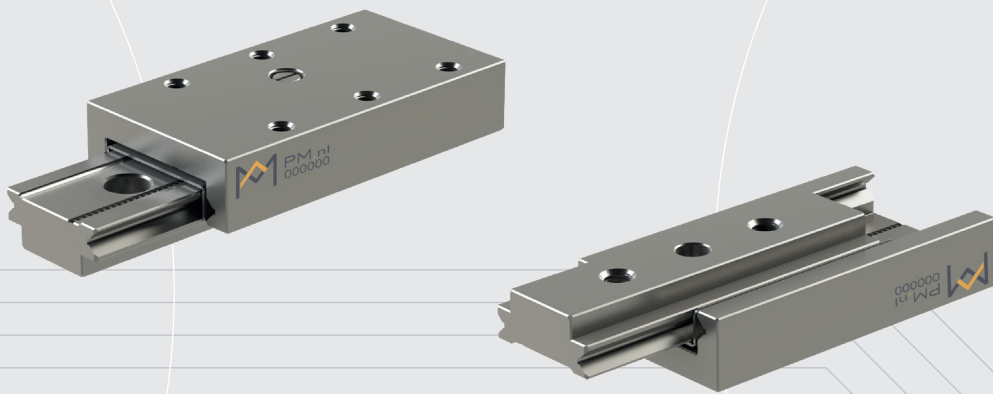


MICRO SLIDES MSR

Maximum performance - minimum space



6 sizes
4 .. 15



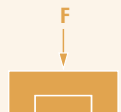
Lengths
10 .. 130 mm



Stroke range
5 .. 112 mm



Weight
1.8 .. 398 g



Load capacity
506 .. 7819 N

**ANTI CAGE CREEP
TECHNOLOGY INCLUDED**



INTRODUCING THE MICRO MSR SERIES: MAXIMUM

PM presents the world's first crossed roller miniature slide with anti cage

Our newly developed miniature, corrosion resistant MSR series slide was designed to meet the requirements of tomorrow's industry. With faster cycle times, superior quality and higher accuracy in a minimum space, the MSR series is the product of choice for precision applications that are subject to high accelerations on a constant basis. This latest product line fits in perfectly with PM's commitment to producing innovations that continually push the boundaries of potential in the high-precision engineering industry.

PERFORMANCE IN MINIMUM SPACE

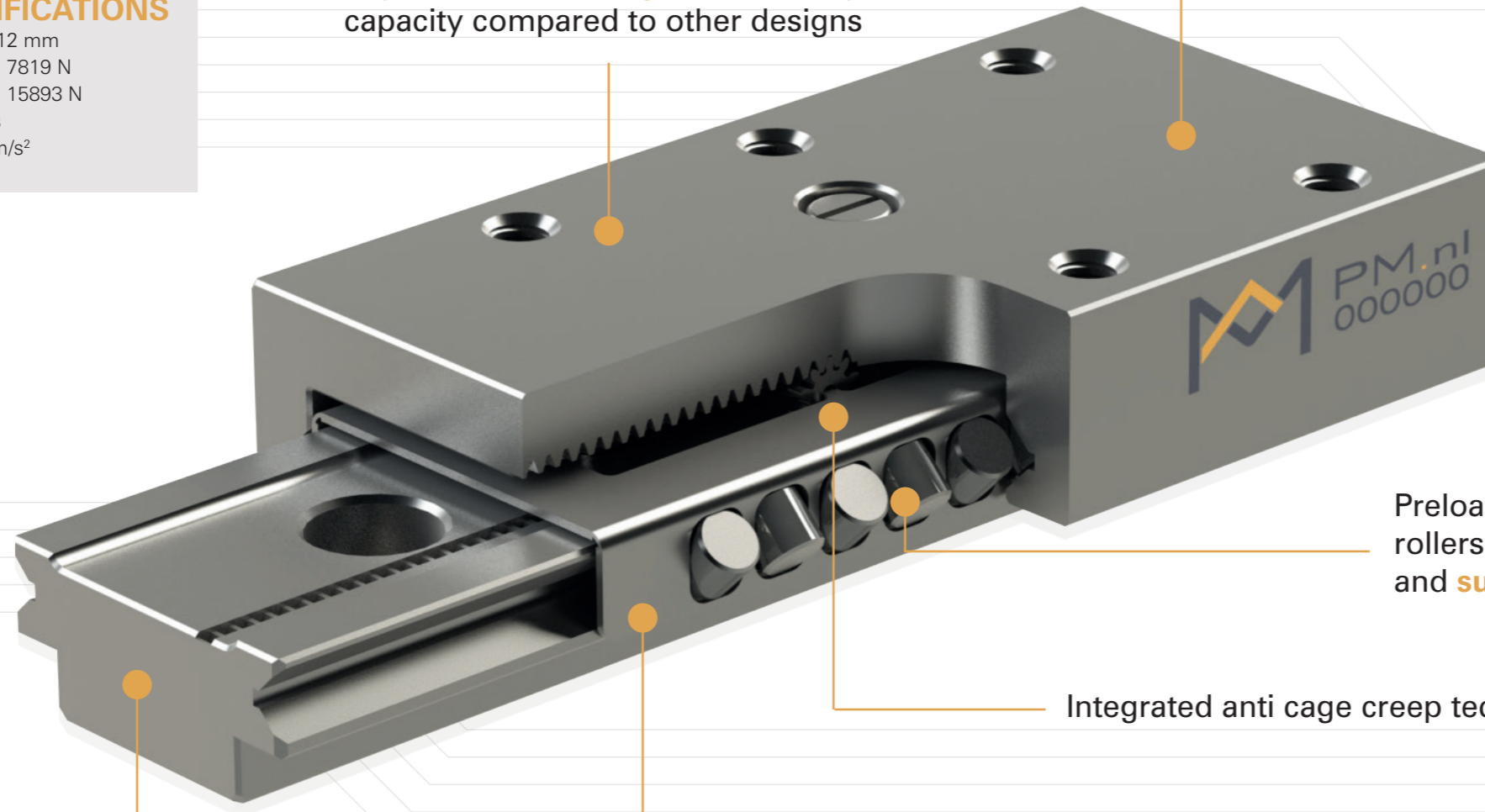
creep technology.

