SCHAEFFLER

# Precision Rail Guides

## Precision rail guides, cages, accessories

Catalog

# Schaeffler precision rail guides
# Product range

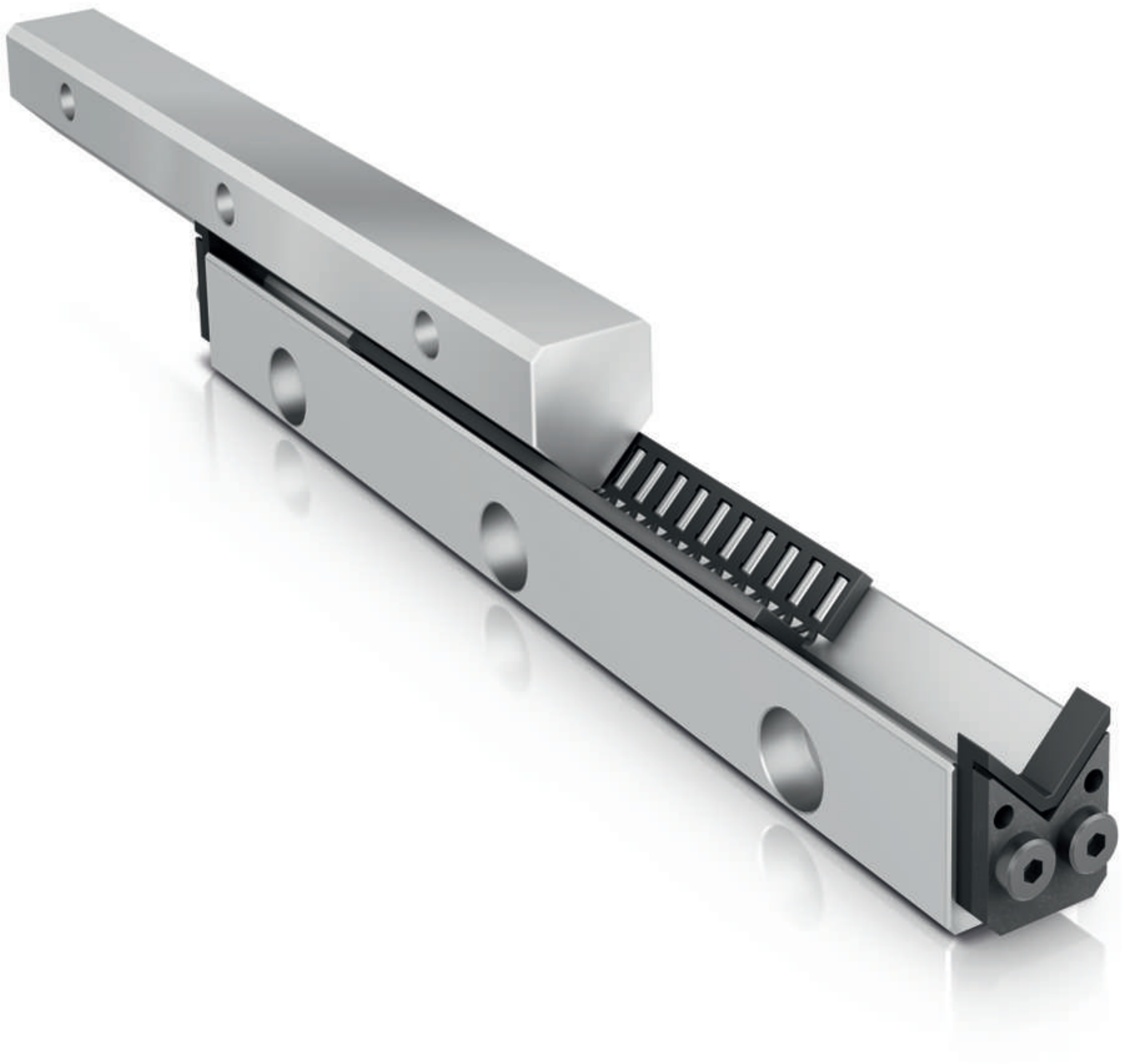
Precision rail guides deliver maximum motion accuracy for demanding industrial, medical, and electronic applications. These specialized guides use ball cages, crossed roller cages, needle roller cages, or plain bearing coatings to ensure highly precise, smooth motion. Available in a wide variety of sizes and rolling element options, these guides are distinguished by their excellent running smoothness and outstanding precision. The catalog consists of two parts and combines the SCHAEFFLER and EWELLIX product ranges.

## Range A: Flat cage guides

Guide rails
Angled flat cages
Needle roller flat cages
Ball cages
Cylindrical roller cages
End pieces
Wipers
Insert nuts


## Range B: Precision rail guides

Precision rail guides
with anti-creeping systems
Rolling element assemblies
End pieces



# Flat Cage Guides

## Guide rails, flat rails

Catalog

# Contents

# 1 Technical principles

## 1.1 Load carrying capacity and life

The size of a flat cage guide is determined by the demands made on its load carrying capacity, life, and operational security.

The load carrying capacity is described in terms of:

- Dynamic load rating C
- Static load rating $C_0$

### Calculation of the basic load rating according to DIN

The basic load ratings for linear guides without rolling element recirculation are defined in accordance with DIN 636-3. The basis of the basic dynamic load ratings in accordance with DIN 636 is a basic rating life of 100 km of displacement distance.

### Differences between DIN 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 rather than 100 km.

### Conversion of basic load ratings

The conversion factors are as follows:

### Ball flat cages

ƒ1

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

ƒ2

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

### Roller flat cages

ƒ3

$$C_{50} = \mathbf{1{,}23} \cdot C_{100}$$

ƒ4

$$C_{100} = \mathbf{0{,}81} \cdot C_{50}$$

| | | |
|---|---|---|
| $C_{50}$ | N | Basic dynamic load rating, based on 50 km |
| $C_{100}$ | N | Basic dynamic load rating according to DIN 636, based on 100 km |

### 1.1.1 Dynamic load carrying capacity and life

The dynamic load carrying capacity is described in terms of the basic dynamic load rating and the basic rating life.

The basic dynamic load rating is the load, in N, at which the guide achieves a displacement distance of 100 km with a survival probability of 90 % ($C_{100}$ ).

1

## 1.1.2 Basic rating life

The basic rating life L and $L_h$ is achieved or exceeded by 90 % of a sufficiently large number of identical flat cage guides before the first signs of material fatigue occur.

ƒ 5

$$L = \left(\frac{C_w}{P}\right)^p$$

ƒ 6

$$L_h = \frac{8.33 \cdot 10^5}{H \cdot n_{osc}} \cdot \left(\frac{C_w}{P}\right)^p$$

ƒ 7

$$L_h = \frac{1666}{\bar{v}} \cdot \left(\frac{C_w}{P}\right)^p$$

| | | |
|---|---|---|
| $C_w$ | N | Effective dynamic load rating |
| H | mm | Single stroke length (stroke end position) |
| L, $L_h$ | m, h | Basic rating life in 100 km or in operating hours |
| $n_{osc}$ | $min^{-1}$ | Number of double strokes per minute |
| P | N | Equivalent dynamic load |
| p | – | Life exponent<br>for ball-type flat cage guides: p = 3<br>for roller-type flat cage guides: $p = {}^{10}/_{3}$ |
| v | m/min | Equivalent dynamic velocity |

! According to DIN 636-3:1994 the equivalent dynamic load P should not exceed the value $0.5 \cdot C$.

## 1.1.3 Equivalent load and velocity

The equations for calculating the basic rating life assume that the load P and the velocity v are constant. Non-constant operating conditions can be taken into consideration by means of equivalent operating values. These have the same effect as the loads occurring in practice.

### Equivalent dynamic bearing load

In general, the following applies:

ƒ 8

$$P = \sqrt[p]{\left(\int_0^T \left|v(t) \cdot F^p(t)\right| dt\right) \Big/ \left(\int_0^T \left|v(t)\right| dt\right)}$$

Where the load varies in steps, the equivalent dynamic load is calculated as follows:

ƒ 9

$$P = \sqrt[p]{\frac{q_1 \cdot F_1^p + q_2 \cdot F_2^p + \ldots q_z \cdot F_z^p}{100}}$$

Where the load and the velocity vary in steps, the equivalent dynamic load is calculated as follows:

ƒ 10

$$P = \sqrt[p]{\frac{q_1 \cdot v_1 \cdot F_1^p + q_2 \cdot v_2 \cdot F_2^p + \ldots q_z \cdot v_z \cdot F_z^p}{q_1 \cdot v_1 + q_2 \cdot v_2 + \ldots q_z \cdot v_z}}$$

## Equivalent dynamic velocity

In general, the following applies:

ƒ 11

$$\bar{v} = \frac{1}{T}\int_0^T |v(t)|\,dt$$

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

ƒ 12

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

| | | |
|---|---|---|
| F | N | Acting force |
| P | N | Equivalent dynamic load |
| p | – | Life exponent<br>for ball-type flat cage guides: p = 3<br>for roller-type flat cage guides: p = $^{10}/_3$ |
| $q_z$ | % | Time proportion of the period of action |
| $\bar{v}$ | m/min | Equivalent dynamic velocity |
| $v_z$ | m/min | Variable velocity |

## 1.1.4 Operating life

The operating life is defined as the life actually achieved by a flat cage guide. It may differ significantly from the calculated rating life.

The following influences can lead to premature failure through wear or fatigue:

- misalignment between the guide rails
- contamination
- inadequate lubrication
- reciprocating motion with very small stroke lengths (false brinelling)
- vibration at standstill (false brinelling)
- overloading of the guide (even for short periods)
- plastic deformation

### 1.1.5 Static load carrying capacity

The static load carrying capacity of the guide is limited by the following factors:

- the permissible load on the flat cage guide
- the load carrying capacity of the raceway
- the permissible load on the screw connections
- the permissible load on the adjacent construction.

! For design purposes, the static load safety factor $S_0$ required for the application must be observed.

### 1.1.6 Basic static load ratings

The basic static load ratings are the loads at which the raceways and rolling elements undergo a permanent overall deformation corresponding to $^1/_{10000}$ of the rolling element diameter.

### 1.1.7 Static load safety factor

The static load safety factor $S_0$ indicates the security against permanent deformation in the rolling contact, which is considered permissible in terms of guide accuracy and smooth running:

ƒ13

$$S_0 = \frac{C_{0w}}{P_0}$$

| | | |
|---|---|---|
| $C_{0w}$ | N | Effective static load rating |
| $P_0$ | N | Maximum equivalent static load |
| $S_0$ | – | Static load safety factor |

! If high demands are placed on running accuracy and smoothness, the static load safety factor $S_0$ should be $> 3$.

For $S_0 < 3$, the screw connections must be checked for tensile and moment loading.

### 1.1.8 Determining the effective load rating

The basic dynamic and static load ratings C and $C_0$ specified in the product tables for flat cages apply to cages with a theoretical reference length of 100 mm. This makes it possible to directly compare the load carrying capacities of flat cages across different series and sizes.

1

### 1.1.9 Effective cage length and basic load ratings

For the effective cage lengths, the effective dynamic and static load ratings $C_w$ and $C_{0w}$ must be determined using the following formulas:

**Basic load ratings for roller flat cages**

f14

$$C_w = C \cdot \left( \frac{l_k - 2a_{k1} + j_k}{100} \right)^{\frac{7}{9}}$$

f15

$$C_{0w} = C_0 \cdot \frac{l_k - 2a_{k1} + j_k}{100}$$

**Basic load ratings for ball flat cages**

f16

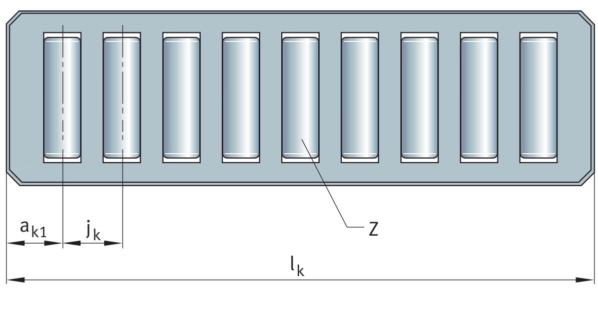
$$C_w = C \cdot \left( \frac{l_k - 2a_{k1} + j_k}{100} \right)^{0.7}$$

f17

$$C_{0w} = C_0 \cdot \frac{l_k - 2a_{k1} + j_k}{100}$$

| | | |
|---|---|---|
| $a_{k1}$ | mm | Distance between center of first or last cage pocket and end of cage |
| $C$ | N | Basic dynamic load rating for a cage length of 100 mm |
| $C_0$ | N | Basic static load rating for a cage length of 100 mm |
| $C_{0w}$ | N | Effective static load rating |
| $C_w$ | N | Effective dynamic load rating |
| $j_k$ | mm | Pocket pitch of the flat cage body |
| $l_k$ | mm | Length of cage |

1 Dimensions for calculating the effective load rating




| | | | |
|---|---|---|---|
| $a_{k1}$ | Distance between center of first or last cage pocket and end of cage | $j_k$ | Pocket pitch of the flat cage body |
| $l_k$ | Length of cage | Z | Number of rolling elements |

1

**Checking the number of rolling elements Z**

The equations for the effective load ratings will only give reliable results if the cage length used $l_k = (Z - 1)\, j_k + 2a_{k1}$ is based on an integer number of rolling elements per row.

The required integer number of rolling elements Z is verified using the following equation:

18

$$Z = \frac{l_k - 2a_{k1}}{j_k} + 1$$

| | | |
|---|---|---|
| $a_{k1}$ | mm | Distance between center of first or last cage pocket and end of cage |
| $j_k$ | mm | Pocket pitch of the flat cage body |
| $l_k$ | mm | Length of cage |
| Z | – | Number of rolling elements per row |

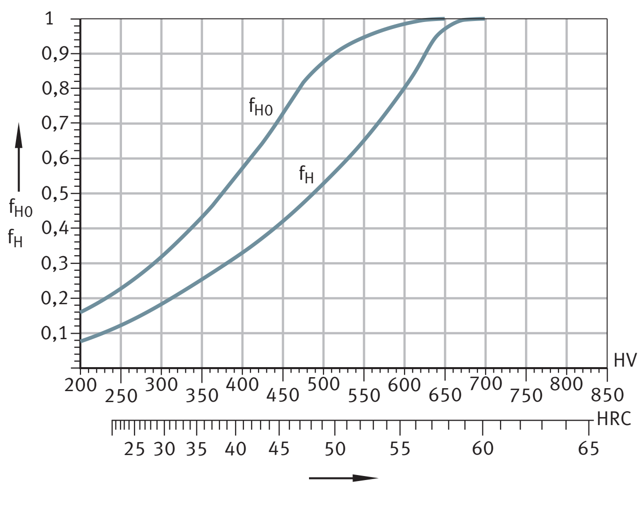
## 1.1.10 Factors influencing the load carrying capacity

The basic load ratings given in the product tables are only valid under certain conditions. For deviations in raceway hardness or off-center loading, correction factors must be taken into account.

### 1.1.10.1 Correction factors for reduced raceway hardness

When flat cages are used on raceways with a surface hardness < 670 HV (58 HRC), the basic load ratings must be multiplied by the hardness factor $f_H$ or $f_{H0}$.

2 Hardness factors for reduced raceway hardness




| | | | |
|---|---|---|---|
| $f_H$ | Dynamic hardness factor | $f_{H0}$ | Static hardness factor |
| HRC | Surface hardness, converted in accordance with DIN 50150 | HV | Surface hardness |

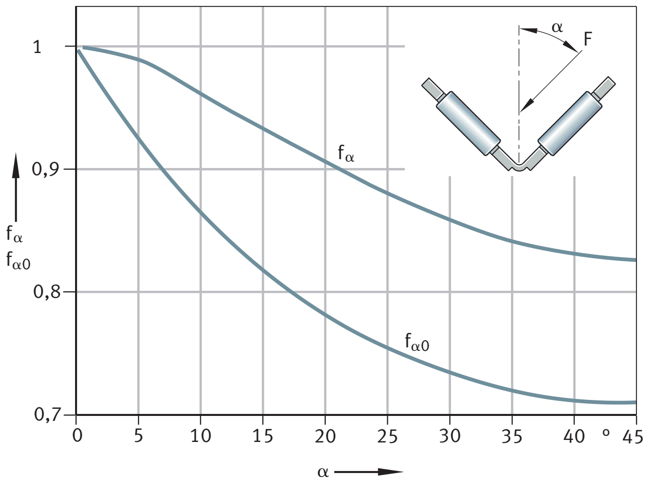
### 1.1.10.2 Correction factors for load direction

The effective load ratings of double row angled flat cages are dependent on the angle α at which the load acts on the guide.

1

The basic load ratings apply only on the condition that the load is introduced symmetrically to the cage legs (α = 0 °). For other load directions, the effective load ratings must be determined using the following equations and the load direction factors for angled flat cages.

3 Load direction factors for angled flat cages




| | | | |
|---|---|---|---|
| $f_\alpha$ | Dynamic load direction factor | $f_{\alpha 0}$ | Static load direction factor |
| α | Force application angle | | |

## Basic dynamic load rating

19

$$C_w = f_\alpha \cdot f_H \cdot C \cdot \left( \frac{l_k - 2a_{k1} + j_k}{100} \right)^p$$

## Basic static load rating

20

$$C_{0w} = f_{\alpha 0} \cdot f_{H0} \cdot C_0 \cdot \left( \frac{l_k - 2a_{k1} + j_k}{100} \right)$$

| | | |
|---|---|---|
| $a_{k1}$ | mm | Distance between center of first or last cage pocket and end of cage |
| $C$ | N | Basic dynamic load rating for a cage length of 100 mm |
| $C_0$ | N | Basic static load rating for a cage length of 100 mm |
| $C_{0w}$ | N | Effective static load rating |
| $C_w$ | N | Effective dynamic load rating |
| $f_\alpha$ | – | Dynamic load direction factor |
| $f_{\alpha 0}$ | – | Static load direction factor |
| $f_H$ | – | Dynamic hardness factor |
| $f_{H0}$ | – | Static hardness factor |
| $j_k$ | mm | Pocket pitch of the flat cage body |
| $l_k$ | mm | Length of cage |
| $p$ | – | Life exponent<br>for ball-type flat cage guides: $p = 0.7$<br>for roller-type flat cage guides: $p = {}^7/_9$ |

### 1.1.10.3 Off-center loading on guide rails

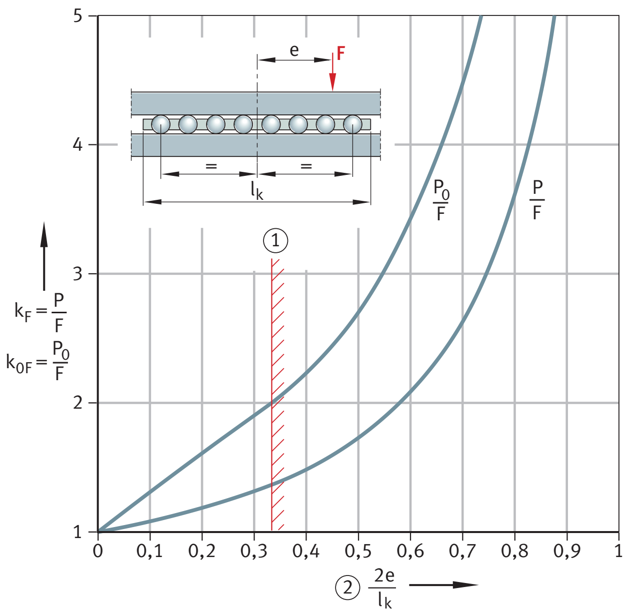
**Open arrangement**

Flat cages travel half the distance of the moving guide rail. As a result, they are not subjected to uniform load in most cases.

The basic load ratings specified in the product tables apply only under uniform load distribution or centered loading. If the cages are subject to off-center loading, the load carrying capacity and life can be determined using the statically or dynamically equivalent cage load.

If the defined utilization limit is exceeded, the cages are only subjected to partial load. The load carrying capacity and rigidity of the guide are reduced as a result.

4 Equivalent load




| | | | |
|---|---|---|---|
| $k_F$ | Dynamic load factor | $k_{0F}$ | Static load factor |
| P | Equivalent dynamic load | $P_0$ | Equivalent static load |
| F | Load on the guide | e | Load offset |
| $l_k$ | Length of cage | 1 | Utilization limit |
| 2 | Relative load offset | | |

**Closed arrangement**

Guide systems in a closed arrangement may be subjected to additional load moments and tilting moments.

The calculation of the equivalent cage load is a highly complex task. It is performed by the Schaeffler Field Service upon request using the appropriate calculation programs.

## 1.1.11 Calculation example

The following values are given:

- guide rails: M6035 and V6035
- flat cage: HW20
- basic dynamic load rating C for a cage length of 100 mm: 40300 N
- basic static load rating $C_0$ for a cage length of 100 mm: 139500 N

- operating load $F_B$ acting centrally on the guide (factors $f_a$, $f_{a0}$, $k_F$, $k_{0F}$ = 1): 25300 N
- distance between stroke end positions H: 200 mm
- number of double strokes per minute $n_{osc}$: 18 $min^{-1}$
- cage length $l_k$: 500 mm

The following values are required:

- basic rating life L and $L_h$
- static load safety factor $S_0$

**Verifying the number of rolling elements**

ƒ 21

$$Z = \frac{l_k - 2a_{k1}}{j_k} + 1$$

ƒ 22

$$Z = \frac{500 - 8}{5.5} + 1 = 90$$

**Effective dynamic load rating $C_w$**

ƒ 23

$$C_w = C \cdot \left( \frac{l_k - 2a_{k1} + j_k}{100} \right)^{\frac{7}{9}}$$

ƒ 24

$$C_w = 40300 \cdot \left( \frac{497.5}{100} \right)^{\frac{7}{9}} = 140000 \text{ N}$$

**Basic rating life L**

ƒ 25

$$L = \left( \frac{C_w}{P} \right)^{\frac{10}{3}}$$

ƒ 26

$$L = \left( \frac{140000}{25000} \right)^{\frac{10}{3}} = 310 \cdot 10^5 \text{ m}$$

**Basic rating life $L_h$**

ƒ 27

$$L_h = \frac{8.33 \cdot 10^5}{H \cdot n_{osc}} \cdot \left( \frac{C_w}{P} \right)^{\frac{10}{3}}$$

𝑓 28

$$L_h = \frac{8.33 \cdot 10^5 \cdot 310}{200 \cdot 18} = 72000 \text{ h}$$

**Static load safety factor $S_0$**

𝑓 29

$$C_{0w} = C_0 \cdot \frac{l_k - 2a_{k1} + j_k}{100}$$

𝑓 30

$$C_{0w} = 133500 \cdot \frac{497.5}{100} = 664000 \text{ N}$$

𝑓 31

$$S_0 = \frac{C_{0w}}{P_0}$$

𝑓 32

$$S_0 = \frac{664000}{25000} = 26.6$$

## 1.2 INA calculation program

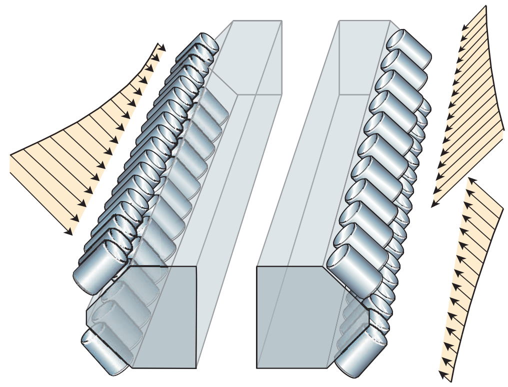
The calculation is primarily intended for the preselection of flat cage guides. It enables an approximate calculation of the equivalent static and dynamic bearing loads, since the equations used to calculate the element load are based on a statically determinate system.

### 1.2.1 Complex influencing factors

In practice, however, the system is statically indeterminate, and therefore cannot be calculated accurately by simple hand calculation. A precise calculation of the equivalent load requires precise knowledge of the internal load distribution. In other words, the load acting on the individual rolling elements must be known. In principle, the internal load distribution could be taken into consideration by means of load factors. However, due to the large number of possible load combinations, an impracticably large number of diagrams would be required.

In many applications, not only the load carrying capacity and life of the system are important, but also the rigidity and displacement under combined loading. The latter values, too, can only be calculated by simple hand calculation for very simple load cases.

5 Internal load distribution under combined load




## 1.2.2 Calculation program

The developed calculation program makes it possible to determine the load carrying capacity and rigidity under any combination of loads. The program takes into consideration the non-linear deflection curves of the rolling elements. The adjacent construction is assumed to be rigid.

Schaeffler offers the calculation of linear guides using this program as a service.

### 1.2.2.1 Parameters and characteristic values

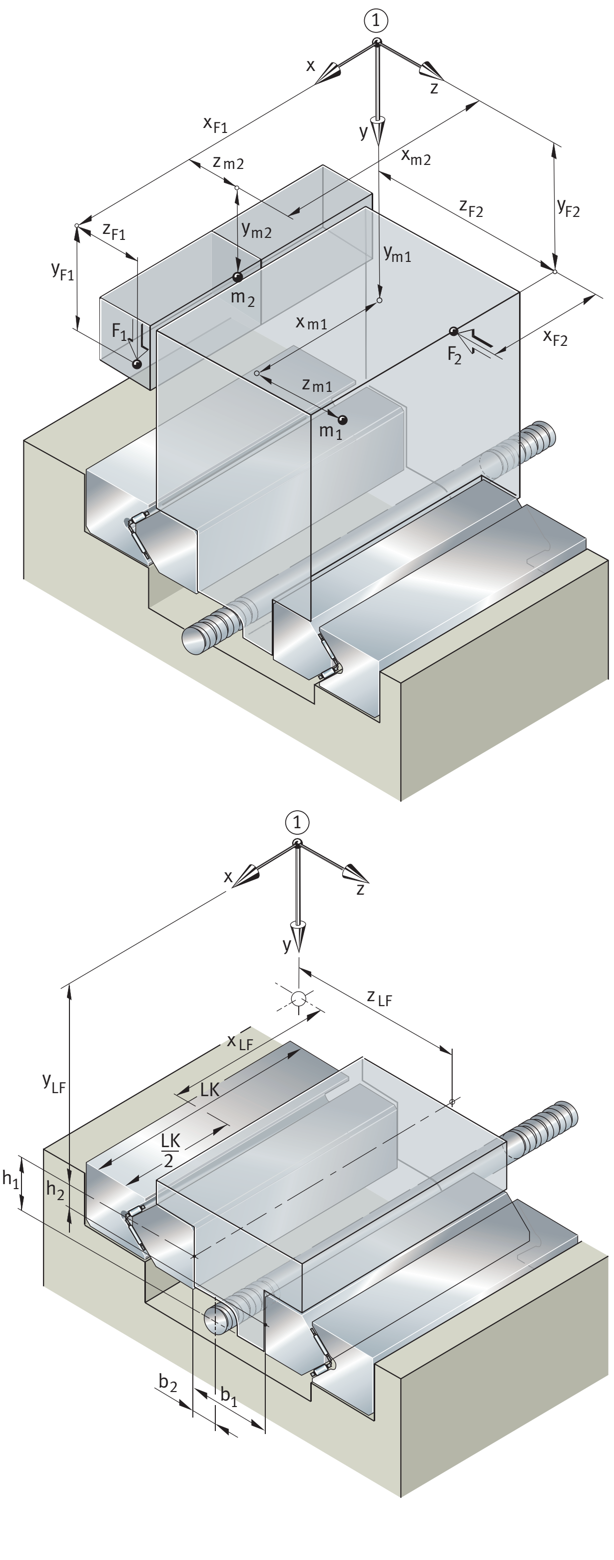
The INA calculation program for linear guides determines, for example, the following parameters:

- static load safety factor $C_0$
- basic rating life L, $L_h$
- displacements resulting from the elasticity of the bearing support

For the calculation, a series of characteristic values must be specified for each load case in a coordinate system with a defined origin:

- geometry and position of the guide elements, including the position of the drive axis
- external force components (any number) and the respective positions of their loading points in the coordinate system
- components of the moments that are free of transverse forces
- masses (any number) and the respective positions of their centers of gravity in the coordinate system
- motion parameters
- duty cycle (proportion of operating time)

6 Load data for flat cage guides




1 Origin of coordinate system

## 1.2.2.2 Data sheet

Simple calculations can be performed in **medias®** *professional* or the new Linear program available online. We will also be happy to carry out the calculation for you. To enable this, please enter your characteristic values in the following data sheet.

