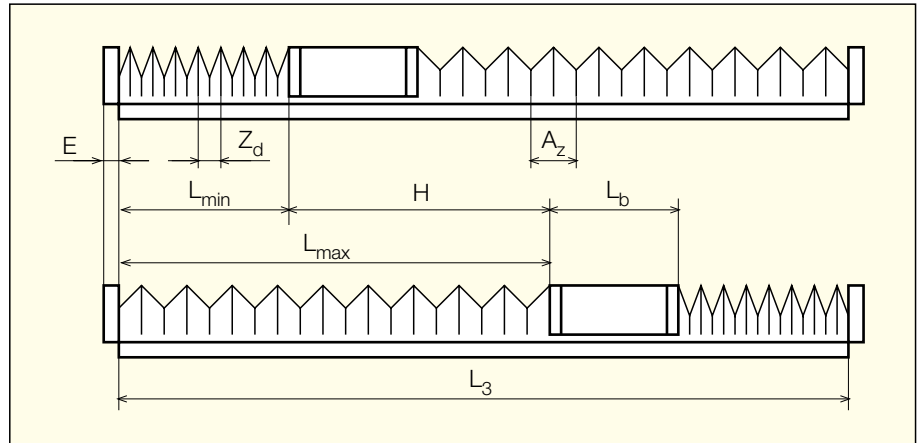
The attaching holes can be drilled into the rail according to the drawing below, if the bellows is to be retrofitted.



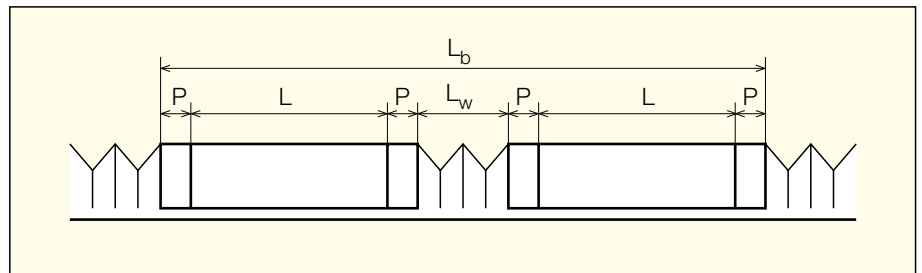
Size	EPB 20	EPB 25	EPB 30	EPB 35	EPB 45
Dimension in mm					
a	25	30	35	40	50
b	43	47	58.5	68	84
H ₁	6.5	8	8	10.5	13.5
H ₂	8.5	10	12	13	16.7
S × t	M 3 × 12	M 4 × 8	M 4 × 8	M 4 × 8	M 6 × 10

Bellows length calculation

$$L_b = L + 2 \cdot P$$



$$L_b = 2 \cdot (L + 2 \cdot P) + L_w$$



$$L_{min} = n \cdot Z_d + 10$$

$$L_{max} = H + L_{min}$$

$$n = \frac{H}{A_z - Z_d} \quad \text{round up to whole number}$$

- A_z : Extension per fold
- E : End plate thickness
- H : Travel distance
- L : Carriage length (chapter 7.2 or 7.3)
- L_b : Total length with adapter plates
- L₃ : Rail length
- L_{max} : Extended length of bellows
- L_{min} : Closed length of bellows
- L_w : Clearance between two carriages
- n : Number of folds per bellows
- P : Adapter plate thickness
- Z_d : Closed distance per fold

Size	FBB 20	FBB 25	FBB 30	FBB 35	FBB 45
Dimension in mm					
A_z	12	12	15	20	22
Z_d	2.0	2.7	2.7	2.7	2.7
E	8	8	8	8	8
P	10	10	10	10	10

Rail length calculation

$$L_3 = L_{\min} + L_{\max} + L_b$$

The plastic assembly rail is recommended for protection of the balls against contamination during transportation and storage. It also facilitates removing the carriage from the rail and the reinstallation of the carriage after the guideway assembly.

If necessary, the two internal screws for fastening the carriage can be tightened through the two holes in the assembly rail.



NEW Assembly rail MBM

Front plate STB – spare part

The red front plates at the end sides of the MONORAIL carriages have two essential functions:

- Supply of lubricant and
- sealing the MONORAIL carriages.

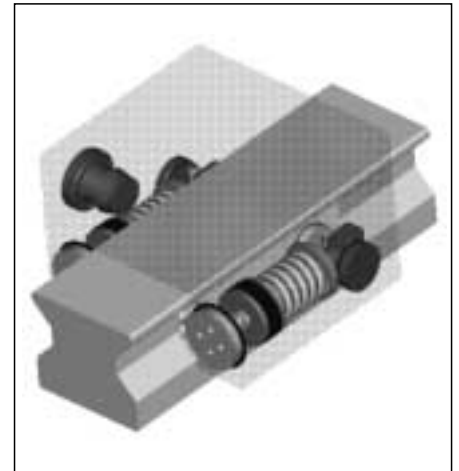
Through several integrated lubrication connections, with the help of a lubricating nipple or by connection to a lubricating line lubricant can be supplied to the carriages, refer to chapter 3.6 Lubrication. Lubricating channels inside the front plate distribute the lubricant and guide it to the balls.

The integrated double-lip cross wipers seal the carriage at the ends and with this prevent the ingress of dirt and the loss of lubricant. Because the cross wipers are subject to wear, the front plates have to be examined regularly and if necessary replaced, also refer to chapter 10, Precautionary Measures.



NEW
Brakes and clamps

SCHNEEBERGER for the most diverse application cases offers clamping – and braking elements for the ball guideway MONORAIL BM. The various alternatives can be utilized for applications like the securing of a position of linear axes, the clamping of machine tables and right to the application of a controllable counter-force in case of chip-removing processes. Available are manual, pneumatic- and hydraulic-actuated products. Versions opening when pressure is applied are optimally suitable for securing vertical axes or linear motor axes in case of an electric power failure. For more detailed information, please contact your SCHNEEBERGER representative.



7.6 Ordering information BM

When custom MONORAIL BM versions are required, additional information is needed to ensure the correct execution of the order. This has to be marked on the supplementary order sheet.

- Type, accuracy class, preload in the event of different carriage types on a rail
- Additional wipers
- Locating sides of carriages and rail
- Position of the lubrication connections
- Installation orientation and type of lubrication

In the case of more than 2 rails, butt joint rails or in the case of more than two carriages per rail, a separate drawing is required on which as well the lengths of all sections of multi-section rails and rail cover strips are indicated.

Guideway BALL-MONORAIL BM

	—	BM	35	-C2	-0964	-U	-19	-25	-X	-G3	-V1	-GP	-SO	-A	-HH
Quantity															
Guideway type BM															
Size			15, 20, 25, 30, 35, 45												
Carriage type	A, B, C, D	When different carriages													
Carriage qty	1, 2, ...	per rail e.g. -A2-B1													
Rail length L₃ (in mm).			State the total length for multi-section rails ground together.												
Rail version*	U	Rails with tapped attachment holes													
Starting hole pitch L₅ (in mm)															
End hole pitch L₁₀ (in mm)															
Rail hole pitch	X	half hole pitch (as MR)													
L₄ special*	Y	L ₄ not standard or not uniform (drawing required)													
Accuracy class	G0, G1, G2, G3														
Preload class	V1, V2, V3														
Matched*	GP														
Lubrication connection not standard*	SO	above													
Position has to be indicated on supplementary sheet	SS	lateral													
	ST	special, 2 × connections per carriage (not sizes 15, 20)													
Carriages with parallel locating sides*	A	carriage width $B_A = (B+0.2) \pm 0.05$ mm													
Hard-chroming*	H	only rails hard-chromed													
	HH	rails and carriages hard-chromed													

*Optional specifications

Accessories **BALL-MONORAIL BM** – to be ordered separately

Rail cover strip

		—	BAB	35	-0958
Quantity					
Type	BAB	(Steel cover strip)			
Size	15, 20, 25, 30, 35, 45				
Rail length L₃	(Length rail cover strip = L ₃ – 5 mm)				