TECHNICAL SPECIFICATIONS

Stroke range: 5 .. 112 mm
Load capacity C_{dyn} : 506 .. 7819 N
Load capacity C_{stat} : 781 .. 15893 N
Speed V_{max} : 2 m/s
Acceleration a_{max} : 200 m/s²

Impressive **+65% higher load** carry capacity compared to other designs

100% stainless steel and **compact design** makes it suitable for the medical and semiconductor industry



Preloaded frictionless linear bearings with crossed rollers, offering **prolonged lifetime**, high precision and **superior stiffness**

Integrated anti cage creep technology enables **high accelerations**

Smart cage design offers **less friction** and **maximum number of rollers** per length

In industry sizes 4, 5, 7, 9, 12 and 15

Rolling elements:	stainless steel 1.4034, through-hardened 54 - 57 HRC
Cage and pinion:	stainless steel 304 and 303
Table and rail:	stainless steel 1.4034, hardness 54 - 57 HRC
Screws:	stainless steel 303
Operating temp.:	-40 °C up to +120 °C
Lubrication:	lightly oiled with Thermoplex ALN 1001/00
Coef. friction:	0.003 - 0.005



MSR DESIGN INFORMATION

MAXIMUM SPEED AND ACCELERATION IN THE SMALLEST SPACES

MSR slides have been designed to achieve high speed and acceleration, without any negative effects on precision performance. Thanks to their precision-finished contact surface, highly tolerance rolling elements and a precision-produced cage, technical performance specifications are brought to a markedly higher level:

- Speed $V_{max} = 2 \text{ m/s}$
- Acceleration $a_{max} = 200 \text{ m/s}^2$

Additionally, the factory-set preload ensures machine stiffness and lifetime precision.

AVAILABLE IN POPULAR SIZES

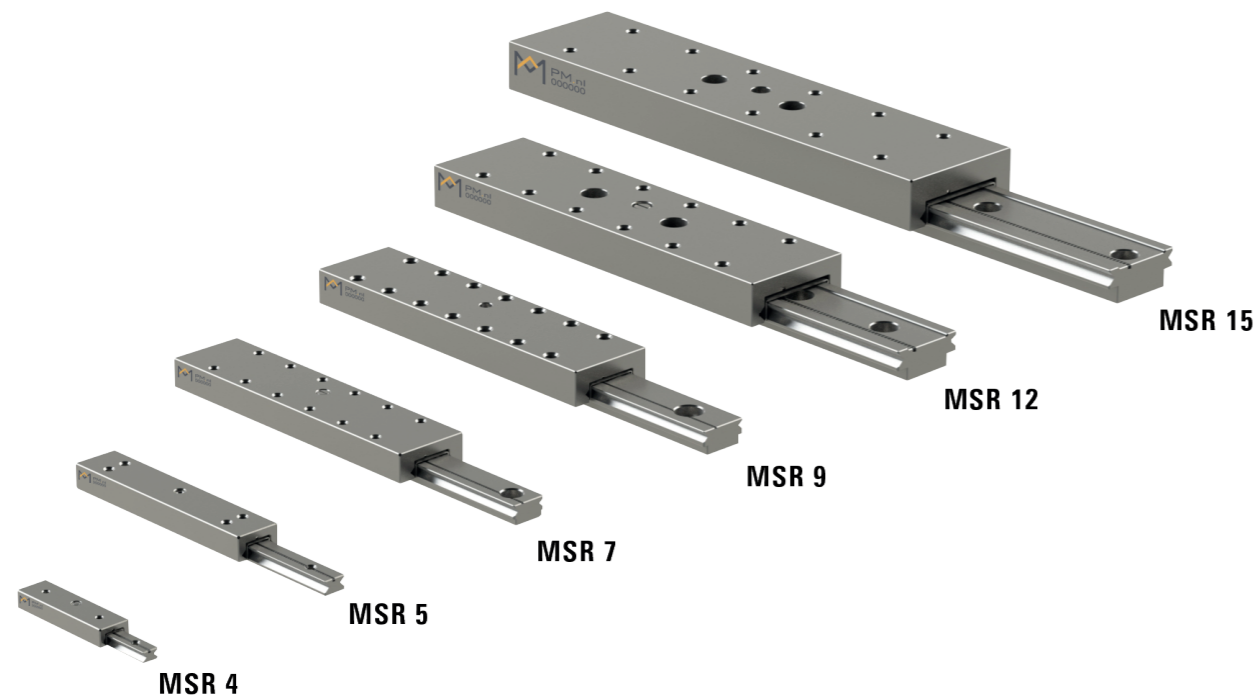
MSR slides start from industry standard size 4 up to 15, covering a dynamic load carry capacity up to 7819 N C_{dyn} . Size 4 includes the smallest crossed rollers in diameter, making it the world's smallest linear slide with both anti creep solution and crossed roller technology available in the market.

IMPRESSIVE 65% HIGHER LOAD CAPACITY

Our NEN-ISO-compatible calculations demonstrate that the MSR slide carries up to at least 65% higher load when compared to ball slides.

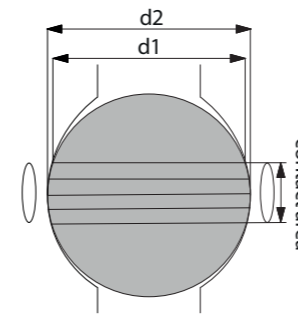
The new crossed roller technology creates a line contact between roller and V-groove. Thanks to optimization of contact surfaces between the cylindrical rollers and V-groove, impressively higher load ratings and lower friction resistance are achieved. These innovative features enable the MSR slide's high load capacity, while the oil film is maintained and stiffness increased allowing for higher system precision and extended lifetime.

Load capacities and moments were calculated in accordance with the latest NEN-ISO standard 14728-1:2017 for rolling element bearings.



