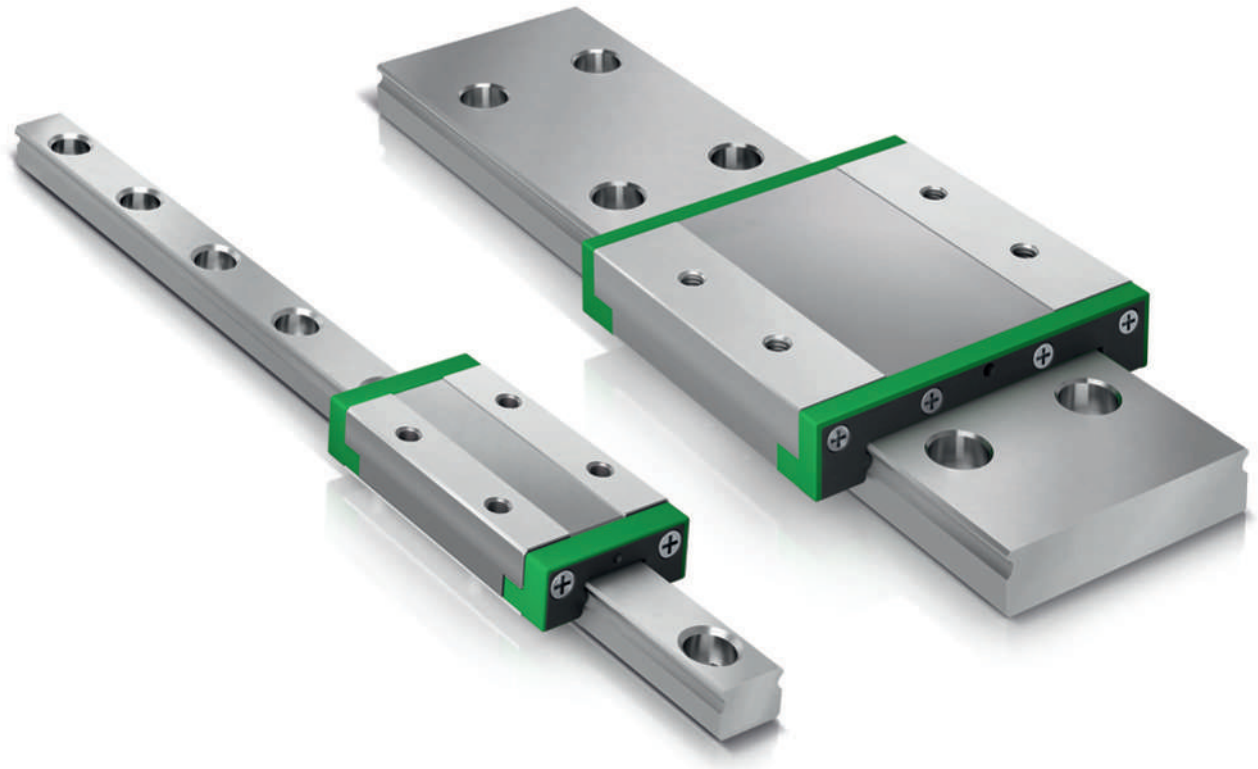
ALMOTION

SCHAEFFLER



Corrosion-resistant miniature linear recirculating ball bearing and guideway assemblies

in sizes 05 to 15

Technical Product Information

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1

1 Technical principles

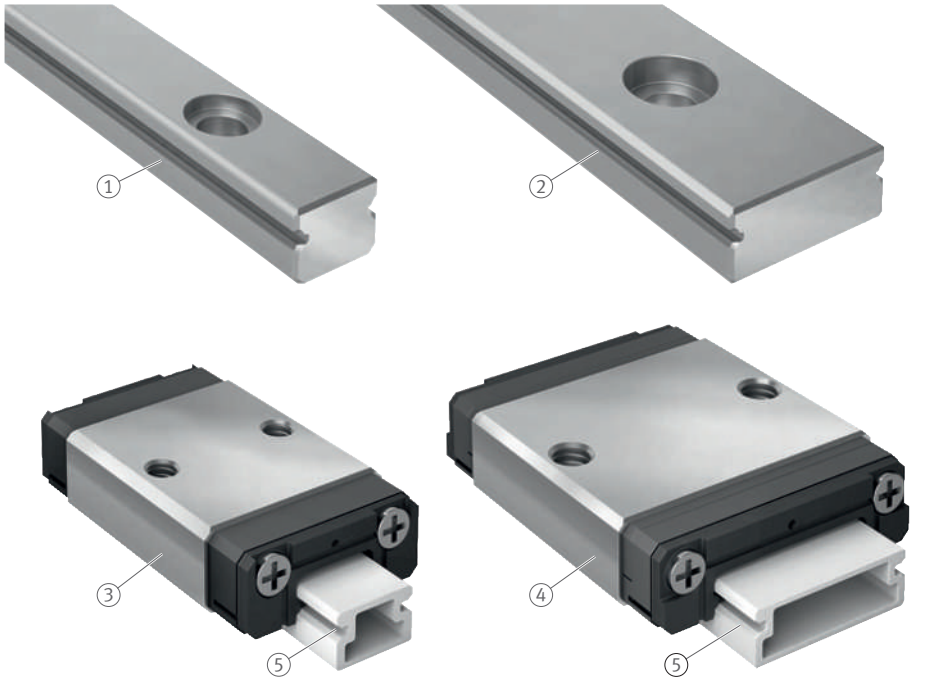
1.1 Miniature linear recirculating ball bearing and guideway assemblies in 2 variants

Miniature linear recirculating ball bearing and guideway assemblies in sizes 05 to 15 are full complement, linear locating bearings of various preload classes for unlimited stroke lengths. They are of a two-row design and comprise a guideway and a carriage. The two-row units have 2 rows of rolling elements in four point contact with the raceways and are preloaded.

1.1.1 Miniature linear recirculating ball bearing and guideway assemblies KUEM05

Miniature linear recirculating ball bearing and guideway assemblies are available in 2 different designs with carriages KWEM05 and KWEM05-W. The matching guideways TKDM05 (in 6 preferred lengths) and TKDM05-W (in 7 preferred lengths) are available in any lengths up to the maximum section length.

1 Miniature linear recirculating ball bearing and guideway assemblies



1	TKDM05	2	TKDM05-W
3	KWEM05	4	KWEM05-W
5	Dummy guideway		

1 Available designs

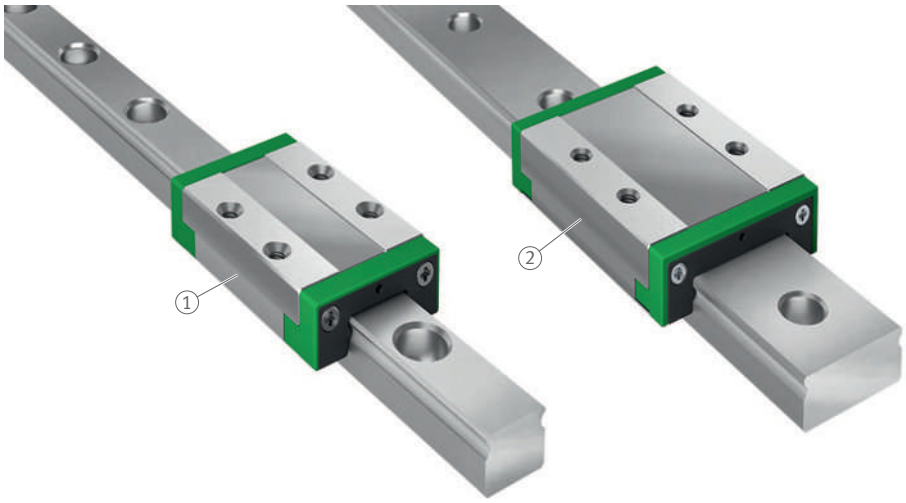
Design	Description
–	Standard
W	Wide design

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1.1.2 Miniature linear recirculating ball bearing and guideway assemblies KUEM..-E

Miniature linear recirculating ball bearing and guideway systems are available in 4 sizes (07, 09, 12 and 15) and 4 different designs with carriages KWEM..-E, KWEM..-E-L, KWEM..-E-W and KWEM..-E-WL. The matching guideways TKDM..-E and TKDM..-E-W for the systems are available in freely selectable lengths, taking into account the maximum length available.

2 Miniature linear recirculating ball bearing and guideway assembly



1	KUEM..-E, KUEM..-E-L	2	KUEM..-E-W, KUEM..-E-WL

2 Available designs

Design	Description
–	Standard
W	Wide design
L	Long design
WL	Wide, long design

1.1.3 Corrosion-resistant design

The miniature linear recirculating ball bearing and guideway assemblies are corrosion-resistant under normal conditions due to the use of high-alloy premium steel for the carriages and guideways.

If very high levels of corrosion resistance are required, the suitability of the units for the specific application must be investigated.

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1.1.4 Applications

The miniature linear recirculating ball bearing and guideway assemblies are particularly suitable for applications:

- in the microelectronics industry and similar sectors
- in optical equipment
- in medical equipment
- in textile machinery
- that require high speeds and very uniform running behaviour
- where particularly economical miniature guidance systems are needed for moderate to high loads and moderate to high rigidity requirements
- requiring high performance in a minimal design envelope

1.2 Load carrying capacity and rating life

1.2.1 Load carrying capacity

The size of the guidance unit is determined by the load carrying capacity of the individual elements. The load carrying capacity is described in terms of the basic dynamic load rating C and the basic static load rating C_0.

Calculation of the basic load rating according to DIN ISO

The calculation of the basic dynamic and static load ratings in the product tables is based on DIN ISO 14728-1 and DIN ISO 14728-2.

Differences between DIN ISO and suppliers from the Far East

Suppliers from the Far East frequently calculate basic load ratings using a basic rating life based on a displacement distance of only 50 km in contrast to 100 km according to DIN ISO. This results in comparatively higher basic load ratings.

Conversion of basic load ratings

For miniature linear recirculating ball bearing and guideway assemblies, the basic load ratings to DIN ISO can be converted to basic load ratings as used in the Far East and vice versa:

f_1

$$C_{50} = \mathbf{1,26} \cdot C_{100}$$

f_2

$$C_{100} = \mathbf{0,79} \cdot C_{50}$$

C_{50}	N	Basic dynamic load rating according to DIN ISO 14728-1, based on 50 km
C_{100}	N	Basic dynamic load rating according to DIN ISO 14728-1, based on 100 km

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1.2.2 Basic rating life

The basic rating life L and L_h is achieved or exceeded by 90 % of a sufficiently large group of identical bearings before the first evidence of material fatigue occurs.

𝑓3

$$L = \left(\frac{C_{100}}{P}\right)^p \cdot 100$$

𝑓4

$$L_h = \frac{833}{H \cdot n_{osc}} \cdot \left(\frac{C_{100}}{P}\right)^p$$

𝑓5

$$L_h = \frac{1666}{v_m} \cdot \left(\frac{C_{100}}{P}\right)^p$$

According to DIN ISO 14728-1, the equivalent dynamic load P should not exceed the value 0,5 ·°C. If lateral forces are present, the frictional locking of the fixing screws should be checked. Ideally, locating edges should be provided.

Mean velocity

Where the velocity varies in steps, the mean velocity is calculated as follows:

𝑓6

$$v_m = v_1 \cdot \frac{q_1}{100} + v_2 \cdot \frac{q_2}{100} + \ldots + v_z \cdot \frac{q_z}{100}$$

q_z	%	Time proportion of the period of action
v_m	m/min	Mean velocity
v_z	m/min	Variable speed

1.2.3 Static load safety factor

The static load safety factor S_0 is the security against permanent deformation at the rolling contact:

𝑓7

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

𝑓8

$$S_0 = \frac{M_0}{M}$$

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The equivalent static bearing load is determined in approximate terms from the maximum loads:

$$P_0 = F_{max} \quad (9)$$

$$M = M_{max} \quad (10)$$

C_0	N	Basic static load rating in the load direction
M	Nm	Equivalent static moment in the load direction
M_0	Nm	Static moment rating in the load direction (M_{0x}, M_{0y}, M_{0z})
P_0	N	Equivalent static bearing load in the load direction
S_0	–	Static load safety factor

If high demands are placed on accuracy and smoothness of running, the static load safety factor should not be less than S_0 = 3. For high loads, the load carrying capacity of the fixing screws must be checked, see VDI Guideline 2230.

1.3 Preload

Increasing the preload increases the rigidity of the guidance system. The preload also influences the displacement force of the guidance system: the higher the preload, the larger the displacement force. Furthermore, the preload also influences the operating life of the guidance system.

The approximate calculation of the equivalent static and dynamic load is based on the standard preload.

Under low load and high preload, the values for rating life and static load safety factor may be lower than those calculated using the approximation formulae for the equivalent static and dynamic load.

Miniature linear recirculating ball bearing and guideway assemblies are available in different preload classes.

The preload class affects the characteristics of a carriage.