Plugs

		—	BRK	35	
Quantity					
Type	BRK	(plastic)			
Size	15, 20, 25, 30, 35, 45				

Additional wipers

		—	ZBN	35	-U
Quantity					
Type	ZBN	(NBR)			
	ZBV	(Viton)			
Size	15, 20, 25, 30, 35, 45				
Version	without specification	Rail with cover strip BAB			
	U	U-rails and rails with plugs BRK			

Metal wipers

		—	ABM	35	
Quantity					
Type	ABM				
Size	15, 20, 25, 30, 35, 45				

Bellows

		—	FBB	30	-24	-EZ
Quantity						
Type	FBB					
Size	20, 25, 30, 35, 45					
Number of folds						
Version	without specification	bellows only, without attachment plates				
	EZ	with 1 endplate (EPL) and 1 adapter plate (ZPL) – For mounting to rail ends				
	ZZ	with 2 adapter plates – For mounting between two carriages				

Attachment plates for bellows

			—	ZPB	-30
Quantity					
Type	ZPB EPB	Adapter plate End plate			
Size	20, 25, 30, 35, 45				

Assembly rail

			—	MBM	-20
Quantity					
Type	MBM				
Size	15, 20, 25, 30, 35, 45				

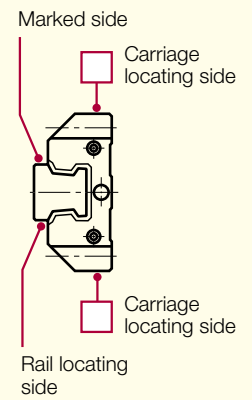
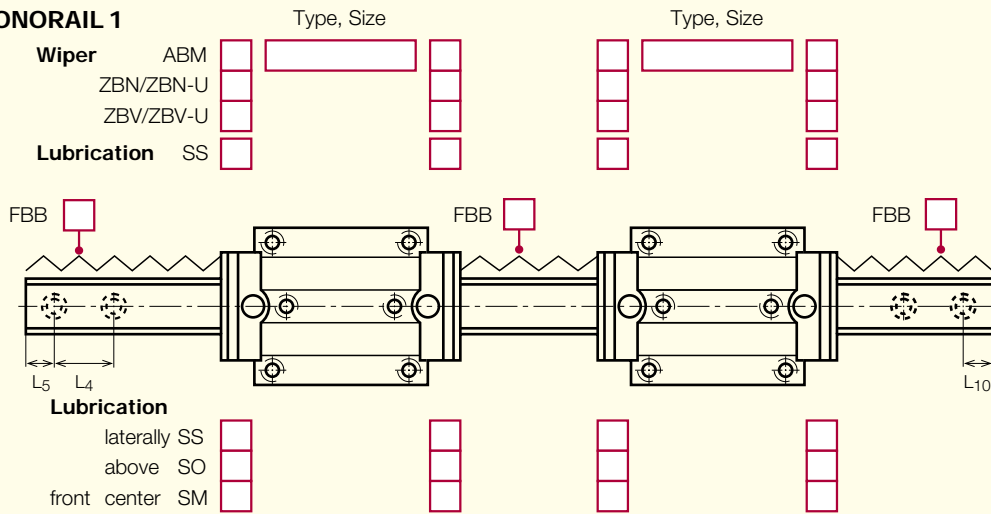
Front plate (spare part)

			—	STB	-30	-AB	-SO
Quantity							
Type	STB						
Size	15, 20, 25, 30, 35, 45						
Version	AB CD	for carriage type BMA, BMB for carriage type BMC, BMD					
Lubrication connection	no specification SO SS ST	Standard, center front from above lateral special, 2 × connections per carriage (not sizes 15, 20)					

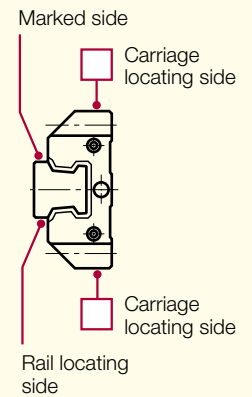
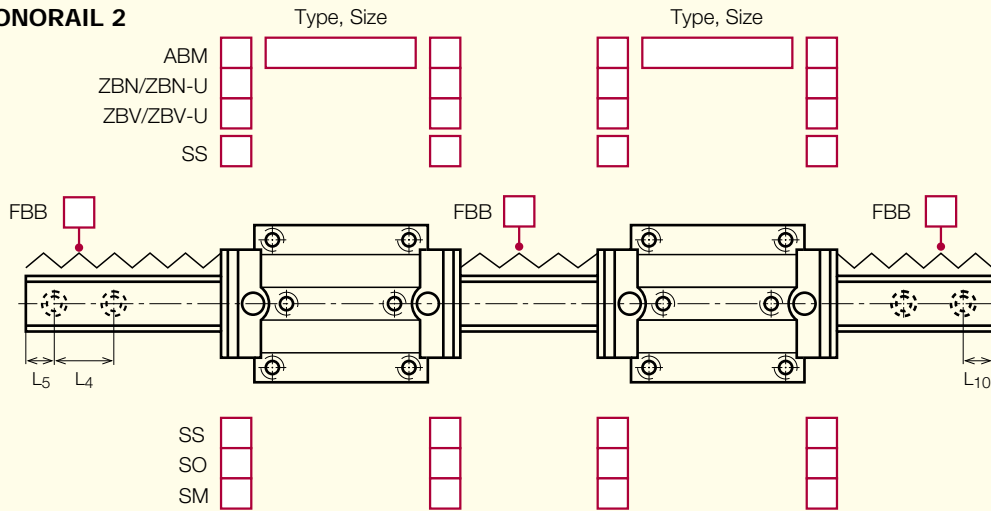
Supplementary sheet for BM 15-45/Arrangement of carriages and accessories

Customer, Address	
Machine, axis	Drawing No. Customer
SCHNEEBERGER-rep.	Drawing No. SCHNEEBERGER
Ordering information MONORAIL 1	
Ordering information MONORAIL 2	

MONORAIL 1



MONORAIL 2



Mounting position

standard (horizontal/vertical)
 special: turned ____° on longitudinal axis of the rail (in combination with oil, see special lubrication instructions)

Lubrication Accessories

Lubricating nipples mounted

Attach

from above
 from bottom (-U-)

Rail covering

BRK
 BAB

8.1 Basics

The demands for accuracy, surface quality and short machining times are becoming increasingly stringent. This is why the anti-friction guideways in modern machine construction are selected according to permissible elastic deformation.

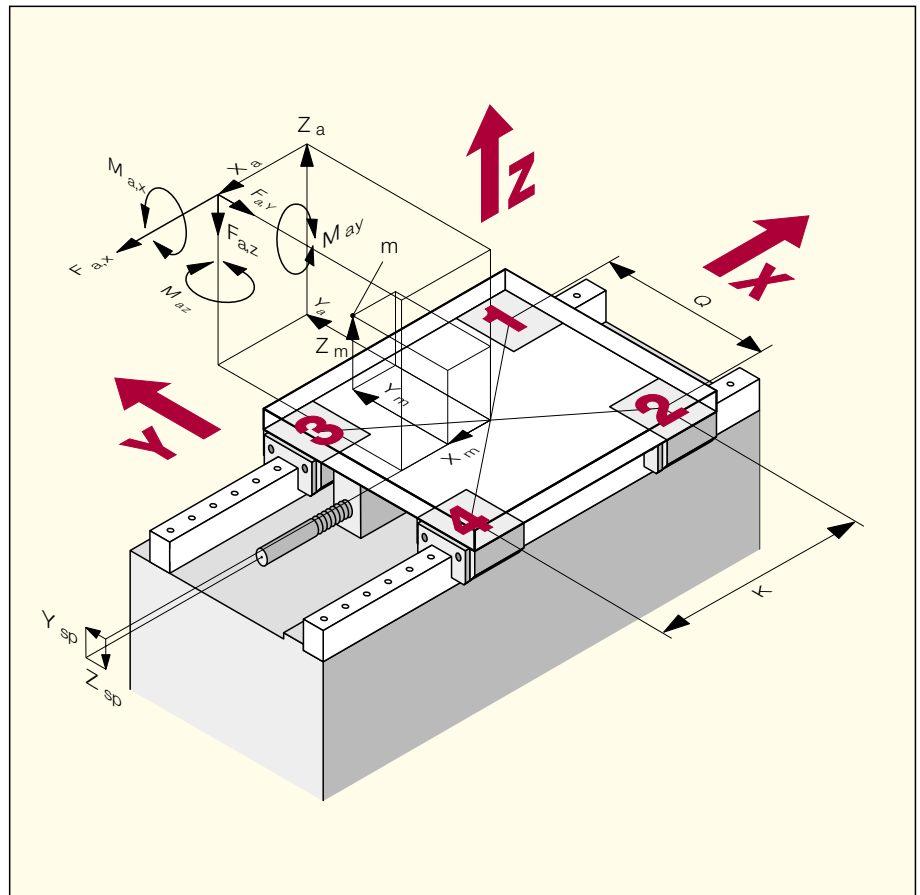
The following steps are therefore necessary for the dimensioning of anti-friction guideways.