MSR SLIDES VS. BALL SLIDES: A COMPARISON

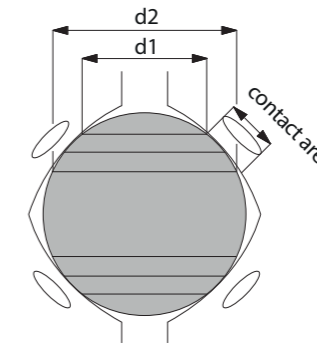
Fig. 1



1. CIRCULAR ARC DESIGN

Circular arc design, widely referred to as 2-point (fig 1), is characterised by ease of deformation of balls when subject to load, smooth running capabilities and low dynamic load carry capacity. A point contact often results in breakage of the oil film resulting in a shorter lifetime of the linear bearing.

Fig. 2

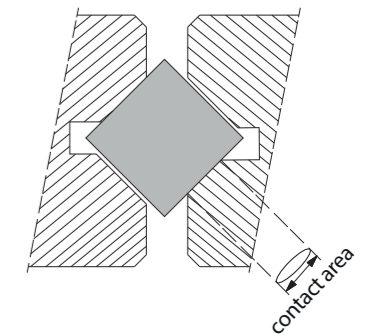


2. GOTHIC ARCH DESIGN

Gothic arch has been popular with manufacturers as it does not require high precision components due to the balls' ability to compensate for poor tolerances through their deformation, thus mitigating negative impact on precision and resulting in lifetime.

As the 2-point contact evolved into the 4-point gothic arch design profile (fig 2), point contact effectively evolved into a contact surface enabling higher load capacity. At the same time, however, this evolution was accompanied by increased friction due to micro slip (since the inner part of the balls must rotate faster than the outer), as well as reduced lifetime.

Fig. 3



3. CROSSED ROLLER DESIGN

Cylindrical rollers offer greater load capacity due to the line contact surface which also boosts rigidity and accuracy. The rollers are arranged at 90 degree angle (criss cross pattern) enabling loads to be carried from four major directions. This is known as a crossed roller design (fig. 3). As the rollers are moving over high precision finished surfaces they offer unsurpassed smooth motion and precision.

Table1) Comparison dynamic load ratings MSR crossed roller design vs. alternatives using gothic arch ball design.

Type	Crossed roller design slide	Gothic arch design slide
	$C_{dyn} \text{ (N)}$	$C_{dyn} \text{ (N)}$
MSR 4-20	670	307
MSR 5-30	1422	857
MSR 7-50	2178	919
MSR 9-50	2178	846
MSR 12-60	4025	1806
MSR 15-90	6249	3628



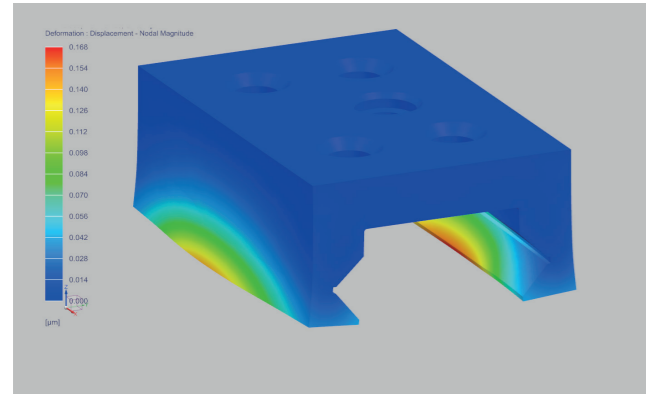
PERMANENT PRECISION

Thanks to its embedded crossed roller technology and extremely high precision parts, the MSR achieves impressive levels of precision and lifetime performance, all in a compact package.

DESIGN OPTIMIZATION BY FEM-ANALYSIS

The MSR series was designed in-house with state-of-the-art design tools such as FEM. The design incorporates the latest findings from the PM R&D department regarding lifetime and stiffness calculations. The development process of this new member of the 'PM family' of innovative product lines has furthermore benefited from the learning-curve obtained through experience since 2011 with the manufacturing of customised micro roller slides.

The result is a miniature slide that firmly sets the industry benchmark in terms of precision, lifetime and dynamics.



FEM designed upperslide

OUR MARKET-DRIVEN APPROACH TO COMPACT DESIGN

The MSR series miniature slide was designed to meet the compact space requirements of our customers' highly demanding applications. Specifically, the MSR offers lifetime precision with zero backlash, excellent positioning accuracy and repeatability. Precision performance is maintained over the MSR's entire service life thanks to its embedded preloading principle.

These performance optimisations make the MSR a perfect component for applications in the field of electronic chip manufacturing. Component placement offers a good example where machines are operated on the basis of high standards for velocity, repeatable precision as well as lifetime of the pick-and-place axes. An equally suitable area of application are surgical robots. Here the linear slides need to be particularly compact and lightweight, with long-lasting precision and smooth motion in every mounting direction.

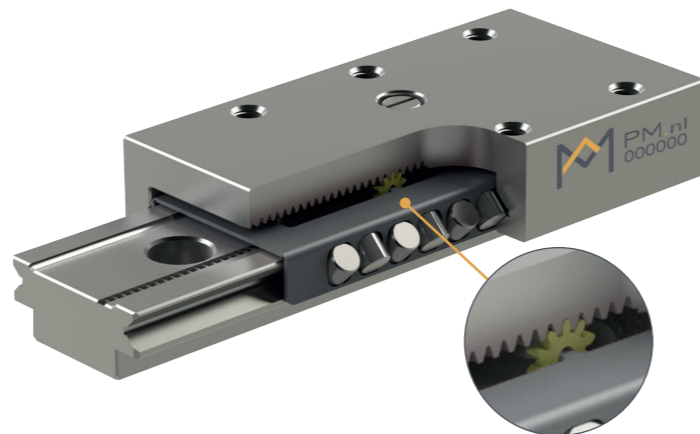
PRECISION ANTI CAGE CREEP TECHNOLOGY

Our anti cage creep integrated (ACCI) technology is enabled for use in ultra-high vacuum applications.

The anti cage creep technology embedded in the rail material was initially integrated into our crossed roller linear bearings. Subsequently the innovation was adapted to also work with our compact size slides.