This data sheet provides a simple way of describing the geometry and load conditions:

- By way of example, 2 masses and 2 forces are given in the data sheet.
- Additional masses and forces can be entered in the same manner.
- If multiple planes are present, a dedicated data sheet must be completed for each plane.
- If planes or guide rails are at an angle to the planes of the coordinate system, a diagram showing the position of the planes must be prepared.
- Data must be provided separately for each load case.

The calculation can also be carried out on the basis of a technical drawing containing the required dimensions and loads.

1 Calculation data sheet

| **Required data for the calculation** | | | |
|---|---|---|---|
| **Guide geometry** | | **Position of the guide** | |
| $l_k$ | mm | $x_{LF}$ | mm |
| $b_1$ | mm | $y_{LF}$ | mm |
| $b_2$ | mm | $z_{LF}$ | mm |
| $h_1$ | mm | | |
| $h_2$ | mm | | |
| **Motion parameters** | | **Duty cycle (proportion of operating time)** | |
| $a_{max}$ | $m/s^2$ | q | % |
| $v_{max}$ | m/min | Moments free of transverse forces | |
| v | m/min | $M_x$ | Nm |
| H | mm | $M_y$ | Nm |
| $n_{osc}$ | $min^{-1}$ | $M_z$ | Nm |
| **Mass 1** | | **Mass 2** | |
| $m_1$ | kg | $m_2$ | kg |
| **Load 1** | | **Load 2** | |
| $F_{1x}$ | N | $F_{2x}$ | N |
| $F_{1y}$ | N | $F_{2y}$ | N |
| $F_{1z}$ | N | $F_{2z}$ | N |
| **Center of mass 1** | | **Center of mass 2** | |
| $x_{m1}$ | mm | $x_{m2}$ | mm |
| $y_{m1}$ | mm | $y_{m2}$ | mm |
| $z_{m1}$ | mm | $z_{m2}$ | mm |
| **Loading point 1** | | **Loading point 2** | |
| $x_{F1}$ | mm | $x_{F2}$ | mm |
| $y_{F1}$ | mm | $y_{F2}$ | mm |
| $z_{F1}$ | mm | $z_{F2}$ | mm |

## 1.3 Preload

### 1.3.1 Influence of preload

Preload increases the rigidity and guidance accuracy of flat cage guides. Under moment loads, preload reduces the peak loads acting on the rolling elements at the cage ends, thereby increasing the moment load carrying capacity of the guide system. Furthermore, the preload affects the displacement resistance and influences the operating life of the flat cage guide.

#### 1.3.1.1 Magnitude of preload

A positive effect of preload is largely achieved with a value of 0.02 to 0.03 · $C_0$. The optimum preload can be determined using the calculation programs provided by the INA Data Service.

! Too little or too much preload can cause uncontrolled displacement of the flat cage (cage creep).

### 1.3.2 Influence of the adjacent construction

To utilize rigidity to its full extent, the adjacent construction must be sufficiently rigid and geometrically accurate. If the surrounding structure is easily deformable or inaccurate, angular misalignment may occur between the raceways, causing the rolling elements to be loaded only at their ends. In such cases, the rigidity of the system is not increased. Furthermore, the operating life of the guides may be reduced due to edge loads, potentially triggering cage creep.

### 1.3.3 Setting the preload force

The preload force can be measured and set using various methods:

- by measuring the carriage displacement friction $F_{RV}$ when using pressure screws or guide rails with an adjusting gib
- by using pressure screws tightened to a specified torque
- by measuring the deformation of the adjacent construction once the correct deformation has been determined using the hydraulic adjustment rail

### 1.3.4 Carriage displacement friction

The formula for determining the displacement friction is valid when the following conditions are met:

- The preload corresponds to 2.5 % of the basic load rating $C_0$.
- The guide is lubricated and not under operating load.
- Movement occurs at 0.05 m/s.

ƒ33

$$F_{RV} = \frac{C_{0w}}{40000}$$

| | | |
|---|---|---|
| $C_{0w}$ | N | Effective static load rating |
| $F_{RV}$ | N | Frictional force |

### 1.3.5 Pressure screws

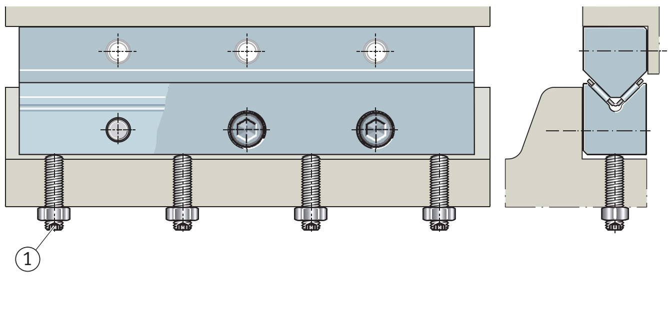
For low loads ($S_0 > 5$), the preload can be applied using pressure screws on the back of the guide rail. The pressure screws should have a flat contact surface (executed as grub screws in accordance with ISO 4026) and should be arranged between the fixing screws and at the ends of the guide rails.

2 Pressure screws and tightening torques

| Guide rail | Pressure screw | | Tightening torque [1] |
|---|---|---|---|
| | Dimension | Spacing | $M_A$ |
| | – | mm | N m |
| M3015, V3015 | M 4 | 40 | 0.34 |
| M4020, V4020 | M 6 | 80 | 1.2 |
| M4525, V4525 | M 6 | 80 | 1 |
| M5025, V5025 | M 6 | 80 | 1.2 |
| M6035, V6035 | M 8 | 100 | 2.9 |
| M6535, V6535 | M 8 | 100 | 3.5 |
| M7040, V7040 | M 10 | 100 | 5.7 |
| M8050, V8050 | M 12 | 100 | 7.7 |
| M8550, V8550 | M 12 | 100 | 7.3 |

[1] Preload = 2.5 % $C_0$

7 Arrangement of pressure screws




1 Pressure screw

## 1.3.6 Guide rails with adjusting gib

For high loads ($S_0 < 5$), or where high requirements are placed on rigidity, it is advantageous to use guide rails ML with an adjusting gib. With these guide rails, the preload is applied evenly over the whole length of the guide and precise adjustment is achieved.

## 1.3.7 Hydraulic adjustment rail

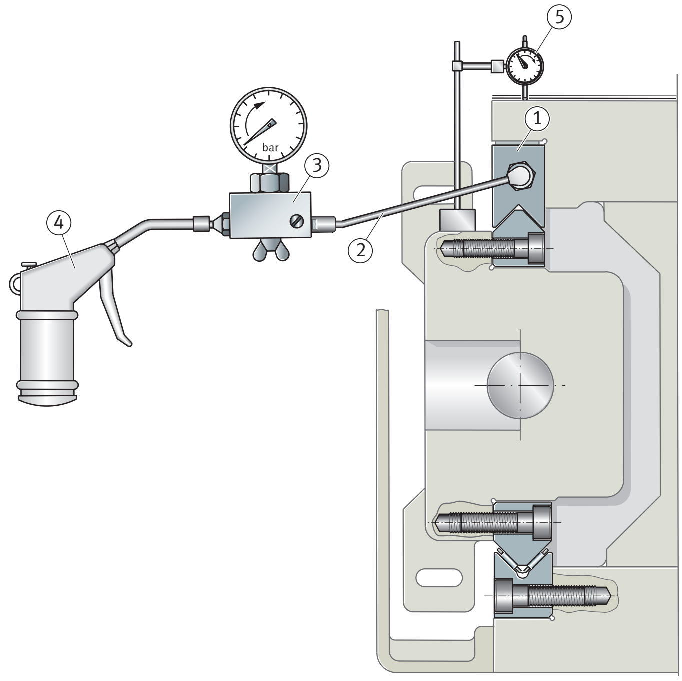
This rail can be used to determine the deformation of the adjacent construction and the preload for M, ML, and V guide rails in closed arrangements. The deformation is specific to the particular design and must only be determined once for a machine type.

Hydraulic adjustment rails are of a modular construction and, as a result, can be matched to practically any installation case. Schaeffler offers such measurements as a service.

Application of the hydraulic adjustment rail:

- During initial assembly, replace one guide rail and one flat cage with the hydraulic adjustment rail.
- Apply the necessary preload using the hydraulic adjustment rail.
- Measure the deformation (deflection) of the adjacent construction under preload.
- Set the preload of the completely reassembled guide in accordance with the measured deformation.

8 Preload with hydraulic adjustment rail




| | | | |
|---|---|---|---|
| 1 | Adjustment rail | 2 | High-pressure hose |
| 3 | Distributor with pressure gage | 4 | Grease gun |
| 5 | Dial gage | | |

## 1.4 Friction

Flat cage guides exhibit low and uniform displacement resistance. The friction curve is uniform and the starting friction is slight. As a result, flat cage guides run without stick-slip effects.

The total friction consists of:

- rolling and sliding friction in the rolling contacts
- lubricant friction
- seal friction

Friction is influenced by the following factors:

- load
- preload
- travel velocity
- lubricant

- lubrication condition
- temperature
- installation accuracy

The factors affecting the coefficient of friction are partly reciprocal and may act in a single direction or opposite directions.

The coefficient of friction is characterized by the ratio of displacement force to normal load. Under normal conditions, the coefficients of friction for rolling guides range between 0.001 and 0.004.

### 1.4.1 Influence of grease on friction

During commissioning and relubrication, the coefficient of friction increases temporarily due to the presence of fresh grease, but returns to a lower value after a short running-in period.

The friction behavior is determined significantly by the characteristics of the grease used. The consistency and base oil viscosity serve as approximate guide values.

! Systems have an increased displacement resistance after initial greasing.

### 1.4.2 Influence of the seal on friction

Contact seals increase the total friction of the linear guide.

The seal friction is at its highest in new guides. It decreases after the running-in period.

### 1.4.3 Displacement resistance

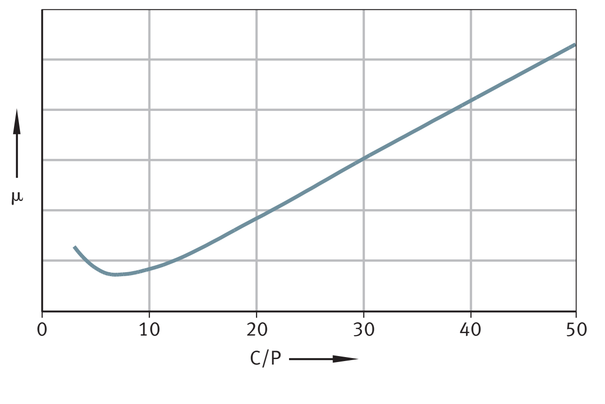
34

$$F_R = \mu \cdot F$$

| | | |
|---|---|---|
| F | N | Load on the linear recirculating roller bearing |
| $F_R$ | N | Displacement resistance |
| μ | – | Coefficient of friction |

The coefficient of friction is dependent on the ratio C/P and is therefore itself a function of the load.

9 Coefficient of friction curve



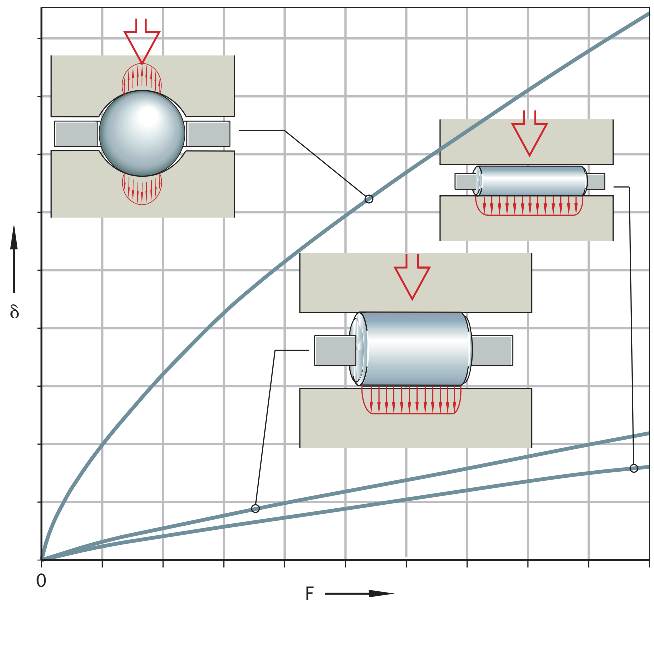

| | |
|---|---|
| μ Coefficient of friction | C/P Load ratio |

## 1.5 Rigidity

In guides with needle or cylindrical rollers, the rolling elements are in line contact, while in guides with balls, the rolling elements are in four point contact. Due to the larger contact surface, guides with needle or cylindrical rollers are significantly more rigid than guides with balls.

Needle rollers and cylindrical rollers have profiled ends, meaning that the outside surfaces are slightly curved toward the ends. This reduces edge stresses at the ends of the rolling elements. The resulting effect on the load carrying capacity is minimal, since the effective contact length between the roller and raceway is only marginally reduced.

10 Rolling element type and elastic deformation (deflection)




| δ | Elastic deformation | F | Load on the guide |
|---|---|---|---|

### 1.5.1 Elastic deformation

Flat cage guides are highly rigid. However, the operating load does lead to elastic deformation at the contact points. Deformation and rigidity can be determined using equations.

! These formulas do not take into account the elastic deformation of the adjacent construction or screw connections, nor any settling effects or similar phenomena. Since the surrounding structure is not completely rigid, the elastic deflection may be somewhat higher in practice.

In closed guides with M guide rails and V guide rails, the rigidity of the guide can be further increased by means of preload ➤18 | 1.3.

### 1.5.2 Rigidity of the flat cage guide

The rigidity of a flat cage guide is determined by the ratio of load to elastic deformation.

ƒ35

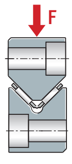
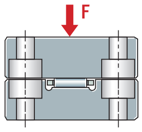
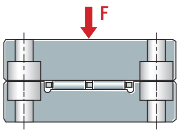
$$C_L = \frac{F}{\delta}$$

| | | |
|---|---|---|
| $C_L$ | N/μm | Rigidity of the flat cage guide |
| F | N | Operating load |
| δ | μm | Elastic deformation |

### 1.5.3 Determining the rigidity

The elastic deformation depends on the load, number, length, and geometrical form of the rolling elements, as well as on the design of the guide rails.

3 Design factors

| Design | Design factor K |
|---|---|
|   | 0 .092 |
|   | 0 .087 |
|   | 0 .049 |

#### Flat cage guides with line contact

ƒ36

$$\delta = K \cdot \frac{\left(\frac{F}{Z}\right)^{0.838}}{L_w^{0.605}}$$

ƒ37

$$C_L = \frac{1}{K} \cdot F^{0.162} \cdot Z^{0.838} \cdot L_w^{0.605}$$

#### Flat cage guides with four point contact

ƒ38

$$\delta = K \cdot \frac{\left(\frac{F}{Z}\right)^{\frac{2}{3}}}{D_w^{\frac{1}{3}}}$$

ƒ 39

$$C_L = \frac{1}{K} \cdot F^{\frac{1}{3}} \cdot Z^{\frac{2}{3}} \cdot D_w^{\frac{1}{3}}$$

| | | |
|---|---|---|
| $C_L$ | N/μm | Rigidity of the flat cage guide |
| $D_W$ | mm | Ball diameter |
| F | N | Operating load |
| K | – | Factor for calculating elastic deformation, dependent on the design type |
| $L_W$ | mm | Rolling element length |
| Z | – | Number of rolling elements per row |
| δ | μm | Elastic deformation |

### 1.5.4 Calculation example

- guide rails: M6035 and V6035
- flat cage: HW20×500
- operating load F: 25000 N
- number of rolling elements per row Z: 90
- rolling element length $L_W$: 9.8
- design factor K: 0.092

#### Elastic deformation

ƒ 40

$$\delta = K \cdot \frac{\left(\frac{F}{Z}\right)^{0.838}}{L_w^{0.605}}$$

ƒ 41

$$\delta = 0.092 \cdot \frac{\left(\frac{25000}{90}\right)^{0.838}}{9.8^{0.605}} = 2.6\ \mu m$$

#### Rigidity

ƒ 42

$$C_L = \frac{25000}{2.6} = 9600\ N/\mu m$$

## 1.6 Lubrication

### 1.6.1 Oil lubrication or grease lubrication

Flat cage guides must be lubricated. Technical, economic, and ecological factors determine whether oil or grease should be used and which lubrication method should be applied.

The functions and effects of lubricants such as grease and oil are extensive:

- reduce friction
- minimize wear
- prevent corrosion
- protect against contamination
- extend the operating life of the guide

### 1.6.2 Delivered condition, suitable lubricants

Flat cage guides are preserved. The preservative is compatible with oils and greases having a mineral oil base. The flat cage guides run exclusively in the mixed friction range. Doped lubricants should therefore be used in preference (type P in accordance with DIN 51502).

! Drilling oils or other coolant emulsions must not be used for lubrication. These have the effect of thinning the lubricants and may cause corrosion. In the same way, lubricants containing solid additives must not be used.

In the case of M guide rails and V guide rails, the lubricant is typically introduced via the lateral gap between the M rail and V rail. If this is not possible, such as in the case of vertical installations, guide rails with a relubrication facility can be supplied by agreement.

! Used lubricants should be disposed of by environmentally-friendly methods. The handling and use of lubricants is governed by national environmental protection and occupational safety regulations, as well as by information from the lubricant manufacturers. These regulations must be observed.

### 1.6.3 Oil lubrication

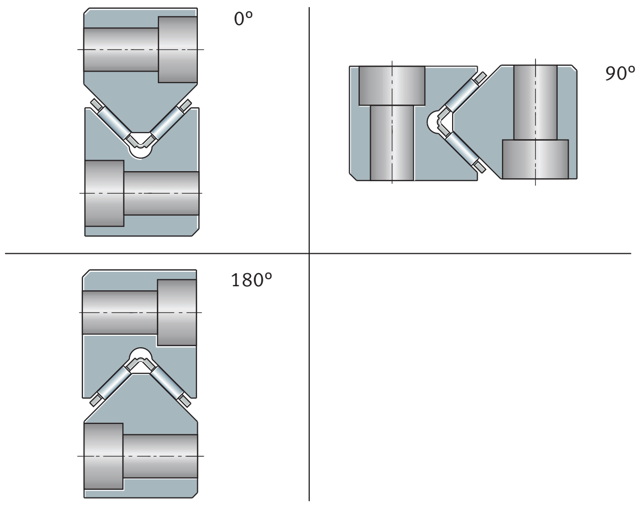
Lubricating oil types CLP in accordance with DIN 51517 and HLP in accordance with DIN 51524 should be used in preference.

At operating temperatures from 0 °C to +70 °C, the viscosity should be between ISO VG 32 and ISO VG 68. In the low-temperature range, oils in accordance with ISO VG 10 or ISO VG 22 should be used. Slideway oils CGLP can be used up to ISO VG 220.

Oil impulse lubrication or oil drop lubrication is recommended. In highly contaminated environments, pneumatic oil lubrication is particularly advantageous. It creates a slight overpressure in the guide, reinforcing the effectiveness of existing seals.

When designing the feed mechanism for the lubricating oil, the installation position must be taken into account to ensure that all rows of rolling elements are provided with lubricant.

11 Installation positions for flat cage guides




### 1.6.3.1 Advantages of oil lubrication

Oil as a lubricant enables heat dissipation and provides good lubricant distribution. During relubrication, the lubricant is almost completely replaced. Contaminant particles are washed out. Furthermore, oil lubrication is advisable where the adjacent machine elements are already supplied with oil.

### 1.6.3.2 Compatibility

If no prior experience or information from the oil manufacturer is available, the behavior of the lubricating oils with respect to plastics, elastomers, non-ferrous metals, and light alloys must be verified before use.

! The compatibility of oils must always be checked.

This check must be performed under dynamic load and at operating temperature.

In case of doubt, the lubricant manufacturer must be consulted.

### 1.6.3.3 Miscibility

Greases may only be mixed when the following criteria are met:

- same base oil type
- compatible thickener type
- similar base oil viscosities (differing by a max. of 1 ISO VG grade)
- same consistency (NLGI class)

If any of the above points differ, the miscibility must be checked.

! If the grease quality deviates from our specifications, adverse effects may result.

### 1.6.3.4 Commissioning

Before commissioning, the raceway and cage of the flat cage guide must be oiled and protected against solid and liquid contaminants.

## 1.6.4 Grease lubrication

Lithium-soap greases with a mineral oil base are recommended. The base oil viscosity should be selected within the range of ISO VG 150 to ISO VG 220.

For high loads ($S_0 < 8$), it is essential to use EP additive-containing greases with a base oil viscosity of approximately ISO VG 220.

For initial greasing, lubricating grease KP2N–20 in accordance with DIN 51825 is recommended.

### 1.6.4.1 Advantages of grease lubrication

The design effort for relubrication devices is very low if a central lubrication system is not required. Relubrication intervals can be as long as one year. Due to the thickener in the grease, this form of lubrication exhibits excellent emergency running characteristics. In addition, grease lubrication provides good support to the sealing arrangement.

### 1.6.4.2 Miscibility

Greases may only be mixed when the following criteria are met:

- same base oil type
- compatible thickener type
- similar base oil viscosities (differing by a max. of 1 ISO VG grade)
- same consistency (NLGI class)

If any of the above points differ, the miscibility must be checked.

### 1.6.4.3 Storage life

Experience has shown that lubricating greases with a mineral oil base can be stored up to 3 a (years).

The following preconditions apply:

- closed storage room
- temperature from 0 °C to +40 °C
- relative humidity < 65 %
- no chemical influences (vapors, gases, fluids)

! After long storage periods, the friction may be temporarily higher than in freshly greased flat cage guides. The lubricity of the grease may also have deteriorated. It is the user's responsibility to follow the directions given by the lubricant manufacturer.

## 1.6.5 Commissioning and initial grease quantity

### 1.6.5.1 Without relubrication device

The initial grease quantity is applied uniformly from both sides into the cage pockets and distributed over the cage surfaces. A thin film of grease must also be applied to the raceways of the guide rails.

! The guide must be protected against solid and liquid contamination both before and during fitting.

#### 1.6.5.2 With relubrication device

Before fitting, a thin film of grease must be applied to the cage and raceways. The guide is then fitted, and the supply line is filled with grease before the initial grease quantity is introduced.

During greasing, the guide should be moved several times over its full stroke length to ensure that the grease is evenly distributed.

4 Initial grease quantities

| Designation | Initial grease quantity |
|---|---|
| | g/mm cage length [1] |
| HW10 | 0.2 … 0.6 |
| HW15 [2], FFW2025, FFW2025ZW | 0.2 … 0.6 |
| HW20 [2], FFW2535, FFW2535ZW | 0.2 … 1 |
| HW25 [2], FFW3045, FFW3045ZW | 0.3 … 1.3 |
| HW30 [2], FFW3555, FFW3555ZW | 0.3 … 2.1 |
| HRW08 | 0.2 … 0.6 |
| HRW50 | 0.2 … 1.5 |
| HRW70 | 0.2 … 3.5 |
| HRW100 | 0.2 … 6.6 |
| H10 [2] | 0.1 … 0.3 |
| H15 [2] | 0.1 … 0.5 |
| H20 [2] | 0.2 … 0.7 |
| H25 [2] | 0.2 … 1.1 |
| FF2010 | 0.1 … 0.3 |
| FF2515 | 0.1 … 0.5 |
| FF3020 | 0.2 … 0.7 |
| FF3525 | 0.2 … 1.1 |

[1] For high velocities, select the lower value; for low velocities, aim for the higher value

[2] For damped cages, use 80 % of the specified values

### 1.6.6 Relubrication

During relubrication, the specified lubrication intervals must be observed.

The relubrication quantity is approximately 50 % of the initial grease quantity. It is preferable to relubricate several times in partial quantities rather than applying the full amount once at the relubrication interval.

### 1.6.7 Lubricating grease operating life

If a linear system cannot be relubricated, the operating life of the lubricating grease is then the decisive factor.

For most applications, the guide value can be calculated using the following formula:

43

$$t_{fG} = 2 \cdot t_{tR}$$

| | | |
|---|---|---|
| $t_{fG}$ | h | Guide value for grease operating life in operating hours |
| $t_{fR}$ | h | Guide value for relubrication interval in operating hours |

1

## 1.6.8 Calculating the lubrication interval

The basic lubrication interval $t_f$ applies to flat cage guides under the following conditions:

- bearing temperature t < +70°C
- load ratio $C_0/P = 20$
- lubrication with high-quality lithium soap grease
- no disruptive environmental influences
- stroke ratio between 1 and 10

### 1.6.8.1 Speed parameter

The speed parameter is defined in accordance with the following formula:

f44

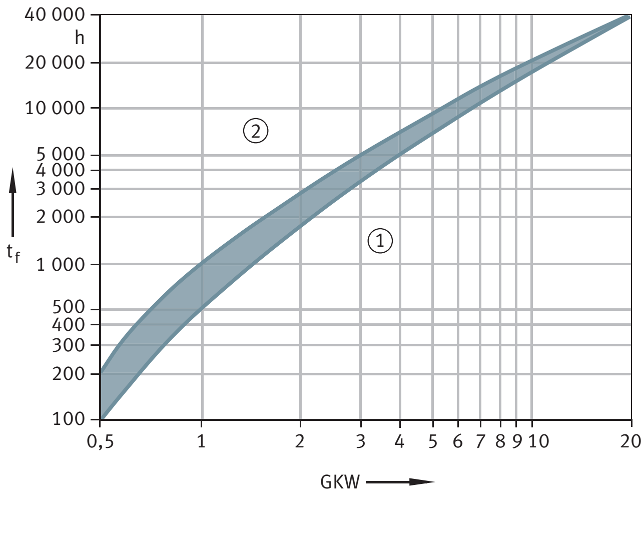
$$GKW = \frac{60}{\overline{v}} \cdot K_{LF}$$

| | | |
|---|---|---|
| GKW | – | Speed parameter |
| $K_{LF}$ | – | Bearing factor |
| $v_m$ | m/min | Medium speed |

5 Bearing factor $K_{LF}$

| Flat cage | Bearing factor $K_{LF}$ |
|---|---|
| HW, HRW, FFW | 1.5 |
| H, HR, FF | 1 |

12 Determining the basic lubrication interval



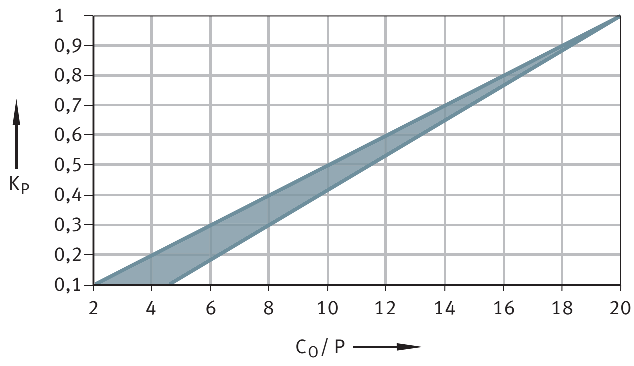

| | | | |
|---|---|---|---|
| 1 | Relubrication possible | 2 | Regreasing required |
| $t_f$ | Basic lubrication interval | GKW | Speed parameter |

### 1.6.8.2 Load correction factor $K_P$

The correction factor $K_P$ takes account of the strain on the grease when the load ratio $C_0/P < 20$.