- **Determination of the external forces and moment loads**
- **Distribution of forces and moment loads acting on individual MONORAIL carriages**
- **Preload and deformation determination**
- **Calculation of operational life**
- **Calculation of static reliability**

The operational life is limited by material fatigue as well as by heavy wear of the rolling-contact surfaces.

The rolling contact of the surfaces causes material fatigue and therefore results in damage to the track and rolling element (spalling). If the force acting on the rolling-contact surfaces is known, the operational life can be calculated according to DIN ISO 281 or DIN 636.

Relative motions of the loaded surfaces cause friction wear. The extent of wear is mainly determined by the magnitude of the relative motion, surface pressure, lubrication and degree of contamination.



The operational life is calculated in the following example. Due to undeterminable factors, there is no standard wear-life calculation procedure.

8.2 Operational life calculation

Determination of external forces and moments

The external forces acting on the guideway system are determined by the force components F_{ax} , F_{ay} , F_{az} with the force application coordinates X_a , Y_a , Z_a . A mass m with the acceleration components a_x , a_y , a_z causes the guideway system to be loaded by the inertia forces F_{mx} , F_{my} , F_{mz} , which act at the center of gravity coordinates X_m , Y_m , Z_m .

$$\begin{aligned} F_{mx} &= m \cdot -a_x \\ F_{my} &= m \cdot -a_y \\ F_{mz} &= m \cdot -a_z \end{aligned}$$

The forces ΣF_y , ΣF_z acting at 90° to the longitudinal axis of the table are to be taken up directly by the guideway system:

The longitudinal forces ΣF_x are transmitted by the longitudinal drive:

External moments M_{ax} , M_{ay} and M_{az} can also act:

The external forces F_{ax} , F_{ay} , F_{az} and inertia forces F_{mx} , F_{my} , F_{mz} in combination with their respective points of actions X_a , Y_a , Z_a or X_m , Y_m , Z_m , also result in moments:

The point of action of the force of the longitudinal drive Y_{sp} , Z_{sp} affects the moments acting on the guideway system.

Distribution of forces and moment loads on the individual MONORAIL carriages

The longitudinal carriage spacing K and lateral spacing Q are required to calculate the side forces F_{jy} and compression-tension forces F_{jz} on each MONORAIL carriages ($j = 1 \dots n$).

The arrangement of carriage and guiderail in the axes must be taken into account.

Determination of preload and deformation

The MONORAIL preload is determined by the service conditions as well as the demands made on the rigidity of the machine guideway.

Preloads V1, V2 or V3 increase not only the rigidity, they also additionally load the rolling-contact surfaces as long as the preload is effective.

The forces acting on the MONORAIL cause displacements which can be obtained from the deformation diagrams in chapter 4.4 for MONORAIL MR, resp. 7.4 for MONORAIL BM.

Operational life calculation

The factors affecting the operational life are the forces acting on MONORAIL carriages, selected preload, dynamic loading capacity C and event probability.

If constant forces act over the entire translation distance, the operational life is calculated with the equivalent force P_j . However, if varying forces are expected, the dynamic equivalent loading must be used.

Equivalent force P

The equivalent force P_j for each MONORAIL ($j = 1 \dots n$) is required for the operational life calculation. The values of the force components F_{jy} and F_{jz} acting on each MONORAIL carriage are added algebraically to obtain the effective F_j :

$$F_j = |F_{jy}| + |F_{jz}|$$

The following formula can be used to calculate the approximate value of the equivalent force P_j which actually acts on the rolling-contact surfaces:

$$P_j = F_{\text{preload}} + 2/3 \cdot F_j \quad \text{for } F_j \leq 3 \cdot F_{\text{preload}}$$

$$P_j = F_j \quad \text{for } F_j > 3 \cdot F_{\text{preload}}$$

Dynamic equivalent loading

If force P is not constant, the equivalent force P in the step-loading mode can be calculated for each MONORAIL with the following formula (the respective force P_{jk} is constant for each partial translation distance l_k):

$$P_j = \sqrt[10/3]{\frac{\sum_{k=1}^n (P_{j,k}^{10/3} \cdot l_k)}{\sum_{k=1}^n l_k}}$$

Dynamic loading capacity C

The loading capacity figures 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 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 capacities

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

$$C_{50} = 1.23 \cdot C_{100} \quad \text{for roller guideways}$$

$$C_{50} = 1.26 \cdot C_{100} \quad \text{for ball guideways}$$

Event probability

According to DIN ISO, the loading capacities for rolling-contact bearings are specified such that a value results from the operational life formula which will be exceeded with a probability of 90%. If this probability is insufficient, the operational life values must be reduced by a factor a_1 according to the adjacent table:

Event probability %	90	95	96	97	98	99
Factor a_1	1.00	0.62	0.53	0.44	0.33	0.21

Operational life calculation

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

$$L = a_1 (C/P)^q \cdot 10^5 \text{ m}$$

L = nominal life (m)
 a_1 = event probability
 $q = 10/3$ for roller guideways
 $q = 3$ for ball guideways

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

L_h = nominal life (h)
 s = stroke length (m)
 n = stroke frequency (min⁻¹)
 v_m = medium traversing speed (m/min)

8.3 Calculation of static reliability factor

The static reliability factor S_0 is the reliability with respect to permanent deformations on rolling elements and tracks and is defined as the ratio of the static loading capacity C_0 to the static equivalent loading P_0 .

$$S_0 = C_0/P_0$$

The actual force acting on the rolling-contact surfaces must be taken into account for P_0 . The governing factor for a deformation of the rolling-contact surfaces is the highest amplitude which can also occur for a very short period of time.

Operating conditions	S_0
Highest rigidity, high shock loads and vibrations	≥ 6
High rigidity, medium, varying loads and vibrations	≥ 4
Uniform load, small vibrations	≥ 3

8.4 Calculation Program for the dimensioning of MONORAILS

The manual calculation of the service lifetime, of the load bearing safety and of the displacement under a combined load is very complicated and can only be carried out for simple applications. For this reason, SCHNEEBERGER as a service offers to carry out these calculations with the help of a computer program.

Objective and Purpose of the Calculation Program

The computer-assisted calculation program for the design of MONORAILS serves for the determination of:

- the required MONORAIL size
- the optimum preload
- the static reliability factor
- the nominal service lifetime
- the elastic displacements of the working point under the effect of a load for a given MONORAIL system.

Taken into consideration to do this are the real, non-linear rigidities of the individual MONORAIL carriages and the interaction of the carriages amongst one another, which are produced by the differing rigidities under tensile, compressive and lateral loads. Additional deformations as a result of thermal expansion and elastic deformation of the machine construction are not taken into consideration.