The MSR slide's integrated anti cage creep solution is unique because it always keeps the cage in perfect positioning without affecting lifetime even in high-dynamic applications. The single piece U-form rigid designed cage, made of stainless steel material, enables high velocities of the rolling elements with minimum cage friction. ACCI-technology furthermore eliminates the need to re-center the cage during operation and increases the level of reliability.

Since the racks are directly integrated into the stainless steel table parts, this represents a very solid and space-efficient solution that is also a perfect choice for applications in clean-room and ultra-high vacuum environments.



Anti cage creep technology (ACCI)

MSR OFFERS MULTIPLE CUSTOMER BENEFITS

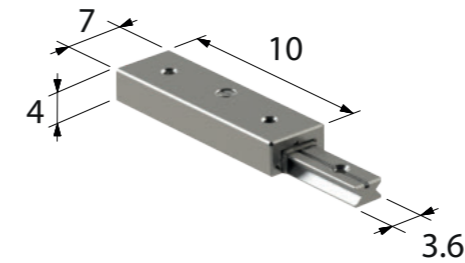
MSR brings multiple benefits and goals within our customers' reach: increased productivity, longer lifetime and a high degree of reliability, all with a minimum need for servicing. With this highly dynamic unit, optimal design solutions can be achieved.

Assembly into your application will be easy because of the embedded preload setting and standard attachment holes.

OPTIMISED FOR HIGH-PRECISION APPLICATIONS

Although MSR slides are comparable in terms of size to miniature slides from other manufacturers offering linear ball bearings, with MSR we now introduce major benefits that make it the new industry benchmark for precision applications:

- Lifetime superior precision
- Up to 65% increased load capacity
- Longer service life
- Extremely compact design
- Anti cage creep technology included



Our smallest MSR 4-10, stroke 5 mm

Units: mm

CLEANROOM / VACUUM USABILITY

MSR series are suitable for use in clean room and vacuum applications up to 10⁻⁹ mbar. PM product specialists are available to provide you with custom advice on requirements for cleaning, lubrication and packaging appropriate to these applications. For blind tapped holes, we are able to either incorporate special ventilation into the slide design or alternatively the use of vented screws would be recommended.

CUSTOMISED SOLUTIONS ARE THE FUTURE

Every application has its unique list of requirements and industry developments are continuously pushing the limits for components. Upon customer request, special versions of MSR slides can be supplied that meet your specific needs, e.g.:

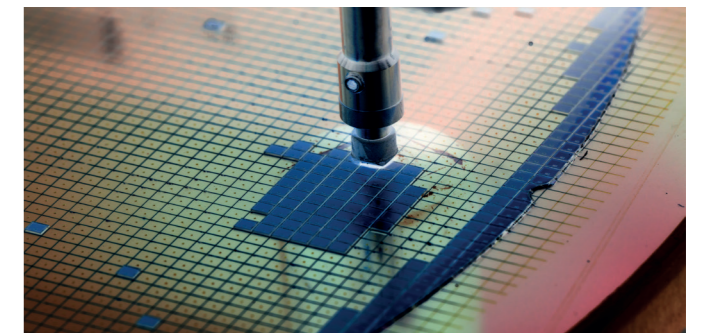
- Alternative lubricant
- Specified pushing force
- Specific table part design
- Customised stroke
- Additional holes
- Cleanroom or vacuum compatible
- No lube, for example Diconite® dry lube treatment

MSR MEETS THE DEMANDS OF A RANGE OF INDUSTRIES

- Semiconductor industry: high speed placement machines, assembly and testing
- Optical industry
- Laboratories
- Nanotechnology: micro manipulators
- Robot-assist medical surgery
- Micro automation / assembly



Robot-assist medical surgery



Semiconductor manufacturing



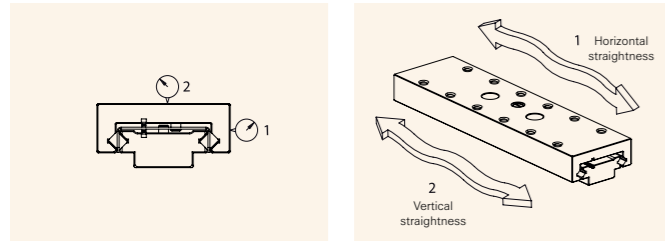
FACTORY-SET PRELOAD

The stainless steel cylindrical rollers, centre rail and table part are produced with high precision and selected within half a micron.

The preload is set at a moderate level of approximately 10% of the dynamic load capacity to ensure smoothness, precision and extended lifetime. Should your specific application require lower or higher preload settings, we can adjust them accordingly. Do note that a higher preload setting reduces lifetime.

RUNNING ACCURACY

Running accuracy measurements on the MSR slides are done on a flat surface in a free state condition. Tolerance on horizontal and vertical straightness of the stroke depends on the length of the MSR slide.



Accuracy during travel	Length A (mm)			
	10 .. 30	35 .. 50	60 .. 80	90 .. 130
Horizontal straightness	3	3	4	4
Vertical straightness	3	3	4	4

Units: μm

TRAVEL – SHORT STROKE

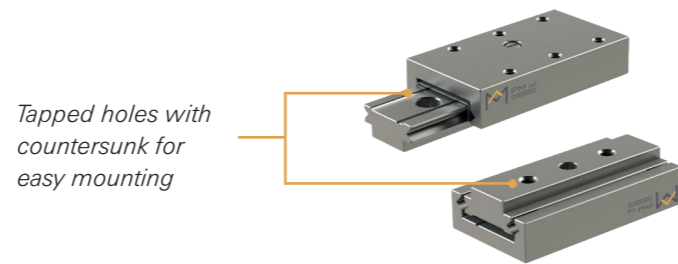
Stroke lengths listed in the tables are used as maximum values. We recommend that the application travel should be 2.5 mm shorter than the maximum available stroke length of the tables. Warning: for applications using a stroke length of less than 3 mm, please pay attention to the term “short-stroke”. As the stroke H is less than 3 mm, lubrication strokes (service strokes) should be applied to re-instate a lubrication film against rolling elements and the running contact surface to prevent wear and lifetime reduction.

NOTE ON DUAL SLIDE USE

Should your application require two or more slides to be mounted in parallel, please consult PM for expert advice. Since the slides have a high rigidity, the finishing of surrounding surfaces needs extra attention to ensure an even load distribution and smooth running, and to prevent any unintended failures from occurring.