! The factors apply to high-quality lithium soap grease only. The preload must be taken into consideration.

13 Correction factor $K_P$

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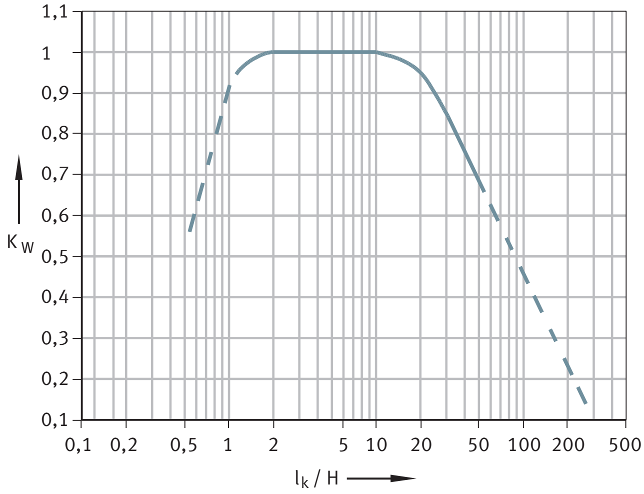
| | | | |
|---|---|---|---|
| $C_0/P$ | Load ratio | $K_P$ | Load correction factor |

### 1.6.8.3 Stroke correction factor $K_W$

The correction factor $K_W$ takes account of the displacement distance to be lubricated. It is dependent on the stroke ratio.

14 Correction factor $K_W$

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| | | | |
|---|---|---|---|
| $K_W$ | Stroke correction factor | $l_k/H$ | Stroke ratio |

The stroke ratio is defined in accordance with the following formula:

45

$$s / D = \frac{l_k}{H}$$

If the stroke ratio is < 10 or > 50, the relubrication interval must be shortened in order to reduce potential tribocorrosion.

With very small or very large strokes, the grease operating life may be shorter than the calculated guide value. In such cases, special greases are recommended. Please consult Schaeffler in this case.

| | | |
|---|---|---|
| H | mm | Distance between stroke end positions |
| $l_k$ | mm | Length of cage |

#### 1.6.8.4 Environmental correction factor $K_U$

The correction factor $K_U$ takes account of shaking forces, vibrations (a cause of tribocorrosion), and shocks.

! These influences place an additional strain on the grease. If cooling lubricants or moisture penetrate the system, calculation is not possible.

6 Environmental influence and correction factor

| Environmental influence | Correction factor $K_U$ |
|---|---|
| Low | 1 |
| Medium | 0.8 |
| High | 0.5 |

#### 1.6.8.5 Relubrication interval

Flat cage guides must be relubricated at appropriate intervals.

The length of the interval is essentially dependent on the following factors:

- velocity
- load
- temperature
- stroke
- ambient conditions

The shorter the lubrication intervals, the more easily the investment in lubrication devices can be economically justified. For long intervals, manual lubrication or the use of semi-automatic devices may be advantageous.

The relubrication interval and quantity can only be determined precisely under operating conditions, since not all influencing factors can be calculated. The observation period must be sufficiently long.

The relubrication interval $t_{fR}$ should not exceed one year, even if the value calculated using the equation is greater:

46

$$t_{fR} = t_f \cdot K_P \cdot K_W \cdot K_U$$

| | | |
|---|---|---|
| $K_P$, $K_W$, $K_U$ | – | Correction factors for load, stroke, and environment |
| $t_f$ | h | Basic lubrication interval in operating hours |
| $t_{fR}$ | h | Guide value for relubrication interval in operating hours |

## 1.7 Sealing

The type of sealing or shielding is of decisive importance in ensuring problem-free operation and a long operating life of the flat cage guides.

Depending on the operating conditions and requirements, the following sealing solutions are possible:

- wipers
- sealing strips
- complete solution for M guide rails and V guide rails with conventional wipers and integrated sealing strips

For most applications, wipers will be sufficient to keep the raceways clean.

! Wipers must remain in contact with the raceways throughout the entire stroke.

If the guide rails are exposed to heavy contamination or aggressive media, special sealing measures must be provided.

## 1.8 Application limits

### 1.8.1 Acceleration

The permissible acceleration of flat cage guides depends on the following factors:

For high accelerations, INA metal flat cages made of light alloy are particularly suitable. These cages have low weight and high strength. They are suitable for accelerations up to 250 m/s² and for velocities up to 15 m/s.

! For accelerations above 100 m/s², one guide rail should be extended by the stroke length, and both end pieces should be fixed to the shorter guide rail. This ensures that the cage is guided between the raceways in every position. If wipers are used, an end piece should also be fitted between the raceways and the rail.

### 1.8.2 Operating temperatures

Guide rails without wipers and used in conjunction with metal flat cages are suitable for continuous temperatures up to +150 °C, if appropriate lubrication is used.

Needle roller and cylindrical roller flat cages made of plastic can be used at temperatures up to +120 °C.

! For guide rails with wipers, the operating temperature must not exceed +100 °C.

Guide rails operated continuously at higher temperatures must be dimensionally stabilized. In this case, please consult Schaeffler.

## 1.9 Design of the bearing support

Flat cage guides can be fitted in open or closed arrangements.

### 1.9.1 M guide rails and V guide rails in a closed arrangement

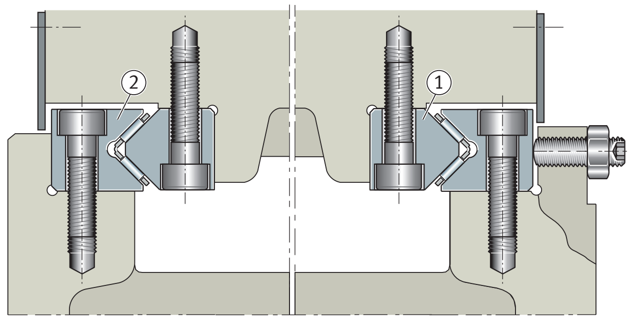
The closed arrangement is a locating/locating bearing support.

It consists of the following components:

- two M guide rails and two V guide rails, each with the corresponding angled flat cages

This arrangement is mainly used for applications featuring all types of load directions and moment loads. It allows for a compact design and any operating position. The arrangement can be preloaded.

15 Closed arrangement




1 M guide rail, V guide rail with angled flat cage

## 1.9.2 Determining the length based on technical requirements

The selection of guide rails and flat cages can be based on technical requirements or design constraints. In both cases, the stroke H is an important factor.

### 1.9.2.1 Cage length

The load carrying capacity and rigidity of the guide are determined by the cage size and cage length. For concentric loading, the size and length of the flat cages can theoretically be selected within wide limits.

However, for determining the cage length $l_k$ the following guide values have proven effective, both technically and economically:

- open arrangement:
  - cage length: $l_k \geq 1.5 \cdot H$
- closed arrangement:
  - cage length: $l_k \geq H$

For off-center loads and moment loads, the largest possible cage lengths and distances between the guide rails should be selected. This gives a more uniform load distribution.

### 1.9.2.2 Length of the guide rails

The cage length $l_k$ and stroke H are decisive in determining the length of the guide rails l.

When determining the length, the following points must be taken into account:

- For kinematic reasons, the flat cage always travels half the distance of the moving guide rail.
- The flat cage remains between the two guide rails, irrespective of the position of the moving guide rail, over its entire length.
- The wipers must remain in contact with the raceway at all times.

### 1.9.2.3 Guide rail without wipers

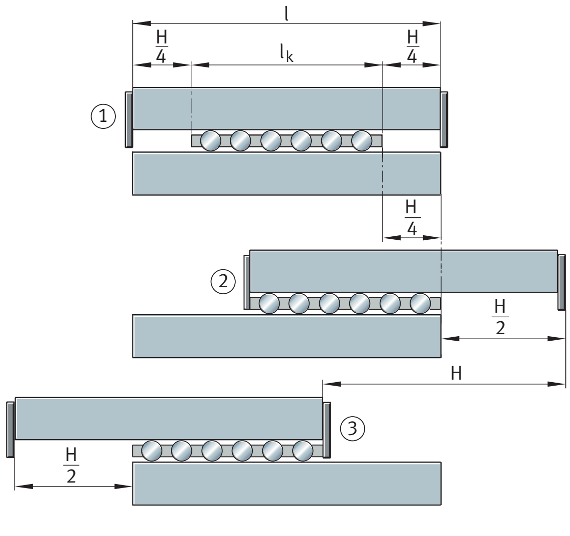
47

$$l = l_k + \frac{H}{2}$$

| | | |
|---|---|---|
| H | mm | Distance between stroke end positions |
| l | mm | Length of the guide rail |
| $l_k$ | mm | Length of cage |



16 Movement of guide rail and cage




| | | | |
|---|---|---|---|
| 1 | Center position | 2 | Right end position |
| 3 | Left end position | | |

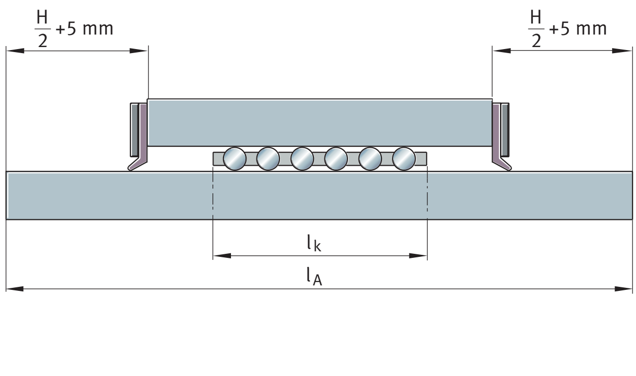
### 1.9.2.4 Guide rail with wipers

48

$$l_A = l_k + 3 \cdot \frac{H}{2} + 10\ \text{mm}$$

| | | |
|---|---|---|
| H | mm | Distance between stroke end positions |
| $l_A$ | mm | Length of guide rail with allowance for wipers |
| $l_k$ | mm | Length of cage |

17 Length of guide rail with wipers




## 1.9.3 Determining the length based on design constraints

In many cases, the maximum possible rail length l, $l_A$ and the stroke H are defined by design constraints. The kinematically possible cage length $l_k$ can then be determined using the following formulas.

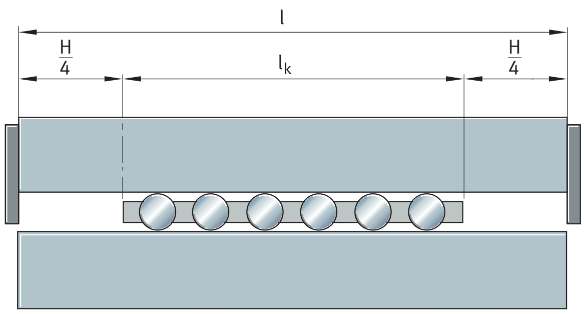
### 1.9.3.1 Guides without wipers

ƒ49

$$l_k = l - \frac{H}{2}$$

| | | |
|---|---|---|
| H | mm | Distance between stroke end positions |
| l | mm | Length of the guide rail |
| $l_k$ | mm | Length of cage |

18 Cage length for rails without wipers



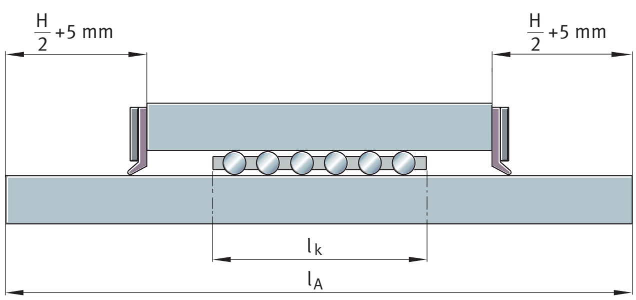

### 1.9.3.2 Guides with wipers

ƒ50

$$l_k = l_A - 3 \cdot \frac{H}{2} - 10\ \text{mm}$$

| | | |
|---|---|---|
| H | mm | Distance between stroke end positions |
| $l_A$ | mm | Length of guide rail with allowance for wipers |
| $l_k$ | mm | Length of cage |

19 Cage length for rails with wipers




## 1.9.4 End pieces and wipers

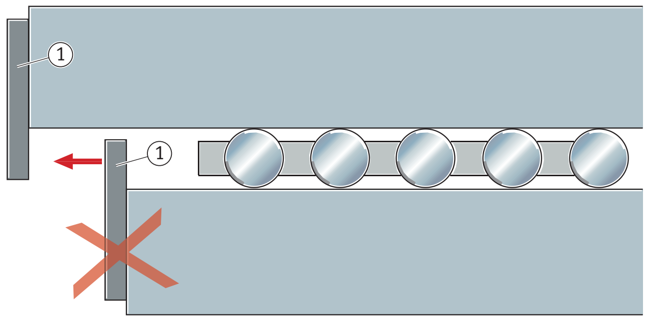
End pieces or wipers hold the cage in its nominal position at the stroke end positions.

Two end pieces or wipers should be fitted per cage. If this is not possible, the function of the end pieces must be fulfilled by elements of the adjacent construction.

Due to the risk of collision, it is not permissible to install end pieces or wipers on both guide rails.

Under special operating conditions, such as varying but constant stroke lengths over extended periods or where extreme loads are applied at the stroke end positions, the standard end pieces may no longer be able to fulfill the cage positioning function. Applications of this type can be managed by using a cage with integrated positive guidance.

20 Impermissible arrangement of end pieces or wipers

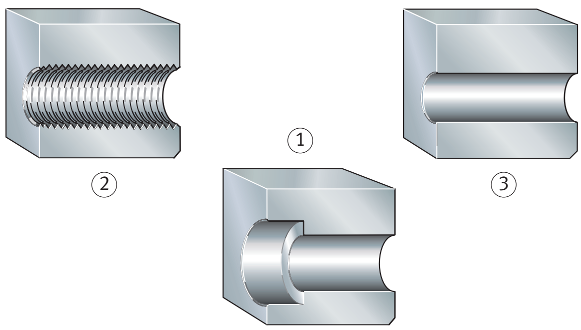



| | |
|---|---|
| 1 | End piece or wipers |

## 1.9.5 Location of guide rails

Guide rails are fastened to the adjacent construction using fixing screws. Various bore types are available for the rails. A symmetrical or an asymmetrical hole pattern can be selected.

21 Bore types




| | | | |
|---|---|---|---|
| 1 | B15 | 2 | B03 |
| 3 | B10 | | |

### 1.9.5.1 Insert nuts

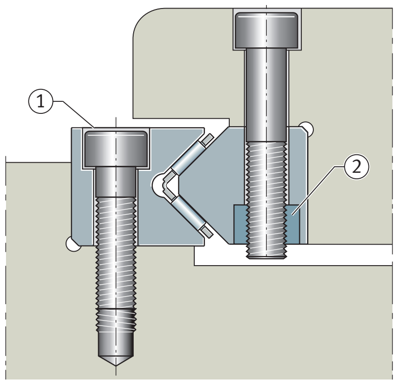
Stocked guide rails of the M and V series in standard lengths are supplied with bore type B15. The use of insert nuts ESM allows these rails to be mounted in the same way as bore type B03.

The insert nuts must be ordered separately.

Insert nuts are supplied loose and must be fixed in the countersunk hole by means of adhesive.

Only screws of strength class 8.8 may be used for fastening.

22 Location of M rails and V rails

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| | | | |
|---|---|---|---|
| 1 | Bore type B15 | 2 | Bore type B15 with ESM |

## 1.9.6 Hole patterns for guide rails

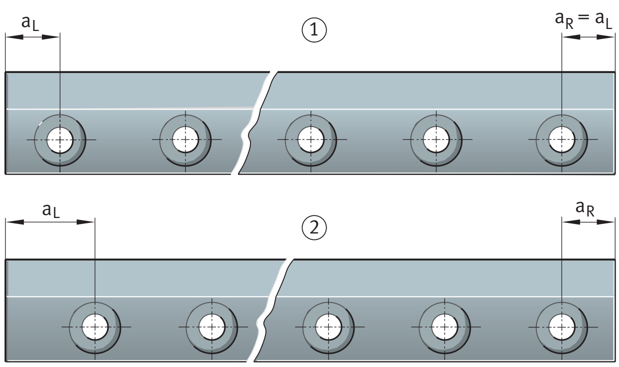
Unless specified otherwise, the guide rails have a symmetrical hole pattern.

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

For a symmetrical hole pattern, $a_L = a_R$, for an asymmetrical hole pattern, $a_L$ $a_R$. The position of $a_L$ depends on the hole pattern.

The position of the distance $a_L$ must be observed.

23 Hole patterns

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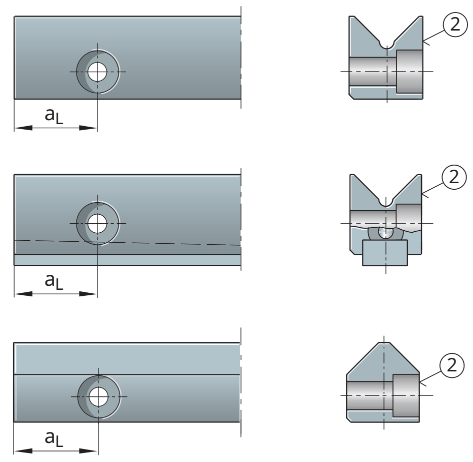
| | | | |
|---|---|---|---|
| 1 | Symmetrical hole pattern | 2 | Asymmetrical hole pattern |

24 Position of the first hole




2 Marking

## 1.9.7 Maximum number of pitches between holes

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

51

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

The distances $a_L$ and $a_R$ are generally determined by:

52

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

For guide rails with a symmetrical hole pattern, the following applies:

53

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

Number of holes:

54

$$x = n + 1$$

| | | |
|---|---|---|
| $a_L$ | mm | Distance from the start of the rail to the next hole |
| $a_R$ | mm | Distance from the end of the rail to the next hole |
| $a_{L\,min}$, $a_{R\,min}$ | mm | Minimum values for $a_L$, $a_R$ |
| $j_L$ | mm | Distance between holes |
| l | mm | Rail length |
| n | – | max. number of pitches |
| x | – | Number of holes |

If the minimum values for $a_L$ and $a_R$ are not observed, the countersunk holes may be cut off.

## 1.9.8 Demands on the adjacent construction

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

### 1.9.8.1 Geometrical and positional accuracy of the mounting surfaces

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

! The supporting surfaces of the guide rails should be fine-finished. To prevent seating errors, the holes must be carefully deburred.

### 1.9.8.2 Parallelism and perpendicularity

Any parallelism defects in the supporting surfaces should not exceed those of the corresponding guide rails.

The supporting and rear face surfaces of the adjacent components for M rails and V rails must be machined perpendicular to each other.

! The deviation must not exceed ±0 .3 mrad.

### 1.9.8.3 Positional tolerances of the fixing holes

A positional tolerance of Ø 0.2 mm must be maintained for the fixing holes in the adjacent construction.

### 1.9.8.4 Height difference

For uniform load distribution along the length of the rolling elements, the height difference ΔH must not be exceeded.

In an open arrangement, the height difference ΔH can be compensated by a shim on the non-locating bearing side or adjusted using the adjusting gib rail ML on the locating bearing side.

For needle roller flat cages:

ƒ55

$$\Delta H < 0.1 \cdot b$$

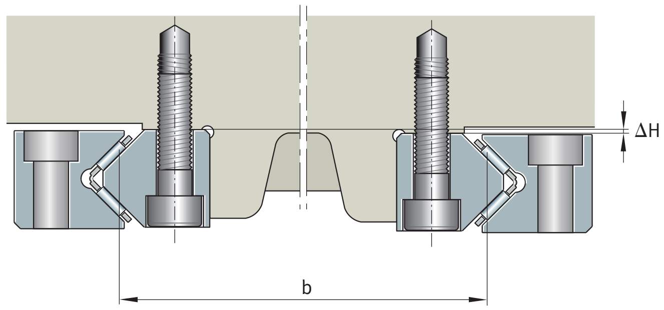
For cylindrical roller flat cages:

ƒ56

$$\Delta H < 0.3 \cdot b$$

| | | |
|---|---|---|
| b | mm | Distance between guides |
| ΔH | mm | Permissible height difference |

25 Height difference in closed configuration




## 1.10 Installation

Flat cage guides are precision machine elements. These products must be handled with great care before and during fitting. Their trouble-free operation also depends on the care taken during mounting.

The guide rails are preserved. Dimensionally matched parts are packaged together. If, for weight reasons, several units must be packaged together, these are marked accordingly.

The flat cages are preserved and packed with corrosion protection.

Packaging must be kept closed and stored in dry, clean rooms at a stable temperature. The relative humidity should not exceed 65 %.

### 1.10.1 Removing the guide rails

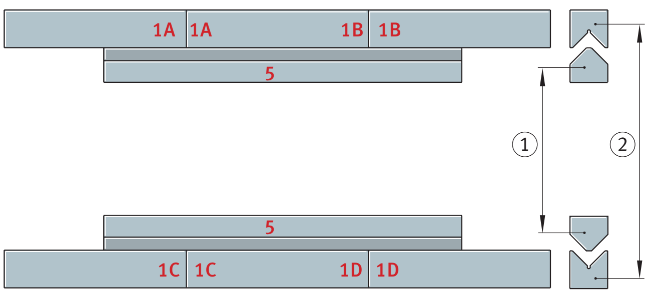
The rails must not be removed from the packaging until immediately before fitting. To protect them from corrosion during fitting, they must be lightly oiled.

Matched rails are supplied as sets.

When marking the parts, the following must be observed:

- parts with the same set number must be fitted in the same guide
- if an additional allocation within rails of the same set number is required, the corresponding parts are marked with the same letter

26 Marking of single-piece and multi-piece guide rails




| | | | |
|---|---|---|---|
| 1 | Pair 1 | 2 | Pair 2 |

! For metal cages, especially longer cages, care must be taken not to bend them during unpacking and fitting.

1

## 1.10.2 Fitting

**Notes on fitting for closed arrangements**

! For closed arrangements, the sequence of work steps must be followed precisely.

Guide rails packaged in pairs and bearing the same number must always be fitted in the same guide unit.

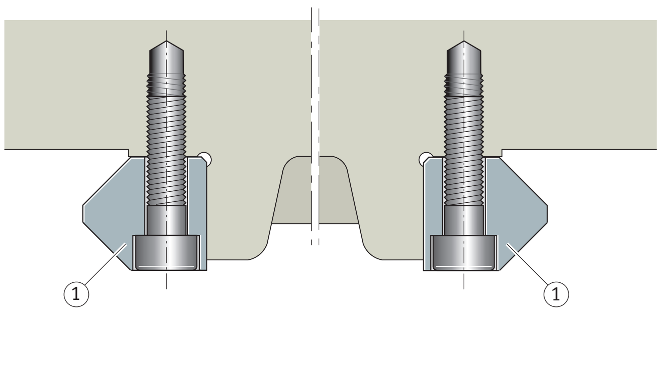
The supporting surfaces of the rails are not marked and can be identified by the larger edge break.

The guide rails must be clamped against the back support before tightening.

**Procedure**

1. Secure the fixed pair of guide rails to the table.

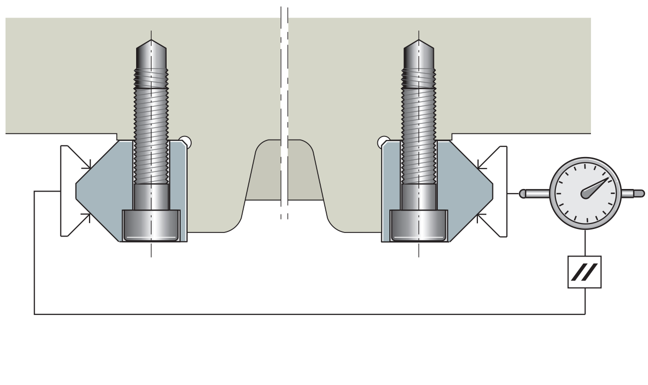
27 Fitting the pair of guide rails




1 Pair of guide rails

2. Check the pair of rails for parallelism.

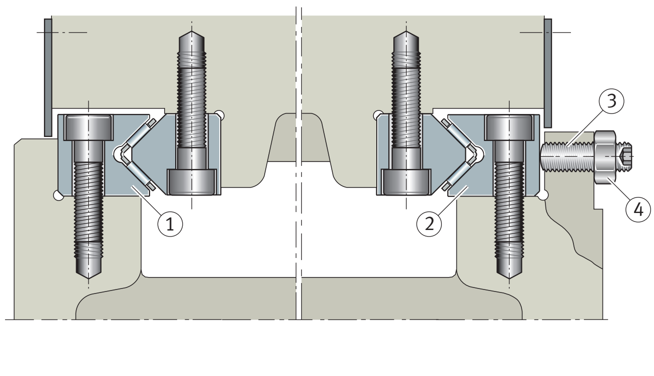
28 Checking parallelism




3. Fit the fixed counter-guide rail.
4. Fit the adjustable guide rail.
5. Do not fully tighten the fixing screws, so that the rail can be adjusted.
6. Insert the guide longitudinally.
7. Insert the cages between the guide rails and position them precisely.
8. Preload the adjustable guide rail using pressure screws (or an adjusting gib) to twice the desired value, then release it again (to compensate for settling effects).

9. Set the preload to the required value.
10. Tighten the fixing screws to the tightening torque $M_A$.
11. Fit the wipers and end pieces.

29 Fitting the closed arrangement




| | | | |
|---|---|---|---|
| 1 | Counter-guide rail | 2 | Adjustable guide rail |
| 3 | Pressure screw | 4 | Locknut |

## 1.10.3 Preloading using pressure screws

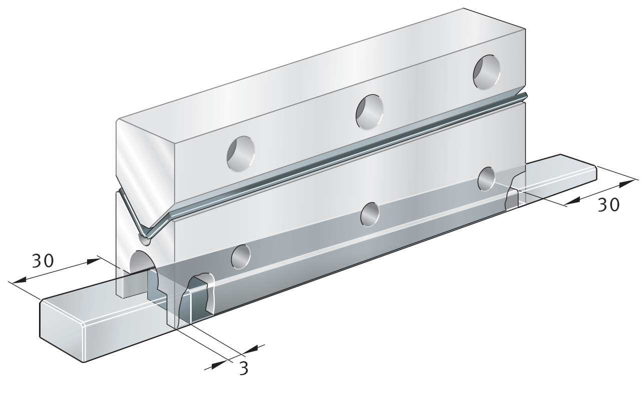
1. Tighten the pressure screws in 2 stages to the required tightening torque $M_A$.
2. Secure the pressure screws using locknuts or thread-locking compound.

! When tightening, move the movable part so that the respective pressure screw is always supported by the flat cage.

## 1.10.4 Preloading using the adjusting gib

1. Insert an unhardened, ground gib under guide rail ML and adjust the guide to be clearance-free.
› The gib will project approximately 30 mm beyond both ends of the rail.
2. Shorten the gib on the adjustment side of the guide rail so that it recedes by approximately 3 mm from the end face of the guide rail.
3. Shorten the gib on the opposite side so that it is flush with the rail end.