3 Preload classes

Preload class	Preload setting
V0 [1]	Very small clearance to clearance-free
V1 [2]	Slight preload
V2 [3]	Moderate preload, higher rigidity

1) Standard for size 05

2) Standard for sizes 07 to 15

3) Not available for size 05, as unit available in sizes 07 to 15

1.4 Load carrying capacity

The units can support forces from all directions, apart from the direction of motion, and moments about all axes. They have moderate load carrying capacity and moderate to high moment load carrying capacity.

1.5 Temperature range

End wipers reduce the maximum permissible operating temperature by +20 °C.

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4 Influence of end wipers on operating temperature

Carriage	Operating temperature	
	°C	
	min.	max.
With end wipers	–10	+80
Without end wipers	–10	+100

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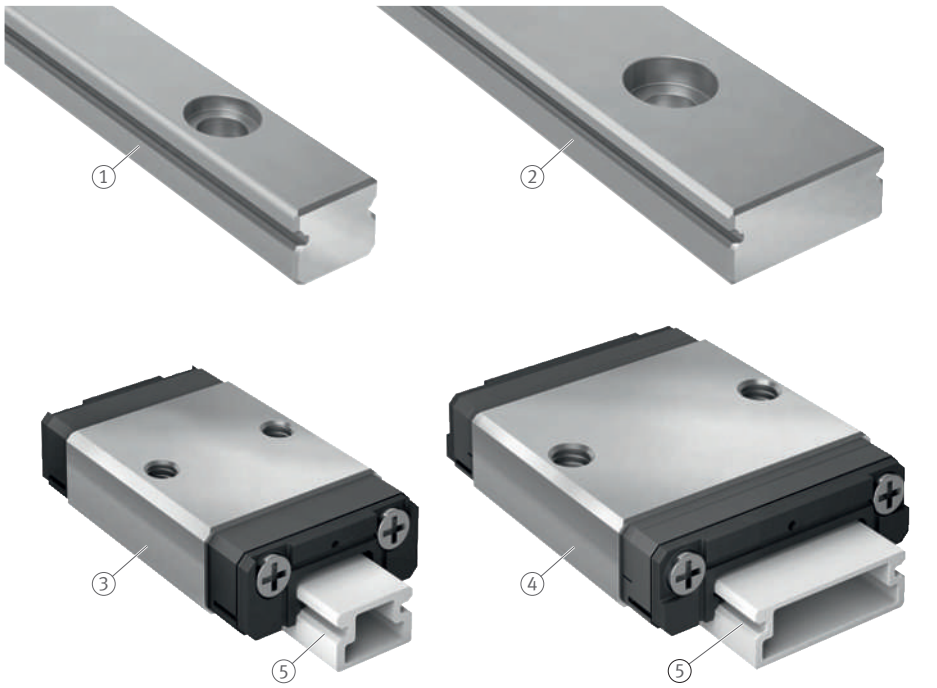
2 Miniature linear recirculating ball bearing and guideway assemblies, carriage KWEM05 and guideway TKDM05

2.1 Product design

2.1.1 Carriage

Carriages KWEM05 have end wipers and are supplied greased. Carriages KWEM05 and guideways TKDM05 are always ordered and supplied separately.

3 Product overview, guideways and carriages with optional long term lubrication unit on dummy guideway



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1	TKDM05	2	TKDM05-W
3	KWEM05	4	KWEM05-W
5	Dummy guideway		

Carriages are always pushed directly from the guideway onto the dummy guideway and must remain there until they are remounted. The plastic dummy guideway prevents damage to the rolling element set and prevents the rolling elements from falling out if the carriage is removed from the guideway. It must be ensured that the dummy guideway remains in contact with the guideway at all times during mounting and dismounting to prevent the loss of rolling elements.

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2.1.2 Guideways

Guideways TKDM05 and TKDM05-W have a locating edge, are made from corrosion-resistant high-grade steel, are hardened and are ground on all faces. The raceways for the rolling elements are ground to very high precision. For fixing to the adjacent construction, they have threaded holes with counterbores for the screw heads. The guideways are fixed from above and are available in preferred lengths up to the maximum length.

5 Preferred lengths of guideways

Designation	Preferred lengths	Maximum length
Guideway	mm	mm
TKDM05, TKDM05-W	60, 90, 105, 120, 150, 210	210

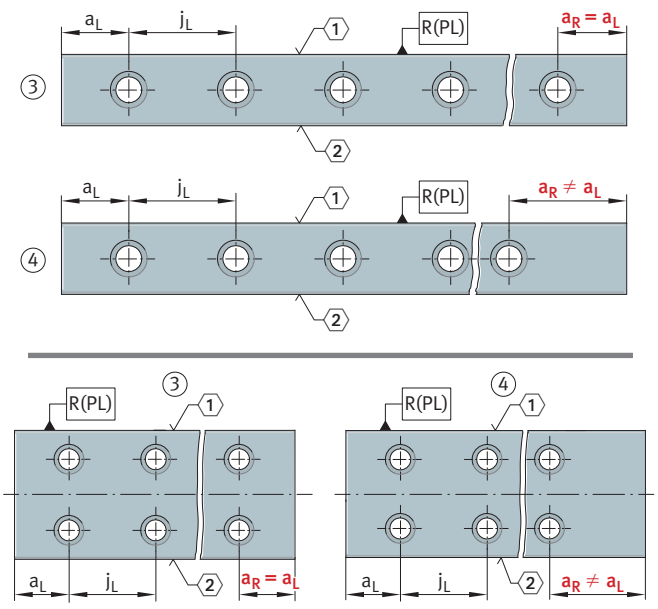
2.1.2.1 Hole patterns for guideways

An asymmetrical hole pattern may also be available upon request. In this case, $a_L \geq a_{L\,min}$ and $a_R \geq a_{R\,min}$.

Unless specified otherwise, the guideways have a symmetrical hole pattern where $a_L = a_R$.

The guideways have 1 locating face. With an asymmetrical hole pattern, the distance from the left is a_L and the distance from the right is a_R. The required orientation of the locating face should also be indicated as 'top' or 'bottom' in the order.

4 Hole patterns of guideways with 1 or 2 rows of holes



1	Locating face	2	Marking
3	Symmetrical hole pattern	4	Asymmetrical hole pattern
R(PL)	Reference face of the guideway		

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2.1.2.2 Maximum number of pitches between holes

The number of pitches between holes is the whole number equivalent to:

$$n = \frac{l - 2 \cdot a_{L\,min}}{j_L} \quad \text{(11)}$$

The distances a_L and a_R are generally determined as follows:

$$a_L + a_R = l - n \cdot j_L \quad \text{(12)}$$

For guideways with a symmetrical hole pattern:

$$a_L = a_R = \frac{1}{2} \cdot (l - n \cdot j_L) \quad \text{(13)}$$

Number of holes:

$$x = n + 1 \quad \text{(14)}$$

a_L, a_R	mm	Distance between start or end of guideway and nearest hole
$a_{L\,min}$, $a_{R\,min}$	mm	Minimum values for a_L, a_R
j_L	mm	Distance between holes
l	mm	Guideway length
n	–	Max. number of pitches
x	–	Number of holes

If the minimum values for a_L and a_R are not observed, the counterbores of the holes may be intersected. Risk of injury.

2.1.3 Interchangeability

Carriages KWEM05 and guideways TKDM05 of the same size can be combined or replaced. If the guideways and carriages are combined or replaced within a single accuracy class, the accuracy class is also maintained for the system.

6 Interchangeability of carriages and guideways

Accuracy class			Comment
Carriage KWEM05	Guideway TKDM05	Unit	
G1	G1	G1	Recommended combination
G1	G2	G2	–
G2	G1	G2	–
G2	G2	G2	Recommended combination

2.2 Acceleration and speed

Carriages KWEM05 permit accelerations up to 50 m/s² and speeds up to 3 m/s.

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2.3 Lubrication

Carriages KWEM05 are supplied in greased form. The carriages can be lubricated through lubrication holes in the end pieces using the relubrication kit.

Protect the carriages against solid and liquid contaminants.

2.3.1 Relubrication kit

The relubrication kit consists of a syringe and needle. The syringe is filled with grease with a lithium soap base in accordance with the classification to DIN 51825 KEHC2K–50.

5 Relubrication kit



7 Available relubrication kit

Type	Ordering designation
Relubrication kit for carriage KWEM05 (-W)	SPRI.KWEM07

2.3.2 Clean room applications

For clean room applications, carriages with clean room grease are available. Please contact us for information about the clean room grease.

2.4 Sealing

In the standard version of carriage KWEM05, end wipers on the end faces protect the rolling element system against contamination.

In order to prevent damage to the guidance systems, the raceways must be kept clean at all times. If the wipers used as standard are not adequate for this purpose, additional seals must be provided in the adjacent construction.

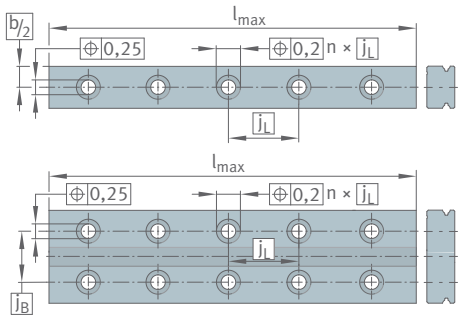
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2.5 Tolerances of guideways

2.5.1 Positional and length tolerances of guideways

The hole pattern corresponds to DIN EN ISO 1101.

6 Positional and length tolerances of guideways



8 Length tolerances of guideways

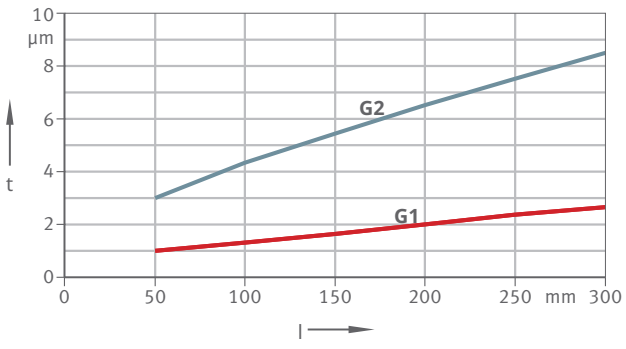
Designation	Tolerances	
Guideway	U	L
	mm	mm
TKDM05, TKDM05-W	+0,2	–2,2

L	mm	Lower limit deviation
U	mm	Upper limit deviation

2.5.2 Accuracy classes

Miniature linear recirculating ball bearing and guideway assemblies KWEM05 are available in accuracy classes G1 and G2. The standard accuracy class is G2.

7 Accuracy classes and parallelism tolerances of guideways



t	Parallelism tolerance	l	Total guideway length
G1	Accuracy class G1	G2	Accuracy class G2 (standard)

2.5.3 Tolerances

The tolerances are arithmetic mean values. They relate to the centre point of the screw mounting surfaces or locating surfaces of the carriage.

The dimensions H and A_1 should always remain within the tolerance irrespective of the position of the carriage on the guideway.

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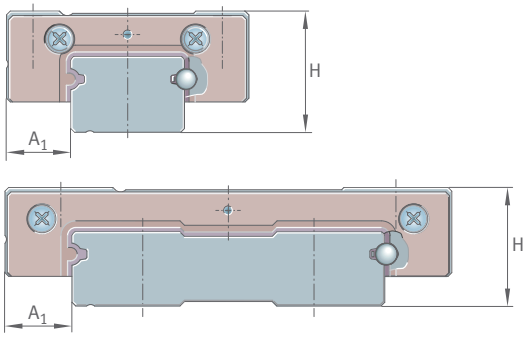
9 Tolerances for height and spacing A_1

Tolerance		Accuracy	
		G1	G2 [1]
		µm	µm
Tolerance for height	H	±10	±20
Difference in height [2]	ΔH	7	15
Tolerance for spacing	A_1	±15	±25
Difference in spacing [2]	$ΔA_1$	10	20

1) Standard

2) Dimensional difference between several carriages on one guideway, measured at the same point on the guideway

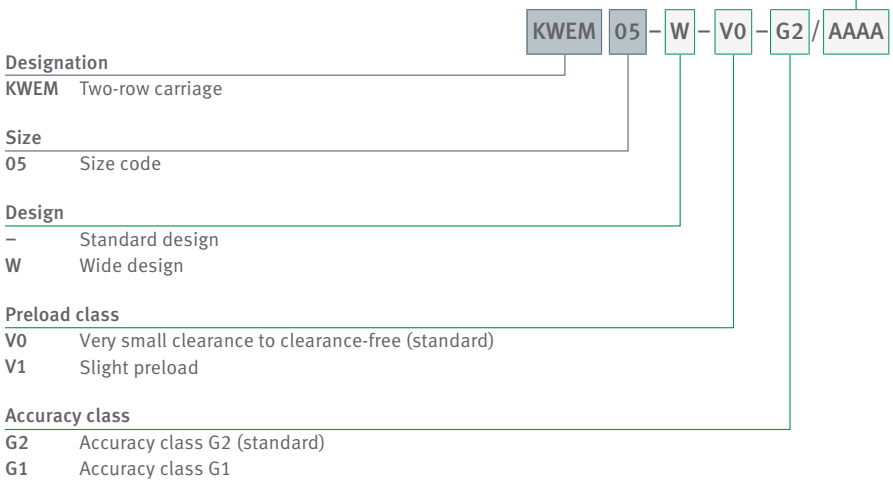
8 Datum dimensions for parallelism of raceways to locating faces