DIFFERENT ATTACHMENT HOLES FOR EASY MOUNTING

The slide table comes with a variety of tapped holes for attachment. The centre rail includes a combination of two through-tapped holes with countersunk (start and finish hole) enabling attachment either from the top or bottom side of the rail. For MSR sizes 04 and 05 the centre rail is available with through-tapped attachment holes only.



EXPECTED LIFETIME

LOAD RATINGS AND EXPECTED LIFETIME

The cylinder rollers we use are compliant with DIN ISO standard 14728-1: 2017. The listed ratings are based on an expected service life L of 100.000 m.

Some suppliers, mostly from the Far East, use higher loadings based on an expected service life of 50.000 m. These C_{50} values can be converted using the following formula:

Conversion of the load ratings to C_{50}
Cylinder roller cage guide $C_{50} = 1.23 \cdot C_{100}$

Conversion of the load ratings to C_{100}
Cylinder roller cage guide $C_{100} = 0.81 \cdot C_{50}$

NOMINAL OPERATIONAL CALCULATION LIFE

We refer to the amount of time during which the performance of the linear bearing is satisfactory as the expected lifetime. The calculation below can be used to estimate the expected lifetime for linear bearings – assuming that PM’s recommendations regarding operating conditions, lubrication and protection from contaminants are being followed. By L_{10} definition, within the expected lifetime and under similar operating conditions, 90% of the linear bearings will attain the lifetime under the dynamic load C_{dyn} , as listed in the product tables.

$$L_n = a_1 \cdot (C_{dyn}/P)^E \cdot 1.15 \cdot F_T \cdot 10^5 \text{ meters}$$

- L = Expected lifetime in meters
- a_1 = Reliability factor
- C_{dyn} = Effective dynamic load rating in N
- P = Equivalent load in N
- E = 10/3 for cylinder and needle rollers, or 3 for balls
- 1.15 = An empirical factor applicable to the materials employed
- F_T = Correction factor for temperature effects

Reliability factor		
Reliability (%)	L_n	a_1
70	L_{30}	2.77
80	L_{20}	1.82
90	L_{10}	1.00
95	L_5	0.62
96	L_4	0.53
97	L_3	0.44
98	L_2	0.33
99	L_1	0.21

TEMPERATURE FACTOR F_T

Diminished rail hardness will start to occur in PM linear bearings when deployed at temperatures over 150 °C. As a result, load ratings must be reduced with a factor F_T as shown in the table below. This applies to the reduction of the dynamic load rating C_{dyn} and the static load rating C_0 .

Temperature in °C	Temperature Factor F_T
125	1.00
150	1.00
175	0.95
200	0.90
225	0.82
250	0.76
275	0.68
300	0.61

STATIC SAFETY FACTOR

The static safety factor S_0 determines the degree of safety against permanent deformation of the contact surfaces of the rails and rolling elements. The safety factor represents the relationship between the basic static load rating C_0 and the equivalent maximum static load P_0 and can be calculated using the following formula:

$$S_0 = \frac{C_0}{P_0}$$

The static equivalent load P_0 is a hypothetical load and is considered to be approximately the maximum applied load F_{max} , as:

$$P_0 = F_{max}$$

- C_0 = Static load capacity (N), see dimension slides
- P_0 = Static equivalent load (N)
- F_{max} = Maximum applied load (N)
- S_0 = Static safety factor

In use cases where high importance is placed on running accuracy and smoothness, a static $S_0 \leq 2$ should be applied. If not, under normal conditions S_0 should be between 2 and 4. For general machinery with loads subject to variable operating conditions, medium vibrations or heavy impact loading on the linear bearings, a static safety factor S_0 between 4 and 5 is recommended.