30 Inserting and shortening the gib

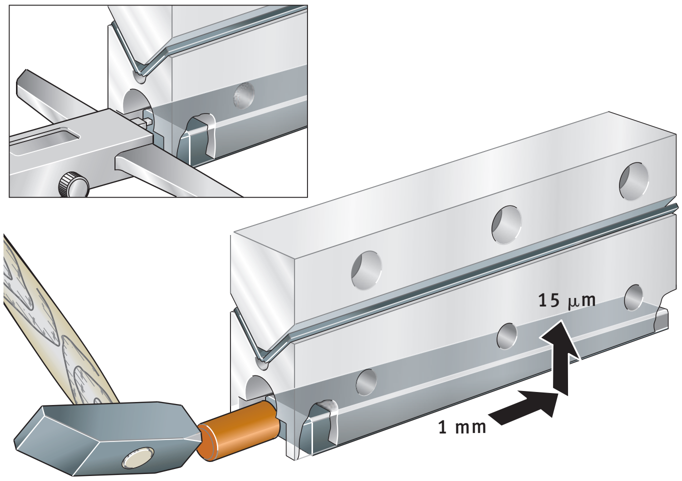


4. Drive in the gib using a copper drift and light hammer blows in order to preload the system.

› If the gib is shifted by 1 mm, the adjustment changes by approximately 15 μm.

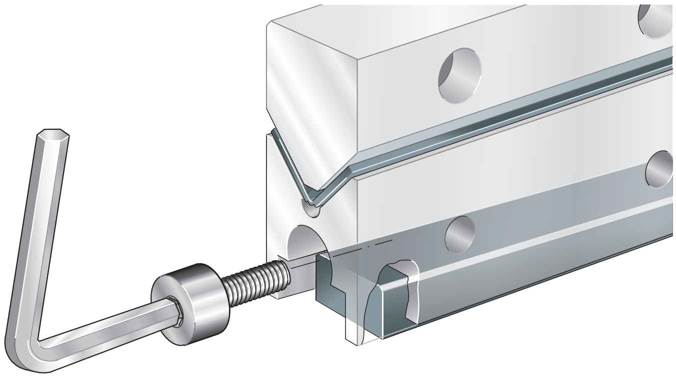
5. Check the preload.

31 Preloading the system




6. After adjustment, fix the position of the gib using the hexagon socket screw located on the end face of the guide rail.

32 Fixing the adjustment

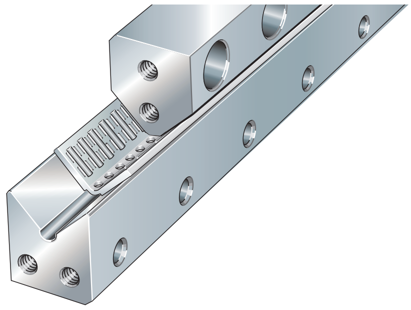


# 2 M guide rails and V guide rails

## 2.1 Product design

Flat cage guides consist of M-type and V-type guide rails, between which high-load-capacity and rigid angled flat cages are arranged. To ensure that loads are reliably supported, the cages contain a large number of needle rollers or cylindrical rollers.

33 Flat cage guide with angled flat cage, design MV




These guides are used as linear locating bearings and are particularly suitable for limited stroke applications. They feature high rigidity, high load-carrying capacity, and low, uniform friction within a very compact design envelope. Their high accuracy remains consistent throughout their entire operating life.

The guide rails are produced from through-hardened steel and have precision ground raceways and supporting surfaces. They exhibit a minimum hardness of 670 HV.

Different bore types (B03, B10, B15) enable flexible mounting solutions. The standard bore type is B15.

The positions of the first and last fixing holes $a_L$ and $a_R$ depend on the rail length and are identical at both ends of a rail ➤38|1.9.6.

Threaded holes at the rail end faces are provided as standard for securing end pieces or wipers.

The rails are available as single-piece designs up to the maximum standard production length of 1500 mm.

Guide rails exceeding the specified maximum length are supplied as multi-piece versions. For multi-piece rails, the total length must be specified when ordering. Single-piece rails exceeding the standard length are available by agreement.

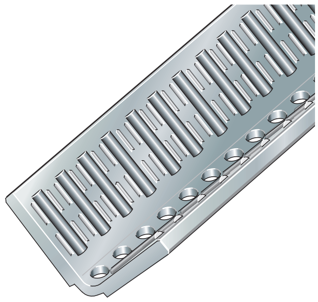
### 2.1.1 Angled flat cages

Angled flat cages are 2-row designs with their legs arranged at right angles to each other. They guide the rolling elements exactly parallel to the axis and maintain a defined spacing between them.

The needle rollers and cylindrical rollers are made of through-hardened rolling bearing steel in accordance with DIN 17230. The rolling elements have a minimum hardness of 670 HV, and their grade is G2.

The needle rollers are manufacturing in accordance with DIN 5402-3, ISO 3096-B and have flat end faces. Their ends are profiled. Due to this profiling, the outside surfaces are slightly crowned toward the ends. This reduces edge stresses at the ends of the rolling elements.

34 Needle roller flat cage, FFW, HW



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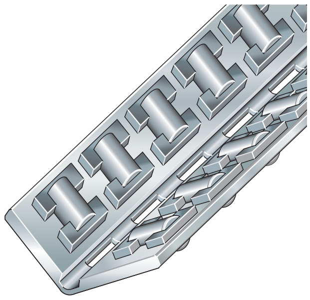
The dimensions and tolerances of the cylindrical rollers conform to DIN 5402-1.

35 Cylindrical roller flat cage, HRW



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Metal or plastic is used as the cage material.

Metal cages combine low weight with high strength. This makes them particularly suitable for demanding conditions, such as high accelerations, high temperatures, and partially exposed cage ends.

Plastic cages are an economical solution for less demanding operating conditions.

### 2.1.2 Operating temperature

Needle roller flat cages FFW are made of plastic. Cylindrical roller flat cage HRW features a light-alloy frame with a plastic insert. Both cage types are suitable for temperatures up to +120 °C. The HW cage is made of metal and can withstand temperatures up to +150 °C.

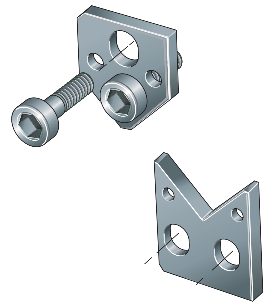
! For flat cage guides with plastic wipers, the operating temperature is limited to +100 °C.

### 2.1.3 End pieces, wipers, insert nuts

Functional accessories, as well as sealing strips for protecting the rolling element system, complete the range of guides.

End pieces EM and EV are made of steel and are supplied with fixing screws in accordance with DIN 7984:2022. They prevent the cage from creeping out of the load zone.

36 End pieces EM, EV



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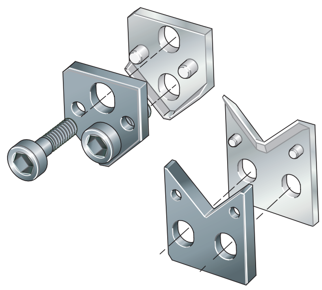
Wipers EAM and EAV protect the raceways of the rolling element system against contamination under normal operating conditions. They are made of plastic and feature a steel support plate.

The wipers are suitable for temperatures up to +100 °C and are supplied with fixing screws.

37 Wipers EAM, EAV



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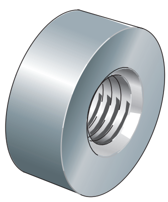
Insert nuts ESM allow bore type B15 (countersunk hole) to be converted into a threaded hole.

38 Insert nut ESM



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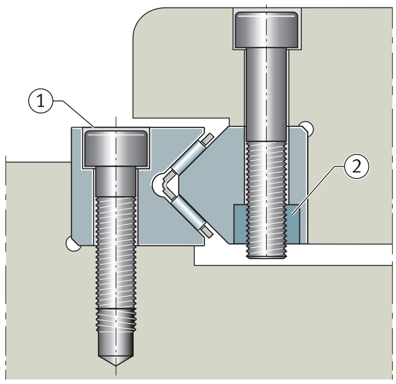
39 Bore with insert nut




| | | | |
|---|---|---|---|
| 1 | Bore type B15 | 2 | Insert nut ESM |

## 2.1.4 Design variants

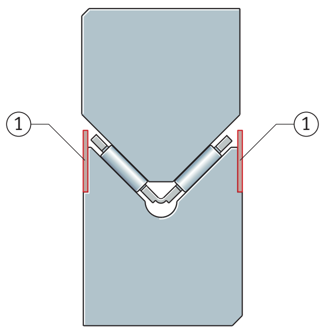
The following variants are available:

- guide rails with restricted tolerance (suffix US)
- Protect A: thin-layer chrome-plated guide rails for wear protection and corrosion protection (suffix KD)
- raceway lead chamfers at the rail ends (suffix E2)
- guide rails without holes in the end faces (suffix E1)
- guide rails without holes in the left end face (suffix E1L)
- guide rails without holes in the right end face (suffix E1R)

The following variants are available by agreement:

- guide rails with sealing strips (gap seals or lip seals)

40 Rail with sealing strips




| | |
|---|---|
| 1 | Sealing strips |

7 Suffixes

| Suffix | Description | Design |
|---|---|---|
| E1 | Rails without holes in the end faces | Standard |
| E1L | Rails without holes in the left end face | Standard |
| E1R | Rails without holes in the right end face | Standard |
| E2 | Raceway lead chamfers at the rail end | Standard |
| KD | Coating for wear protection and corrosion protection | Standard |
| US | Rails with restricted tolerance ±0.005 for $A_1$ or $A_2$ | Standard |

## 2.1.5 Planning guidelines

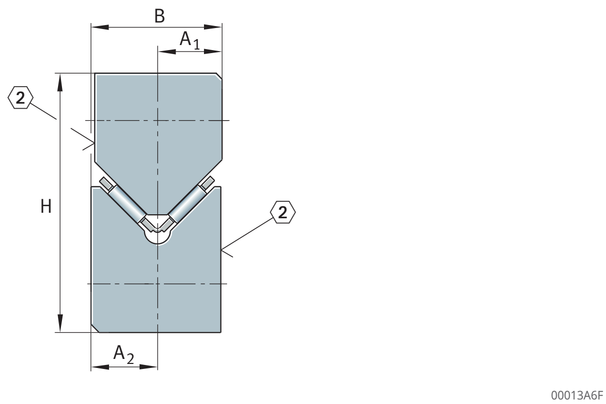
In a closed arrangement, 2 V rails or 2 M rails with identical dimensions $A_1$ or $A_2$ must always be used to ensure proper function.

Rails with restricted tolerance ±0.005 for dimensions $A_1$ or $A_2$ are identified by the suffix US. These rails can be freely paired when only standard accuracy requirements apply.

Where accuracy requirements are higher, pairing can be carried out in accordance with the marking on the rail:

- marking US-1:
  dimension $A_1$ or $A_2$
- marking US-2:
  dimension $A_1$ or $A_2$

41 Standard tolerances of rail profiles



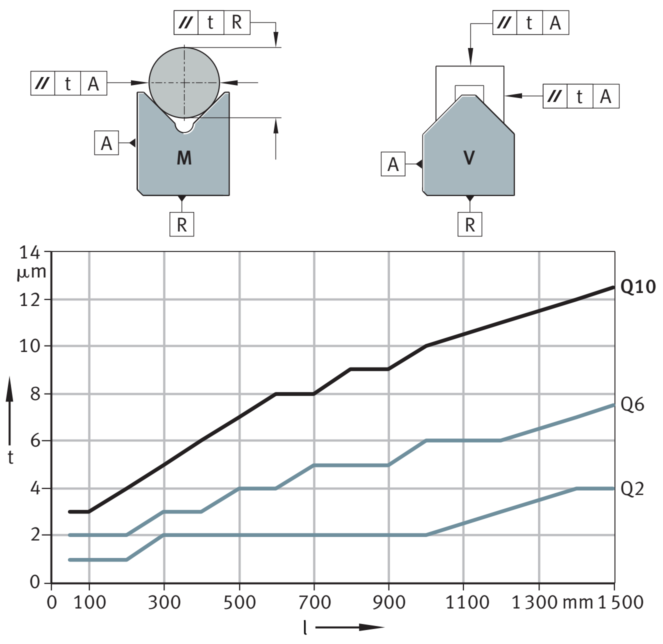

| | | | |
|---|---|---|---|
| 2 | Marking | B | Installation width $A_1$+ $A_2$ |
| H | Installation height | | |

## 2.1.6 Quality classes of guide rails

M guide rails and V guide rails are available in quality classes Q2, Q6, and Q20. The standard quality is Q10:

- Q2 is used for the highest requirements in precision machinery. This quality should only be applied when the accuracy of the adjacent construction is also correspondingly high.
- Q6 meets the requirements of precision carriage guides in machine tool construction.
- Q10 is the standard quality, suitable for all general machine construction requirements.
- Q20 meets the requirements associated with handling systems.

42 Quality classes and parallelism tolerances



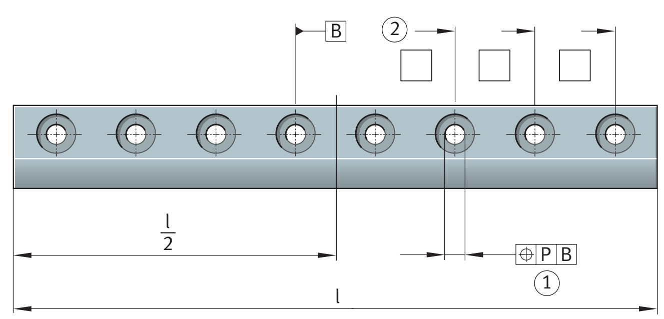

| | | | |
|---|---|---|---|
| t | Parallelism tolerance based on differential measurement | l | Rail length |

## 2.1.7 Positional tolerances

8 Positional tolerances of the fixing holes

| Designation | Positional tolerance P | Rail length l |
|---|---|---|
| | mm | mm |
| M3015 | 1.05 | 1500 |
| M4020 | 1.3 | 1500 |
| M4525 | 1.3 | 1500 |
| M5025 | 1.3 | 1500 |
| M6035 | 1.8 | 1500 |
| M6535 | 1.8 | 1500 |
| M7040 | 2.3 | 1500 |
| M8050 | 1.8 | 1500 |
| M8550 | 1.8 | 1500 |

43 Positional tolerances of the hole pattern




| | | | |
|---|---|---|---|
| 1 | Positional tolerance | 2 | Reference B is the hole located closest to the center of the rail (based on DIN 644) |
| l | Rail length | | |

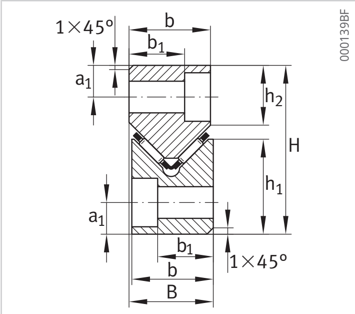
# 2.2 Product tables

## 2.2.1 Explanations

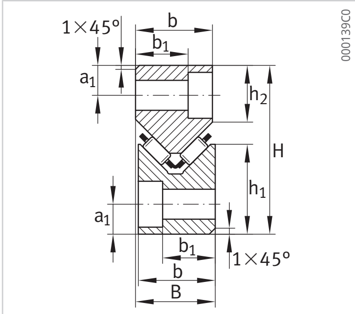
| | | |
|---|---|---|
| (1) | - | Holes for wipers, end piece |
| (2) | - | Marking |
| $a_1$ | mm | Mounting dimension |
| $a_L$ | mm | Distance from the start of the rail to the next hole |
| $a_R$ | mm | Distance from the end of the rail to the next hole |
| b | mm | Mounting dimension |
| b | mm | Width of the end piece |
| B | mm | Width of the rail |
| $b_1$ | mm | Mounting dimension |
| G | – | Thread |
| $G_1$ | – | Fixing screw |
| h | mm | Height of the insert nut |
| H | mm | Height of the rail |
| $h_1$ | mm | Mounting dimension |
| $h_1$ | mm | Height of the end piece |
| $h_2$ | mm | Mounting dimension |
| $h_2$ | mm | Height of the end piece |
| $j_L$ | mm | Distance between holes |
| $K_1$ | – | Fixing screw |
| l | mm | Rail length |
| $N_1$ | mm | Bore diameter |
| $N_2$ | mm | Bore diameter |
| $N_2$ | mm | Diameter of the insert nut |
| S | mm | Dimension |
| $S_1$ | mm | Dimension |
| $T_5$ | mm | Thread depth |

## 2.2.2 M guide rails and V guide rails

With angled flat cage




With needle roller flat cage



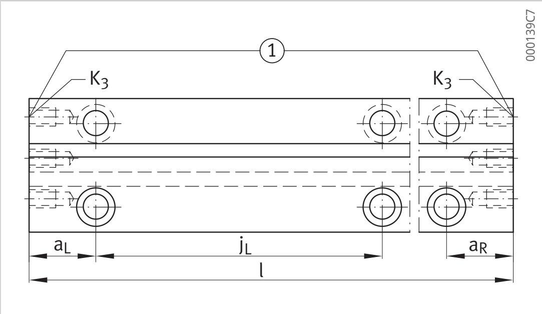

With cylindrical roller flat cage

| Designation | l [1] | H | B | b | $h_1$ | $h_2$ | $a_1$ | $b_1$ | $j_L$ [2] | $a_L$ [3] | $a_R$ [3] | $T_5$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | –0.2 | –0.1 | –0.2 | | | | | | min. | min. | min. |
| | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm |
| **M3015** | 1500 | 30 | 15 | 15 | 15.5 | – | 5.5 | 10.3 | 40 | 15 | 15 | 15 |
| **V3015** | 1500 | 30 | 15 | 15 | – | 10.5 | 5.5 | 10.3 | 40 | 15 | 15 | 15 |
| **M4020** | 1500 | 40 | 20 | 20 | 22.25 | – | 7.5 | 13 | 80 | 15 | 15 | 20 |
| **V4020** | 1500 | 40 | 20 | 20 | – | 13.5 | 7.5 | 13 | 80 | 15 | 15 | 20 |
| **M4525** | 1500 | 45 | 25 | 25 | 22.5 | – | 7.5 | 18 | 80 | 20 | 20 | 15 |
| **V4525** | 1500 | 45 | 25 | 25 | – | 14 | 7.5 | 18 | 80 | 20 | 20 | 15 |
| **M5025** | 1500 | 50 | 25 | 25 | 27.8 | – | 10 | 18 | 80 | 20 | 20 | 15 |
| **V5025** | 1500 | 50 | 25 | 25 | – | 17 | 10 | 18 | 80 | 20 | 20 | 15 |
| **M6035** | 1500 | 60 | 35 | 35 | 34.75 | – | 11 | 25.8 | 100 | 20 | 20 | 20 |
| **V6035** | 1500 | 60 | 35 | 35 | – | 20 | 11 | 25.8 | 100 | 20 | 20 | 20 |
| **M6535** | 1500 | 65 | 35 | 35 | 33 | – | 11 | 25.8 | 100 | 20 | 20 | 20 |
| **V6535** | 1500 | 65 | 35 | 35 | – | 20 | 11 | 25.8 | 100 | 20 | 20 | 20 |
| **M7040** | 1500 | 70 | 40 | 40 | 39.75 | – | 13 | 28.8 | 100 | 20 | 20 | 25 |
| **V7040** | 1500 | 70 | 40 | 40 | – | 24 | 13 | 28.8 | 100 | 20 | 20 | 25 |
| **M8050** | 1500 | 80 | 50 | 50 | 44.75 | – | 14 | 36.8 | 100 | 20 | 20 | 30 |
| **V8050** | 1500 | 80 | 50 | 50 | – | 26 | 14 | 36.8 | 100 | 20 | 20 | 30 |
| **M8550** | 1500 | 85 | 50 | 50 | 42 | – | 14 | 36.8 | 100 | 20 | 20 | 30 |
| **V8550** | 1500 | 85 | 50 | 50 | – | 26 | 14 | 36.8 | 100 | 20 | 20 | 30 |

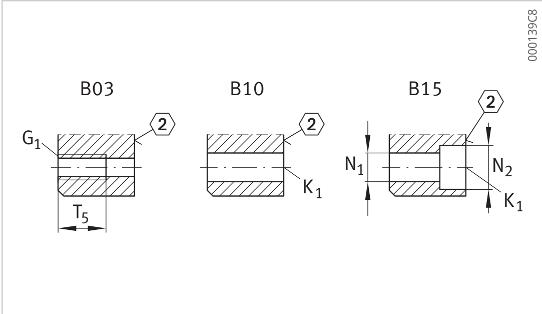
[1] Extended lengths available by agreement.

[2] M3015 and V3015: For l = 100 mm to 109 mm, $j_L$ = 35 mm (3 holes).
Other sizes: For $l < j_L + a_{L\,min} + a_{R\,min}$, $j_L$ = 50 mm.

[3] $a_L$ and $a_R$ depend on the rail length.
The minimum values must not be undercut.




M rail and V rail

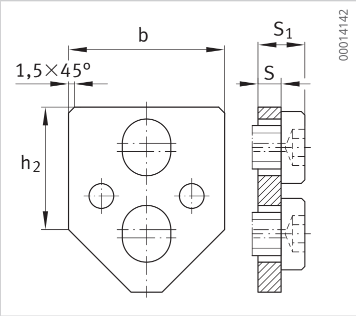



Bore types

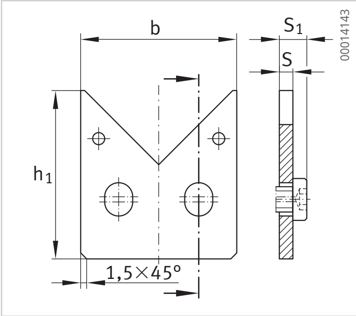
| $N_1$ | $N_2$ | $K_1$ | $G_1$ | Needle roller cage | | Cylindrical roller cage | End pieces | | Insert nut |
|---|---|---|---|---|---|---|---|---|---|
| | | DIN ISO 4762-12.9 | | Plastic | Metal | | Without wipers | With wipers | |
| mm | mm | – | – | | | | | | |
| 5.25 | 8.5 | M4 | M3 | – | HW10 | – | EM3015 | EAM3015 | ESM-M4 |
| 5.25 | 8.5 | M4 | M3 | – | HW10 | – | EV3015 | EAV3015 | ESM-M4 |
| 7.5 | 11.5 | M6 | M5 | FFW2025 | HW15 | – | EM4020 | EAM4020 | ESM-M6 |
| 7.5 | 11.5 | M6 | M5 | FFW2025 | HW15 | – | EV4020 | EAV4020 | ESM-M6 |
| 7.5 | 11.5 | M6 | M6 | – | – | HRW50 | EM4525 | EAM4525 | ESM-M6 |
| 7.5 | 11.5 | M6 | M6 | – | – | HRW50 | EV4525 | EAV4525 | ESM-M6 |
| 7.5 | 11.5 | M6 | M6 | FFW2025 | HW16 | – | EM5025 | EAM5025 | ESM-M6 |
| 7.5 | 11.5 | M6 | M6 | FFW2025 | HW16 | – | EV5025 | EAV5025 | ESM-M6 |
| 10 | 15 | M8 | M6 | FFW2535 | HW20 | – | EM6035 | EAM6035 | ESM-M8 |
| 10 | 15 | M8 | M6 | FFW2535 | HW20 | – | EV6035 | EAV6035 | ESM-M8 |
| 10 | 15 | M8 | M6 | – | – | HRW70 | EM6535 | EAM6535 | ESM-M8 |
| 10 | 15 | M8 | M6 | – | – | HRW70 | EV6535 | EAV6535 | ESM-M8 |
| 12.5 | 18.5 | M10 | M6 | FFW3045 | HW25 | – | EM7040 | EAM7040 | ESM-M10 |
| 12.5 | 18.5 | M10 | M6 | FFW3045 | HW25 | – | EV7040 | EAV7040 | ESM-M10 |
| 14 | 20 | M12 | M6 | FFW3555 | HW30 | – | EM8050 | EAM8050 | ESM-M12 |
| 14 | 20 | M12 | M6 | FFW3555 | HW30 | – | EV8050 | EAV8050 | ESM-M12 |
| 14 | 20 | M12 | M6 | – | – | HRW100 | EM8550 | EAM8550 | ESM-M12 |
| 14 | 20 | M12 | M6 | – | – | HRW100 | EV8550 | EAV8550 | ESM-M12 |

## 2.2.3 End pieces

Series EV, EM




EV



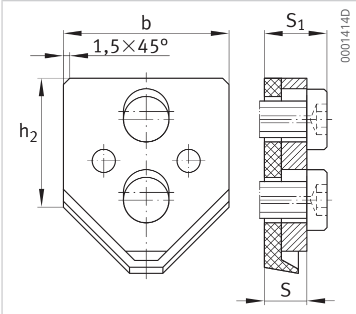

EM

| Designation [1] | b | $h_2$ | $h_1$ | $S_1$ max. | S | Guide rail |
|---|---|---|---|---|---|---|
| | mm | mm | mm | mm | mm | |
| **EV3015** | 13.4 | 10.7 | – | 4 | 2 | V3015 |
| **EM3015** | 13.4 | – | 15.1 | 4 | 2 | M3015 |
| **EV4020** | 18 | 14.88 | – | 6.5 | 3 | V4020 |
| **EM4020** | 18.7 | – | 22.1 | 6.5 | 3 | M4020 |
| **EV4525** | 23.1 | 19.44 | – | 7 | 3 | V4525 |
| **EM4525** | 23.1 | – | 26.1 | 7 | 3 | M4525 |
| **EV5025** | 23.1 | 17.4 | – | 7 | 3 | V5025 |
| **EM5025** | 23.1 | – | 28.1 | 7 | 3 | M5025 |
| **EV6035** | 33 | 20.4 | – | 7 | 3 | V6035 |
| **EM6035** | 33 | – | 34 | 7 | 3 | M6035 |
| **EV6535** | 33 | 26.75 | – | 7 | 3 | V6535 |
| **EM6535** | 33 | – | 39 | 7 | 3 | M6535 |
| **EV7040** | 38 | 25 | – | 7 | 3 | V7040 |
| **EM7040** | 38 | – | 40 | 7 | 3 | M7040 |
| **EV8050** | 48 | 28 | – | 7 | 3 | V8050 |
| **EM8050** | 48 | – | 48 | 7 | 3 | M8050 |
| **EV8550** | 48 | 37.2 | – | 7 | 3 | V8550 |
| **EM8550** | 48 | – | 52.5 | 7 | 3 | M8550 |

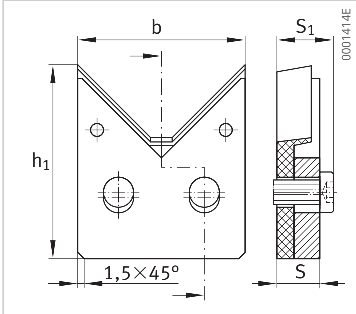
[1] The end pieces are supplied with fixing screws in accordance with DIN 7984.

## 2.2.4 Wipers

Series EAV, EAM




EAV



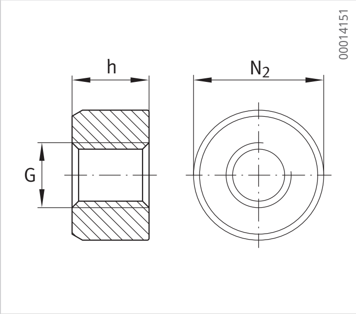

EAM

| Designation [1] | b | $h_2$ | $h_1$ | $S_1$ max. | S | Guide rail |
|---|---|---|---|---|---|---|
| | mm | mm | mm | mm | mm | |
| **EAV3015** | 13.4 | 12.9 | – | 6 | 4 | V3015 |
| **EAM3015** | 13.4 | – | 17.7 | 6 | 4 | M3015 |
| **EAV4020** | 18 | 16.7 | – | 8.5 | 5 | V4020 |
| **EAM4020** | 18.7 | – | 24.85 | 8.5 | 5 | M4020 |
| **EAV4525** | 23.1 | 21.2 | – | 9 | 5 | V4525 |
| **EAM4525** | 23.1 | – | 28.8 | 9 | 5 | M4525 |
| **EAV5025** | 23.1 | 19.9 | – | 9 | 5 | V5025 |
| **EAM5025** | 23.1 | – | 30.8 | 9 | 5 | M5025 |
| **EAV6035** | 33 | 23.7 | – | 9 | 5 | V6035 |
| **EAM6035** | 33 | – | 37.4 | 9 | 5 | M6035 |
| **EAV6535** | 33 | 29.3 | – | 9 | 5 | V6535 |
| **EAM6535** | 33 | – | 42.4 | 9 | 5 | M6535 |
| **EAV7040** | 38 | 27.7 | – | 9 | 5 | V7040 |
| **EAM7040** | 38 | – | 43.7 | 9 | 5 | M7040 |
| **EAV8050** | 48 | 30.5 | – | 9 | 5 | V8050 |
| **EAM8050** | 48 | – | 51.5 | 9 | 5 | M8050 |
| **EAV8550** | 48 | 39.7 | – | 9 | 5 | V8550 |
| **EAM8550** | 48 | – | 56.5 | 9 | 5 | M8550 |

[1] The end pieces are supplied with fixing screws in accordance with DIN 7984.