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2.6 Structure of the ordering designation

9 Ordering designation structure, carriage



001B1B9D

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10 Ordering designation structure, guideway

Letter code

AAAA These features are stored in a four-digit letter code in the order confirmation

AAAA

TKDM 05 – W – G2 / 75 – 10 / 05

Designation

TKDM Guideway for carriage KWEM

Size

05 Size code of guideway

Design

– Standard design

W Wide design

Accuracy class

G2 Accuracy class G2 (standard)

G1 Accuracy class G1

Length of guideway

75 ... 210 Length of guideway (75 mm, 90 mm, 105 mm, 150 mm, 210 mm)

Hole spacing, start of guideway

10 Distance between start of guideway and nearest hole

Hole spacing, end of guideway

05 Distance between end of guideway and nearest hole

001B1BAD

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2

2 carriages and matching guideway

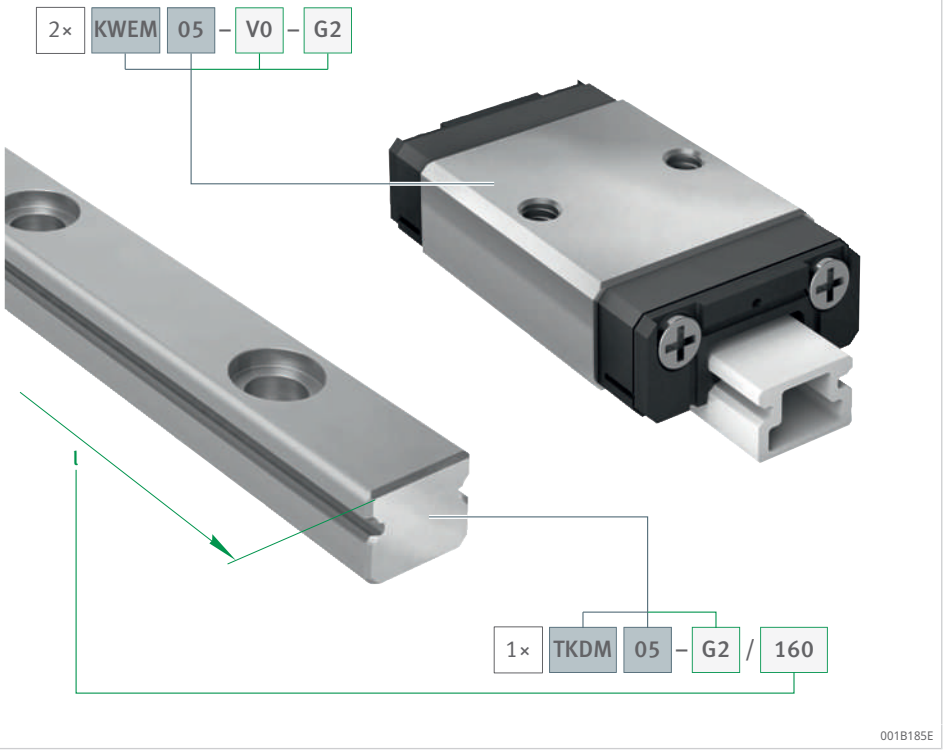
An order is to be placed for 2 identical carriages and 1 matching guideway with a symmetrical hole pattern:

- 2 carriages: KWEM05
- size: 05
- preload: V0
- accuracy class: G2
- with end wipers
- matching guideway: TKDM05
- size: 05
- accuracy class: G2
- length: 160 mm

Ordering designation provided by the customer and in the order confirmation (with sample letter code):

- 2×KWEM05-V0-G2
- 1×TKDM05-G2/160

11 Ordering example, ordering designation



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Carriage

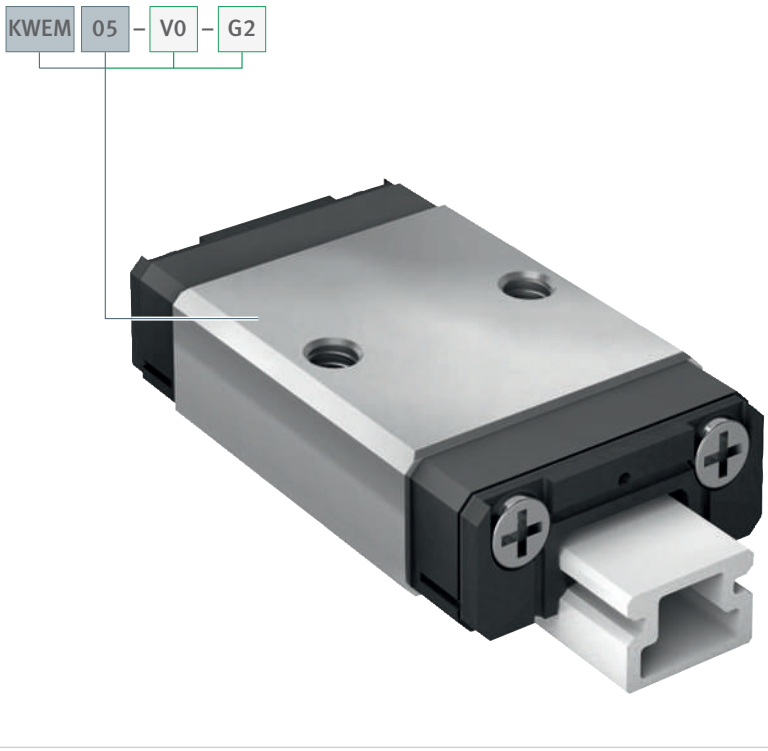
Single carriages can be ordered as follows:

- carriage: KWEM05
- size: 05
- preload: V0
- accuracy class: G2
- with end wipers

Ordering designation provided by the customer and in the order confirmation (with sample letter code):

- 1×KWEM05-V0-G2

12 Ordering example, ordering designation



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Guideway

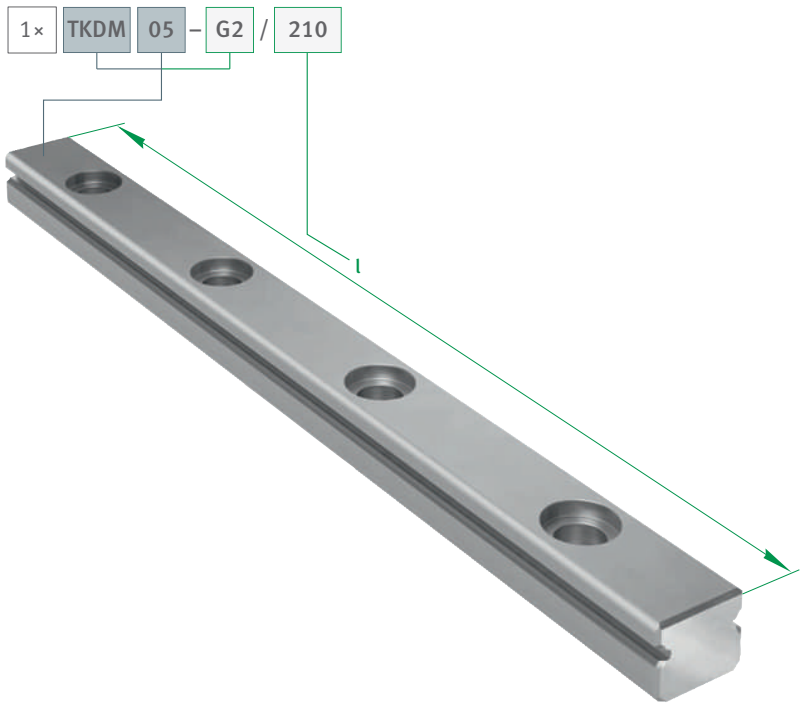
Single guideways can be ordered as follows:

- guideway that can be combined with the existing carriage of identical width and belonging to accuracy class G2:
  TKDM05
- size: 05
- accuracy class: G2
- length: 210 mm

Ordering designation provided by the customer and in the order confirmation (with sample letter code):

- 1×TKDM05-G2/210

13 Ordering example, ordering designation



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2.7 Design of the bearing arrangement

The running accuracy is essentially dependent on the straightness, accuracy and rigidity of the fit and mounting surfaces.

The straightness of the system is most readily achieved by pressing the guideway against a locating face.

If high demands are to be made on the running accuracy and/or if soft substructures and/or movable guideways are used, please contact Schaeffler.

2.7.1 Geometrical and positional accuracy of the mounting surfaces

The higher the requirements for accuracy and smooth running of the guidance system, the more attention must be paid to the geometrical and positional accuracy of the mounting surfaces.

Tolerances of mounting surfaces and parallelism of mounted guideways must be observed.

Surfaces should be ground or precision milled: aim to achieve a mean roughness value Ramax 1,6.

Any deviations from the stated tolerances will impair the overall accuracy, alter the preload and reduce the operating life of the guidance system.

2.7.2 Height difference ΔH

For ΔH, permissible values are in accordance with the following formula. If larger deviations are present, please consult Schaeffler.

f15

$$\Delta H = a \cdot b$$

a	–	Factor, as a function of the preload class
b	mm	Centre distances between guidance elements
ΔH	µm	Maximum permissible deviation from the theoretically precise position

10 Factor a

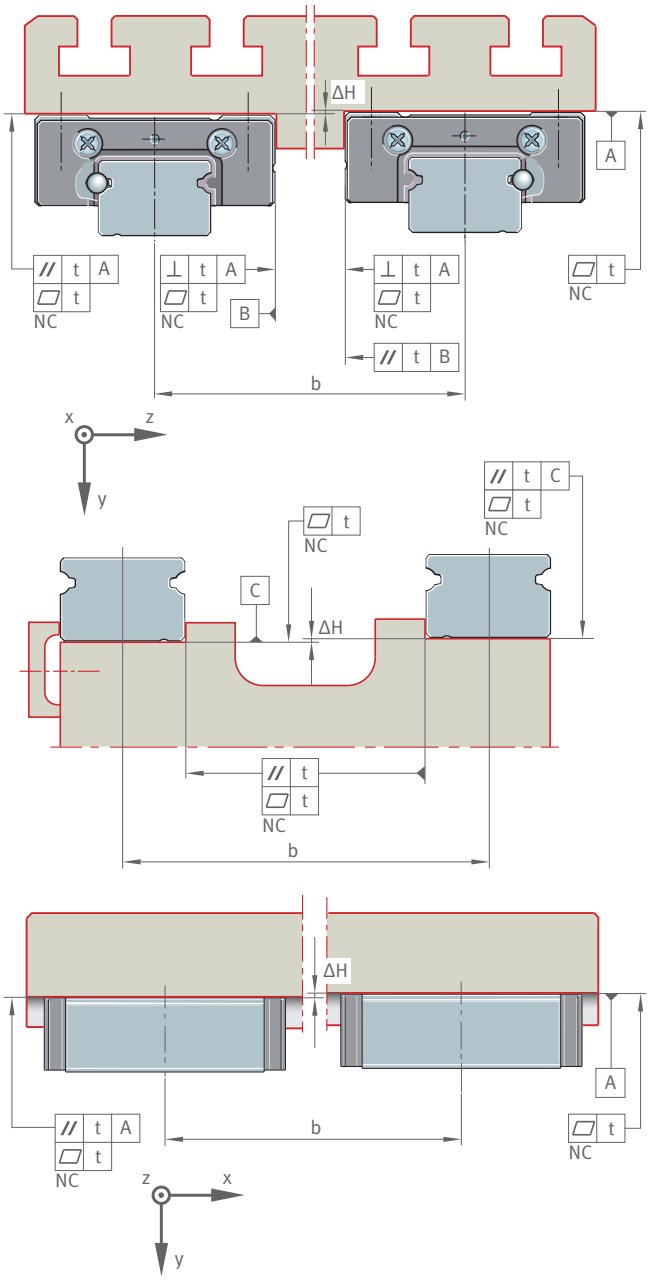
Designation	Factor a	
Carriage	Preload classes	
	V0 [1]	V1
KWEM05, KWEM05-W	0,1	0,01

[1] Standard

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2

14 Tolerances of mounting surfaces and parallelism of mounted guideways and carriages



001B167E

NC	Not convex	b	Spacing between guidance elements
ΔH	Height difference	t	Parallelism, flatness and perpendicularity tolerance

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2.7.3 Parallelism of mounted guideways

For guideways arranged in parallel, a parallelism t is required. If the maximum values are used, this may increase the displacement resistance. If larger tolerances are present, please contact Schaeffler.

11 Values for the parallelism tolerances of two-row units

Designation	Parallelism tolerance t	
Guideway	Accuracy class	
	G1	G2 [1]
	µm	
TKDM05, TKDM05-W	20	30

[1] Standard

2.7.4 Locating heights and corner radii

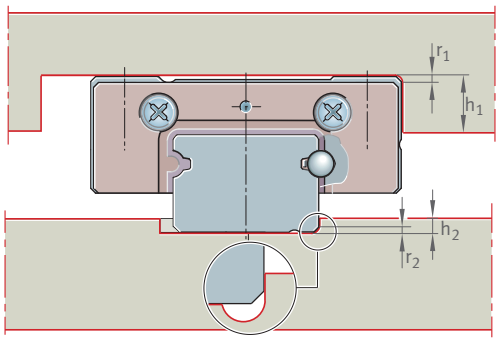
The following data can be used to design the locating heights and corner radii.