Required Data

For the calculation, all information is required, as represented on the following machine drawing with data sheet:

- Guideway geometries with the number of carriages and rails, carriage spacings longitudinally and laterally
- Position of the axes in space and distances between them (distances between the reference points of neighboring axes)
- Masses of all machine axes and workpieces to be calculated
- Location of the mass centers of gravity
- Location of the drive elements versus the corresponding of the axis reference point
- Location of the load point (point of attack of force and moment)
- Maximum travel distances (stroke) of the axes to be calculated
- Maximum speed and acceleration of the axes

Additionally, in the case of differing load cases:

- Collective load with speed, acceleration, travel distance and percentage proportion of time as well as magnitude and direction of the forces and moments applied at the point of work in function of the corresponding load case.

All geometrical dimensions are referred to the corresponding axis center (refer to drawing). The designation of the axes in the cartesian coordinates' system can be selected as required.

For a large number of typical machines and designs, SCHNEEBERGER can provide machine sketches and data sheets. For further information, please contact a SCHNEEBERGER representative.

Sample data sheet for an x-/y-table

Masses

$m_x =$ kg $m_y =$ kg $m_w =$ kg

Dimensions

$S_1 =$ mm $S_2 =$ mm $S_3 =$ mm
 $S_4 =$ mm $S_5 =$ mm $S_6 =$ mm
 $S_7 =$ mm $S_8 =$ mm $S_9 =$ mm

$K_1 =$ mm $K_5 =$ mm
 $Q_2 =$ mm $Q_4 =$ mm

$A_2 =$ mm $A_3 =$ mm
 $A_4 =$ mm $A_6 =$ mm

$L_4 =$ mm $L_5 =$ mm $L_6 =$ mm

$B_1 =$ mm $B_2 =$ mm $B_3 =$ mm

Stroke (max.)

$s_x =$ mm $s_y =$ mm

Acceleration (max.)

$a_x =$ m/s² $a_y =$ m/s²

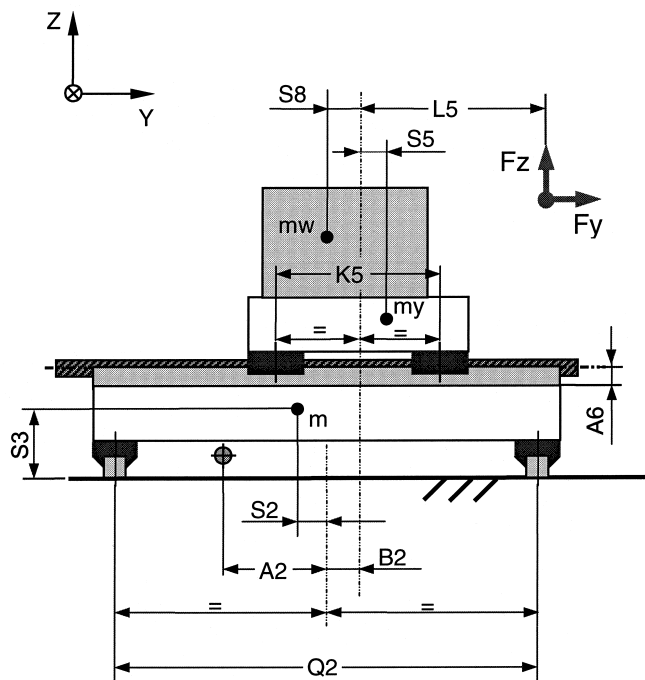
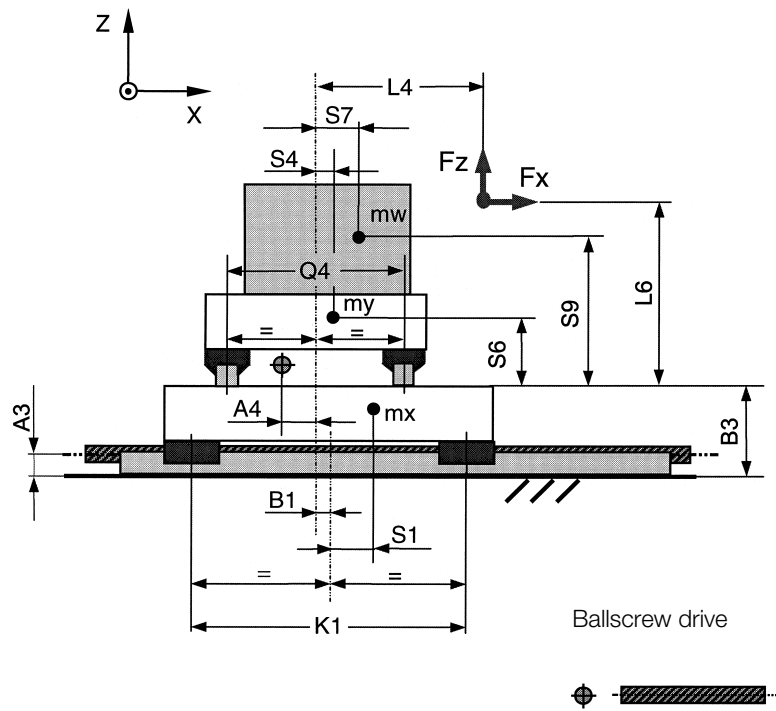
Collective load: Forces/Moments

No.	Cycle	F_x N	F_y N	F_z N	M_x Nm	M_y Nm	M_z Nm
1							
2							
3							
4							
5							

Collective load: Travel distance / Proportion of time

No.	x-axis speed v (m/min)	Proportion of time t (%)	Travel distance s (mm)	y-axis speed v (m/min)	Proportion of time t (%)	Travel distance s (mm)
1						
2						
3						
4						
5						

Sample machine drawing for an x-/y-table



8.5 MONORAIL AutoCAD® library

The MONORAIL and AutoCAD library was created by SCHNEEBERGER to provide support for design and developments departments. This library can be used with the following resources:

Library version 13:

- AutoCAD release 13c2 or higher
- Operating system MS-DOS 3.5 or higher, Windows 3.1, Windows 95 and Windows NT

Library version 14:

- AutoCAD release 14c1 or higher
- Operating system Windows 95 and Windows NT

Information: The major specifications of the selected size is displayed.

Type of insert: Carriage or rail.

Positioning: You can shift the carriages or rails longitudinally as required.

Drawing: The MONORAILS are drawn in the selected layer when you quit the program. When you have made your choice, the program automatically returns to AutoCAD and you can carry on drawing.

Further use: You can call all AutoCAD commands to edit the MONORAILS that you have drawn.

The library can be supplied by all SCHNEEBERGER companies or representatives or can be downloaded from our website at www.schneeberger.com at menu «SERVICES».

MONORAIL BM

The AutoCAD library for MONORAIL BM is in preparation. Please contact your SCHNEEBERGER representative.



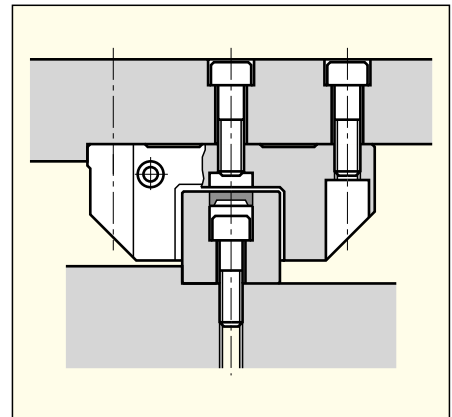
9.1 Installation methods

MONORAILS can be installed horizontally or vertically. To achieve maximum carriage rigidity, use of all six mounting bolts is necessary.

The MRA/MRB and BMA/BMB carriage types can be fastened to the structure in two ways. They therefore are fitted with so called combination holes.

a) Using the tapped holes

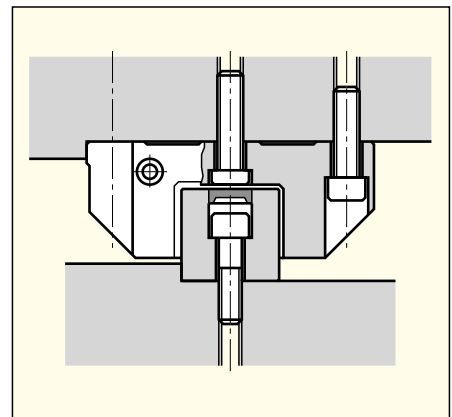
This is the preferred method. It results in a stronger joint because the thread permits the use of a larger diameter screw.