## 2.2.5 Insert nuts

Series ESM




ESM

| Desig-nation [1)] | G | $N_2$ | h | Guide rail | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | −0.05<br>−0.1 | | | | | | | |
| | – | mm | mm | | | | | | |
| **ESM-M4** | M4 | 8.5 | 4.3 | M3015 | V3015 | – | – | – | – |
| **ESM-M6** | M6 | 11.5 | 6.5 | M4020 | V4020 | M4525 | V4525 | M5025 | V5025 |
| **ESM-M8** | M8 | 15 | 8.5 | M6035 | V6035 | M6535 | V6536 | – | – |
| **ESM-M10** | M10 | 18.5 | 10.5 | M7040 | V7040 | – | – | – | – |
| **ESM-M12** | M12 | 20 | 12.5 | M8050 | V8050 | M8550 | V8550 | – | – |

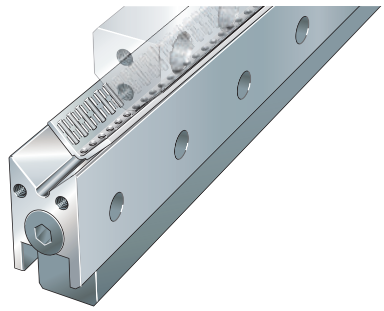
[1)] Insert nuts must be ordered separately.
Use insert nuts ESM for screws of strength class 8.8.

# 3 ML guide rails and V guide rails with adjusting gib

## 3.1 Product design

Flat cage guides consist of ML-type guide rails with adjusting gib and V-type guide rails, between which high-load-capacity and rigid angled flat cages are arranged. To ensure that loads are reliably supported, the cages contain a large number of needle rollers.

44 Flat cage guide, design MLV



00013C5A

The unhardened adjusting gib in the ML rail is used to apply preload to the guide. The adjusting gib ensures the preload is distributed evenly along the entire length of the guide. The slope of the gib surface is 1.5 %. A displacement of the gib by 1 mm changes the height by 15 μm.

These guides are used as linear locating bearings and are particularly suitable for limited stroke applications. They feature high rigidity, high load-carrying capacity, and low, uniform friction within a very compact design envelope. Their high accuracy remains consistent throughout their entire operating life.

The guide rails are produced from through-hardened steel and have precision ground raceways and supporting surfaces. They exhibit a minimum hardness of 670 HV.

Different bore types of the ML guide rail (B03, B15) enable flexible mounting solutions. The standard bore type is B15.

The positions of the first and last fixing holes $a_L$ und $a_R$ depend on the rail length and are identical at both ends of the rail ➤38 | 1.9.6.

Threaded holes at the rail end faces are provided as standard for securing end pieces or wipers.

The rails are available as single-piece designs up to the maximum standard production length of 1000 mm. Single-piece rails exceeding the standard length are available by agreement.

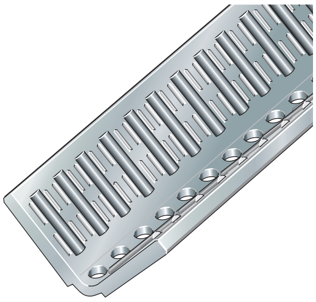
### 3.1.1 Angled flat cages

Angled flat cages are 2-row designs with their legs arranged at right angles to each other. They guide the rolling elements exactly parallel to the axis and maintain a defined spacing between them.

The needle rollers used are made of through-hardened rolling bearing steel in accordance with DIN 17230. The rolling elements have a minimum hardness of 670 HV, and their grade is G2.

The needle rollers are manufactured in accordance with DIN 5402-3 and ISO 3096-B and have flat end faces. Their ends are profiled. Due to this profiling, the outside surfaces are slightly crowned toward the ends. This reduces edge stresses at the ends of the rolling elements.

45 Needle roller flat cage, FFW, HW



00014086

Metal or plastic is used as the cage material.

Metal cages combine low weight with high strength. This makes them particularly suitable for demanding conditions, such as high accelerations, high temperatures, and partially exposed cage ends.

Plastic cages are an economical solution for less demanding operating conditions.

### 3.1.2 Operating temperature

Needle roller flat cages FFW are made of plastic. Cage type FFW is suitable for temperatures up to +120 °C. Needle roller flat cages HW are made of metal and can withstand temperatures up to +150 °C.

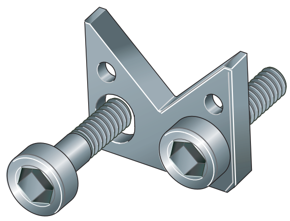
! For flat cage guides with plastic wipers, the operating temperature is limited to +100 °C.

### 3.1.3 End pieces, wipers, insert nuts

Functional accessories, as well as sealing strips for protecting the rolling element system, complete the range of guides.

End pieces EML are made of steel. They prevent the cage from creeping out of the load zone.

46 End pieces EML

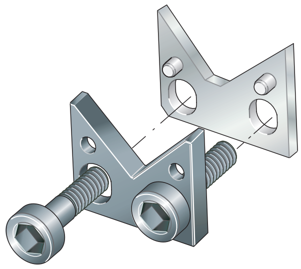


000148FA

Wipers EAML protect the raceways of the rolling element system against contamination under normal operating conditions. They are made of plastic and feature a steel support plate.

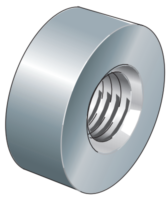
The wipers are suitable for temperatures up to +100 °C and are supplied with fixing screws.

47 Wipers EAML

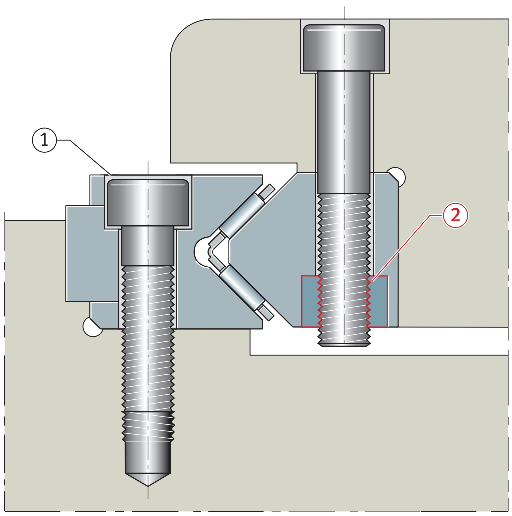



Insert nuts ESM allow bore type B15 (countersunk hole) to be converted into a threaded hole.

48 Insert nut ESM




49 Bore with insert nut




| | | | |
|---|---|---|---|
| 1 | Bore type B15 | 2 | Insert nut ESM |

3

### 3.1.4 Design variants

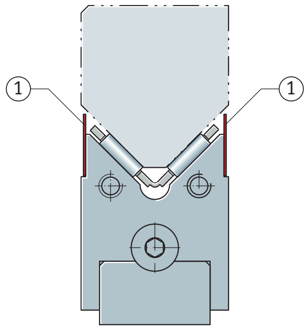
The following variants are available:

- guide rails with restricted tolerance (suffix US)
- Protect A: thin-layer chrome-plated guide rails for wear protection and corrosion protection (suffix KD)
- raceway lead chamfers at the rail ends (suffix E2)
- guide rails without holes in the end faces (suffix E1)
- guide rails without holes in the left end face (suffix E1L)
- guide rails without holes in the right end face (suffix E1R)

The following variants are available by agreement:

- guide rails with sealing strips (gap seals or lip seals)

50 Rail with sealing strips




1 Sealing strips

9 Suffixes

| Suffix | Description | Design |
|---|---|---|
| E1 | Rails without holes in the end faces | Standard |
| E1L | Rails without holes in the left end face | Standard |
| E1R | Rails without holes in the right end face | Standard |
| E2 | Raceway lead chamfers at the rail end | Standard |
| KD | Coating for wear protection and corrosion protection | Standard |
| US | Rails with restricted tolerance ±0.005 for $A_1$ or $A_2$ | Standard |

### 3.1.5 Planning guidelines

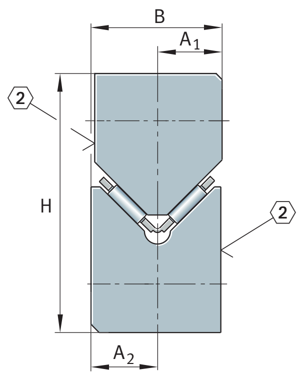
In a closed arrangement, 2 V rails or 1 ML rail and 1 M rail with identical dimensions $A_1$ or $A_2$ must always be used to ensure proper function.

Rails with restricted tolerance ± 0.005 for dimensions $A_1$ or $A_2$ are identified by the suffix US. These rails can be freely paired when only standard accuracy requirements apply.

Where accuracy requirements are higher, pairing can be carried out in accordance with the marking on the rail:

- marking US-1:
  dimension $A_1$ or $A_2$
- marking US-2:
  dimension $A_1$ or $A_2$

51 Standard tolerances of rail profiles



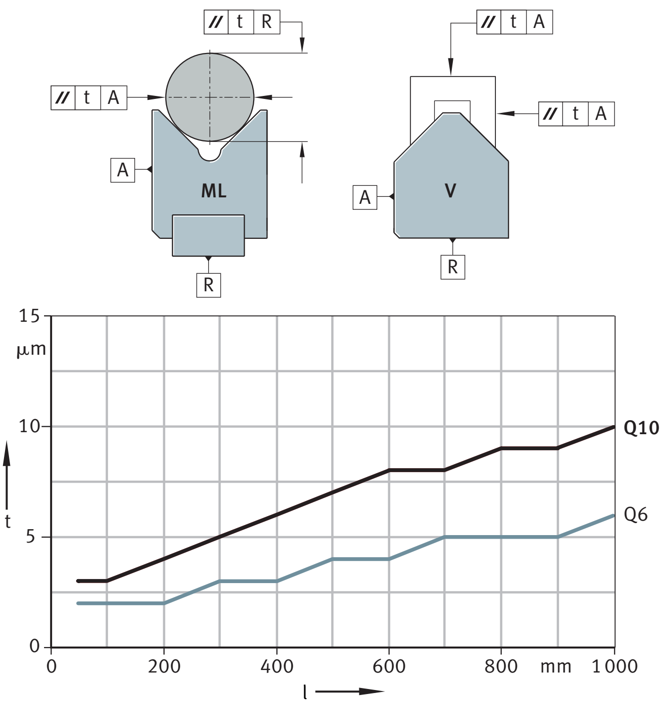

| | | | |
|---|---|---|---|
| 2 | Marking | B | Installation width $A_1$+ $A_2$ |
| H | Installation height | | |

## 3.1.6 Quality classes of guide rails

ML guide rails and V guide rails are available in quality classes Q6 and Q10:

- Q6 meets the requirements of precision carriage guides in machine tool construction.
- Q10 is the standard quality, suitable for all general machine construction requirements.

52 Quality classes and parallelism tolerances




| | | | |
|---|---|---|---|
| t | Parallelism tolerance based on differential measurement | l | Rail length |

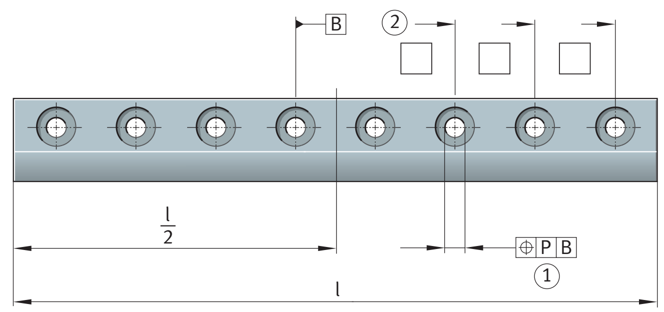
3

## 3.1.7 Positional tolerances

10 Positional tolerances of the fixing holes

| Designation | Positional tolerance P | Rail length l |
|---|---|---|
| | mm | mm |
| ML5020 | 1.3 | 300 |
| ML5520 | 1.3 | 600 |
| ML5525 | 1.3 | 250 |
| ML6025 | 1.3 | 500 |
| ML6525 | 1.3 | 750 |
| ML7025 | 1.3 | 1000 |
| ML7035 | 1.8 | 500 |
| ML8035 | 1.8 | 1000 |
| ML8040 | 2.3 | 500 |
| ML9040 | 2.3 | 1000 |
| ML9050 | 1.8 | 500 |
| ML10050 | 1.8 | 1000 |

53 Positional tolerances of the hole pattern




| | | | |
|---|---|---|---|
| 1 | Positional tolerance | 2 | Reference B is the hole located closest to the center of the rail (based on DIN 644) |
| l | Rail length | | |

## 3.2 Product tables

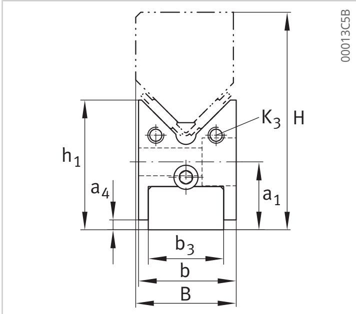
### 3.2.1 Explanations

| | | |
|---|---|---|
| (1) | - | Holes for wipers, end piece |
| (2) | - | Marking |
| $a_1$ | mm | Mounting dimension |
| $a_4$ | mm | Mounting dimension |
| $a_5$ | mm | Mounting dimension |
| $a_L$ | mm | Distance from the start of the rail to the next hole |
| $a_R$ | mm | Distance from the end of the rail to the next hole |
| b | mm | Mounting dimension |
| b | mm | Width of the end piece |
| B | mm | Width of the rail |
| $b_1$ | mm | Mounting dimension |
| $b_3$ | mm | Mounting dimension |
| G | – | Thread |
| $G_1$ | – | Fixing screw |
| h | mm | Height of the insert nut |
| H | mm | Height of the rail |
| $h_1$ | mm | Mounting dimension |
| $h_1$ | mm | Height of the end piece |
| $j_L$ | mm | Distance between holes |
| $K_1$ | – | Fixing screw |
| l | mm | Rail length |
| $N_1$ | mm | Bore diameter |
| $N_2$ | mm | Bore diameter |
| $N_2$ | mm | Diameter of the insert nut |
| S | mm | Dimension |
| $S_1$ | mm | Dimension |
| $T_5$ | mm | Thread depth |

3

## 3.2.2 ML guide rails

With adjusting gib and angled flat cage




ML

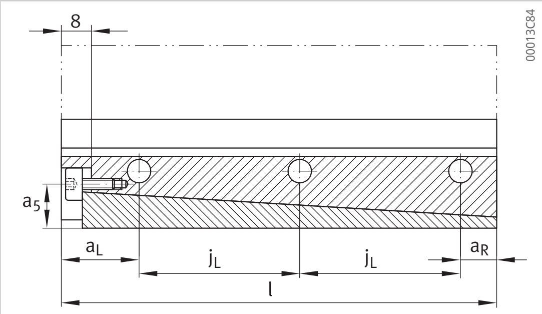
| Designation | l [1)] | | H [2)] | B | b | $h_1$ [2)] | $a_1$ | $b_1$ | $b_3$ | $a_4$ | $j_L$ [3)] | $a_L$ [4)] | $a_R$ [4)] | $T_5$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | min. | max. | | –0.1 | –0.2 | | | | | | | min. | min. | min. |
| | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm |
| **ML5020** | 100 | 300 | 50 | 20 | 20 | 32.5 | 17.5 | 13 | 15 | 5.5 | 80 | 30 | 15 | 20 |
| **ML5520** | 301 | 600 | 55 | 20 | 20 | 37.5 | 22.5 | 13 | 15 | 6 | 80 | 30 | 15 | 20 |
| **ML5525** | 100 | 250 | 55 | 25 | 25 | 32.5 | 15 | 18 | 20 | 2.5 | 80 | 30 | 20 | 15 |
| **ML6025** | 251 | 500 | 60 | 25 | 25 | 37.5 | 20 | 18 | 20 | 3.5 | 80 | 30 | 20 | 15 |
| **ML6525** | 501 | 750 | 65 | 25 | 25 | 42.5 | 25 | 18 | 20 | 5 | 80 | 30 | 20 | 15 |
| **ML7025** | 751 | 1000 | 70 | 25 | 25 | 47.5 | 30 | 18 | 20 | 6.5 | 80 | 30 | 20 | 15 |
| **ML7035** | 100 | 500 | 70 | 35 | 35 | 45 | 21 | 25.8 | 25 | 3 | 100 | 32 | 20 | 20 |
| **ML8035** | 501 | 1000 | 80 | 35 | 35 | 55 | 31 | 25.8 | 25 | 5 | 100 | 32 | 20 | 20 |
| **ML8040** | 100 | 500 | 80 | 40 | 40 | 50 | 23 | 28.8 | 30 | 3 | 100 | 32 | 20 | 25 |
| **ML9040** | 501 | 1000 | 90 | 40 | 40 | 60 | 33 | 28.8 | 30 | 5 | 100 | 32 | 20 | 25 |
| **ML9050** | 100 | 500 | 90 | 50 | 50 | 55 | 24 | 36.8 | 40 | 3 | 100 | 32 | 20 | 30 |
| **ML10050** | 501 | 1000 | 100 | 50 | 50 | 65 | 34 | 36.8 | 40 | 5 | 100 | 32 | 20 | 30 |

1) Extended lengths available by agreement.

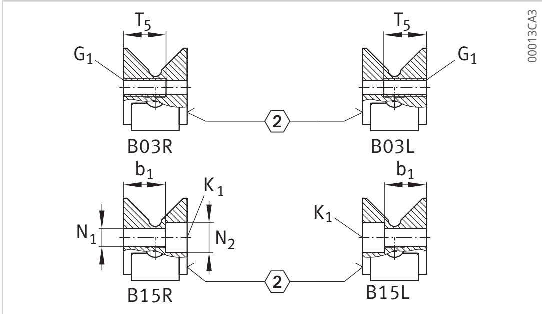
2) The different side heights H and $h_1$ of a profile are determined by the gib heights, which depend on the gib length. Adjustment range for H: –0.5 mm to +0.3 mm.

3) For the length $l < j_L + a_{L\,min} + a_{R\,min}$, $j_L$ = 50 mm.

4) $a_L$ is always on the side of the adjusting gib. The end distances $_L$ and $a_R$ depend on the rail length. The minimum values must not be undercut.
If $l - \Sigma \cdot j_L < 2 \cdot a_{L\,min}$, then $a_R < a_{L\,min}$ up to $a_R = a_{R\,min}$
, or if $l - \Sigma \cdot j_L \leq 2 \cdot a_{L\,min}$, then $a_L = a_R$.
In contrast to M guide rails and V guide rails, the asymmetry of $a_L$ and $a_R$ is not indicated separately for series ML.




ML




Bore types

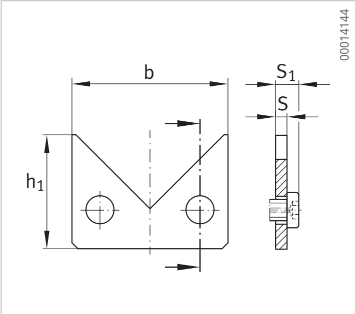


| $N_1$ | $N_2$ | $a_5$ | $K_1$ | $G_1$ | Guide rail | Angled flat cages | | End pieces | | Insert nut |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | DIN 912-8.8 | | | Plastic | Metal | Without wipers | With wipers | |
| mm | mm | mm | – | – | | | | | | |
| 7.5 | 11.5 | 15 | M6 | M4 | V4020 | FFW2025 | HW15 | EML20 | EAML20 | ESM-M6 |
| 7.5 | 11.5 | 20 | M6 | M4 | V4020 | FFW2025 | HW15 | EML20 | EAML20 | ESM-M6 |
| 7.5 | 11.5 | 11.5 | M6 | M5 | V5025 | FFW2025 | HW16 | EML25 | EAML25 | ESM-M6 |
| 7.5 | 11.5 | 16.5 | M6 | M5 | V5025 | FFW2025 | HW16 | EML25 | EAML25 | ESM-M6 |
| 7.5 | 11.5 | 21.5 | M6 | M5 | V5025 | FFW2025 | HW16 | EML25 | EAML25 | ESM-M6 |
| 7.5 | 11.5 | 26.5 | M6 | M5 | V5025 | FFW2025 | HW16 | EML25 | EAML25 | ESM-M6 |
| 10 | 15 | 15.5 | M8 | M6 | V6035 | FFW2535 | HW20 | EML35 | EAML35 | ESM-M8 |
| 10 | 15 | 25.5 | M8 | M6 | V6035 | FFW2535 | HW20 | EML35 | EAML35 | ESM-M8 |
| 12.5 | 18.5 | 16 | M10 | M6 | V7040 | FFW3045 | HW25 | EML40 | EAML40 | ESM-M10 |
| 12.5 | 18.5 | 26 | M10 | M6 | V7040 | FFW3045 | HW25 | EML40 | EAML40 | ESM-M10 |
| 14 | 20 | 15.5 | M12 | M6 | V8050 | FFW3555 | HW30 | EML40 | EAML40 | ESM-M12 |
| 14 | 20 | 25.5 | M12 | M6 | V8050 | FFW3555 | HW30 | EML40 | EAML40 | ESM-M12 |

3

### 3.2.3 End piece

Series EML



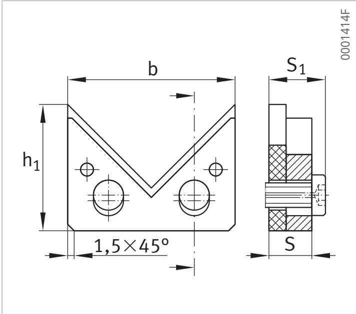

EML

| Designation 1) | b | $h_1$ | $S_1$ | S | Guide rail | |
|---|---|---|---|---|---|---|
| | | | max. | | | |
| | mm | mm | mm | mm | | |
| **EML20** | 19 | 12 | 6.5 | 3 | ML5020 | ML5520 |
| **EML25** | 24 | 15 | 6.5 | 3 | ML5525 | ML7025 |
| **EML35** | 34 | 23 | 6.5 | 3 | ML7035 | ML8035 |
| **EML40** | 39 | 28.5 | 6.5 | 3 | ML8040 | ML9040 |
| **EML50** | 49 | 35 | 6.5 | 3 | ML9050 | ML10050 |

1) The end pieces are supplied with fixing screws in accordance with DIN 7984.

## 3.2.4 Wipers

Series EAML




EAML

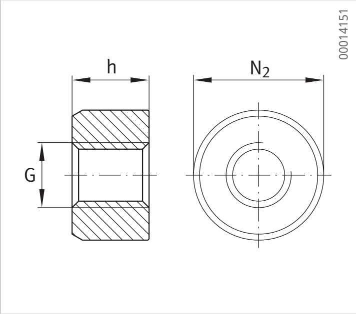
| Designation [1] | b | $h_1$ | $S_1$ | S | Guide rail | |
|---|---|---|---|---|---|---|
| | | | max. | | | |
| | mm | mm | mm | mm | | |
| **EAML20** | 19 | 14 | 8 | 5 | ML5020 | ML5520 |
| **EAML25** | 24 | 18.4 | 8.5 | 5 | ML5525 | ML7025 |
| **EAML35** | 34 | 25.7 | 8.5 | 5 | ML7035 | ML8035 |
| **EAML40** | 39 | 31.2 | 8.5 | 5 | ML8040 | ML9040 |
| **EAML50** | 49 | 39.6 | 8.5 | 5 | ML9050 | ML10050 |

[1] The end pieces are supplied with fixing screws in accordance with DIN 7984.

3

## 3.2.5 Insert nuts

Series ESM




ESM

| Designation [1] | G | $N_2$ | h | Guide rail | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | −0.05 −0.1 | | | | | | | |
| | – | mm | mm | | | | | | |
| **ESM-M6** | M6 | 11.5 | 6.5 | ML5020 | ML5520 | ML5525 | ML6025 | ML6525 | ML7025 |
| **ESM-M8** | M8 | 15 | 8.5 | ML7035 | ML8035 | – | – | – | – |
| **ESM-M10** | M10 | 18.5 | 10.5 | ML8040 | ML9040 | – | – | – | – |
| **ESM-M12** | M12 | 20 | 12.5 | ML9050 | ML10050 | – | – | – | – |

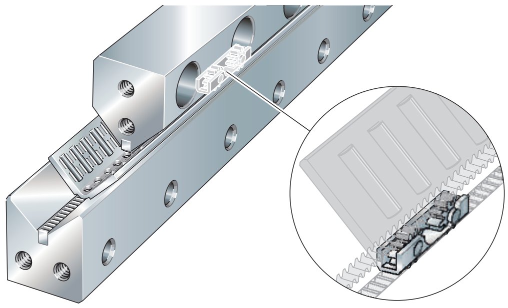
[1] Insert nuts must be ordered separately.
Use insert nuts ESM for screws of strength class 8.8.

# 4 M guide rails and V guide rails with positive cage control

## 4.1 Product design

Flat cage guides consist of M-type and V-type guide rails, between which high-load-capacity and rigid angled flat cages with an integrated gear unit are arranged. To provide positive cage control, the V rail is equipped with a toothed rack. The cages reliably support high loads thanks to the large number of needle rollers.

54 Flat cage guide with angled flat cage, toothed rack, and gear unit, design MVZ




Guide rails with positive cage control are used when there is a risk of cage creep, for example in designs with uneven rigidity within the guide area or when the end positions are not regularly reached.

These guides are used as linear locating bearings and are particularly suitable for limited stroke applications. They feature high rigidity, high load-carrying capacity, and low, uniform friction within a very compact design envelope. Their high accuracy remains consistent throughout their entire operating life.

The guide rails are produced from through-hardened steel and have precision ground raceways and supporting surfaces. They exhibit a minimum hardness of 670 HV. The toothed rack is unhardened. The mounting dimensions of the rails correspond to those of the M and V guide rails.

Different bore types (B03, B10, B15) enable flexible mounting solutions. The standard bore type is B15.

The positions of the first and last fixing holes $a_L$ und $a_R$ depend on the rail length and are identical at both ends of the rail ➤38|1.9.6.

Threaded holes at the rail end faces are provided as standard for securing end pieces or wipers.

The rails are available as single-piece designs up to the maximum standard production length of 1500 mm. Single-piece rails exceeding the standard length are available by agreement.

MVZ guides are supplied as sets only, comprising 2 M rails and 2 V rails with 2 angled flat cages. M guide rails and V guide rails with positive cage control are available by agreement.

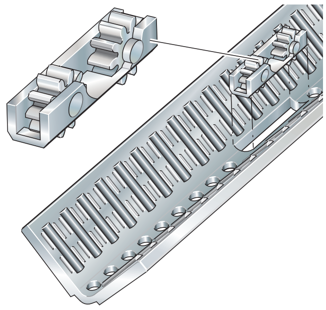
### 4.1.1 Angled flat cages

Angled flat cages are 2-row designs with their legs arranged at right angles to each other. They are positively guided by an integrated gear unit.