12 Locating heights, corner radii

Designation		Locating heights		Corner radii	
Carriage	Guideway	h_1	h_2	r_1	r_2 [1]
		mm	mm	mm	mm
		max.	max.	max.	max.
KWEM05	TKDM05	2	0,8	0,3	0,2
KWEM05-W	TKDM05-W	2	1,2	0,3	0,2

[1] Preferably with undercut

15 Locating heights and corner radii



001B1FAF

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2.8 Product tables

2.8.1 Explanations

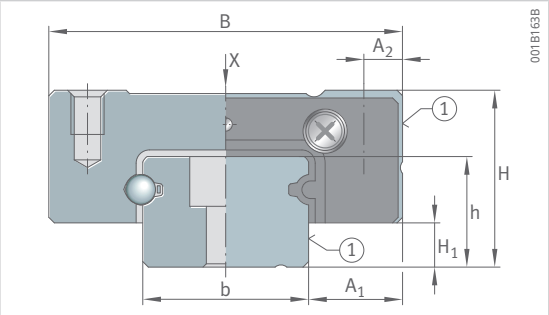
(1)	–	Locating face
A_1	mm	Distance from locating edge of the carriage to locating edge of the guideway
A_2	mm	Distance between locating edge and hole
A_3	mm	Position of lubrication connector
a_L	mm	Distance from start of guideway to nearest hole
a_R	mm	Distance from end of guideway to nearest hole
b	mm	Width of guideway
B	mm	Width
C_{0I+II}	N	Basic static load rating in load directions I and II: tensile load and compressive load
C_{0III}	N	Basic static load rating in load direction III: lateral load
C_{I+II}	N	Basic dynamic load rating in load directions I and II: tensile load and compressive load
C_{III}	N	Basic dynamic load rating in load direction III: lateral load
G_2	–	Thread, DIN ISO 4762-12.9
h	mm	Height of guideway
H	mm	Height
h_1	mm	Height of through hole
H_1	mm	Guideway clearance
J_B	mm	Distance between fixing threads in carriage
j_L	mm	Distance between holes
J_L	mm	Distance between fixing threads in carriage
K_1	–	Thread size, DIN ISO 4762-12.9
L	mm	Length of carriage
L_1	mm	Effective saddle plate length
l_{max}	mm	Max. length of guideway
M_{0x}	Nm	Static moment rating about x axis
M_{0y}	Nm	Static moment rating about y axis
M_{0z}	Nm	Static moment rating about z axis
M_A	Nm	Tightening torque
m_c	kg	Mass of carriage
m_r	kg/m	Mass of guideway
T_5	mm	Thread depth

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2.8.2 KWEM05, TKDM05

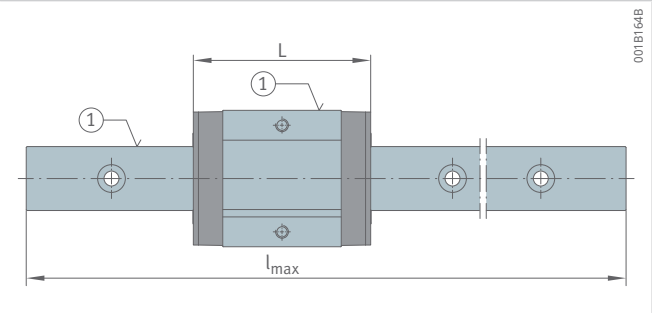
Double row



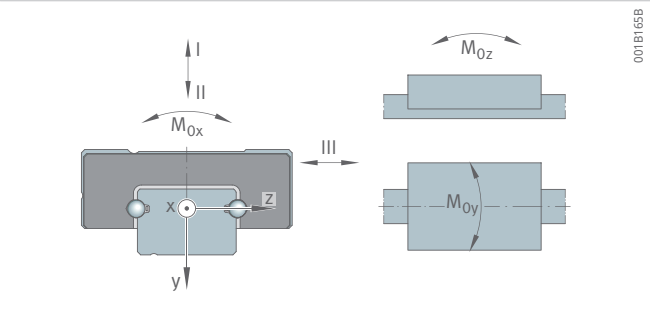
KWEM05 with TKDM05

Carriage		Guideway		l_{max}	H	B	L	h	b
Designation	m_c	Designation	m_r						
–	kg	–	kg/m	mm	mm	mm	mm	mm	mm
KWEM05	0,12	**TKDM05**	0,004	210	6	12	19	3,7	5
KWEM05-W	0,28	**TKDM05-W**	0,008	300	6,5	17	24,5	4	10

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KWEM05 with TKDM05, view rotated 90°



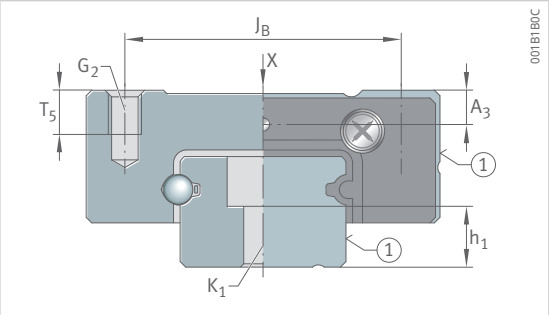
Moments and load direction

A_1	A_2	H_1	C_{I+II}	C_{0I+II}	C_{III}	C_{0III}	M_{0x}	M_{0y}	M_{0z}
mm	mm	mm	N	N	N	N	Nm	Nm	Nm
3,5	2	1	534	1090	470	916	2,9	1,9	2,3
3,5	2	1,5	671	1510	590	1268	7,8	3,5	4,2

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KWEM05, TKDM05

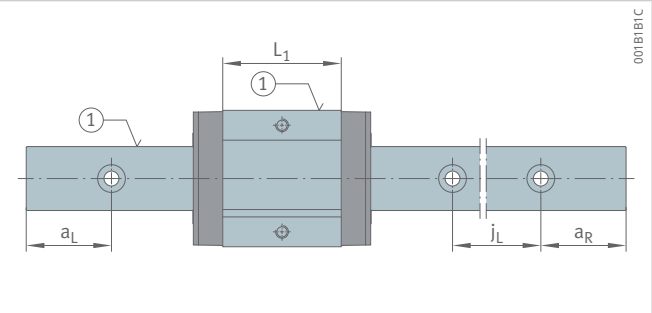
Double row



KWEM05 with TKDM05

Carriage	Guideway	J_B	L_1	T_5	A_3
Designation	Designation				
–	–	mm	mm	mm	mm
KWEM05	**TKDM05**	8	12,6	1,5	1,2
KWEM05-W	**TKDM05-W**	13	17,6	1,5	1,3

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KWEM05 with TKDM05, view rotated 90°

G_2		h_1	j_L	a_L		a_R		K_1	
–	M_A			min	max	min	max	–	M_A
–	Nm	mm	mm	mm	mm	mm	mm	–	Nm
M2	0,6	2,9	15	4	11,5	4	11,5	M2	0,6
M2	0,6	2,9	15	4	11,5	4	11,5	M2	0,6

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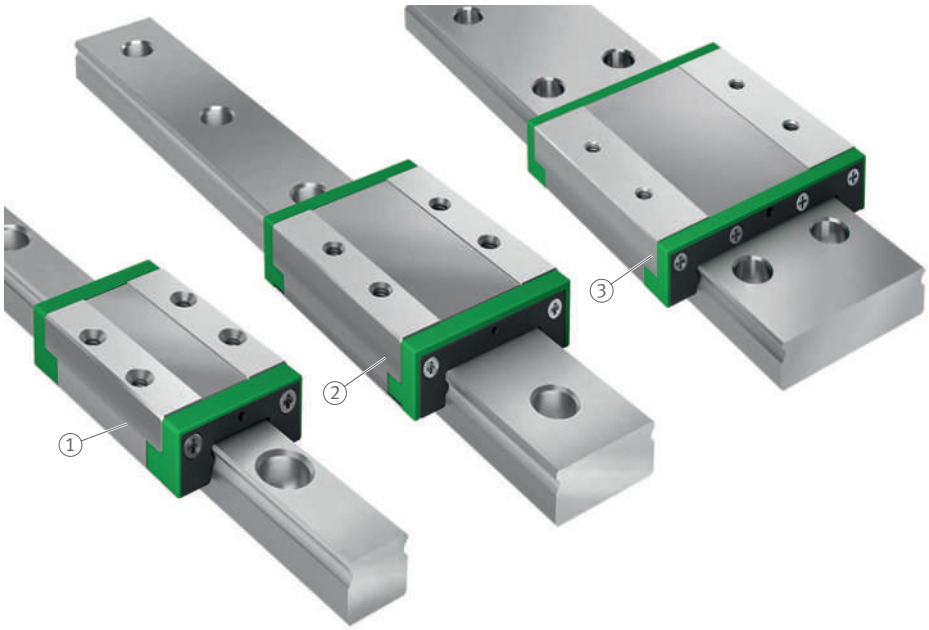
3 Miniature linear recirculating ball bearing and guideway assemblies KUEM..-E

3.1 Product design

3.1.1 Linear recirculating ball bearing and guideway assemblies, carriages and guideways

The miniature linear recirculating ball bearing and guideway assemblies designated KUEM..-E are available in 4 sizes (07, 09, 12, 15) and in 4 different designs (KUEM..-E, KUEM..-E-L, KUEM..-E-W and KUEM..-E-WL). Guideway and carriage are matched to each other within accuracy class G1 and must be ordered together as KUEM..-E. Carriages KWEM..-E, KWEM..-E-L, KWEM..-E-W and KWEM..-E-WL and guideways TKDM..-E and TKDM..-E-W can also be ordered separately. The matching guideways are available in freely selectable lengths, taking into account the maximum length available. A dummy guideway is not required.

16 Product overview, linear recirculating ball bearing and guideway system consisting of carriage and guideway



001B15E5

1	KUEM07-E, KUEM09-E, KUEM12-E, KUEM15-E	2	KUEM07-E-W, KUEM09-E-W, KUEM12-E-W
3	KUEM15-E-W		

Carriages are available to order as an option. Carriages KWEM..-E have a lubricant reservoir filled with oil and are available with or without end wipers (PP).

Carriages KWEM..-E-L are variants. With the long version, a higher basic load rating is achieved.

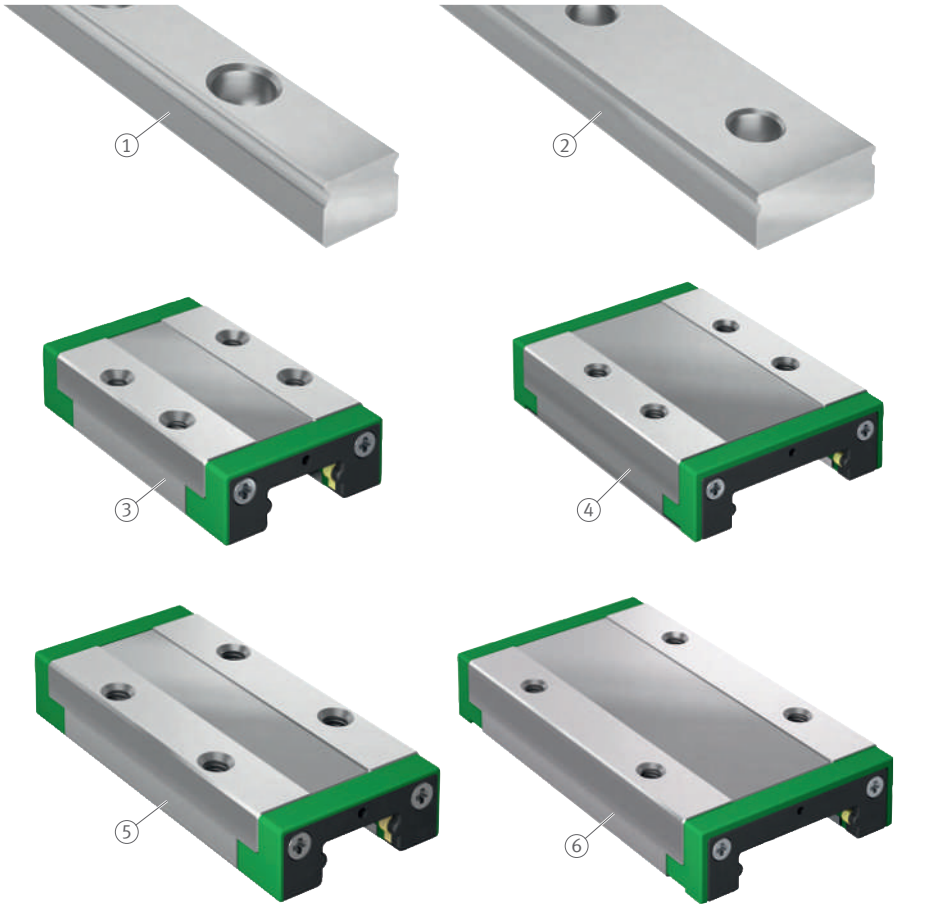
Carriages KWEM..-E-W are variants. With the wide version, higher moment loads can be supported.