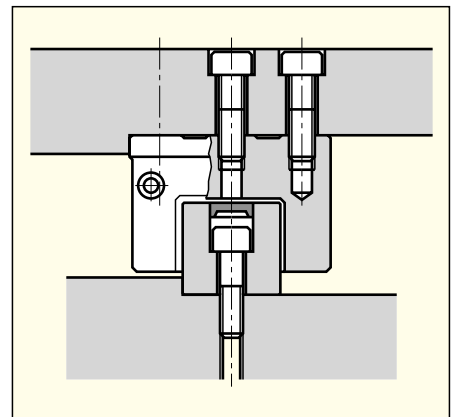
b) Using the through-holes

In this case screws with low screw heads DIN 6912 have to be used in the two middle attaching holes.

Remove the protective plugs if both middle attaching holes in the carriage are also needed.



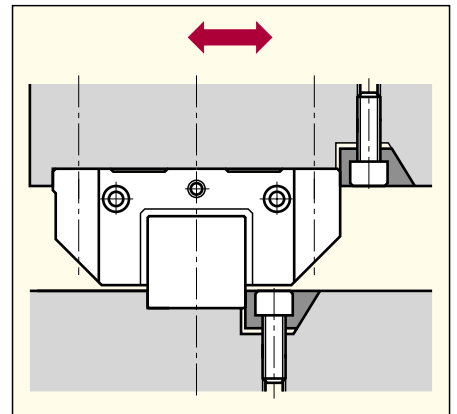
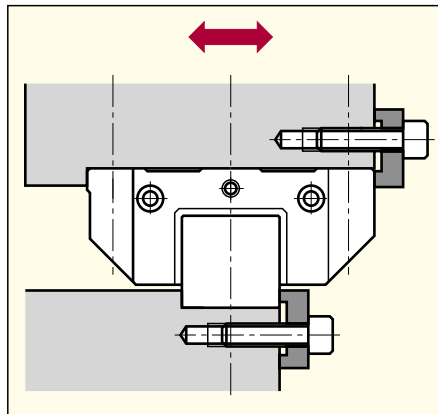
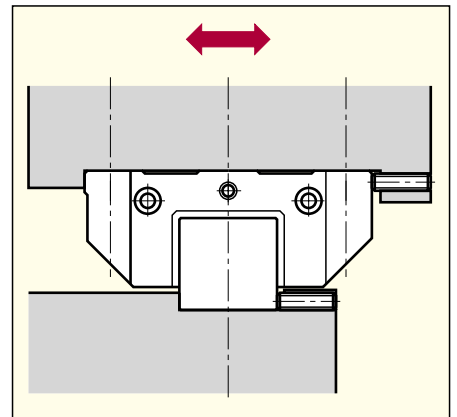
The MRC/MRD and BMC/BMD carriage types can be fastened only by using the tapped holes. Remove the protective plugs if the middle attaching holes in the carriage are needed.



9.2 Configuration of the locating surfaces

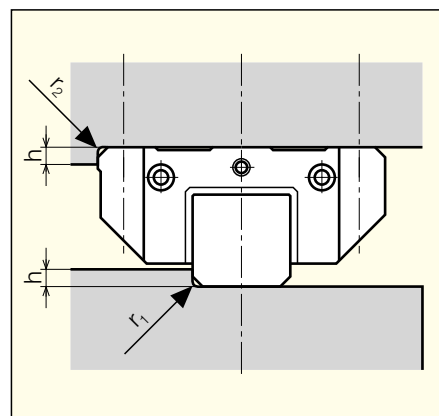
Methods of lateral fixation

MONORAILS can be fastened with or without lateral locating surfaces. If the MONORAIL is subjected to considerable side loads, we recommend the use of locating surfaces. Fastening can be effected with clamping screws (illustration on right), by laterally fixing the rail and carriage with a clamping strip (below left) or with a taper gib strip (below right).



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.



Type	Size	h	r ₁ max	r ₂ max
MR	25	5	0.8	0.8
	35	6	0.8	0.8
	45	8	0.8	0.8
	55	10	1.2	1.2
	65	10	1.5	1.5
BM	15	3.5	0.8	0.6
	20	4	0.9	0.9
	25	5	1.1	1.1
	30	5.5	1.3	1.3
	35	6	1.3	1.3
	45	8	1.3	1.3

9.3 Configuration of assembly surfaces

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

The surface quality of the supporting surfaces 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 to enable the specified flatness tolerances to be maintained.

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

Geometrical and position accuracy of the support surfaces

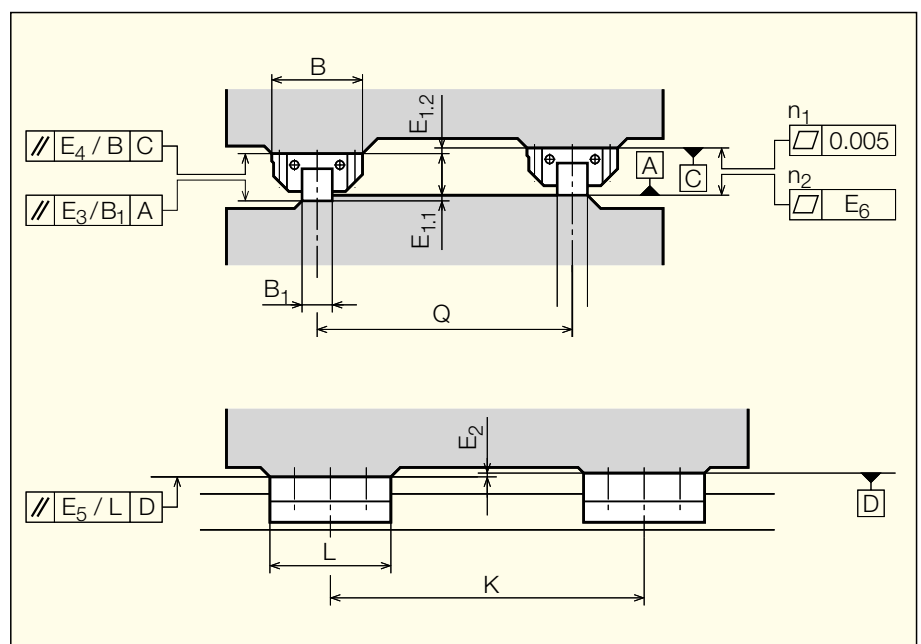
Permissible height deviations
(use values in mm for the calculation)

- A MONORAIL height
- B Carriage width
- B₁ Rail width
- K Longitudinal carriage spacing
- L Carriage length
- Q Rail spacing
- n₁ Flatness per carriage
- n₂ Flatness per rail

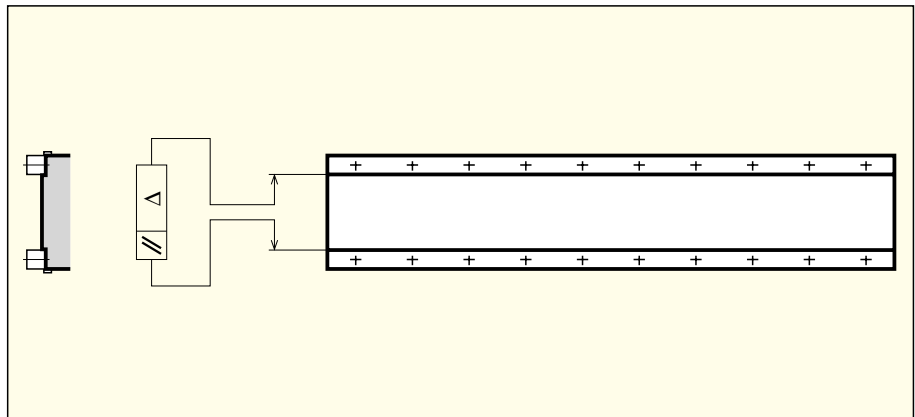
- E₁ Max. permissible lateral height deviation; also includes tolerance for dimension A
- E₂ Max. permissible longitudinal height deviation; also includes tolerance Δ A
- E₃ Max. permissible lateral parallelism tolerance of rail supporting surface
- E₄ Max. permissible lateral parallelism of carriage supporting surface
- E₅ Max. permissible longitudinal parallelism of carriage supporting surface
- E₆ Flatness of each rail support surface over entire length as a function of accuracy class