The needle rollers used are made of through-hardened rolling bearing steel in accordance with DIN 17230. The rolling elements have a minimum hardness of 670 HV, and their grade is G2.

The needle rollers are manufactured in accordance with DIN 5402-3 and ISO 3096-B and have flat end faces. Their ends are profiled. Due to this profiling, the outside surfaces are slightly crowned toward the ends. This reduces edge stresses at the ends of the rolling elements.

55 Needle roller flat cage with integrated gear unit, HW



000140E0

Metal or plastic is used as the cage material.

Metal cages combine low weight with high strength. This makes them particularly suitable for demanding conditions, such as high accelerations, high temperatures, and partially exposed cage ends.

### 4.1.2 Operating temperature

Needle roller flat cages with gear unit are made of metal and can withstand temperatures up to +150 °C.

! For flat cage guides with plastic wipers, the operating temperature is limited to +100 °C.

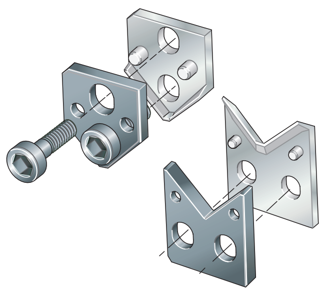
### 4.1.3 Wipers, insert nuts

Functional accessories complete the guides.

Wipers EAM and EAV protect the raceways of the rolling element system against contamination under normal operating conditions. They are made of plastic and feature a steel support plate.

The wipers are suitable for temperatures up to +100 °C and are supplied with fixing screws.

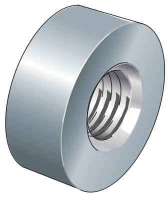
56 Wipers EAM, EAV



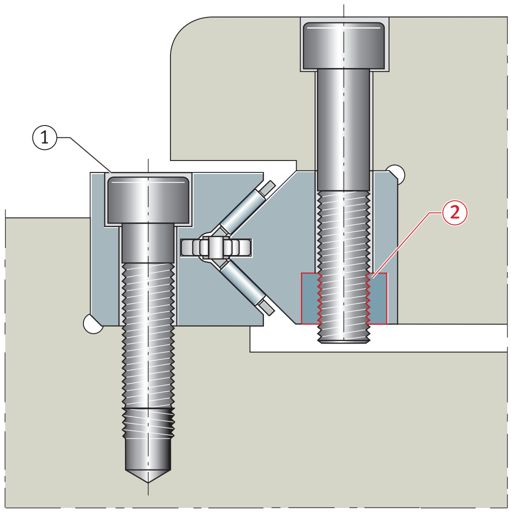
000148F0

Insert nuts ESM allow bore type B15 (countersunk hole) to be converted into a threaded hole.

57 Insert nut ESM




58 Bore with insert nut




| | | | |
|---|---|---|---|
| 1 | Bore type B15 | 2 | Insert nut ESM |

### 4.1.4 Design variants

The following variants are available:

- guide rails with restricted tolerance (suffix US)
- Protect A: thin-layer chrome-plated guide rails for wear protection and corrosion protection (suffix KD)
- raceway lead chamfers at the rail ends (suffix E2)
- guide rails without holes in the end faces (suffix E1)
- guide rails without holes in the left end face (suffix E1L)
- guide rails without holes in the right end face (suffix E1R)

11 Suffixes

| Suffix | Description | Design |
|---|---|---|
| E1 | Rails without holes in the end faces | Standard |
| E1L | Rails without holes in the left end face | Standard |
| E1R | Rails without holes in the right end face | Standard |
| E2 | Raceway lead chamfers at the rail end | Standard |
| KD | Coating for wear protection and corrosion protection | Standard |
| US | Rails with restricted tolerance ±0.005 for $A_1$ or $A_2$ | Standard |

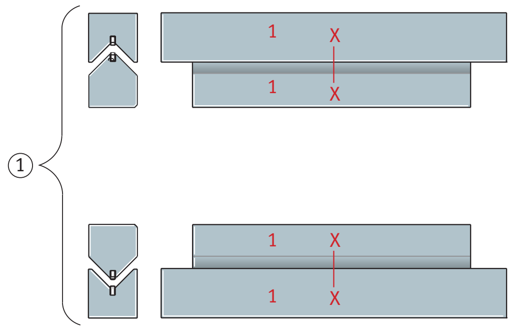
### 4.1.5 Planning guidelines

The guide rails must be fitted as sets, ensuring that the set number is observed in each case.

**!** An incorrect relative position between the guide rails and the flat cage can cause the cage to collide with the wipers or connection points. For this reason, it is essential to observe the marking x–x, which indicates the correct relative position of the guide rails and flat cage in the stroke center position.

The correct relative position between the guide rail and the flat cage must be ensured at all times during installation.

59 Marking of rail profiles and cages




00014B14

| | | | |
|---|---|---|---|
| 1 | Set | x–x | Marking |

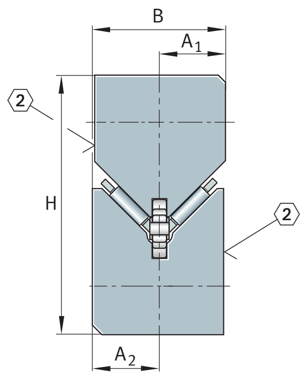
In a closed arrangement, 2 V rails or 2 M rails with identical dimensions $A_1$ or $A_2$ must always be used to ensure proper function.

Rails with restricted tolerance ±0.005 for dimensions $A_1$ or $A_2$ are identified by the suffix US. These rails can be freely paired when only standard accuracy requirements apply.

Where accuracy requirements are higher, pairing can be carried out in accordance with the marking on the rail:

- marking US-1:
  dimension $A_1$ or $A_2$
- marking US-2:
  dimension $A_1$ or $A_2$

60 Standard tolerances of rail profiles



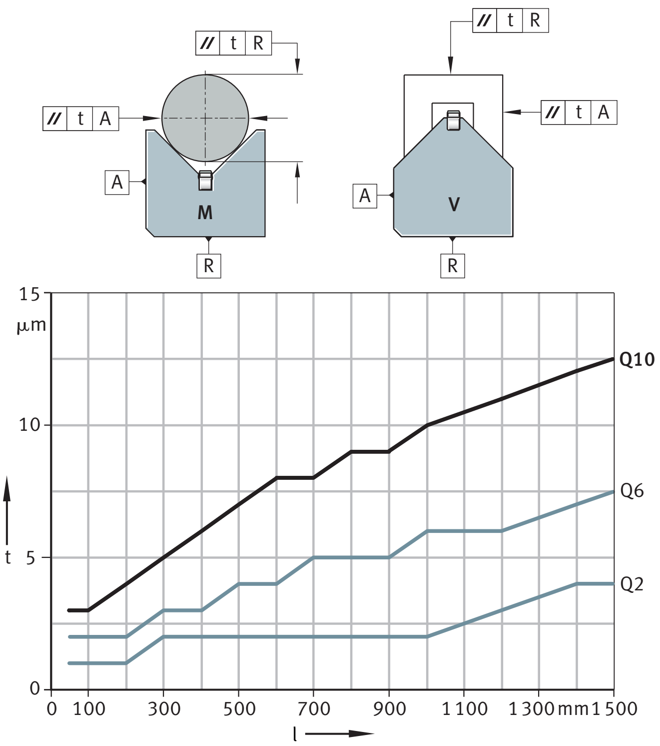

000140DB

| | | | |
|---|---|---|---|
| 2 | Marking | B | Installation width $A_1$+ $A_2$ |
| H | Installation height | | |

### 4.1.6 Quality classes of guide rails

M guide rails and V guide rails are available in quality classes Q2, Q6, and Q10:

- Q2 is used for the highest requirements in precision machinery. This quality should only be applied when the accuracy of the adjacent construction is also correspondingly high.
- Q6 meets the requirements of precision carriage guides in machine tool construction.
- Q10 is the standard quality, suitable for all general machine construction requirements.




| | | | |
|---|---|---|---|
| t | Parallelism tolerance based on differential measurement | l | Rail length |

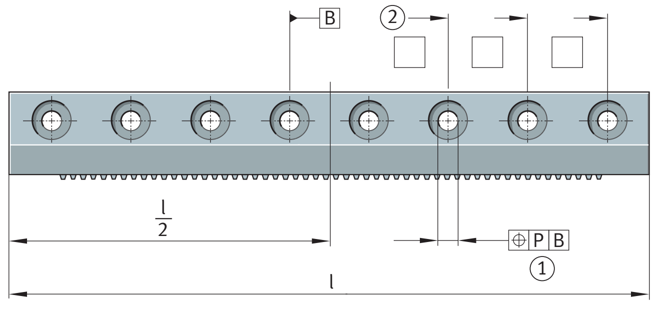
### 4.1.7 Positional tolerances

12 Positional tolerances of the fixing holes

| Designation | Positional tolerance P | Rail length l |
|---|---|---|
| | mm | mm |
| M3015 | 1.05 | 1500 |
| M4020 | 1.3 | 1500 |
| M5025 | 1.3 | 1500 |
| M6035 | 1.8 | 1500 |
| M7040 | 2.3 | 1500 |
| M8050 | 1.8 | 1500 |

4

61 Positional tolerances of the hole pattern




| | | | |
|---|---|---|---|
| 1 | Positional tolerance | 2 | Reference B is the hole located closest to the center of the rail (based on DIN 644) |
| l | Rail length | | |

## 4.2 Product tables

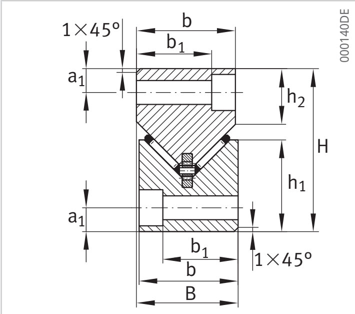
### 4.2.1 Explanations

| | | |
|---|---|---|
| (1) | - | Holes for wipers, end piece |
| (2) | - | Marking |
| $a_1$ | mm | Mounting dimension |
| $a_L$ | mm | Distance from the start of the rail to the next hole |
| $a_R$ | mm | Distance from the end of the rail to the next hole |
| b | mm | Mounting dimension |
| b | mm | Width of the end piece |
| B | mm | Width of the rail |
| $b_1$ | mm | Mounting dimension |
| G | – | Thread |
| $G_1$ | – | Fixing screw |
| h | mm | Height of the insert nut |
| H | mm | Height of the rail |
| $h_1$ | mm | Mounting dimension |
| $h_1$ | mm | Height of the end piece |
| $h_2$ | mm | Mounting dimension |
| $h_2$ | mm | Height of the end piece |
| $j_L$ | mm | Distance between holes |
| $K_1$ | – | Fixing screw |
| l | mm | Rail length |
| $N_1$ | mm | Bore diameter |
| $N_2$ | mm | Bore diameter |
| $N_2$ | mm | Diameter of the insert nut |
| S | mm | Dimension |
| $S_1$ | mm | Dimension |
| $T_5$ | mm | Thread depth |

4

## 4.2.2 M guide rails and V guide rails

With integrated toothed rack for positive cage control



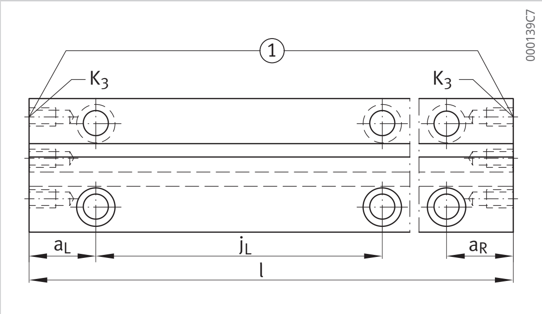

MVZ

| Designation | l [1] | H | B | b | $h_1$ | $h_2$ | $a_1$ | $b_1$ | $j_L$ [2] | $a_L$ [3] | $a_R$ [3] | $T_5$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | −0.2 | −0.1 | −0.2 | | | | | | min. | min. | min. |
| | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm |
| **M3015** | 1500 | 30 | 15 | 15 | 15.5 | – | 5.5 | 10.3 | 40 | 15 | 15 | 15 |
| **V3015** | 1500 | 30 | 15 | 15 | – | 10.5 | 5.5 | 10.3 | 40 | 15 | 15 | 15 |
| **M4020** | 1500 | 40 | 20 | 20 | 22.25 | – | 7.5 | 13 | 80 | 15 | 15 | 20 |
| **V4020** | 1500 | 40 | 20 | 20 | – | 13.5 | 7.5 | 13 | 80 | 15 | 15 | 20 |
| **M5025** | 1500 | 50 | 25 | 25 | 27.8 | – | 10 | 18 | 80 | 20 | 20 | 15 |
| **V5025** | 1500 | 50 | 25 | 25 | – | 17 | 10 | 18 | 80 | 20 | 20 | 15 |
| **M6035** | 1500 | 60 | 35 | 35 | 34.75 | – | 11 | 25.8 | 100 | 20 | 20 | 20 |
| **V6035** | 1500 | 60 | 35 | 35 | – | 20 | 11 | 25.8 | 100 | 20 | 20 | 20 |
| **M7040** | 1500 | 70 | 40 | 40 | 39.75 | – | 13 | 28.8 | 100 | 20 | 20 | 25 |
| **V7040** | 1500 | 70 | 40 | 40 | – | 24 | 13 | 28.8 | 100 | 20 | 20 | 25 |
| **M8050** | 1500 | 80 | 50 | 50 | 44.75 | – | 14 | 36.8 | 100 | 20 | 20 | 30 |
| **V8050** | 1500 | 80 | 50 | 50 | – | 26 | 14 | 36.8 | 100 | 20 | 20 | 30 |

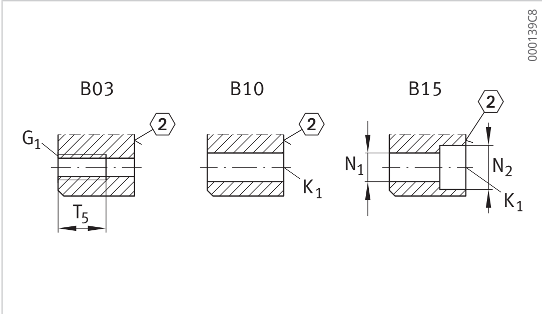
1) Extended lengths available by agreement.

2) M3015 and V3015: For l = 100 mm to 109 mm, $j_L$ = 35 mm (3 holes).
Other sizes: For l < $j_L + a_{L\,min} + a_{R\,min}$, $j_L$ = 50 mm.

3) $a_L$ and $a_R$ depend on the rail length.
The minimum values must not be undercut.




MVZ

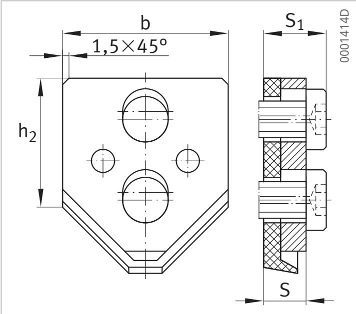



Bore types

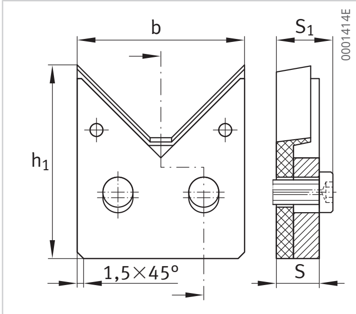
| $N_1$ | $N_2$ | $K_1$ | $G_1$ | Angled flat cages | End pieces with wipers | Insert nut |
|---|---|---|---|---|---|---|
| | | DIN 912-8.8 | | | | |
| mm | mm | – | – | | | |
| 5.25 | 8.5 | M4 | M3 | HW10 | EAM3015 | ESM-M4 |
| 5.25 | 8.5 | M4 | M3 | HW10 | EAV3015 | ESM-M4 |
| 7.5 | 11.5 | M6 | M5 | HW15 | EAM4020 | ESM-M6 |
| 7.5 | 11.5 | M6 | M5 | HW15 | EAV4020 | ESM-M6 |
| 7.5 | 11.5 | M6 | M6 | HW16 | EAM5025 | ESM-M6 |
| 7.5 | 11.5 | M6 | M6 | HW16 | EAV5025 | ESM-M6 |
| 10 | 15 | M8 | M6 | HW20 | EAM6035 | ESM-M8 |
| 10 | 15 | M8 | M6 | HW20 | EAV6035 | ESM-M8 |
| 12.5 | 18.5 | M10 | M6 | HW25 | EAM7040 | ESM-M10 |
| 12.5 | 18.5 | M10 | M6 | HW25 | EAV7040 | ESM-M10 |
| 14 | 20 | M12 | M6 | HW30 | EAM8050 | ESM-M12 |
| 14 | 20 | M12 | M6 | HW30 | EAV8050 | ESM-M12 |

## 4.2.3 Wipers

Series EAV, EAM




EAV



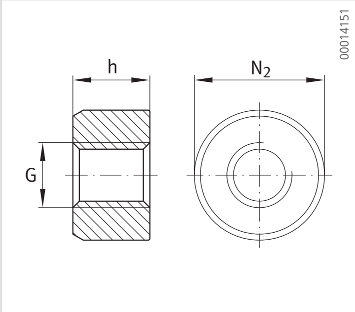

EAM

| Designation [1] | b | $h_2$ | $h_1$ | $S_1$ | S | Guide rail |
|---|---|---|---|---|---|---|
| | | | | max. | | |
| | mm | mm | mm | mm | mm | |
| **EAV3015** | 13.4 | 12.9 | – | 6 | 4 | V3015 |
| **EAM3015** | 13.4 | – | 17.7 | 6 | 4 | M3015 |
| **EAV4020** | 18 | 16.7 | – | 8.5 | 5 | V4020 |
| **EAM4020** | 18.7 | – | 24.85 | 8.5 | 5 | M4020 |
| **EAV4525** | 23.1 | 21.2 | – | 9 | 5 | V4525 |
| **EAM4525** | 23.1 | – | 28.8 | 9 | 5 | M4525 |
| **EAV5025** | 23.1 | 19.9 | – | 9 | 5 | V5025 |
| **EAM5025** | 23.1 | – | 30.8 | 9 | 5 | M5025 |
| **EAV6035** | 33 | 23.7 | – | 9 | 5 | V6035 |
| **EAM6035** | 33 | – | 37.4 | 9 | 5 | M6035 |
| **EAV6535** | 33 | 29.3 | – | 9 | 5 | V6535 |
| **EAM6535** | 33 | – | 42.4 | 9 | 5 | M6535 |
| **EAV7040** | 38 | 27.7 | – | 9 | 5 | V7040 |
| **EAM7040** | 38 | – | 43.7 | 9 | 5 | M7040 |
| **EAV8050** | 48 | 30.5 | – | 9 | 5 | V8050 |
| **EAM8050** | 48 | – | 51.5 | 9 | 5 | M8050 |
| **EAV8550** | 48 | 39.7 | – | 9 | 5 | V8550 |
| **EAM8550** | 48 | – | 56.5 | 9 | 5 | M8550 |

[1] The end pieces are supplied with fixing screws in accordance with DIN 7984.

## 4.2.4 Insert nuts

Series ESM




ESM



| Desig-nation [1)] | G | $N_2$ | h | Guide rail | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | −0.05 −0.1 | | | | | | | |
| | – | mm | mm | | | | | | |
| **ESM-M4** | M4 | 8.5 | 4.3 | M3015 | V3015 | – | – | – | – |
| **ESM-M6** | M6 | 11.5 | 6.5 | M4020 | V4020 | M4525 | V4525 | M5025 | V5025 |
| **ESM-M8** | M8 | 15 | 8.5 | M6035 | V6035 | M6535 | V6536 | – | – |
| **ESM-M10** | M10 | 18.5 | 10.5 | M7040 | V7040 | – | – | – | – |
| **ESM-M12** | M12 | 20 | 12.5 | M8050 | V8050 | M8550 | V8550 | – | – |

1) Insert nuts must be ordered separately.
Use insert nuts ESM for screws of strength class 8.8.

# 5 Flat cages

## 5.1 Product design

Flat cages are available in 1-row or 2-row designs. Depending on the series, they are made of plastic or metal and contain a large number of rolling elements that are guided in precision-machined pockets. They are available as needle roller flat cages, cylindrical roller flat cages, or ball flat cages.

The cages have a low section height, offer high rigidity while maintaining a low weight, and have a very high load carrying capacity. Their use presupposes that hardened and ground surfaces can be used as raceways.

They are supplied as individual parts or in combination with guide rails.

The needle rollers and cylindrical rollers are made of through-hardened rolling bearing steel in accordance with DIN 17230. The rolling elements have a minimum hardness of  670 HV, and their grade is G2. The rolling elements of the ball flat cages have a grade of G10.

Metal cages combine low weight with high strength. This makes them particularly suitable for demanding conditions, such as high accelerations, high temperatures, and partially exposed cage ends.

Plastic cages are an economical solution for less demanding operating conditions.

### 5.1.1 Needle roller flat cages

Needle roller flat cages offer the highest rigidity of all flat cage designs and are also available as angled flat cages.

The needle rollers are manufactured in accordance with DIN 5402-3 and ISO 3096-B and have flat end faces. Their ends are profiled. Due to this profiling, the outside surfaces are slightly crowned toward the ends. This reduces edge stresses at the ends of the rolling elements.

The 2-row flat cage (FF..-ZW) can be bent at any angle as required. This is achieved by heating the cage to  +70 °C to + 90 °C, bending it to the desired angle, and allowing it to cool in this position.

In the plastic versions (FF, FF..-ZW, and FFW), dovetail grooves allow for the easy connection of any number of elements.

! The flat cage FF2025-ZW can be adjusted at temperatures between 0 °C and + 90 °C.

In angled flat cage FFW, the legs are bent at right angles to each other.

In angled flat cage FFW2025, the legs can be assembled at either a 0° or 90° angle.

### 5.1.2 Operating temperature

Needle roller flat cages FFW are made of plastic. Cylindrical roller flat cage HRW features a light-alloy frame with a plastic insert. Both cage types are suitable for temperatures up to +120 °C. The HW cage is made of metal and can withstand temperatures up to +150 °C.

! For flat cage guides with plastic wipers, the operating temperature is limited to +100 °C.

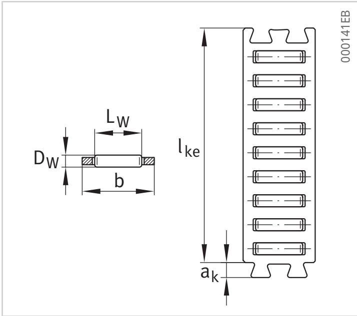
## 5.2 Product tables

### 5.2.1 Explanations

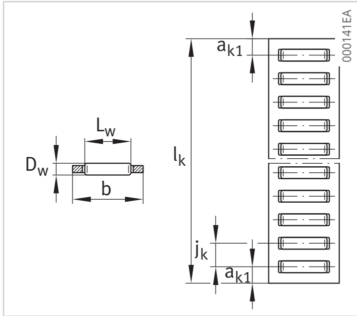
| | | |
|---|---|---|
| $a_k$ | mm | Dimension |
| $a_{k1}$ | mm | Distance between center of first or last cage pocket and end of cage |
| b | mm | Width of flat cage |
| $b_1$ | mm | Dimension |
| C | N | Basic dynamic load rating |
| $C_0$ | N | Basic static load rating |
| $D_W$ | mm | Ball diameter |
| $E_B$ | mm | Mounting dimension |
| $E_{B1}$ | mm | Mounting dimension |
| $E_H$ | mm | Mounting dimension |
| $j_k$ | mm | Pocket pitch of the flat cage body |
| $l_k$ | mm | Length of cage |
| $l_{ke}$ | mm | Cage dimension |
| $L_W$ | mm | Mounting dimension |
| m | g | Mass |
| $Z_e$ | – | Number of rolling elements per row in a cage element |

## 5.2.2 Flat cages

1-row




FF



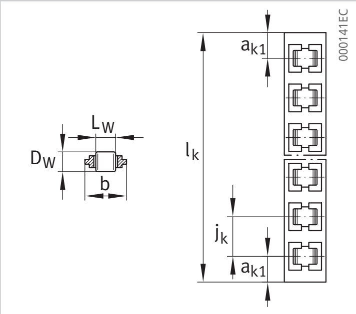

H, BF

| Designation | m [1] | $l_k$ [2] | $D_W$ | b | $L_W$ | $j_k$ | $a_{k1}$ |
|---|---|---|---|---|---|---|---|
| | | max. | | | | | |
| | ≈g | mm | mm | mm | mm | mm | mm |
| **FF2010** | 46 | – | 2 | 10 | 6.8 | – | – |
| **H10** | 63 | 4000 | 2 | 10 | 6.8 | 4.5 | 3.5 |
| **FF2515** | 84 | – | 2.5 | 15 | 9.8 | – | – |
| **H15** | 120 | 4000 | 2.5 | 15 | 9.8 | 5 | 3.5 |
| **FF3020** | 148 | – | 3 | 20 | 13.8 | – | – |
| **H20** | 202 | 4000 | 3 | 20 | 13.8 | 6 | 4.5 |
| **BF3020** | 342 | 6000 | 3 | 20 | 15.8 | 6 | 4.5 |
| **FF3525** | 221 | – | 3.5 | 25 | 17.8 | – | – |
| **H25** | 294 | 4000 | 3.5 | 25 | 17.8 | 7 | 5 |
| **HR50** | 105 | 4000 | 5 | 10.5 | 5 | 10 | 6.5 |
| **BF5015** | 375 | 6000 | 5 | 15 | 11.8 | 8 | 5.5 |
| **BF5023** | 530 | 6000 | 5 | 23 | 19.8 | 8 | 5.5 |
| **BF5032** | 722 | 6000 | 5 | 32 | 27.8 | 8 | 5.5 |
| **HR70** | 295 | 4000 | 7 | 17 | 10 | 13 | 8.5 |
| **BF7028** | 875 | 6000 | 7 | 28 | 24 | 11 | 7.5 |
| **BF7035** | 1080 | 6000 | 7 | 35 | 30 | 11 | 7.5 |
| **HR100** | 598 | 4000 | 10 | 24 | 14 | 17 | 10 |
| **BF12022** | 1220 | 6000 | 12 | 22 | 18 | 16 | 10 |
| **BF12040** | 1970 | 6000 | 12 | 40 | 36 | 16 | 10 |

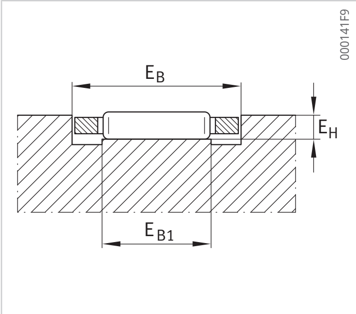
1) Mass for $l_k$ = 1000 mm.

2) Length tolerance: +0/–1 · $j_k$.

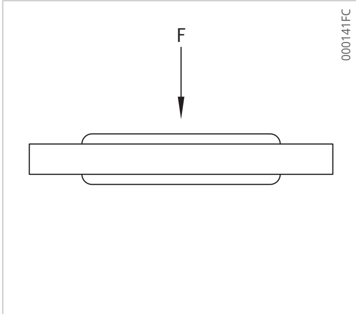
3) For a theoretical cage length of 100 mm in the direction of load.