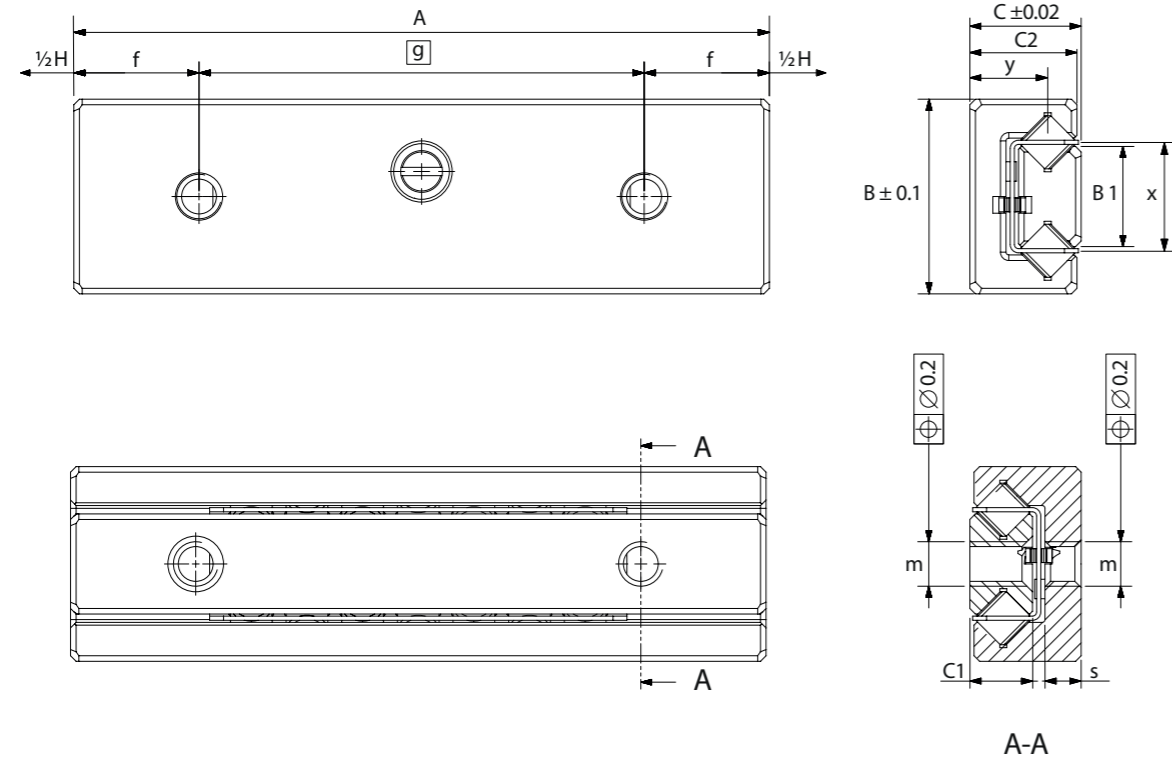


Fig. 1

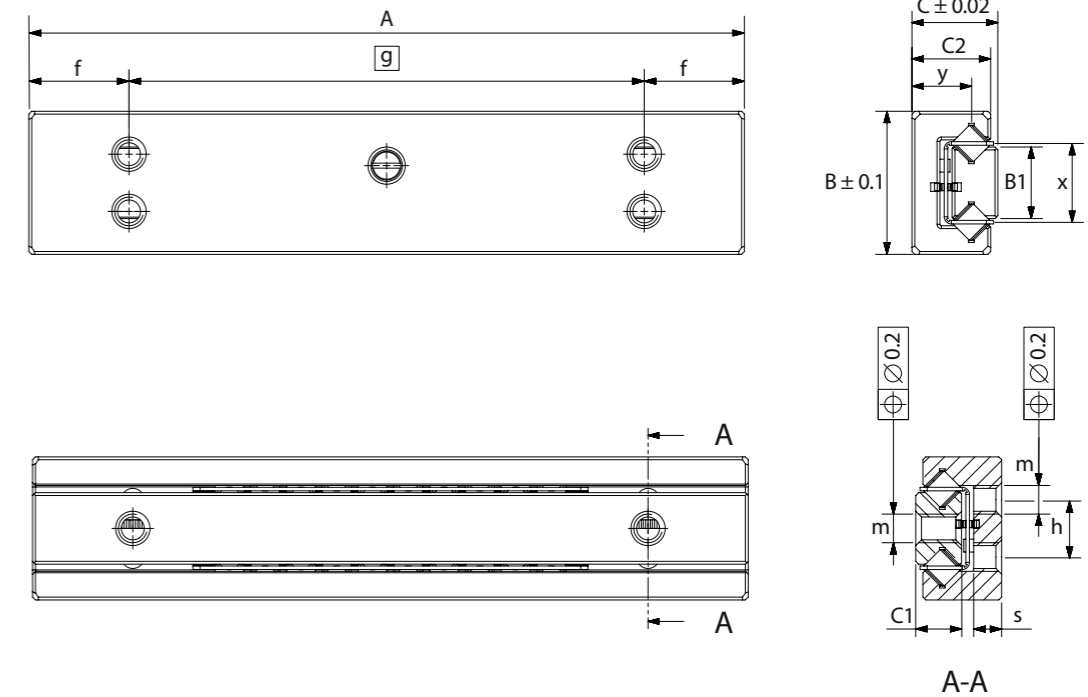
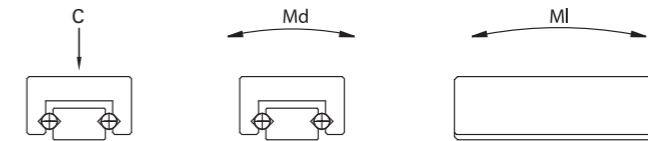


Fig. 2



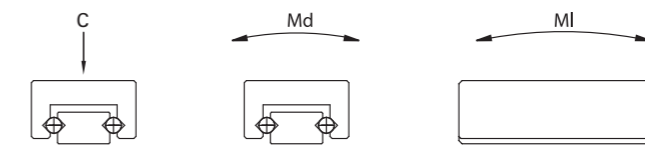
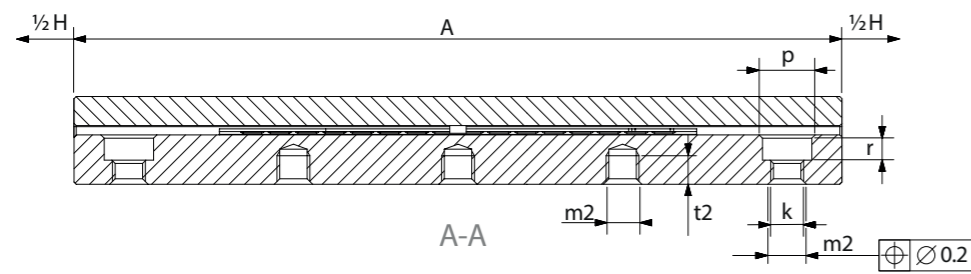
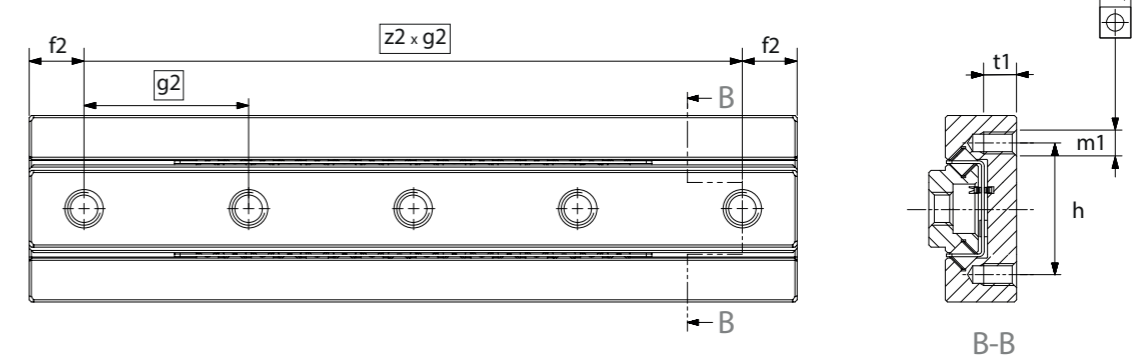
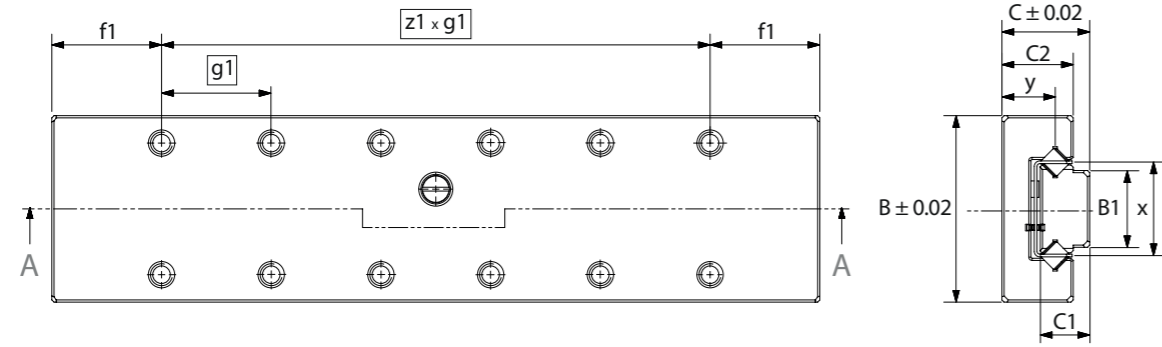
Type	Main dimensions			Stroke H						
	A	B	C		B1	C1	C2	f	g	h
MSR 4-10	10			5				2.5	5	
MSR 4-15	15			11				3.5	8	
MSR 4-20	20	7	4	16	3.6	2.25	3.85	4	12	-
MSR 4-25	25			22				4.5	16	
MSR 5-15	15			10				3.5	8	
MSR 5-20	20			15				4	12	
MSR 5-30	30	10	6	25	5	3.2	5.5	5	20	4
MSR 5-40	40			35				6	28	
MSR 5-50	50			45				7	36	