	Preload class		
	V1	V2	V3
$E_1 = E_{1,1} + E_{1,2}$	0.0003 Q	0.0002 Q	0.0001 Q
E ₂ MRA/MRC/BMA/BMC		0.00005 K	
E ₂ MRB/MRD/BMB/BMD		0.00004 K	
E ₃	0.0003 B ₁	0.0002 B ₁	0.0001 B ₁
E ₄	0.0003 B	0.0002 B	0.0001 B
E ₅		0.00004 L	
E ₆	Values from diagram 3.3 Running accuracy Δ		

The flatness E₆ is given as well as the parallelism tolerance to prevent the total permissible tolerance from being accommodated by a single carriage when, for example, four carriages are running on one rail.



**Parallelism tolerances
of the locating surfaces**



Tolerances for preload class (mm)	15	20	25	30	35	45	55	65
V1	0.010	0.012	0.016	0.016	0.021	0.024	0.026	0.028
V2	0.007	0.008	0.010	0.010	0.014	0.016	0.017	0.018
V3	0.003	0.004	0.005	0.005	0.008	0.009	0.010	0.011

The specified values are also valid when locating surfaces are provided for the carriages only.

Because of parts and mounting tolerances the preload can be increased. Together with the during the operation arising uneven deformations of the rail surroundings an increased stress of the rolling partners may occur.

Example

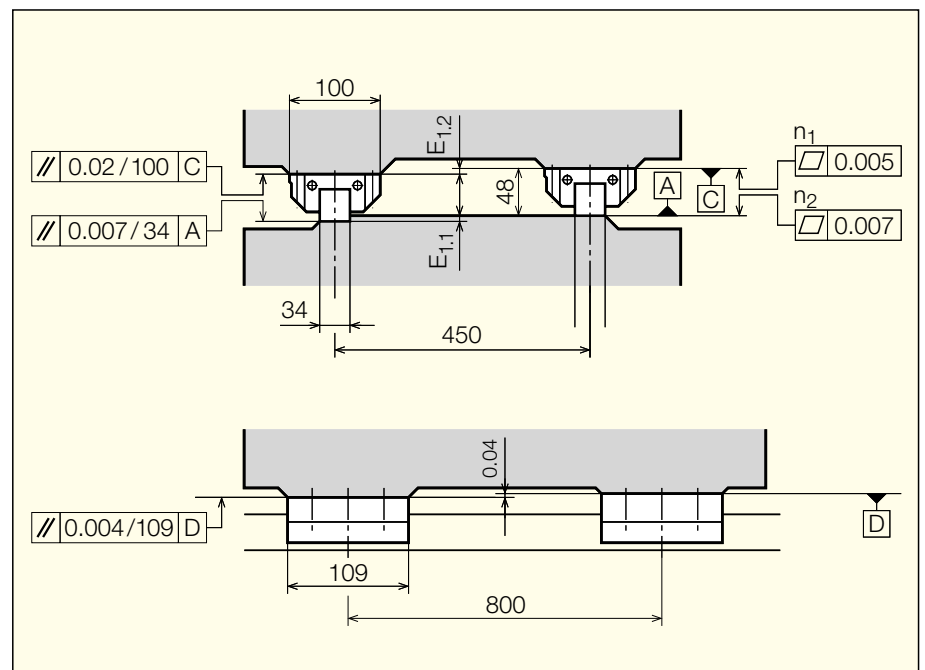
MONORAIL-System: $2 \times \text{MR 35-A2-1800-G1-V2}$
 Longitudinal carriage spacing K: $K = 800 \text{ mm}$
 Rail spacing Q: $Q = 450 \text{ mm}$

MONORAIL-height A from chart 4.2: $A = 48 \text{ mm}$
 Carriage width B from chart 4.2: $B = 100 \text{ mm}$
 Rail width B1 from chart 4.2 resp. 4.3: $B1 = 34 \text{ mm}$
 Carriage length L from chart 4.2: $L = 109 \text{ mm}$

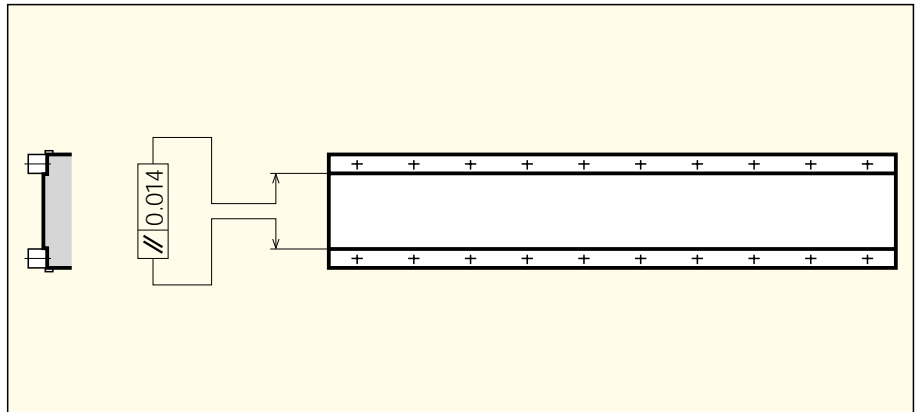
Values from chart 3.2 dimensional tolerances:
 Max. tolerance MONORAIL-height A between two rails for accuracy class G1: Tol. A = 0.020 mm (standard)
 Tol. A matched = 0.007 mm
 Max. tolerance ΔA of two carriages on a rail: $\Delta A = 0.005 \text{ mm}$

Values from above diagram:
 perm. lateral height deviation $E_1 = 0.0002 \cdot Q$: $E_1 = 0.090 \text{ mm}$ (incl. Tol. A)
 perm. longitudinal height deviation $E_2 = 0.00005 \cdot K$: $E_2 = 0.040 \text{ mm}$ (incl. ΔA)
 perm. lateral parallelism rail supporting surface $E_3 = 0.0002 \cdot B1$: $E_3 = 0.007 \text{ mm}$
 perm. lateral parallelism of carriage supporting surface $E_4 = 0.0002 \cdot B$: $E_4 = 0.020 \text{ mm}$
 perm. longitudinal parallelism of carriage supporting surface $E_5 = 0.00004 \cdot L$: $E_5 = 0.004 \text{ mm}$

Flatness of each rail support surface E_6 from chart 3.3 with $L_3 = 1800 \text{ mm}$ and accuracy class G1: $E_6 = 0.007 \text{ mm} / 1800 \text{ mm}$
 Flatness per carriage n_1 from picture page 97: $n_1 = 0.005 \text{ mm}$
 Flatness per rail n_2 : $n_2 = E_6 = 0.007 \text{ mm} / 1800 \text{ mm}$



Parallelism tolerances of the locating surfaces from chart page 98: $\Delta = 0.014$ mm



9.4 Attaching the rails



MONORAIL MR, MZ and BM

See the table for the max. tightening torques for attaching screws DIN 912. Values are based on a coefficient of friction of $\mu = 0.125$.

Attention:

- The recommendations of the screw suppliers have to be followed.
- Screws with low head DIN 6912 are installed according to strength grade 8.8
- For rails with measuring system **AMS**, screws of strength grade 8.8 have to be used.