HR




Mounting dimensions



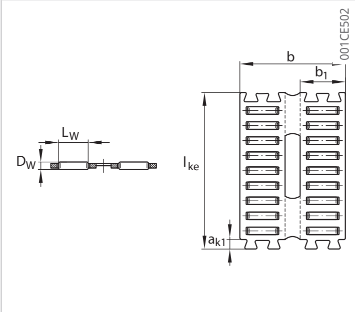

Load direction



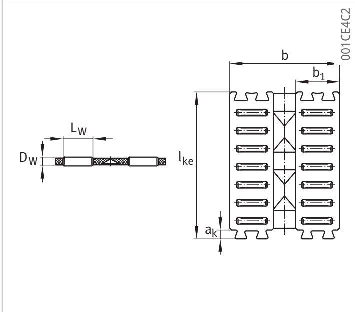
| $a_k$ | $l_{ke}$ | $Z_e$ | $E_B$ | | | $E_{B1}$ | $E_H$ | C [3)] | $C_0$ [3)] | Guide rail | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | – | U | L | min. | | | | | | | |
| mm | mm | mm | mm | mm | mm | mm | mm | N | N | | | | |
| 2 | 32 | 7 | 10.3 | +0.2 | 0 | 7 | 1.7 | 21300 | 61900 | J3525 | S3525 | – | – |
| – | – | – | 10.3 | +0.2 | 0 | 7 | 1.7 | 21600 | 62800 | J3525 | S3525 | – | – |
| 2.5 | 45 | 8 | 15.3 | +0.2 | 0 | 10 | 2.2 | 32700 | 92300 | J4025 | S4025 | J5025 | S5025 |
| – | – | – | 15.3 | +0.2 | 0 | 10 | 2.2 | 35800 | 103800 | J4025 | S4025 | J5025 | S5025 |
| 3 | 60 | 9 | 20.4 | +0.2 | 0 | 14 | 2.7 | 47800 | 133200 | J5030 | S5030 | – | – |
| – | – | – | 20.4 | +0.2 | 0 | 14 | 2.7 | 51900 | 148000 | J5030 | S5030 | – | – |
| – | – | – | 20.4 | +0.2 | 0 | 16 | 2.7 | 57800 | 170100 | J5530 | S5530 | – | – |
| 3 | 75 | 10 | 25.4 | +0.2 | 0 | 18 | 3.2 | 64700 | 177300 | J5531 | S5531 | – | – |
| – | – | – | 25.4 | +0.2 | 0 | 18 | 3.2 | 68200 | 190000 | – | – | – | – |
| – | – | – | 10.9 | +0.2 | 0 | 5 | 3.4 | 29400 | 50800 | – | – | – | – |
| – | – | – | 15.3 | +0.2 | 0 | 12 | 4.6 | 69900 | 154700 | – | – | – | – |
| – | – | – | 23.4 | +0.2 | 0 | 20 | 4.6 | 106400 | 265100 | – | – | – | – |
| – | – | – | 32.5 | +0.3 | 0 | 28 | 4.6 | 139500 | 375600 | – | – | – | – |
| – | – | – | 17.4 | +0.2 | 0 | 10 | 4.8 | 69800 | 114200 | – | – | – | – |
| – | – | – | 28.4 | +0.2 | 0 | 24 | 6.5 | 150800 | 331800 | – | – | – | – |
| – | – | – | 35.6 | +0.3 | 0 | 30 | 6.5 | 179800 | 416200 | – | – | – | – |
| – | – | – | 24.4 | +0.2 | 0 | 14 | 6.5 | 109900 | 174200 | – | – | – | – |
| – | – | – | 22.4 | +0.2 | 0 | 18 | 11 | 178800 | 288300 | – | – | – | – |
| – | – | – | 40.5 | +0.3 | 0 | 36 | 11 | 147600 | 938600 | – | – | – | – |

## 5.2.3 Flat cages

2-row




FF..-ZW, except FF2025-ZW




FF2025-ZW

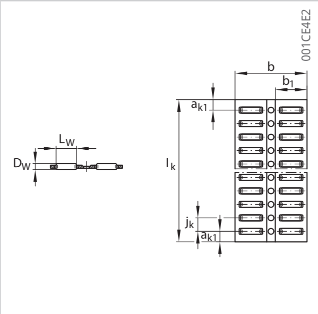
| Designation [1] | m [2] | $l_k$ [3] | $D_W$ | b | $L_W$ | $b_1$ | $j_k$ | $a_{k1}$ |
|---|---|---|---|---|---|---|---|---|
| | | max. | | | | | | |
| | ≈g | mm | mm | mm | mm | mm | mm | mm |
| **H19-ZW** | 219 | 3500 | 2 | 19.2 | 4.8 | 8 | 4 | 3 |
| **FF2025-ZW** | 94 | – | 2 | 25 | 6.8 | 10 | – | – |
| **H24-ZW** | 138 | 4000 | 2 | 24 | 6.8 | 10.5 | 4.5 | 3.5 |
| **FF2535-ZW** | 182 | – | 2.5 | 35 | 9.8 | 15 | – | – |
| **H34-ZW** | 239 | 4000 | 2.5 | 33.5 | 9.8 | 14.3 | 5.5 | 4 |
| **FF3045-ZW** | 315 | – | 3 | 45 | 13.8 | 20 | – | – |
| **H44-ZW** | 408 | 4000 | 3 | 44 | 13.8 | 19 | 6 | 4.5 |
| **FF3555-ZW** | 464 | – | 3.5 | 55 | 17.8 | 25 | – | – |
| **H55-ZW** | 598 | 4000 | 3.5 | 55 | 17.8 | 24 | 7 | 5 |
| **HR50-ZW** | 215 | 4000 | 5 | 24 | 5 | 10.5 | 10 | 6.5 |
| **HR70-ZW** | 602 | 4000 | 7 | 40 | 10 | 17 | 13 | 8.5 |
| **HR100-ZW** | 1233 | 4000 | 10 | 55 | 14 | 24 | 17 | 10 |

1) H19-ZW: Steel body.

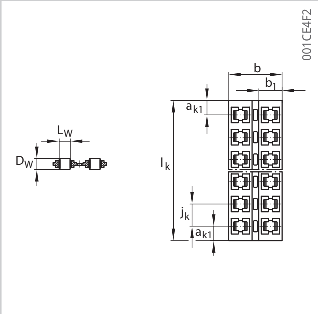
2) Mass for $l_k$ = 1000 mm.

3) Length tolerance: +0/–1 · $j_k$.

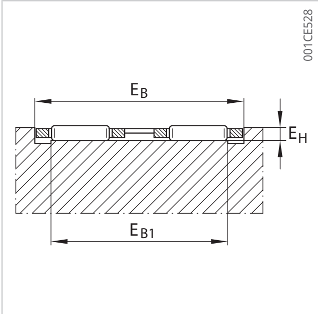
4) For a theoretical cage length of 100 mm in the direction of load.



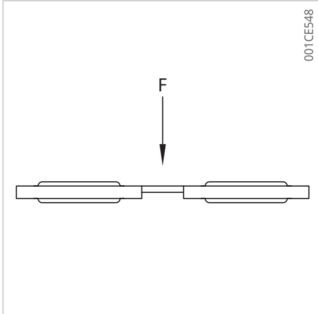
H..-ZW



HR..-ZW



Mounting dimensions



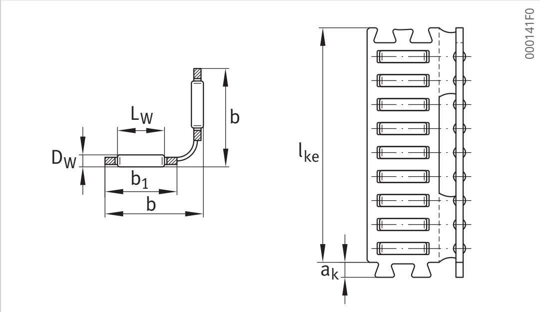
Load direction



| $a_k$ | $l_{ke}$ | $Z_e$ | $E_B$ | | | $E_{B1}$ | $E_H$ | C [4)] | $C_0$ [4)] | Guide rail | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | – | U | L | min. | | | | | |
| mm | mm | mm | mm | mm | mm | mm | mm | N | N | | |
| – | – | – | 19.6 | +0.2 | 0 | 17 | 1.7 | 30300 | 97200 | – | – |
| 2 | 32 | 7 | 25.4 | +0.2 | 0 | 22 | 1.7 | 36600 | 123700 | – | – |
| – | – | – | 24.4 | +0.2 | 0 | 21 | 1.7 | 37000 | 125700 | J6035 | S6035 |
| 2.4 | 45 | 8 | 35.5 | +0.2 | 0 | 30 | 2.2 | 56000 | 184600 | – | – |
| – | – | – | 34 | +0.2 | 0 | 28.5 | 2.2 | 57000 | 188800 | J7040 | S7040 |
| 3 | 60 | 9 | 45.5 | +0.2 | 0 | 39 | 2.7 | 81900 | 266500 | – | – |
| – | – | – | 44.5 | +0.2 | 0 | 38 | 2.7 | 88900 | 296100 | J8050 | S8050 |
| 3.2 | 75 | 10 | 55.5 | +0.2 | 0 | 48 | 3.2 | 110900 | 354700 | – | – |
| – | – | – | 55.5 | +0.2 | 0 | 48 | 3.2 | 117000 | 380000 | – | – |
| – | – | – | 24.4 | +0.2 | 0 | 19.5 | 3.4 | 50500 | 101600 | – | – |
| – | – | – | 40.5 | +0.2 | 0 | 34 | 4.8 | 112800 | 228400 | – | – |
| – | – | – | 55.5 | +0.2 | 0 | 46 | 6.5 | 188400 | 348300 | – | – |

5

## 5.2.4 Angled flat cages




FFW

| Designation [1)] | m [2)] | $l_k$ [3)] max. | $D_W$ | b | $L_W$ | $b_1$ | $j_k$ | $a_{k1}$ |
|---|---|---|---|---|---|---|---|---|
| | ≈g | mm | mm | mm | mm | mm | mm | mm |
| **HW10** | 219 | 3500 | 2 | 10 | 4.8 | 8 | 4 | 3 |
| **FFW2025** | 94 | – | 2 | 15 | 6.8 | 10 | – | – |
| **HW15** | 138 | 4000 | 2 | 14 | 6.8 | 10.5 | 4.5 | 3.5 |
| **HW16** | 190 | 4000 | 2 | 16 | 8.8 | 13.5 | 3.8 | 2.8 |
| **FFW2535** | 182 | – | 2.5 | 20.5 | 9.8 | 15 | – | – |
| **HW20** | 239 | 4000 | 2.5 | 20 | 9.8 | 14.3 | 5.5 | 4 |
| **FFW3045** | 315 | – | 3 | 26 | 13.8 | 20 | – | – |
| **HW25** | 408 | 4000 | 3 | 25 | 13.8 | 19 | 6 | 4.5 |
| **FFW3555** | 464 | – | 3.5 | 31.5 | 17.8 | 25 | – | – |
| **HW30** | 598 | 4000 | 3.5 | 30 | 17.8 | 24 | 7 | 5 |
| **HRW50** | 215 | 4000 | 5 | 15.5 | 5 | 10.5 | 10 | 6.5 |
| **HRW70** | 602 | 4000 | 7 | 25 | 10 | 17 | 13 | 8.5 |
| **HRW100** | 1233 | 4000 | 10 | 34 | 14 | 24 | 17 | 10 |

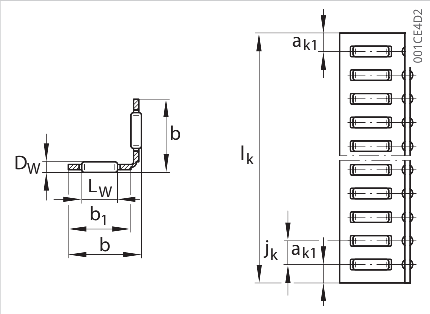
1) HW10: Steel body.

2) Mass for $l_k$ = 1000 mm.

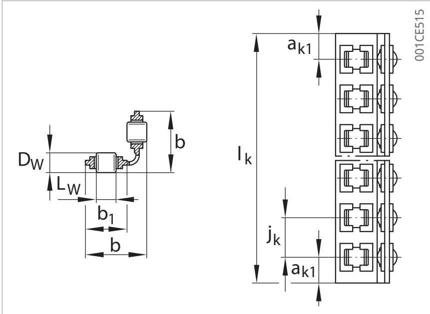
3) Length tolerance: +0/–1 · $j_k$.

4) For a theoretical cage length of 100 mm in the direction of load.

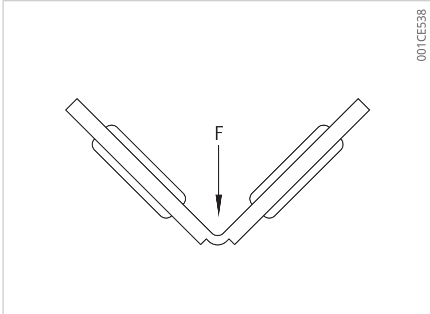
5) For HW15 and HW20: higher basic load ratings available by agreement.




HW




HRW



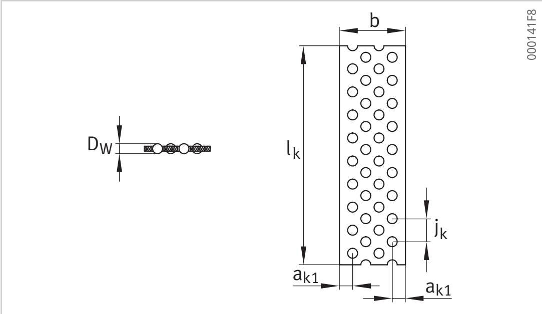

Load direction



| $a_k$ | $l_{ke}$ | $Z_e$ | C [4) 5)] | $C_0$ [4) 5)] | Guide rail | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | mm | mm | N | N | | | | | | | |
| – | – | – | 21400 | 68700 | M3015 | V3015 | – | – | – | – | – |
| 2 | 32 | 7 | 25900 | 87500 | M4020 | V4020 | ML5020 | ML5520 | M5025 | V5025 | ML5525 |
| – | – | – | 26200 | 88900 | M4020 | V4020 | ML5020 | ML5520 | M5025 | V5025 | ML5525 |
| – | – | – | 36900 | 138100 | M5025 | V5025 | ML5525 | ML6025 | ML6525 | ML7025 | – |
| 2.4 | 45 | 8 | 39600 | 130500 | M6035 | V6035 | ML7035 | ML8035 | – | – | – |
| – | – | – | 40300 | 133500 | M6035 | V6035 | ML7035 | ML8035 | – | – | – |
| 3 | 60 | 9 | 57900 | 188400 | M7040 | V7040 | ML8040 | ML9040 | – | – | – |
| – | – | – | 62900 | 209400 | M7040 | V7040 | ML8040 | ML9040 | – | – | – |
| 3.2 | 75 | 10 | 78400 | 250800 | M8050 | V8050 | ML9050 | ML10050 | – | – | – |
| – | – | – | 82700 | 268700 | M8050 | V8050 | ML9050 | ML10050 | – | – | – |
| – | – | – | 35700 | 71900 | M4525 | V4525 | – | – | – | – | – |
| – | – | – | 79700 | 161500 | M6535 | V6535 | – | – | – | – | – |
| – | – | – | 133200 | 246300 | M8550 | V8550 | – | – | – | – | – |

5

### 5.2.5 Ball flat cages

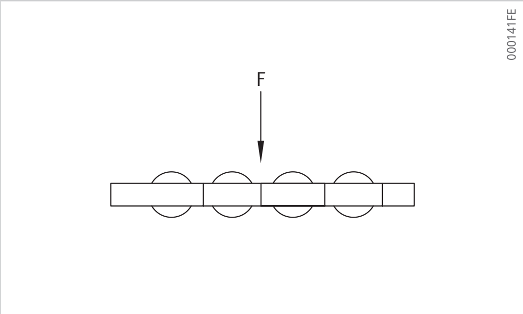



HB

| Designation | m 1) | $l_k$ | $D_W$ | b | $j_k$ | $a_{k1}$ |
|---|---|---|---|---|---|---|
| | | max. | | | | |
| | ≈g | mm | mm | mm | mm | mm |
| **HB2515** | 95 | 4000 | 2.5 | 15 | 3 | 4.5 |
| **HB3020** | 167 | 4000 | 3 | 20 | 3.5 | 4 |
| **HB3023** | 187 | 4000 | 3 | 23 | 3.5 | 5.5 |
| **HB4025** | 250 | 4000 | 4 | 25 | 3 | 5 |

1) Mass for $l_k$ = 1000 mm.

2) For a theoretical cage length of 100 mm in the direction of load.



Load direction



| C 2) | C0 2) | Guide rail | | | |
|---|---|---|---|---|---|
| N | N | | | | |
| 3330 | 3040 | J4025 | S4025 | J5025 | S5025 |
| 5350 | 5000 | J5030 | S5030 | – | – |
| 5350 | 5000 | – | – | – | – |
| 7630 | 62200 | J5530 | S5530 | – | – |

# 6 Ordering example, ordering designation

## 6.1 M guide rails and V guide rails, configuration for four axes

- Rails for closed arrangement: M and V
- Stroke S: 90 mm
- Profile size: 5025
- Bore type: B15
- Length of M rail l: 400 mm
- Length of V rail l: 500 mm
- Rail quality: Q6
- Restricted tolerance ±0.005 for $A_1$: US
- Insert nuts for V rails: ESM
- Angled flat cages made of metal: HW
- Length of flat cage $l_k$: 355 mm
- End pieces with wipers: EAM

For calculation purposes, the dimension of the longer rail is used:

ƒ57

$$l_k = l - 3 \cdot \frac{S}{2} - 10 \text{ mm}$$

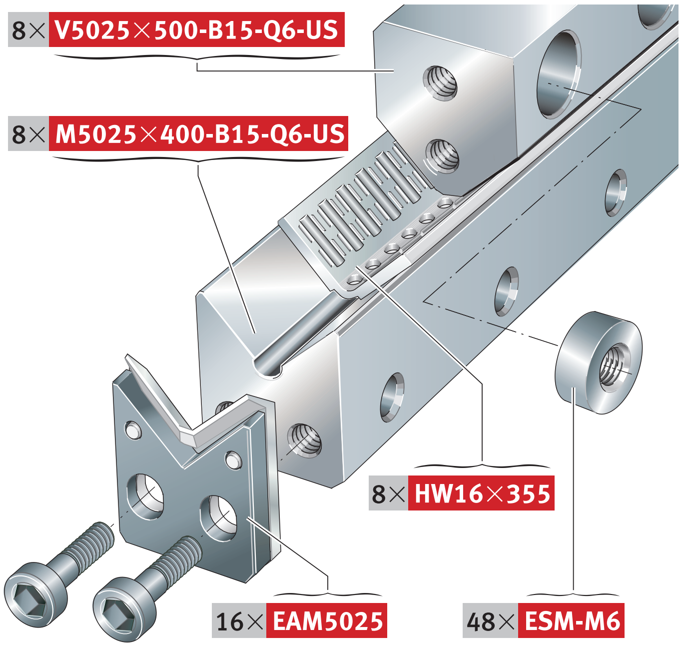
ƒ58

$$l_k = 500 - 3 \cdot 45 - 10 \text{ mm} = 355 \text{ mm}$$

Ordering designation:

- 8×M5025×400-B15-Q6-US
- 8×V5025×600-B15-Q6-US
- 48×ESM-M6
- 8×HW16×355
- 16×EAM5025

62 Ordering designation




## 6.2 ML guide rails and V guide rails, configuration for one axis

- Rails for closed arrangement: ML and V
- Stroke S: 150 mm
- Profile width: 25 mm
- Bore type, countersink left: B15 L
- Length of ML rail l: 450 mm
- Length of V rail l: 600 mm
- Rail quality: Q6
- Angled flat cages made of metal: HW
- Length of flat cage $l_k$: 365 mm
- End pieces: EML

For calculation purposes, the dimension of the longer rail is used:

59

$$l_k = l - 3 \cdot \frac{S}{2} - 10 \text{ mm}$$

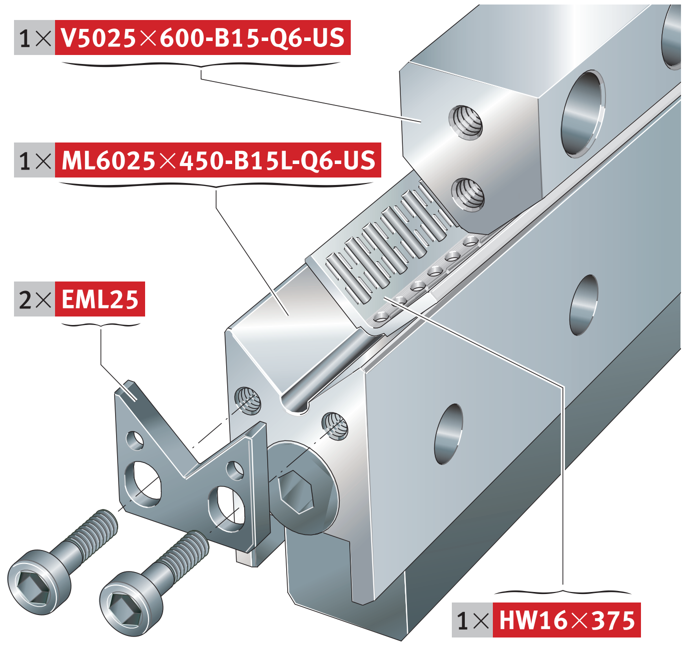
60

$$l_k = 600 - 3 \cdot 75 - 10 \text{ mm} = 365 \text{ mm}$$

Ordering designation:

- 1×ML6025× 450-B15L-Q6
- 1×V5025× 600-B15-Q6
- 1×HW16×375
- 2×EML25

63 Ordering designation




## 6.3 M guide rails and V guide rails with positive cage control, configuration for four axes

The stroke center position must be specified and dimensioned with a sketch/ drawing.

- Rails with integrated positive control for closed arrangement: M and V
- Stroke S: 190 mm
- Stroke center position for M rail and V rail: centered
- Profile size: 4020
- Bore type of M rail: B03
- Bore type of V rail: B15
- Length of M rail l: 400 mm
- Length of V rail l: 600 mm
- Rail quality: Q6
- Angled flat cages made of metal: HW
- Length of flat cage $l_k$: 305 mm
- Wipers for M rails: EAM

For calculation purposes, the dimension of the longer rail is used:

61

$$l_k = l - 3 \cdot \frac{S}{2} - 10\ \text{mm}$$

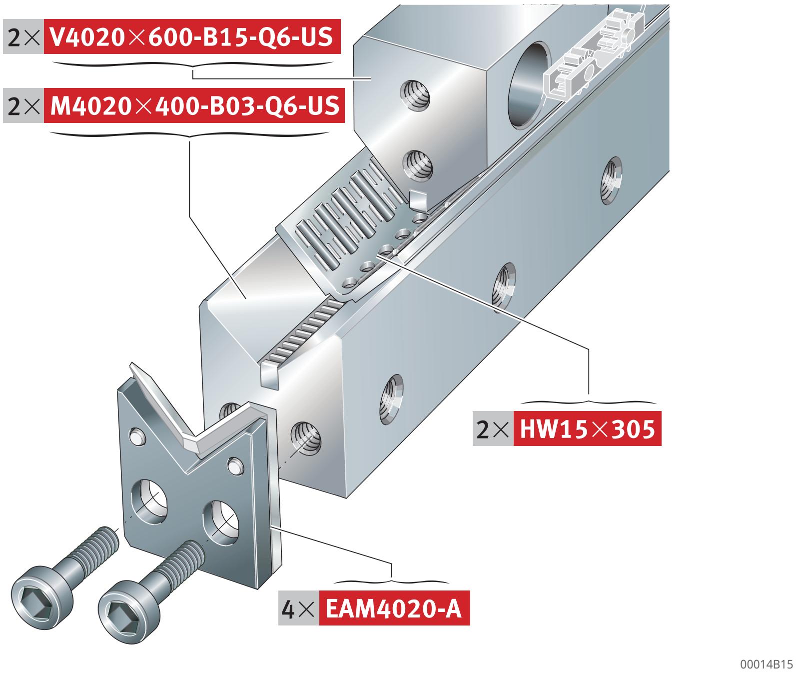
62

$$l_k = 600 - 3 \cdot 95 - 10\ \text{mm} = 305\ \text{mm}$$

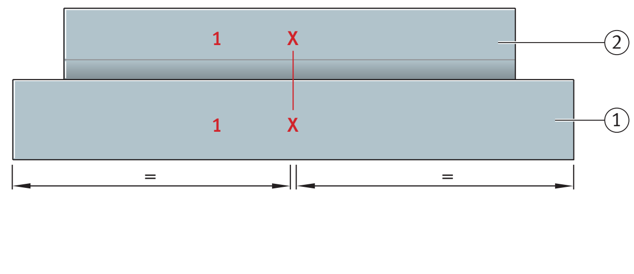
Ordering designation:

- 2×M4020× 400-B03-Q6
- 2×V4020× 600-B15-Q6
- 2×HW15×305
- 4× EAM4020

64 Ordering designation




65 Stroke center length




## 6.4 Flat cages

### 6.4.1 Needle roller flat cages

2 H needle roller flat cages:

- rolling element diameter: 3 mm
- cage width: 20 mm
- cage length: 400

Ordering designation:

- 2× H20×400

66 Ordering designation


## 6.4.2 Angled needle roller flat cages

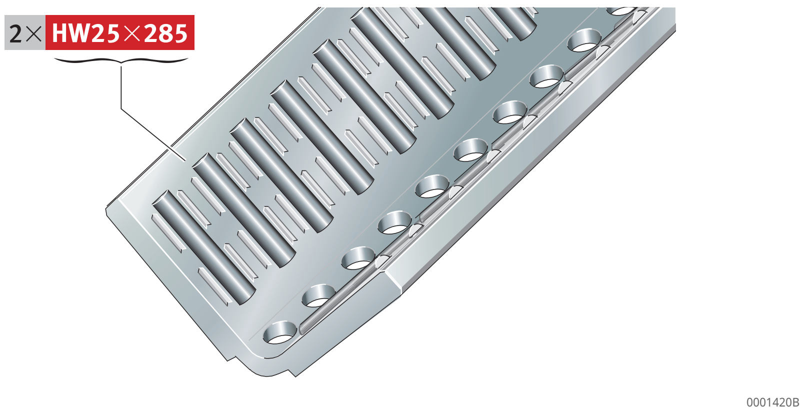
2 HW angled needle roller flat cages for closed guide:

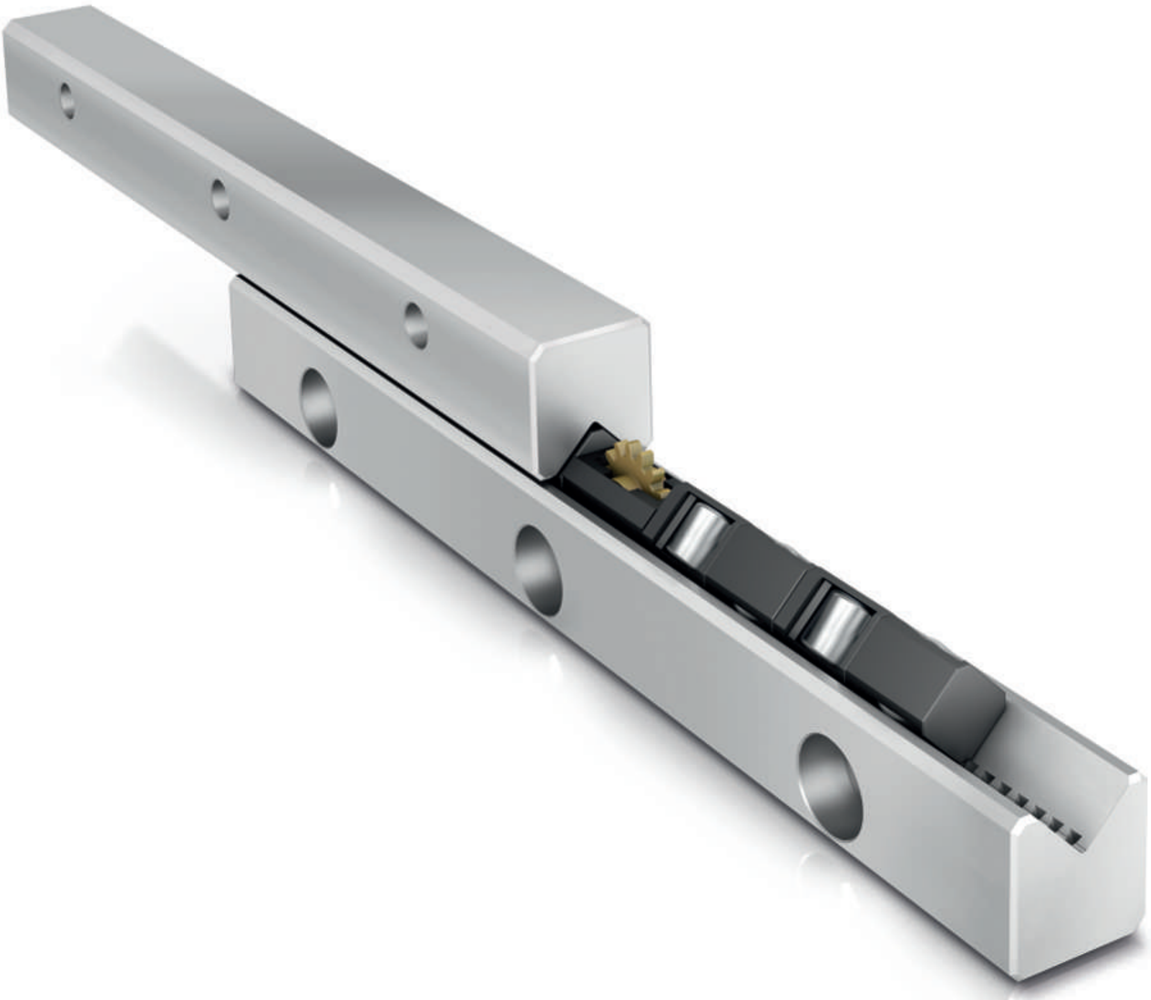
- rolling element diameter: 3 mm
- cage leg length: 25 mm
- cage length: 280 mm

Ordering designation:

- 2× HW25×280

67 Ordering designation





# Precision rail guides

## Precision rail guides, cages, accessories and precision rail guide slides

Catalog

# Preface

Precision rail guides from Schaeffler offer maximum movement precision and are used in demanding industrial, medical and electronic applications. The non-recirculating rolling elements are retained in a rigid cage, which ensures smooth movement with low friction, even under high loads.