Bold = Short lead time item

Regular = Long lead time item - please ask us about prices and lead times

m	s	x	y	Weight (g)	C (N)	C ₀ (N)	MI (Nm)	MI ₀ (Nm)	Md (Nm)	Md ₀ (Nm)	Fig.
					dynamic	static	dynamic	static	dynamic	static	
M1.6	1.3	3.90	2.80	1.8	506	781	0.7	1.0	1.0	1.5	1
				2.8	606	976	1.2	2.0	1.2	1.9	1
				3.6	670	1171	1.9	3.1	1.4	2.3	1
				4.5	791	1360	2.6	4.6	1.5	2.7	1
M2	1.95	5.50	4.15	5.7	911	1360	1.5	2.3	2.5	3.7	2
				7.6	1089	1699	2.7	4.2	3.0	4.7	2
				11.3	1422	2379	5.9	9.9	3.9	6.5	2
				15.1	1882	3399	12.6	22.7	5.2	9.3	2
				18.9	2180	4079	18.2	34	6.0	12.2	2

Units: mm



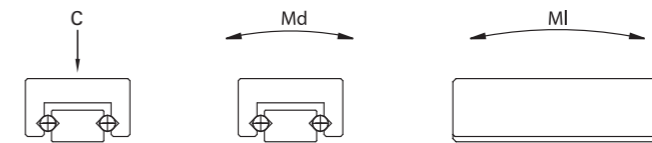
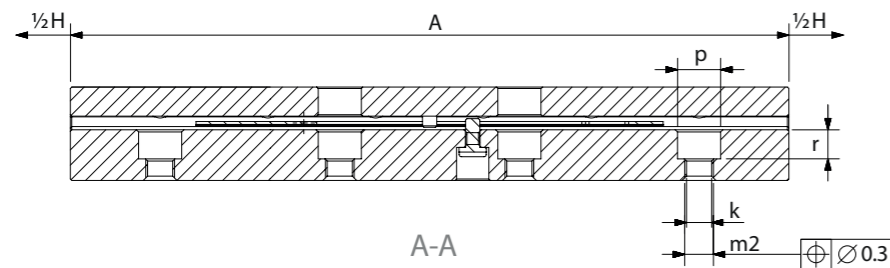
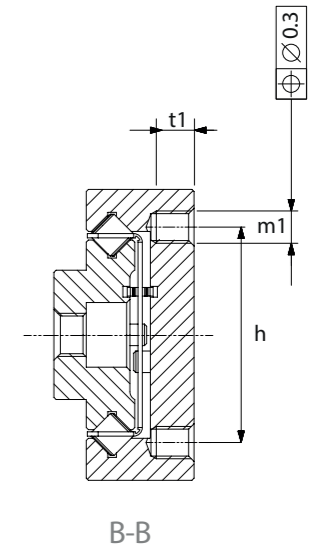
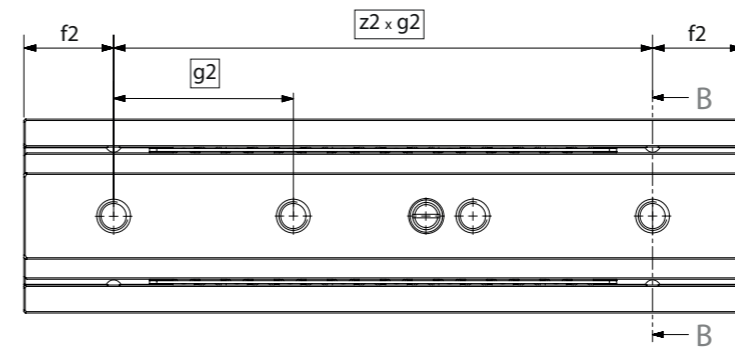
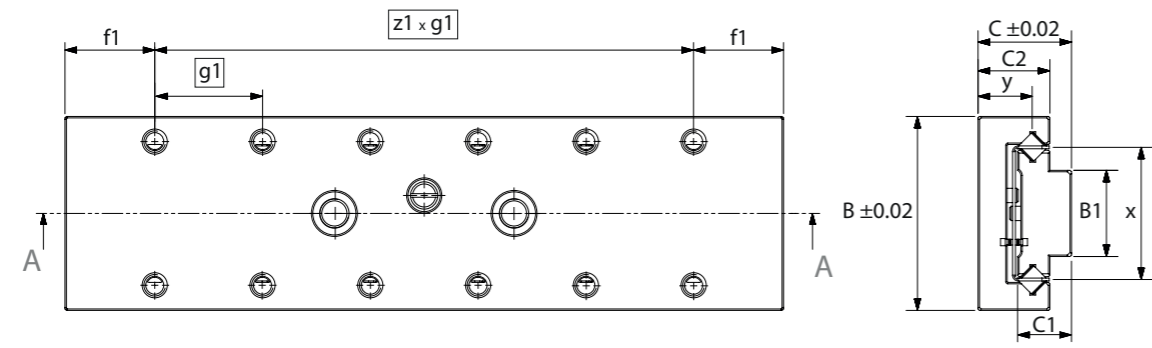
Type	Main dimensions			Stroke H											
	A	B	C		B1	C1	C2	f1	f2	z1 x g1	z2 x g2	h	p	k	r
MSR 7-30	30			22					7.5	1x10	1x15				
MSR 7-40	40			30				5	2x10	2x15					
MSR 7-50	50	17	8	40	7	4.5	6.5	10	10	3x10	2x15	12	4.5	2.5	2.3
MSR 7-60	60			50					7.5	4x10	3x15				
MSR 7-70	70			60					5	5x10	4x15				
MSR 9-40	40			28					10	2x10	1x20				
MSR 9-50	50			42					5	3x10	2x20				
MSR 9-60	60	20	10	50	9	5.5	8	10	10	4x10	2x20	15	6	3.2	2.5
MSR 9-70	70			60					5	5x10	3x20				
MSR 9-80	80			70					10	6x10	3x20				