Carriages KWEM..-E-WL are variants. With the wide, long version, higher moment loads can be supported and a higher basic load rating is achieved.

Carriage and guideway can be ordered separately within accuracy class G2.

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17 Product overview, guideways and carriages with lubricant reservoir



1	TKDM..-E	2	TKDM..-E-W
3	KWEM..-E, KWEM..-E-PP	4	KWEM..-E-W, KWEM..-E-W-PP
5	KWEM..-E-L, KWEM..-E-L-PP	6	KWEM..-E-WL, KWEM..-E-WL-PP

3.1.2 Guideways

Guideways can be ordered individually. Guideways TKDM..-E and TKDM..-E-W have 2 locating edges. The guideways are made from corrosion-resistant high-grade steel and are hardened and ground, the rolling element raceways are precision ground. For fixing to the adjacent construction, the guideways have fixing holes with counterbores for the screw heads. The guideways are fixed from above. The maximum length of a guideway is dependent on the size.

13 Maximum lengths of guideways

Designation Guideway	Maximum length mm
TKDM07-E	1000
TKDM07-E-W	2000
TKDM09-E, TKDM09-E-W	2000
TKDM12-E, TKDM12-E-W	2000
TKDM15-E, TKDM15-E-W	2000

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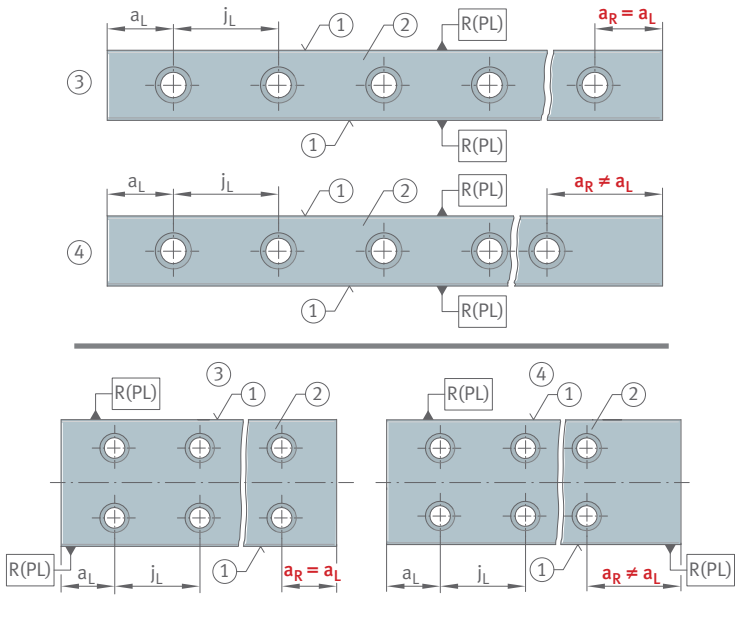
3.1.2.1 Hole patterns for guideways

Unless specified otherwise, guideways TKDM..-E and TKDM..-E-W have a symmetrical hole pattern.

An asymmetrical hole pattern may also be available upon request. In this case, $a_L \geq a_{L\,min}$ and $a_R \geq a_{R\,min}$.

The guideways have 2 locating faces. When ordering a guideway with an asymmetrical hole pattern, the distance from the left is a_L and the distance from the right is a_R.

18 Hole patterns of guideways with 1 or 2 rows of holes



1	Locating face	2	Marking
3	Symmetrical hole pattern	4	Asymmetrical hole pattern
R(PL)	Reference face of the guideway		

3.1.2.2 Maximum number of pitches between holes

The number of pitches between holes is the rounded whole number equivalent to:

16

$$n = \frac{l - 2 \cdot a_{L\,min}}{j_L}$$

The distances a_L and a_R are generally determined as follows:

17

$$a_L + a_R = l - n \cdot j_L$$

For guideways with a symmetrical hole pattern:

18

$$a_L = a_R = \frac{1}{2} \cdot (l - n \cdot j_L)$$

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Number of holes:

f19

$x = n + 1$

a_L, a_R	mm	Distance between start or end of guideway and nearest hole
$a_{L\,min}$, $a_{R\,min}$	mm	Minimum values for a_L, a_R
j_L	mm	Distance between holes
l	mm	Guideway length
n	–	Max. number of pitches
x	–	Number of holes

If the minimum values for a_L and a_R are not observed, the counterbores of the holes may be intersected. Risk of injury.

3.1.3 Interchangeability

Carriages KWEM..-E and guideways TKDM..-E of the same size can be combined or replaced in accuracy class G2. Accuracy class G1 is only possible with miniature linear recirculating ball bearing and guideway system KUEM..-E.

14 Interchangeability of carriages and guideways

Accuracy class			Comment
Carriages KWEM..-E, KWEM..-E-W	Guideway TKDM..-E, TKDM..-E-W	Unit	
G1	G1	G1	As complete system only
G2	G2	G2	Recommended combination

3.2 Acceleration and speed

Carriages KWEM..-E permit accelerations up to 140 m/s² and speeds up to 5 m/s.

3.3 Lubrication

Carriages KWEM..-E are supplied lubricated with a food grade lubricant (NSF H1 and ISO VG grade). The carriages can be lubricated through lubrication holes in the end pieces using the SPRI.KWEM09 relubrication kit.

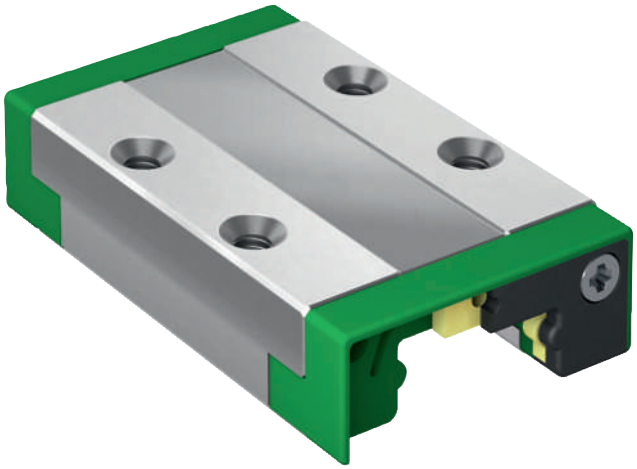
Protect the carriages against solid and liquid contaminants.

3.3.1 Lubricant reservoir

The miniature linear recirculating ball bearing and guideway assemblies are supplied as standard with a lubricant reservoir, which is located in the end piece. The lubricant reservoir ensures long-term and uniform distribution of the lubricant, allowing the assemblies to operate over particularly long distances without the need for relubrication.

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19 Lubricant reservoir in carriage KWEM..-E



001B177E

3.3.2 Relubrication kits

The relubrication kit consists of a syringe and needle. The syringe is filled with a food grade lubricant (NSF H1 and ISO VG grade).

20 Relubrication kit



001B175E

15 Available relubrication kits

Type	Ordering designation
Relubrication kit for carriages KWEM07-E (-L, -W, -WL), KWEM09-E (-L, -W, -WL), KWEM12-E (-L, -W, -WL), KWEM15-E (-L, -W, -WL)	SPRI.KWEM09

3.3.3 Clean room applications

For clean room applications, carriages with clean room grease are available. Please contact us for information about the clean room grease.

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3.4 Sealing

In the standard version, carriages KWEM..-E are fitted with gap seals on the end faces. If high demands are placed on protecting the rolling element system against contamination, the end faces of carriages KWEM..-E can optionally be ordered with end wipers made of highly abrasion-resistant material. Carriages with end wipers have the suffix PP.

2 ball retaining plates are attached to the underside of the carriage. The narrow gap seals between the guideway and ball retaining plates protect against contaminants from the underside of the carriage.

In order to prevent damage to the guidance systems, the raceways must be kept clean at all times. If the wipers used as standard are not adequate for this purpose, additional seals must be provided in the adjacent construction.

3.4.1 End wipers

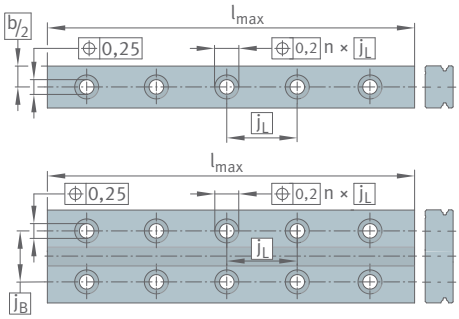
The special version of carriage KWEM..-E with contact type end wipers has the suffix PP.

3.5 Tolerances of guideways

3.5.1 Positional and length tolerances of guideways

The hole pattern corresponds to DIN EN ISO 1101.

21 Positional tolerances of guideways



16 Length tolerances of guideways

Designation	Tolerances	
Guideway	U	L
	mm	mm
TKDM07-E, TKDM07-E-W, TKDM09-E, TKDM09-E-W, TKDM12-E, TKDM12-E-W, TKDM15-E, TKDM15-E-W	+1,5	–1,5

L	mm	Lower limit deviation
U	mm	Upper limit deviation

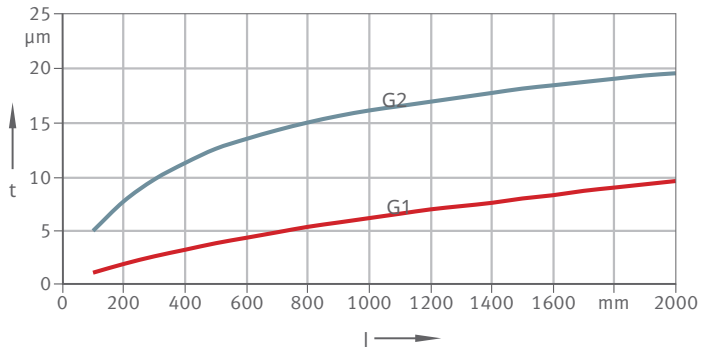
3.5.2 Accuracy classes

Miniature linear recirculating ball bearing and guideway assemblies KWEM..-E are available in accuracy classes G1 and G2. The standard accuracy class is G2.

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3

22 Accuracy classes and parallelism tolerances of guideways



t	Parallelism tolerance	l	Total guideway length
G1	Accuracy class G1	G2	Accuracy class G2 (standard)

3.5.3 Tolerances

The tolerances are arithmetic mean values. They relate to the centre point of the screw mounting surfaces or locating surfaces of the carriage.

The dimensions H and A_1 should always remain within the tolerance irrespective of the position of the carriage on the guideway.

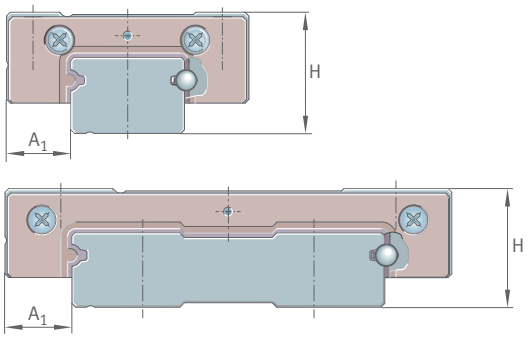
17 Tolerances for height and spacing A_1

Tolerance		Accuracy	
		G1	G2 [1]
		µm	µm
Tolerance for height	H	±10	±20
Difference in height [2]	ΔH	7	15
Tolerance for spacing	A_1	±15	±25
Difference in spacing [2]	$ΔA_1$	10	20

1) Standard

2) Dimensional difference between several carriages on one guideway, measured at the same point on the guideway