Tightening torques for DIN 912 attaching screws, $\mu = 0.125$

Strength grade	Max. tightening torque (Nm)							
	M 4	M 5	M 6	M 8	M 10	M 12	M 14	M 16
8.8	3	6	10	24	48	83	132	200
12.9	5	10	16	40	81	95	166	265

A more uniform preload force is obtained when grease containing MoS₂ (Molybdenum di-sulfide) is applied to the rail attaching screws which are then tightened with a torque wrench. This results in a marked improvement of running accuracy.



Attention:

By using greases, especially greases containing MoS₂, the coefficient of friction μ can drop to half. The torques must be reduced accordingly. It may be necessary to execute field tests to evaluate the exact coefficient of friction.

Secure the screws in case of expected decreasing of the internal tension.

9.5 Permissible side force with no locating surfaces

The guide values for the maximum permissible side forces can be obtained from the table below for cases where **no locating surfaces** are provided. The F_{max} values depend on dynamic load carrying capacity C, the method of fastening the MONORAIL and the strength grade of screws.

Max. side force F_{max} (N) per carriage without locating surfaces

Depending on size and number of attaching screws DIN 912

Strength grade	F_{max} (N)		M 5		M 6		M 8	
	M 4 4 scr.	6 scr.	4 scr.	6 scr.	4 scr.	6 scr.	4 scr.	6 scr.
8.8	1 250	1 900	2 100	3 150	2 950	4 450	5 400	8 100
12.9	2 150	3 250	3 550	5 300	5 000	7 500	9 200	13 800

Strength grade	F_{max} (N)		M 12		M 14		M 16	
	M 10 4 scr.	6 scr.	4 scr.	6 scr.	4 scr.	6 scr.	4 scr.	6 scr.
8.8	8 600	13 000	12 600	19 000	17 300	26 000	23 900	35 800
12.9	14 600	21 900	21 300	32 000	29 300	44 000	40 300	60 400

Max. side force F_{max} (N) on the rail without locating surfaces

Depending on the size of the attaching screws DIN 912. The values in the chart indicate the max. allowed side force of one carriage on the rail and are valid for a standard hole pitch L_4 . The values increase accordingly by the use of two or more carriages.

MR Strength grade	F_{max} (N)				
	M 6	M 8	M 12	M 14	M 16
8.8	3 400	6 200	13 900	20 000	29 800
12.9	5 700	10 600	23 500	33 700	50 400

BM Strength grade	F_{max} (N)				
	M 4	M 5	M 6	M 8	M 12
8.8	450	1 100	1 750	2 850	7 200
12.9	800	1 850	3 000	4 800	12 200

9.6 Installation guidelines MONORAIL

Installation instructions

The installation of the MONORAIL guideways, distance measuring system and accessories is described in detail in the

- **Installation Instructions MONORAIL** (Content: MR, BM) and
- **Installation Instructions MONORAIL AMS** (Content: MR, AMS).

As delivered condition

The SCHNEEBERGER guideways **MONORAIL MR, MONORAIL MZ, MONORAIL BM** and **MONORAIL AMS** are delivered in a suitable packaging and are protected with a corrosion protection coating for transportation:

- Carriages on the rails ready for installation.
- Additional wipers and lubrication plates installed on the carriage.
- Other accessories included in a separate package.
- 2-part steel plugs included in a separate package.
- Cover strip enclosed separate from the rail.
- Standard lubrication connection at the front center in the front plate, or optional lubrication connections prepared in accordance with the order and closed off with plastic plugs to prevent the ingress of dirt.
- Lubrication connections not required for use are closed.
- O-rings for the «lubrication connection top» separately packed.
- AMS measuring systems are assembled ready to plug-in.
- Electrical accessories and cables are packed with the mechanics.
- Product related mounting notes and operating instructions are delivered with the products.

Transportation and intermediate storage

The MONORAIL guideways and the measuring system are highly precise components, which have to be treated with care. As a protection against damage, the following instructions should be followed:

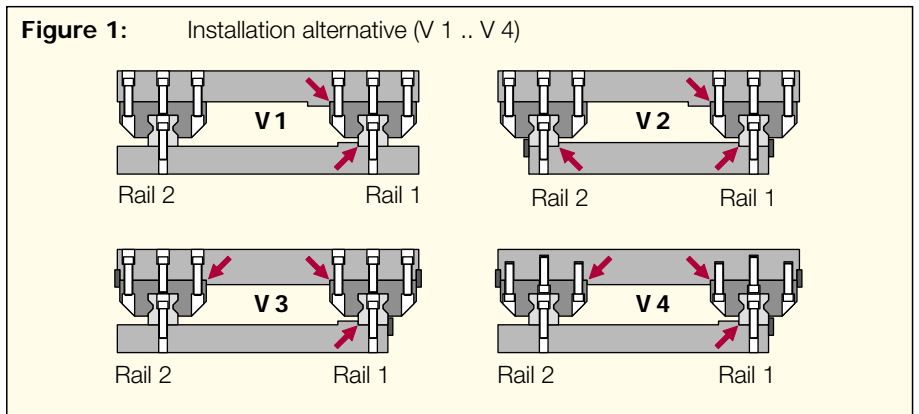
- Always store and transport MONORAIL guideways in their original packaging.
- Protect the guideways against impacts and dampness/humidity.
- Suspend long rails at several points with a crane during transportation.
- Protect MONORAIL rails with distance measuring systems from magnetic fields and from mechanical damage. Magnetic fields can destroy the magnetization of the measuring ruler.

Preparation for the installation

- Check the scope of supply of the components for completeness and with respect to their condition.
- Check the locating sides of the machine bed and mounting plate with regard to correct shape and locating accuracy in accordance with the guidelines in chapter 9.2/9.3 and if necessary rework them.
- Clean all locating sides thoroughly, remove any burrs and unevennesses with an oil stone (oil rubber).
- Take care, that the guideways and the mounting base have the same ambient temperature before and during the installation.
- Remove the corrosion protection from carriages and rails.
- Lightly oil the locating sides of the carriages and rails.

Installation alternatives

Described in the following are four typical installation alternatives (figure 1). These differ with respect to the location of the locating sides on the machine side and therefore to the lateral guide. They are described in detail in the separate **Mounting Instructions MONORAIL**.



Handling the rails

When handling the rails, the following has to be observed:

- Always place the rails with their locating side on to the locating side of the mounting base. The locating side of the rail is that side of the rail opposite the one with the SCHNEEBERGER lettering and the type number.
 - Always tighten the fixing screws alternately starting from the center of the rail, or multi-section rails (figure 2).
 - Multi-section rails are numbered and marked on the rail joints (figure 3). Install the rails in such a way, that the numbers on the rail joints correspond to each other. The rail with the number 1 is designated as the reference rail.
 - When installing multi-section rails without locating side, press the rail joints together by means of pins (figure 4). When installing multi-section rails with locating side always place it on to the locating side of the mounting base. In both cases, pay attention, that the rails touch.
 - In the case of MONORAIL AMS, install the rail with the magnetic ruler as the rail 1. You can identify guideways of the type MONORAIL AMS by the designation on the rail and by the carriage with the scanning head.
- Note included instructions.