m1	t1	m2	t2	x	y	Weight (g)	C (N)	C ₀ (N)	MI (Nm)	MI ₀ (Nm)	Md (Nm)	Md ₀ (Nm)
							dynamic	static	dynamic	static	dynamic	static
M2	3	M3	2.5	8.50	4.85	27	1412	2363	5.9	9.8	6.0	10.0
						33	1882	3399	12.6	22.7	8.0	14.3
						42	2178	4079	18.2	34.0	9.2	17.2
						50	2458	4758	24.6	47.6	10.4	20.1
						58	2728	5438	31.8	63.4	11.5	23.0
M3	3	M4	3.3	11.50	5.85	47	1822	3399	12.6	22.7	10.9	19.5
						57	2178	4079	18.2	34.0	12.5	23.5
						69	2458	4758	24.6	47.6	14.1	27.4
						81	2728	5438	31.8	63.4	15.7	31.3
						92	2975	6076	39.7	81.0	17.1	34.9

Bold = Short lead time item

Regular = Long lead time item - please ask us about prices and lead times

Units: mm



Type	Main dimensions			Stroke H											
	A	B	C		B1	C1	C2	f1	f2	z1 x g1	z2 x g2	h	p	k	r
MSR 12-50	50			48				10	12.5	2x15	1x25				
MSR 12-60	60			53				7.5	5	3x15	2x25				
MSR 12-80	80	27	13	72	12	7.5	10	10	15	4x15	2x25	20	6	3.2	4
MSR 12-100	100			82				12.5	12.5	5x15	3x25				
MSR 15-70	70			66				15	15	2x20	1x40				
MSR 15-90	90			70				15	5	3x20	2x40				
MSR 15-110	110	32	16	102	15	8.5	12	15	15	4x20	2x40	25	6	3.2	3
MSR 15-130	130			112				15	5	5x20	3x40				

m1	t1	m2	x	y	Weight (g)	C (N)	C ₀ (N)	MI (Nm)	MI ₀ (Nm)	Md (Nm)	Md ₀ (Nm)
						dynamic	static	dynamic	static	dynamic	static
M3	3.5	M4	18.5	7.6	105	3303	5292	24.4	39.2	30.4	48.7
					125	4025	6804	39.7	67.1	37.0	62.6
					167	5044	9071	68.4	123.1	46.4	83.5
					208	6318	12095	108.0	206.8	58.1	111.3
M3	4	M4	21.5	9.6	214	4549	7946	44.9	78.4	48.7	85.0
					276	6249	11919	100.2	191.1	66.9	127.5
					337	6573	12714	113.5	219.5	70.3	136.0
					398	7819	15893	173.6	352.8	83.7	170.1

Bold = Short lead time item

Regular = Long lead time item - please ask us about prices and lead times

Units: mm

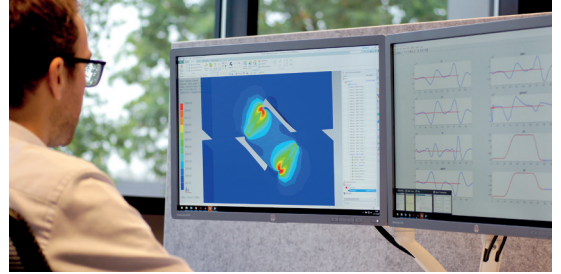
DESIGN TO CLIENT SPECIFICATION

Our expert advisers provide full lifetime product support no matter what the specific needs are in your field of industry. As a PM client you can expect to see a customer-centric approach in all aspects of how we do business, in all of our product groups and from the prototype stage through to large volume production. All PM products are designed and manufactured at our state-of-the-art facilities in the Netherlands.

Expert advice and consulting



Design to client specification



State-of-the-art milling



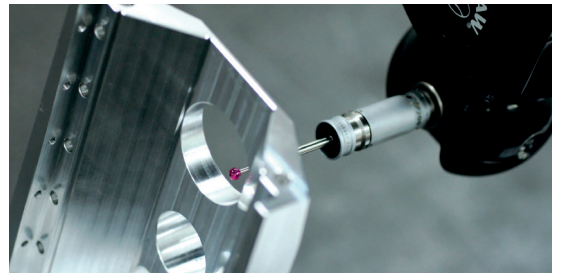
In-house heat treatment



High precision grinding



Full quality control



Assembly to the highest standard of precision



The highest standards for packaging and delivery



PM B.V.

Galileistraat 2, NL-7701 SK, Dedemsvaart, The Netherlands

Tel: +31 523 61 22 58 | info@PM.nl