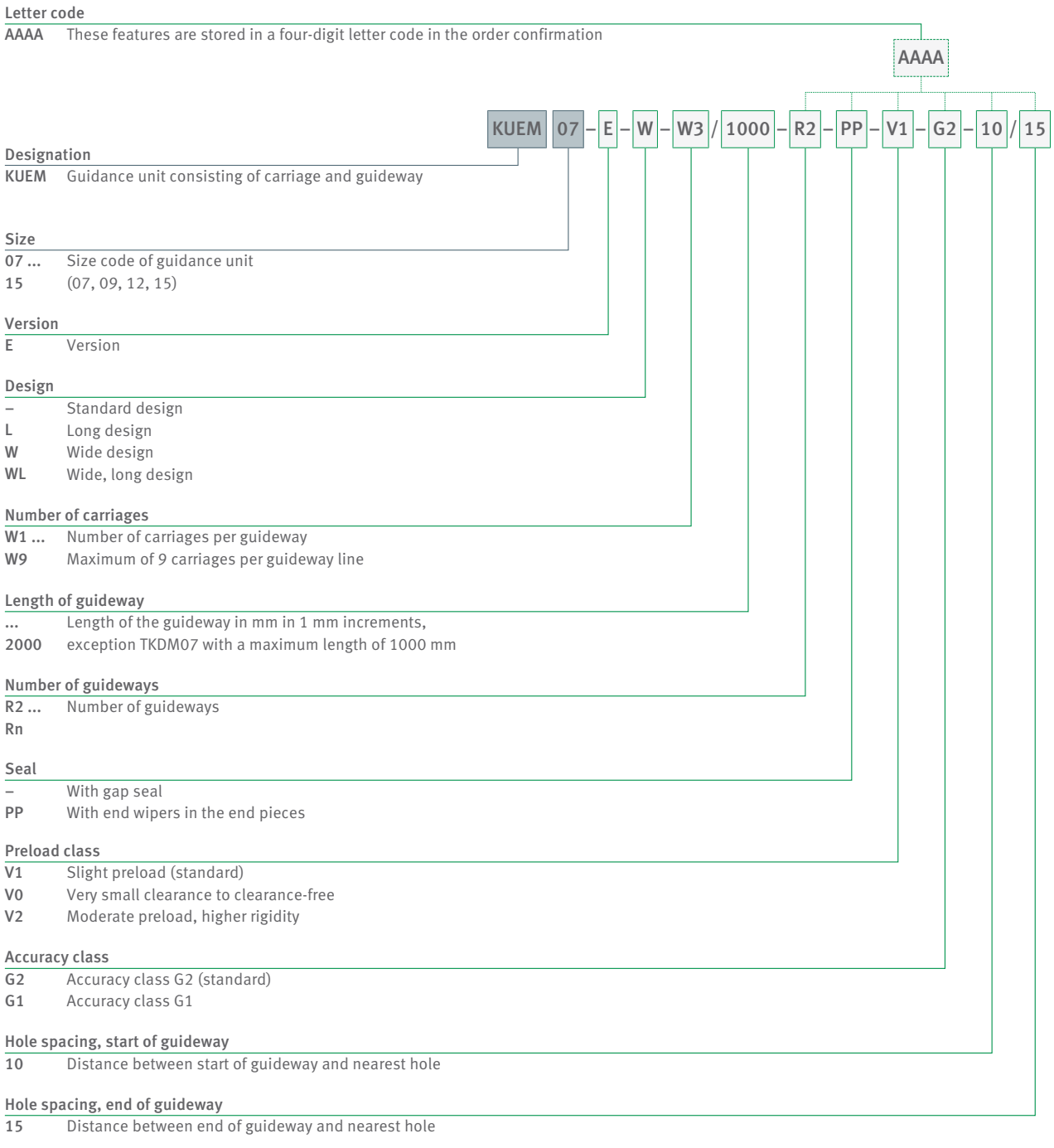
23 Datum dimensions for parallelism of raceways to locating faces



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3.6 Structure of the ordering designation

24 Ordering designation structure, guidance unit



Letter code
AAAA These features are stored in a four-digit letter code in the order confirmation

Designation
KUEM Guidance unit consisting of carriage and guideway

Size
07 ... Size code of guidance unit
15 (07, 09, 12, 15)

Version
E Version

Design
– Standard design
L Long design
W Wide design
WL Wide, long design

Number of carriages
W1 ... Number of carriages per guideway
W9 Maximum of 9 carriages per guideway line

Length of guideway
... Length of the guideway in mm in 1 mm increments,
2000 exception TKDM07 with a maximum length of 1000 mm

Number of guideways
R2 ... Number of guideways
Rn

Seal
– With gap seal
PP With end wipers in the end pieces

Preload class
V1 Slight preload (standard)
V0 Very small clearance to clearance-free
V2 Moderate preload, higher rigidity

Accuracy class
G2 Accuracy class G2 (standard)
G1 Accuracy class G1

Hole spacing, start of guideway
10 Distance between start of guideway and nearest hole

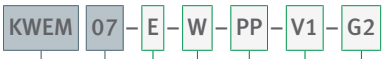
Hole spacing, end of guideway
15 Distance between end of guideway and nearest hole

001B1BBD

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3

25 Ordering designation structure, carriage



Designation
KWEM Two-row carriage

Size
07 ... Size code of carriage
15 (07, 09, 12, 15)

Version
E Version

Design
– Standard design
L Long design
W Wide design
WL Wide, long design

Seal
– With gap seal
PP With end wipers in the end pieces

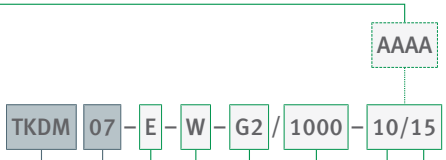
Preload class
V1 Slight preload (standard)
V0 Very small clearance to clearance-free

Accuracy class
G2 Accuracy class G2 (standard)

001B1BCD

26 Ordering designation structure, guideway

Letter code
AAAA These features are stored in a four-digit letter code in the order confirmation



Designation
TKDM Guideway for carriage KWEM

Size
07 ... Size code of guideway
15 (07, 09, 12, 15)

Version
E Version

Design
– Standard design
W Wide design

Accuracy class
G2 Accuracy class G2 (standard)

Length of guideway
... Length of the guideway in mm in 1 mm increments,
2000 exception TKDM07 with a maximum length of 1000 mm

Hole spacing, start of guideway
10 Distance between start of guideway and nearest hole

Hole spacing, end of guideway
15 Distance between end of guideway and nearest hole

001B1BDD

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Linear recirculating ball bearing and guideway assemblies KUEM..-E with carriage and guideway in accuracy class G1 as complete unit

If carriage and guideway are to have accuracy class G1, a KUEM..-E system must be ordered. Carriage and guideway are then ordered under a joint order number.

An order is to be placed for one KWEM..-E carriage with accuracy class G1 and a matching guideway. As accuracy class G1 is required, carriage KWEM..-E and guideway TKDM..-E must be ordered together.

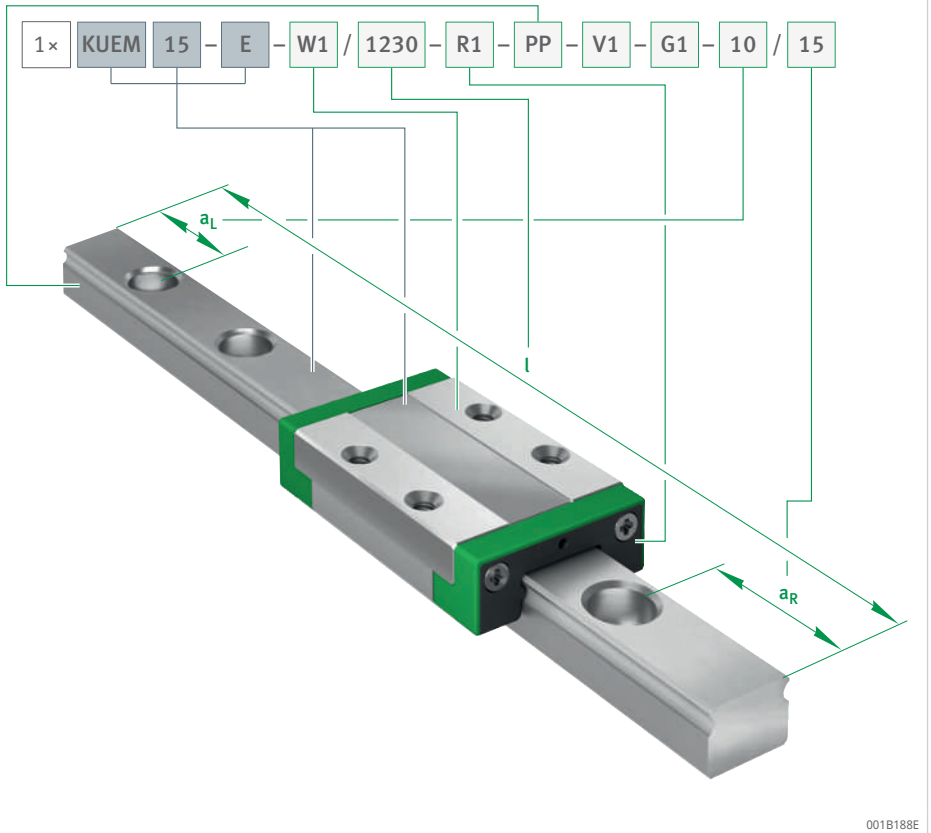
An order is placed for one linear recirculating ball bearing and guideway assembly KUEM..-E:

- 1 carriage: KWEM..-E
- size: 15
- preload: V1
- accuracy class: G1
- with end wipers
- with lubricant reservoir
- matching guideway: TKDM..-E
- size: 15
- accuracy class G1
- length: 1230 mm
- a_L: 15 mm
- a_R: 15 mm

Ordering designation provided by the customer and in the order confirmation (with sample letter code):

- 1×KUEM15-E-W1/1230-R1-PP-V1-G1-10/15

27 Ordering example, ordering designation



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Guideway with carriage ordered separately

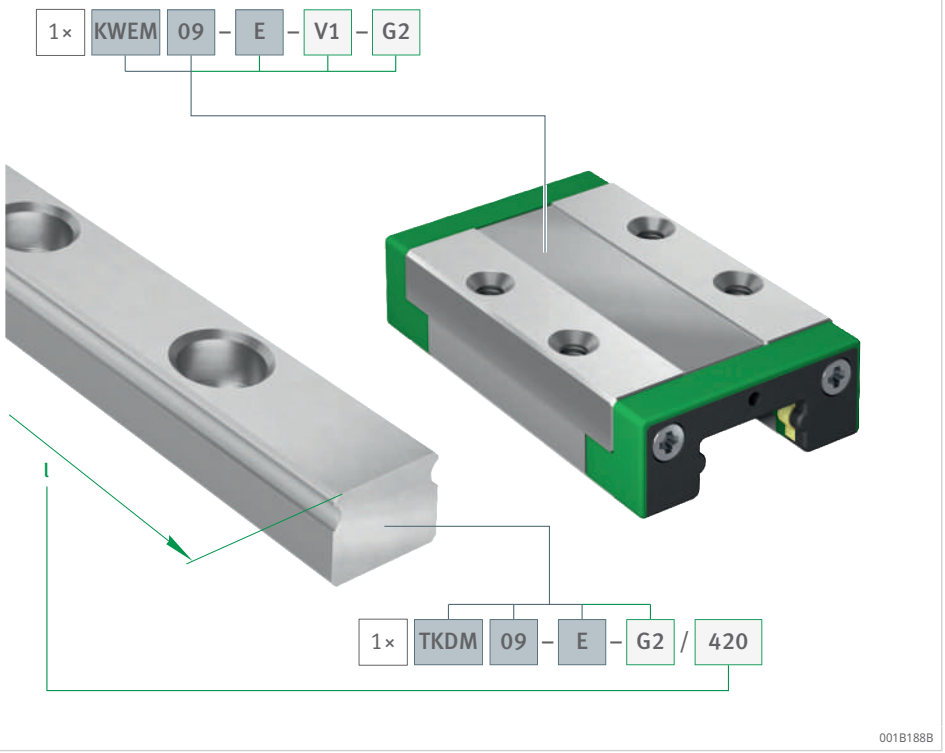
An order is placed for a carriage and a matching guideway with a symmetrical hole pattern:

- carriage: KWEM..-E
- size: 09
- preload: V1
- accuracy class: G2
- with lubricant reservoir
- matching guideway: TKDM..-E
- size: 09
- accuracy class G2
- length: 420 mm

Ordering designation provided by the customer and in the order confirmation (with sample letter code):

- 1×KWEM09-E-V1-G2
- 1×TKDM09-E-G2/420

28 Ordering example, ordering designation



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Carriage

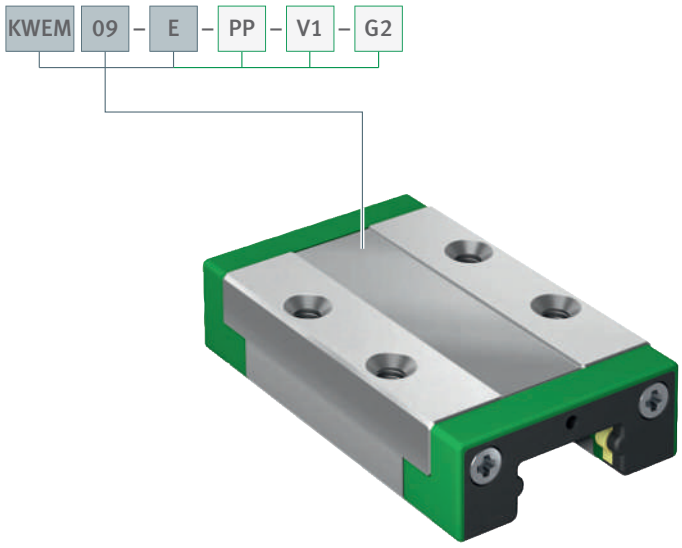
Single carriages can be ordered as follows:

- carriage: KWEM..-E
- size: 09
- with end wipers: PP
- preload: V1
- accuracy class: G2
- with lubricant reservoir

Ordering designation provided by the customer and in the order confirmation (with sample letter code):

- KWEM09-E-PP-V1-G2

29 Ordering example, ordering designation



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Guideway

The displacement distance needs to be extended. As a result, a longer guideway is required.