Figure 2: Alternate rail fixing starting from the center

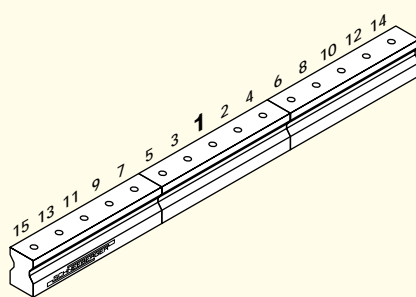


Figure 3: Numbering of the rails and rail joints in the case of multisection rails

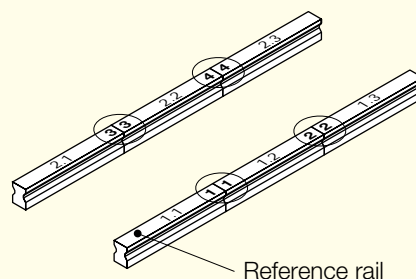
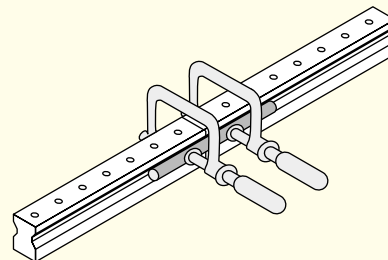


Figure 4: Fixing the rail joint with a clamping device



Handling the carriages

For handling the carriages, the following rules apply:

- Carriages and rails form a unit. Do **not** exchange carriages belonging to different rails. This is especially applicable to matched versions.
- If at all possible, always leave the carriages on the rail. For removing a carriage from the rail and when sliding it on again, always use a mounting rail MRM in the case of MONORAIL MR (figure 5). For MONORAIL BM a mounting rail MBM is recommended to facilitate the installation. It can be done without it when the carriages are carefully moved from and on the rail.
- Protect individual carriages against dirt. During transportation and storage always leave the carriages on a mounting rail MRM, or on the transportation protection in case of MONORAIL BM, as a protection against dirt and against the loss of bearing elements.
- In the case of carriages with a scanning head, always remove the scanning head before sliding the carriage on to a mounting rail MRM.
- Always place the locating side of the carriages against the locating side on the slide. The locating side of the carriage is the side with a ground finish.
- Any retrofitting work on the front plates for the purpose of changing lubrication connections should be carried out by SCHNEEBERGER.

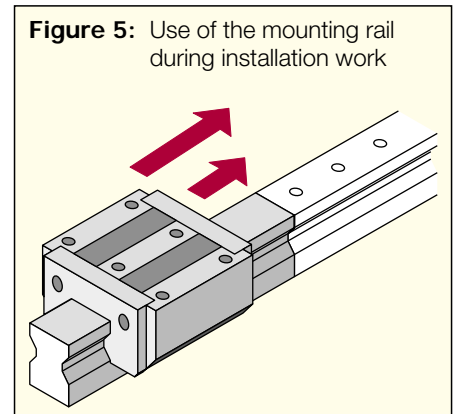


Figure 5: Use of the mounting rail during installation work

MONORAIL installation

- Prepare the mounting base and the guideways for installation in accordance with the preceding section.
- Install the MONORAIL guideways depending on the installation alternative in accordance with the **Installation Instructions MONORAIL**.
- Close the fixing bores of the rails with plugs or steel cover strip, refer to section «Installation Accessories».
- In the case of guideways with a distance measuring system, install the AMS scanning head, measuring electronics and extension cable in accordance with the **Installation Instructions MONORAIL AMS**.
- Slightly rub the rail surface with lubricant.
- If applicable, install the bellows.
- △ Carry out the initial lubrication of the carriage – for this refer to chapter 3.6.

Installation accessories

The installation of the accessories is described in detail in the **Installation Instructions MONORAIL**. The following has to be observed:

- MONORAIL MR carriages with **additional wipers ZCN/ZCV** on rails with through holes and without a rail cover strip are supplied with an installation protection strip. This strip serves to protect the sealing lips during the installation and it must only be removed after the rail bores have been closed off.
- In the case of single carriages with **sheet metal wipers ASM** or **ABM**, release the wiper slightly before running it on to a rail. After running on, adjust the wipers so that there is a uniform gap in the running surface area. Then tighten the fixing screws again.
- Install the **cover strip MAB** or **BAB** (figure 6) in accordance with the installation instructions. In the case of cover strips in several parts, the individual parts are marked the same way as the rails. Install the cover strips so that the rail joints and cover strip joints are not above one another (do not coincide).
- Support the **cover strips** during transportation and storage along their whole length and never let them buckle.
- For the installation of **plastic**, resp., **brass** plugs, use a hammer with an intermediate plate (see figure 7). First place the plug on the rail bore. In doing so, pay attention to the parallel seating of the plug with respect to the rail surface. First tap the plug in lightly, check the seating again and remove any chips produced. Thereafter hammer the plug in until it is flush with the rail surface.
- Steel plugs **MRZ** are supplied in two pieces. First place the bushing onto the screw head, then insert the plug into the bushing. In doing so, pay attention to the parallel seating of the plug with respect to the rail surface. For pressing the plug in, use the hydraulic installation tool **MWH** (see figure 8).
- Install the **bellows FBM** resp. **FBB** in accordance with the Installation Instructions MONORAIL.

Figure 6: Installation of the cover strip

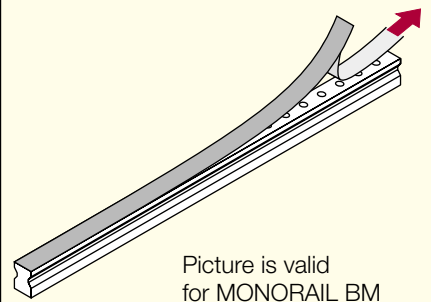


Figure 7: Installation of the plastic-/brass plugs

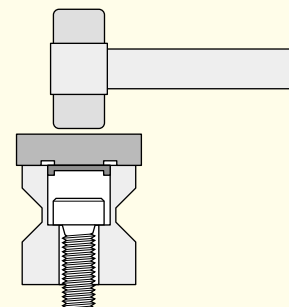
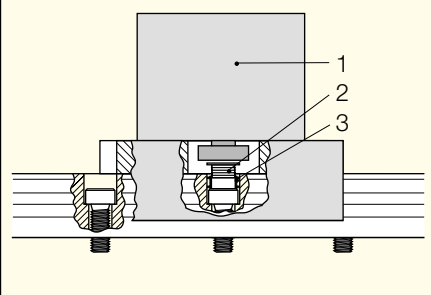


Figure 8: Installation tool MWH for 2-part steel plugs

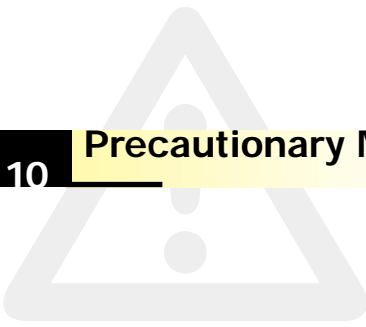


- 1 Hydraulic installation tool
- 2 Tapered steel plug
- 3 Seal ring

AMS installation

The installation of the MONORAIL rails with integrated measuring system is described in the **Installation Instructions MONORAIL AMS**. In addition, the following remarks have to be observed:

- Fix the MONORAIL AMS rails against a lateral stop.
- The rails in the case of MONORAIL AMS size 25 can only be attached from underneath.
- For the removal of the scanning head, additional clearance is required, especially in the case of AMS 25 (at least 2 mm above the scanning head).
- Pay attention to the diameters of the cable plugs (dia 28 mm).



In order to maintain the operability of the MONORAIL guideways during the demanded service lifetime, the following points must imperatively be noted:

- The MONORAIL linear guideways and the distance measuring system AMS are precision components. Therefore the guideways during transportation and storage have to be protected against shocks and humidity and the distance measuring system additionally against strong magnetic fields.
- The installation of the guideways has to be carried out properly and expertly in accordance with the instructions of the manufacturer; in particular, the rail bores have to be closed off flush with the rail surface.
- The profile rail guideways have to be adequately supplied with a lubricant, which is suitable for the movement and the load profile as well as adapted to the environmental conditions. For the selection of the lubricant, if so required a lubricant producer should be directly consulted.
- The compatibility of coolants and lubricants has to be checked and verified by the user, in order to preclude any detrimental influences on the linear guideway.
- The guideways should be protected against contamination with dirt, hot metal chips and any direct contact with coolants by means of covers or corresponding installation positions.
- Depending on the material to be machined, resp., the dirt produced and in cases, where coolant comes into contact with the linear guideways, it is indispensable, that additional wipers are installed in front of the front plates. In addition, shorter inspection intervals are also called for.
- In such case, where the linear guideways come into contact with hot metal chips, in addition the utilization of metal wipers is recommended.
- The wipers on the ends of the MONORAIL carriages have to be examined for wear at regular time intervals and if necessary replaced. This is also applicable for additional wipers.



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