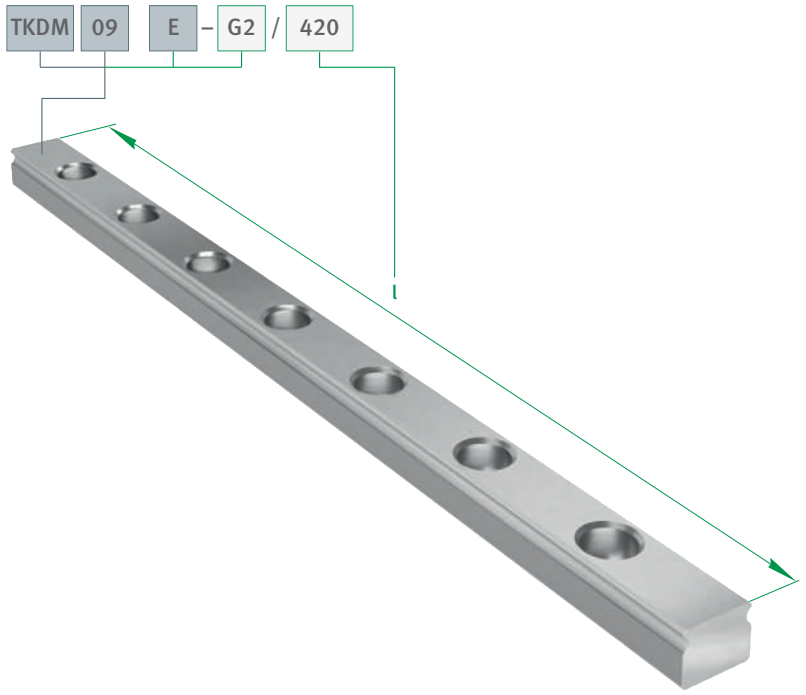
The guideway can be ordered as follows:

- guideway that can be combined with the existing carriage of identical size and belonging to accuracy class G2: TKDM..-E
- size: 09
- accuracy class: G2
- length: 420 mm

Ordering designation provided by the customer and in the order confirmation (with sample letter code):

- TKDM09-E-G2/420

30 Ordering example, ordering designation



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3.7 Design of the bearing arrangement

The running accuracy is essentially dependent on the straightness, accuracy and rigidity of the fit and mounting surfaces.

The straightness of the system is most readily achieved by pressing the guideway against a locating face.

If high demands are to be made on the running accuracy and/or if soft substructures and/or movable guideways are used, please contact us.

3.7.1 Geometrical and positional accuracy of the mounting surfaces

The higher the requirements for accuracy and smooth running of the guidance system, the more attention must be paid to the geometrical and positional accuracy of the mounting surfaces.

Tolerances of mounting surfaces and parallelism of mounted guideways must be observed.

Surfaces should be ground or precision milled: aim to achieve a mean roughness value Ramax 1,6.

Any deviations from the stated tolerances will impair the overall accuracy, alter the preload and reduce the operating life of the guidance system.

3.7.2 Height difference S1 and S2

The height deviation in transverse direction S1 is dependent on the preload class and the guideway spacing b and is permissible in accordance with the following formulae.

$$S1 = b \cdot Y \quad (20)$$

$$S1 < 2 \cdot H \quad (21)$$

$$S1 < \Delta H \quad (22)$$

18 System height tolerance H as a function of the accuracy class

Accuracy class	H
	µm
G2	+20 / –20
G1	+10 / –10

19 Height deviation ΔH as a function of the accuracy class

Accuracy class	ΔH
	µm
G2	15
G1	7

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20 Side factor Y as a function of the preload class

Side factor	Preload class		
	V0	V1	V2
Y	0,0003	0,00015	0,0001

The height deviation in longitudinal direction S2 with more than one carriage on the same guideway is permissible in accordance with the following formulae.

$$S2 = c \cdot X \quad (23)$$

$$S2 < 2 \cdot \Delta H \quad (24)$$

21 Height deviation ΔH as a function of the accuracy class

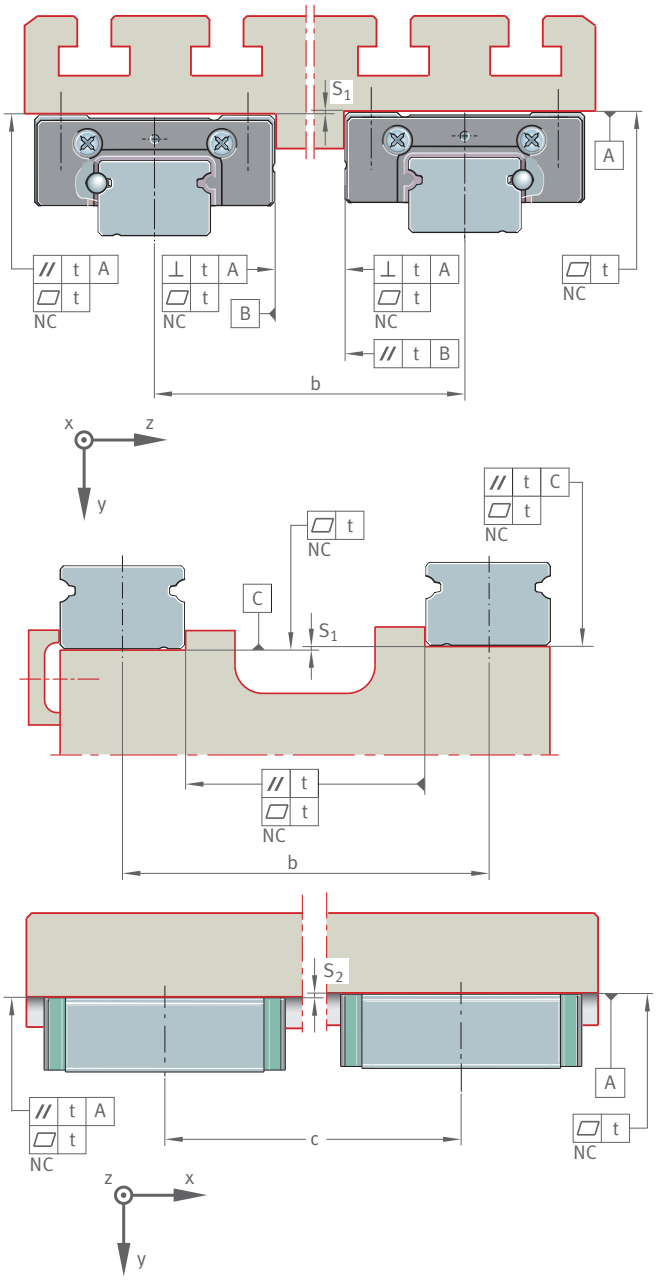
Accuracy class	ΔH
	µm
G2	15
G1	7

22 Longitudinal factor X

Longitudinal factor
X	0,00007

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31 Tolerances of mounting surfaces and parallelism of mounted guideways and carriages



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NC	Not convex	b	Spacing between guidance elements
S1	Height deviation in transverse direction	S2	Height deviation in longitudinal direction
t	Parallelism, flatness and perpendicularity tolerance		

3.7.3 Parallelism of mounted guideways

For guideways arranged in parallel, a parallelism t is required. If the maximum values are used, this may increase the displacement resistance. If larger tolerances are present, please contact Schaeffler.

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23 Values for the parallelism tolerances of two-row units

Designation	Parallelism tolerance t				
Guideway	Accuracy class		Preload class		
	G1	G2	V0	V1	V2
	µm	µm	µm	µm	µm
TKDM07-E, TKDM07-E-W	20	30	5	2	1
TKDM09-E, TKDM09-E-W	20	30	6	3	2
TKDM12-E, TKDM12-E-W	20	30	7	4	2
TKDM15-E, TKDM15-E-W	20	30	10	7	4

3.7.4 Locating heights and corner radii

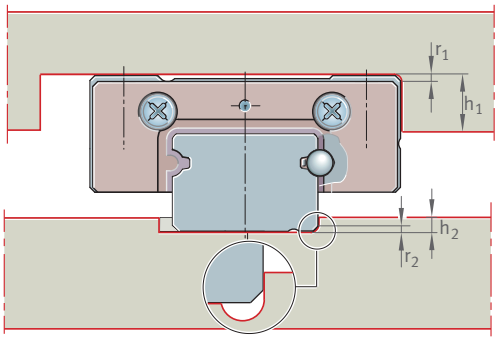
The following data can be used to design the locating heights and corner radii.

24 Locating heights, corner radii

Designation		Locating heights		Corner radii	
Carriage	Guideway	h_1	h_2	r_1	r_2 1)
		mm	mm	mm	mm
		max.	max.	max.	max.
KWEM07-E, KWEM07-E-L	TKDM07-E	2,2	1,1	0,2	0,3
KWEM07-E-W, KWEM07-E-WL	TKDM07-E-W	2,2	1,1	0,2	0,3
KWEM09-E, KWEM09-E-L	TKDM09-E	2,5	1,3	0,2	0,3
KWEM09-E-W, KWEM09-E-WL	TKDM09-E-W	2,5	1,3	0,2	0,3
KWEM12-E, KWEM12-E-L	TKDM12-E	3,5	2	0,2	0,4
KWEM12-E-W, KWEM12-E-WL	TKDM12-E-W	3,5	2	0,2	0,4
KWEM15-E, KWEM15-E-L	TKDM15-E	4,5	3,0	0,4	0,4
KWEM15-E-W, KWEM15-E-WL	TKDM15-E-W	4,5	3,0	0,4	0,4

1) Preferably with undercut

32 Locating heights and corner radii



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3.8 Product tables

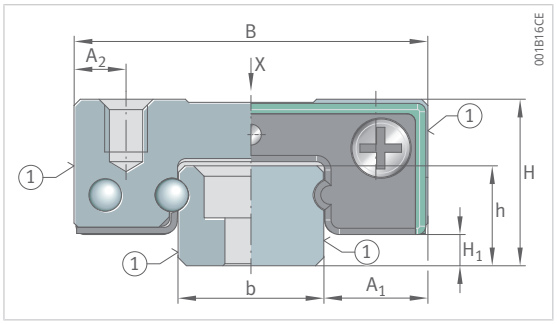
3.8.1 Explanations

(1)	–	Locating face
A_1	mm	Distance from locating edge of the carriage to locating edge of the guideway
A_2	mm	Distance between locating edge and hole
A_3	mm	Position of lubrication connector
a_L	mm	Distance from start of guideway to nearest hole
a_R	mm	Distance from end of guideway to nearest hole
b	mm	Width of guideway
B	mm	Width
C	N	Basic dynamic load rating
C_0	N	Basic static load rating
G_2	–	Thread, DIN ISO 4762-12.9
h	mm	Height of guideway
H	mm	Height
h_1	mm	Height of through hole
H_1	mm	Guideway clearance
j_B	mm	Distance between holes
J_B	mm	Distance between fixing threads in carriage
j_L	mm	Distance between holes
J_L	mm	Distance between fixing threads in carriage
K_1	–	Thread size, DIN ISO 4762-12.9
L	mm	Length of carriage
L_1	mm	Effective saddle plate length
l_{max}	mm	Max. length of guideway
M_{0x}	Nm	Static moment rating about x axis
M_{0y}	Nm	Static moment rating about y axis
M_{0z}	Nm	Static moment rating about z axis
M_A	Nm	Tightening torque
m_c	kg	Mass of carriage
m_r	kg/m	Mass of guideway
T_5	mm	Thread depth

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3.8.2 KUEM..-E

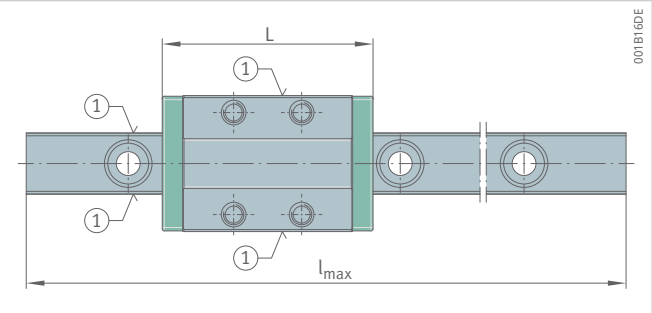
Double row



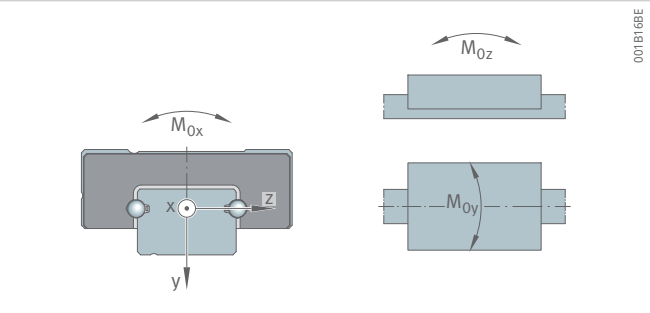
KUEM..-E

System	Carriage		Guideway		l_{max}	H	B	L	h	b
Designation	Designation	m_c	Designation	m_r						
–	–	kg	–	kg/m	mm	mm	mm	mm	mm	mm
KUEM07-E	KWEM07-E	0,012	TKDM07-E	0,230	1000	8	17	23,5	4,8	7
KUEM07-E-L	KWEM07-E-L	0,017	TKDM07-E	0,230	1000	8	17	31,5	4,8	7
KUEM09-E	KWEM09-E	0,021	TKDM09-E	0,395	2000	10	20	31	6,5	9
KUEM09-E-L	KWEM09-E-L	0,280	TKDM09-E	0,395	2000	10	20	40,5	6,5	9
KUEM12-E	KWEM12-E	0,041	TKDM12-E	0,745	2000	13	27	35	8,8	12
KUEM12-E-L	KWEM12-E-L	0,057	TKDM12-E	0,745	2000	13	27	46,5	8,8	12
KUEM15-E	KWEM15-E	0,080	TKDM15-E	1,035	2000	16	32	44	9,5	15
KUEM15-E-L	KWEM15-E-L	0,119	TKDM15-E	1,053	2000	16	32	62	9,5	15

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KUEM..-E, view rotated 90°



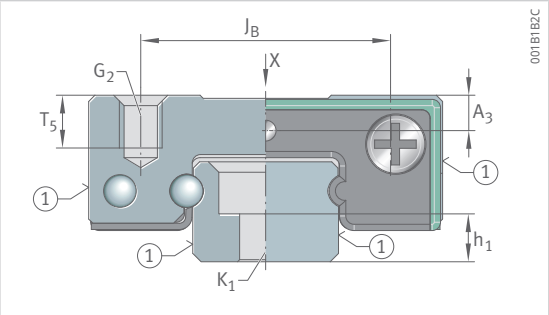
Moments and load direction

A_1	A_2	H_1	C	C_0	M_{0x}	M_{0y}	M_{0z}
mm	mm	mm	N	N	Nm	Nm	Nm
5	2,5	1,5	915	1460	4,6	2,6	2,6
5	2,5	1,5	1270	2400	7,9	8,7	8,7
5,5	2,5	2,35	1700	2800	11,5	7,5	7,5
5,5	2,5	2,35	2280	4300	18,5	20	20
7,5	3,5	3,35	2500	3900	21,5	11,7	11,7
7,5	3,5	3,35	3550	6300	35,9	33,4	33,4
8,5	3,5	4	3900	5850	38,9	23,9	23,9
8,5	3,5	4	5500	9800	64,1	63,3	63,3

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KUEM..-E

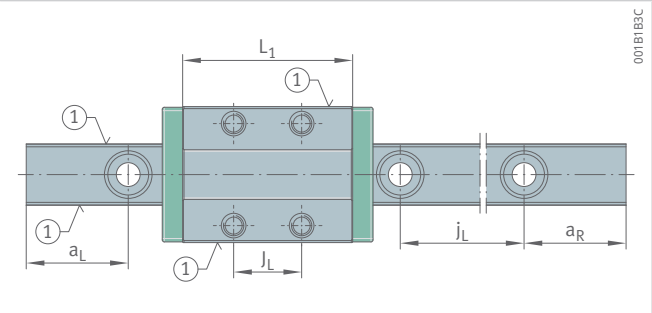
Double row



KUEM..-E

System	Carriage	Guideway	J_B	L_1	J_L	T_5	A_3
Designation	Designation	Designation					
–	–	–	mm	mm	mm	mm	mm
KUEM07-E	KWEM07-E	TKDM07-E	12	18	8	2,5	1,7
KUEM07-E-L	KWEM07-E-L	TKDM07-E	12	26	13	2,5	1,7
KUEM09-E	KWEM09-E	TKDM09-E	15	25	10	3	1,65
KUEM09-E-L	KWEM09-E-L	TKDM09-E	15	34,5	16	3	1,65
KUEM12-E	KWEM12-E	TKDM12-E	20	29	15	3,5	2,65
KUEM12-E-L	KWEM12-E-L	TKDM12-E	20	40,5	20	3,5	2,65
KUEM15-E	KWEM15-E	TKDM15-E	25	37	20	4	2,3
KUEM15-E-L	KWEM15-E-L	TKDM15-E	25	55	25	4	2,3

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KUEM..-E, view rotated 90°

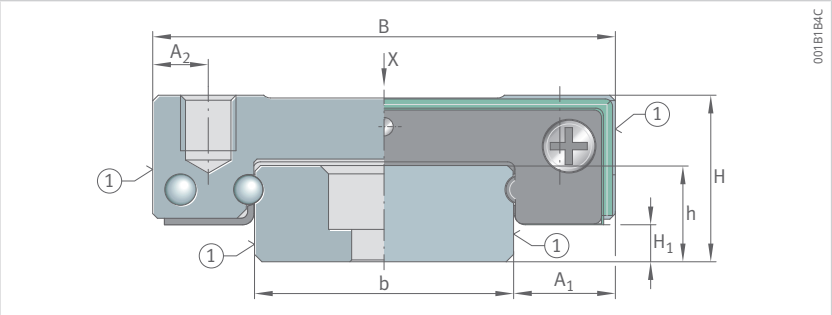
G_2		h_1	j_L	a_L		a_R		K_1	
–	M_A			min	max	min	max	–	M_A
–	Nm	mm	mm	mm	mm	mm	mm	–	Nm
M2	0,32	2,3	15	4	11	4	11	M2	0,32
M2	0,32	2,3	15	4	11	4	11	M2	0,32
M3	1,1	3	20	5	15	5	15	M3	1,1
M3	1,1	3	20	5	15	5	15	M3	1,1
M3	1,1	4,3	25	5	20	5	20	M3	1,1
M3	1,1	4,3	25	5	20	5	20	M3	1,1
M3	1,1	5	40	5	35	5	35	M3	1,1
M3	1,1	5	40	5	35	5	35	M3	1,1

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3.8.3 KUEM..-E-W

Double row

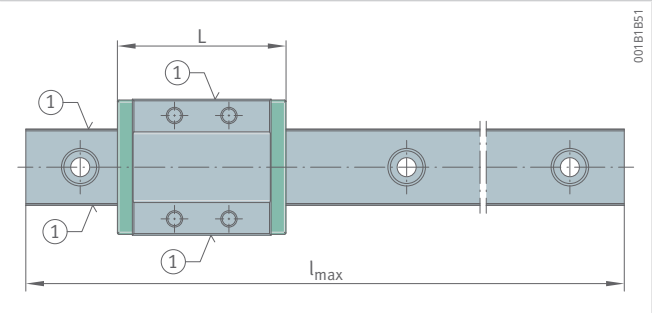
Wide design



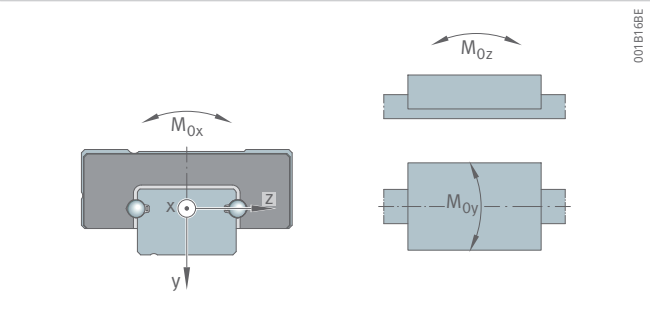
KUEM..-E-W

System	Carriage		Guideway		l_{max}	H	B	L	h	b
Designation	Designation	m_c	Designation	m_r						
–	–	kg	–	kg/m	mm	mm	mm	mm	mm	mm
KUEM07-E-W	KWEM07-E-W	0,540	TKDM07-E-W	0,024	2000	9	25	31	5,2	14
KUEM07-E-WL	KWEM07-E-WL	0,540	TKDM07-E-W	0,034	2000	9	25	41,5	5,2	14
KUEM09-E-W	KWEM09-E-W	0,940	TKDM09-E-W	0,051	2000	12	30	39	7	18
KUEM09-E-WL	KWEM09-E-WL	0,940	TKDM09-E-W	0,068	2000	12	30	50,5	7	18
KUEM12-E-W	KWEM12-E-W	1,525	TKDM12-E-W	0,085	2000	14	40	43,5	8,5	24
KUEM12-E-WL	KWEM12-E-WL	1,525	TKDM12-E-W	0,118	2000	14	40	58	8,5	24
KUEM15-E-W	KWEM15-E-W	2,960	TKDM15-E-W	0,169	2000	16	60	55,5	9,5	42
KUEM15-E-WL	KWEM15-E-WL	2,960	TKDM15-E-W	0,236	2000	16	60	74,5	9,5	42

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KUEM..-E-W, view rotated 90°



Moments and load direction

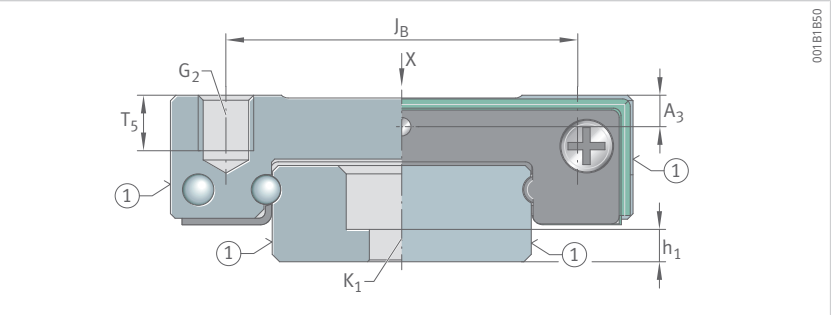
A_1	A_2	H_1	C	C_0	M_{0x}	M_{0y}	M_{0z}
mm	mm	mm	N	N	Nm	Nm	Nm
5,5	3	2	1220	2200	14,7	6,4	6,4
5,5	3	2	1660	3450	23	15,8	15,8
6	4,5	2,5	2160	4050	36,2	17,3	17,3
6	4,5	2,5	2850	5850	51,7	36,1	36,1
8	6	3	3100	5300	69,1	28,5	28,5
8	6	3	4250	8300	96,8	57,9	57,9
9	7,5	4	5000	8500	178,8	54,3	54,3
9	7,5	4	6550	12500	241,8	105,5	105,5

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KUEM..-E-W

Double row

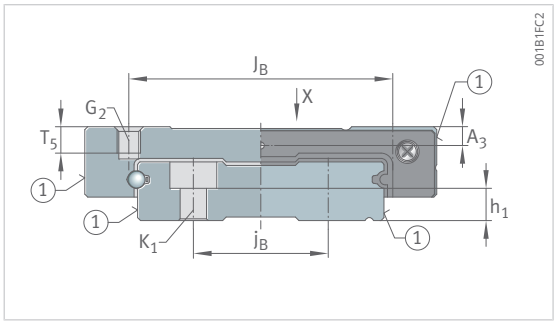
Wide design



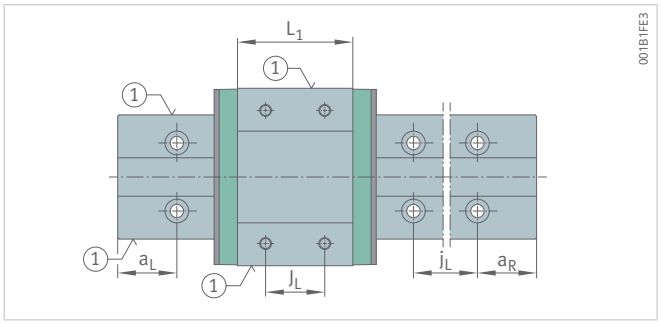
KUEM..-E-W (size 07, 09, 12)

System	Carriage	Guideway	J_B	L_1	J_L	T_5	A_3
Designation	Designation	Designation					
–	–	–	mm	mm	mm	mm	mm
KUEM07-E-W	KWEM07-E-W	TKDM07-E-W	19	25,5	10	3	1,7
KUEM07-E-WL	KWEM07-E-WL	TKDM07-E-W	19	36	19	3	1,7
KUEM09-E-W	KWEM09-E-W	TKDM09-E-W	21	33	12	3	2,35
KUEM09-E-WL	KWEM09-E-WL	TKDM09-E-W	23	44,5	24	3	2,35
KUEM12-E-W	KWEM12-E-W	TKDM12-E-W	28	37,5	15	3,5	2,7
KUEM12-E-WL	KWEM12-E-WL	TKDM12-E-W	28	52	28	3,5	2,7
KUEM15-E-W	KWEM15-E-W	TKDM15-E-W	45	48,5	20	4,5	2,7
KUEM15-E-WL	KWEM15-E-WL	TKDM15-E-W	45	67,5	35	4,5	2,7

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KUEM..-E-W



KUEM15-E-W, view rotated 90°

G_2		h_1	j_L	j_B	a_L		a_R		K_1	
–	M_A				mm	max	min	max	–	M_A
–	Nm	mm	mm	mm	mm	mm	mm	mm	–	Nm
M3	1,1	1,7	30	–	5	25	5	25	M3	1,1
M3	1,1	1,7	30	–	5	25	5	25	M3	1,1
M3	1,1	2,5	30	–	5	25	5	25	M3	1,1
M3	1,1	2,5	30	–	5	25	5	25	M3	1,1
M3	1,1	4	40	–	6	34	6	34	M4	1,1
M3	1,1	4	40	–	6	34	6	34	M4	1,1
M4	2,6	5	40	23	6	34	6	34	M4	2,6
M4	2,6	5	40	23	6	34	6	34	M4	2,6

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