Precision rail guides are available in different sizes and standard lengths and can be equipped with ball cages, roller cages or needle roller cages, as well as slide coatings to suit the application. The product range also includes accessories for mounting and sealing.

If there is a risk of cage-creeping, especially in vertical installations or applications with high acceleration speeds, the precision rails can be equipped with an anti-creeping system (ACS), which is available for all types of rolling elements.

Rail guides with slide coating are available for applications subject to impact loads or requiring good vibration damping.

All standard precision rails can also be purchased in our handy kit packaging, which simplifies procurement and ensures that you receive all the necessary individual parts, such as end pieces and screws.

# Contents

1

# 1 Technical principles

## 1.1 Load rating and rating life

The following calculation methods are used to determine which size of linear guide is most suitable for the respective application:

- calculation of the basic rating life
- calculation of the static safety factor

Both calculation methods must take into account all loads and forces acting on the precision rail guide system. Representative loads are therefore used to express the resulting total load. These represent a combination of all forces, lever arms and torque loads, which can vary in terms of duration or stroke length.

The rating life of a precision rail guide with rolling elements is defined as the travel distance that the guide travels until the first signs of material fatigue occur on one of the raceways or rolling elements. The dynamic load rating C is used to select a rail guide system based on the basic rating life calculation. It indicates the load at which a basic rating life of a 100 km travel distance is achieved.

### 1.1.1 Calculation concept for static safety factor

When selecting a linear guide, the static safety factor must be calculated if one of the following cases is present:

- The rail guide is operated under load at very low speeds.
- The rail guide operates under normal operating conditions, but must absorb high impact loads.
- The rail guide remains loaded during prolonged periods in idle state.
- The rail guide is loaded with P > 50 % of the dynamic load rating C, meaning that the theoretical principles for calculating the basic rating life no longer apply.

In all of the cases listed, the permissible load is not based on material fatigue, but rather on the avoidance of plastic deformation of rolling elements or raceways. Loads when idle or at very low operating speeds and high impact loads flatten the rolling elements, resulting in damage to the raceways. This damage may be unevenly distributed on the rail or occur along the raceway according to the rolling element separation. Permanent deformation leads to vibrations in the bearing, high running noises and increased friction and can also lead to reduced preload, and in advanced stages to increased clearance. If operation continues, the permanent deformation caused by the resulting peak loads can lead to fatigue damage. The extent of the damage and its effects depends on the specific application.

### 1.1.2 Calculation method for static safety factor

When designing a precision rail guide based on the static load rating, the static safety factor $s_0$, expressed as the ratio of the static load rating $C_0$ to the maximum static bearing load $P_0$, must be taken into account. The static safety factor $s_0$ indicates the level of protection against permanent plastic deformation of the rolling elements and raceways. The static load rating $C_0$ is defined as the static load that produces a permanent total deformation of 0.0001 times the rolling element diameter. Depending on the contact conditions, ISO 14728-2 permits a maximum Hertzian pressure of 4000 MPa at the contact point subjected to the highest load without impairing the running behavior.

### 1.1.3 Calculating the static safety factor

The static safety factor $s_0$ for a specific precision rail guide and a defined load case can be calculated as follows.

If the maximum load occurs in the idle state:

ƒ 1

$$s_0 = \frac{C_{0,\ eff\ slide}}{P_0}$$

If the maximum load occurs during operation:

ƒ 2

$$s_0 = \frac{C_{0,\ eff\ slide}}{F_{res\ max}}$$

| | | |
|---|---|---|
| $C_{0,\ eff\ slide}$ | N | Effective static load rating of the slide |
| $F_{res,\ max}$ | N | Maximum resulting load |
| $P_0$ | N | Maximum static load |
| $s_0$ | – | static safety factor |

The following reference values are recommended for the static safety factor $s_0$ under various operating conditions.

1 Static safety factor $s_0$

| Ambient conditions | $s_0$ |
|---|---|
| Normal conditions | > 1 ... 2 |
| Smooth, vibration-free operation | > 2 ... 4 |
| Moderate vibration | > 3 ... 5 |
| High vibration or shock loads | > 5 |

For overhead installations, the general technical regulations and standards for the respective industry must be taken into account. If there is a high risk of injury during use, the user must take suitable design measures and safety precautions to prevent components from becoming detached (e.g. due to rolling elements falling out or faulty screw connections).

For example, if the precision rail guide system is exposed to external vibrations from other machines in the surrounding area, higher safety factors should be taken into account. The load transfer paths between the guide and the adjacent construction must also be taken into account in the design.

! Check that screw connections are sufficiently secure. When installing precision rail guides overhead, use higher safety factor values.

! Always observe the general technical regulations and standards applicable to the respective industry.

### 1.1.4 Required static load rating

The following formulas can be used to calculate the required static load rating $C_0$ for specific operating conditions with a corresponding recommended safety factor and a defined load case.

If the maximum load occurs in the idle state:

f3

$$C_{0,\ eff\ slide} = s_0 \cdot P_0$$

If the maximum load occurs during operation:

f4

$$C_0 = C_{0,\ eff\ slide} = s_0 \cdot F_{res\ max}$$

| | | |
|---|---|---|
| $C_{0,\ eff\ slide}$ | N | Effective static load rating of the slide |
| $F_{res,\ max}$ | N | Maximum resulting load |
| $P_0$ | N | Equivalent static bearing load |
| $s_0$ | – | static safety factor |

### 1.1.5 Basic rating life

It has been demonstrated both under laboratory conditions and in practice that even bearings that appear to be identical and are operated under completely identical operating conditions can have different basic rating lives. Calculating the required bearing size therefore requires a precise definition of the term “rating life.”

All data on the dynamic load rating of precision rail guides is based on a basic rating life, which is reached or exceeded by 90 % of a sufficiently large number of apparently identical bearings (compare ISO 14728-1). The majority of bearings achieved a longer rating life and half of the total number of bearings achieved at least 5 times the basic rating life.

### 1.1.6 Calculating the basic rating life

The rating life $L_{ns}$ of a precision rail guide, specified in km, can be calculated using the following formula:

f5

$$L_{ns} = c_1 \cdot 100 \cdot \left( \frac{C_{eff\ slide}}{P} \right)^p$$

In the case of a constant travel distance and unchanged stroke frequency, it is often necessary to calculate the basic rating life $L_{nh}$ in operating hours. This value can be determined using the following formula:

f6

$$L_{nh} = c_1 \cdot \frac{5 \cdot 10^7}{S_{sin} \cdot n \cdot 60} \cdot \left( \frac{C_{eff\ slide}}{P} \right)^p$$

| | | |
|---|---|---|
| $c_1$ | – | Coefficient for reliability |
| $C_{eff\ slide}$ | N | Effective dynamic load rating of the slide |
| $L_{nh}$ | h | Basic rating life |
| $L_{ns}$ | km | Basic rating life |
| n | $min^{-1}$ | Stroke frequency |
| P | N | Equivalent dynamic load |
| p | – | Life exponent<br>• Roller bearing p = 10/3<br>• Ball bearing p = 3 |
| $S_{sin}$ | mm | Single stroke length |

! The concept for calculating the basic rating life is only applicable if the equivalent dynamic load P does not exceed 50 % of the dynamic load rating C.

! The more precisely known or determinable the expected loads and operating conditions are, the more accurately and reliably the rating life of precision rail guides can be calculated.

! The rating life calculation is related to the physical effect of material fatigue. Fatigue is the result of cyclic shear stresses occurring directly beneath the load-bearing surface. Over time, these stresses can cause cracks that gradually propagate toward the surface. When the rolling elements pass over these cracks, spalling or flaking of the material may occur. These surface defects then intensify progressively and ultimately lead to bearing failure.

#### 1.1.6.1 The influence of reliability, coefficient $c_1$

The coefficient $c_1$ is used to determine the rating life in cases where the intended prediction of reliability has to exceed 90 %.

2 Coefficient $c_1$ for reliability

| Reliability<br>% | L | $c_1$ |
|---|---|---|
| 90 | $L_{10s}$ | 1 |
| 95 | $L_{5s}$ | 0.62 |
| 96 | $L_{4s}$ | 0.53 |
| 97 | $L_{3s}$ | 0.44 |
| 98 | $L_{2s}$ | 0.33 |
| 99 | $L_{1s}$ | 0.21 |

### 1.1.7 Service life

In addition to the rating life, the term "service life" is also used. This refers to the length of time for which a linear guide remains functional in a given application.

The service life of a bearing therefore does not necessarily depend on fatigue, but also on the following factors:

- wear
- corrosion
- seal failure
- lubrication interval (grease life)
- vibrations at standstill

The service life can usually only be determined through practical tests or comparisons with similar applications.

1

## 1.1.8 Determining the bearing load

The load can be included directly in the rating life equations and the equation for calculating the static load rating if the load F acting on a rail guide is constant in terms of size, position, and direction and acts perpendicular to the center of the raceway. In all other cases , the maximum resulting load $F_{res,max}$ and the equivalent dynamic load P must be calculated first. These representative loads are defined as the loads that have the same influence on the rating life and the static safety factor $s_0$ as the totality of the actual load cases.

The approaches for loads that are not perpendicular and do not act on the center of the rail guide system are described in ➤12 | 1.1.8.1 ➤13 | 1.1.8.3. The approach for time- and position-varying loads is explained in ➤14 | 1.1.8.4.

### 1.1.8.1 Transfer of external loads to $F_y$, $F_z$, $M_x$, $M_y$, $M_z$

For the following calculations, the actual application must be considered using the definitions given in the Schaeffler coordinate system. The moving direction is defined as the X axis. The origin of the coordinate system is located in the center of the rolling element assembly, and from there all lever arms are measured in the X direction. This means that the coordinate system is not stationary and the lever arms change as the rail guide moves. For the other directions, the origin of the coordinates is located symmetrically between the rolling element assemblies at $B_1/2$ and at the center height of the rail.

All payloads that have an impact on the rail guide system must then be determined. Load directions and lever arms must also be taken into account.

The individual loads are combined into 5 values: $F_y$, $F_z$, $M_x$, $M_y$, $M_z$.

These are calculated as follows:

ƒ7

$$F_y = \sum_{i=1}^{u} F_{y,i}$$

ƒ8

$$F_z = \sum_{i=1}^{u} F_{z,i}$$

ƒ9

$$M_x = -\sum_{i=1}^{u} F_{y,i} \cdot z_i + \sum_{i=1}^{u} F_{z,i} \cdot y_i$$

ƒ10

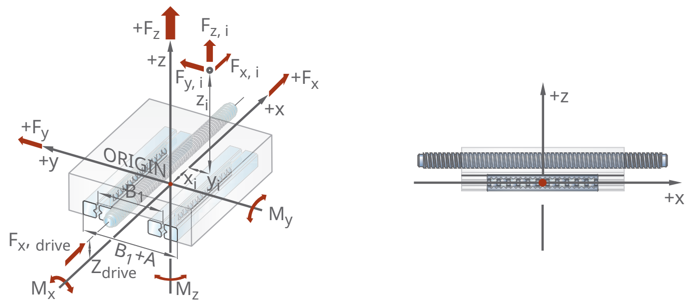
$$M_y = \sum_{i=1}^{u} F_{x,i} \cdot z_i - \sum_{i=1}^{u} F_{z,i} \cdot x_i$$

ƒ11

$$M_z = -\sum_{i=1}^{u} F_{x,i} \cdot y_i + \sum_{i=1}^{u} F_{y,i} \cdot x_i$$

| | | |
|---|---|---|
| $F_{x,i}$, $F_{y,i}$, $F_{z,i}$ | N | External loads in x-direction, y-direction, z-direction |
| $F_y$, $F_z$ | N | Combined forces (load) in Y direction or Z direction |
| i | – | Index for external loads |
| $M_x$, $M_y$, $M_z$ | Nm | Combined torque loads in X direction, Y direction or Z direction |
| U | – | Number of simultaneously acting loads |
| $x_i$, $y_i$, $z_i$ | mm | Lever arms for external loads |

1 Definition of the coordinate system

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The 5 values $F_y$, $F_z$, $M_x$, $M_y$ and $M_z$ are independent of the specific geometry of the rail guide system.

To perform the subsequent calculation steps, the type and length of the rolling element assembly must be selected and the associated characteristic values C, $C_0$ and $L_T$ must be defined. In addition, a value must be defined for the average distance between the rolling element assemblies, $B_1$.

## 1.1.8.2 Preload force

The additional load generated by the preload when the rail guides are in a clamped arrangement must be taken into account in the design. The coefficient for the preload $f_{Pr}$ is dependent on the type of rolling element assembly ➤50 | 1.10.12.

The following applies for clamped arrangements:

12

$$C_{eff} = C_{eff\ slide}$$

13

$$F_{Pr} = C_{eff} \cdot f_{Pr}$$

| | | |
|---|---|---|
| $C_{eff}$ | N | Effective dynamic load rating |
| $C_{eff\ slide}$ | N | Effective dynamic load rating of the slide |
| $F_{Pr}$ | N | Preload force |
| $f_{pr}$ | % | Preload coefficient |

## 1.1.8.3 Combined bearing load

Load values $F_y$, $F_z$, $M_x$, $M_y$ and $M_z$ are added together to form a combined bearing load.

1

ƒ14

$$F_{comb} = |F_y| + |F_z| + \left( \left| \frac{2000 \cdot M_x}{B_1} \right| + \left| \frac{6000 \cdot M_y}{L_T} \right| + \left| \frac{6000 \cdot M_z}{L_T} \right| \right)$$

The resulting bearing load $F_{res}$, which contains the preload force $F_{pr}$, is used for the static design.

ƒ15

$$F_{res} = F_{Pr} + F_{comb} = F_{Pr} + |F_y| + |F_z| + \left( \left| \frac{2000 \cdot M_x}{B_1} \right| + \left| \frac{6000 \cdot M_y}{L_T} \right| + \left| \frac{6000 \cdot M_z}{L_T} \right| \right)$$

The dynamic design uses the equivalent dynamic load P, which takes into account the coefficient $f_s$ for the stroke length.

ƒ16

$$P = f_s \cdot F_{res} = f_s \cdot \left[ F_{Pr} + |F_y| + |F_z| + \left( \left| \frac{2000 \cdot M_x}{B_1} \right| + \left| \frac{6000 \cdot M_y}{L_T} \right| + \left| \frac{6000 \cdot M_z}{L_T} \right| \right) \right]$$

| | | |
|---|---|---|
| $B_1$ | mm | Average distance between the rolling element assemblies |
| $F_{comb}$ | N | Combined bearing load |
| $F_{Pr}$ | N | Preload force |
| $F_{res}$ | N | Resulting load |
| $f_s$ | – | Coefficient for stroke length |
| $F_y$, $F_z$ | N | Combined forces (load) in Y direction or Z direction |
| $L_T$ | mm | Load-carrying length |
| $M_x$, $M_y$, $M_z$ | Nm | Combined torque loads in X direction, Y direction or Z direction |
| P | N | Equivalent dynamic bearing load |

### 1.1.8.4 Equivalent dynamic mean load

The formulas for calculating the basic rating life are based on the assumption that the load and the running speed are constant. In actual practice, however, the external loads, running positions and running speeds vary in most cases. The work sequence must therefore be divided into load phases with constant or near-constant conditions during the individual strokes. Because the lever arms change in the X direction with the rail guide movement, the equivalent dynamic load also changes continuously and the formula must be simplified for calculations without the use of electronic aids. All single load phases are summarized to the equivalent dynamic mean load $P_m$ depending on their individual stroke length.

ƒ17

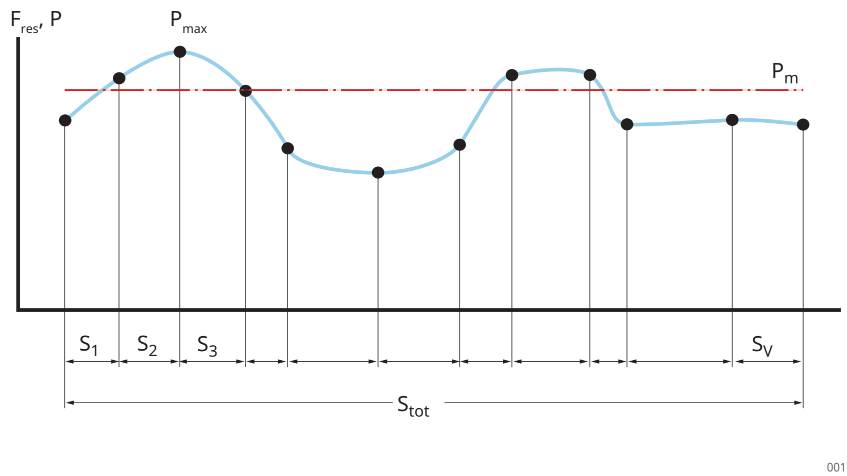
$$P_m = \sqrt[p]{\frac{\sum_{j=1}^{v} |P_j^p| \cdot S_j}{S_{tot}}}$$

18

$$S_{tot} = S_1 + S_2 + S_3 \ldots + S_v$$

| | | |
|---|---|---|
| j | – | Index for load phases |
| $P_j$ | N | Equivalent dynamic load during a specific load phase |
| $P_m$ | N | Equivalent dynamic mean load |
| p | – | Life exponent<br>• Roller bearing p = 10/3<br>• Ball bearing p = 3 |
| $S_j$ | mm | Individual stroke length of a specific load phase |
| $S_{tot}$ | mm | Total stroke length |
| V | – | Number of load phases |

2 Variable load on a precision rail guide




## 1.1.8.5 Maximum resulting load

If the maximum load occurs during the linear guide movement, the maximum $F_{res}$ value is required to calculate the static safety factor $s_0$. To determine this value, all loads for the individual stroke lengths must be calculated. These values can be used to determine the maximum resulting load $F_{res,\,max}$, which can then be used in the equation for $s_0$.

19

$$F_{res,\,max} = \underset{j=1}{\overset{v}{MAX}} \cdot \left|F_{res,\,j}\right|$$

20

$$F_{res,\,max} = \underset{j=1}{\overset{v}{MAX}} \cdot \left[F_{Pr} + \left|F_y\right| + \left|F_z\right| + \left(\left|\frac{2000 \cdot M_x}{B_1}\right| + \left|\frac{6000 \cdot M_y}{L_T}\right| + \left|\frac{6000 \cdot M_z}{L_T}\right|\right)\right]$$

| | | |
|---|---|---|
| $B_1$ | mm | Average distance between the rolling element assemblies |
| $F_{res, j}$ | N | Resulting load during a specific load phase |
| $F_{res, max}$ | N | Maximum resulting load |
| $F_{Pr}$ | N | Preload force |
| $F_y$ | N | Bearing load in y-direction |
| $F_z$ | N | Bearing load in z-direction |
| j | – | Index for load phases |
| $L_T$ | mm | Load-carrying length |
| $M_x$, $M_y$, $M_z$ | Nm | Combined torque loads in X direction, Y direction or Z direction |
| V | – | Number of load phases |

A similar formula is used to calculate $P_0$, the maximum static load during standstill. Either $P_0$ or $F_{res, max}$ is used to calculate the static safety factor $s_0$, depending on which value is greater.

### 1.1.9 Determining the effective load rating

For a rail guide consisting of four precision rails and two rolling element assemblies with a unique number of rolling elements, the effective dynamic and static load ratings are calculated as follows:

ƒ21

$$C_{0,\ eff\ slide} = f_{h0} \cdot f_t \cdot C_{0,\ 10} \cdot \frac{2 \cdot z_T}{10 \cdot f_1}$$

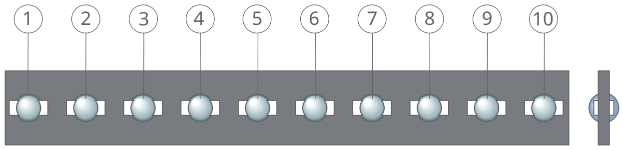
ƒ22

$$C_{eff\ slide} = f_h \cdot f_t \cdot C_{10} \cdot \left(\frac{2 \cdot z_T}{10 \cdot f_1}\right)^w$$

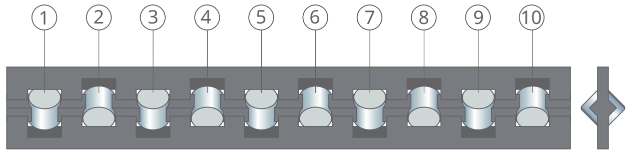
| | | |
|---|---|---|
| $C_{eff\ slide}$ | N | Effective dynamic load rating of the slide |
| $C_{0,\ eff\ slide}$ | N | Effective static load rating of the slide |
| $C_{0,\ 10}$ | N | Effective static load rating of a rail guide with a specific number of load-carrying rolling elements |
| $C_{10}$ | N | Dynamic load rating of a rail guide with a specific number of load-carrying rolling elements |
| $f_h$ | – | Coefficient for hardness under dynamic load |
| $f_{h,0}$ | – | Coefficient for hardness under static load |
| $f_t$ | – | Coefficient for operating temperature |
| $f_1$ | – | Coefficient for load direction |
| w | – | Rolling element exponent<br>• Rollers w = 7/9<br>• Balls w = 0.7 |
| $z_T$ | – | Number of load-carrying rolling elements |

Load ratings $C_{10}$ and $C_{0.10}$ in the product tables apply to a rail guide with one load direction and the specified number of rolling elements.

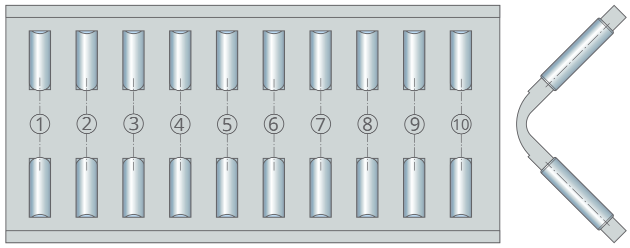
3 10 load-carrying balls



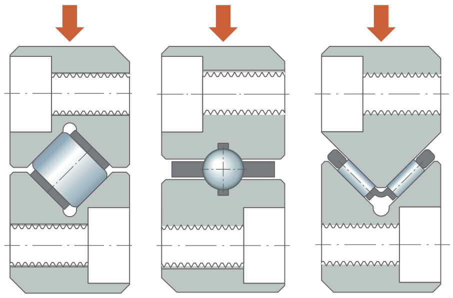

4 10 load-carrying crossed rollers




5 20 load-carrying needle rollers




6 Load direction



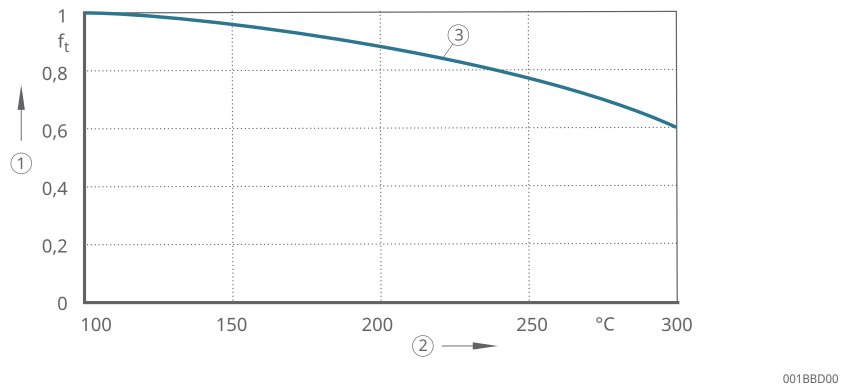

## 1.1.10 Influencing factors

### 1.1.10.1 The influence of the operating temperature, coefficient $f_t$

If a precision rail guide without a plastic cage is permanently used at operating temperatures above +120 °C, the load ratings will be reduced. In such cases, the coefficient for operating temperature $f_t$ must be taken into account.

1

7 Coefficient $f_t$ for the influence of the operating temperature



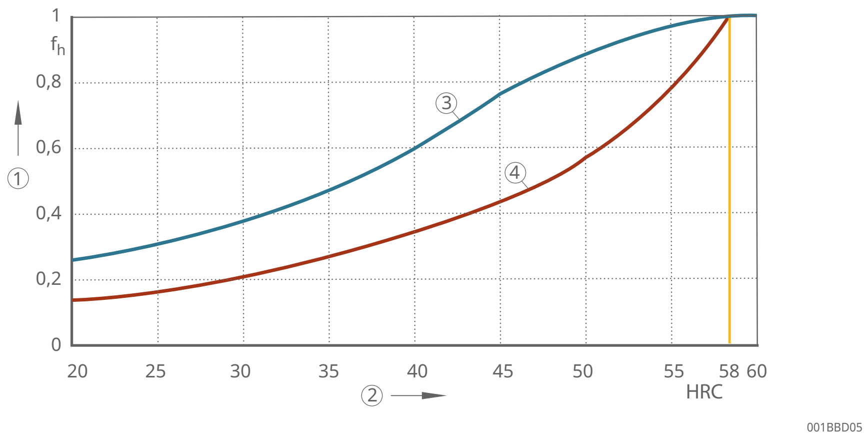

| | | | |
|---|---|---|---|
| 1 | Coefficient $f_t$ | 2 | Temperature |
| 3 | Temperature-dependent coefficients $f_t$ | | |

### 1.1.10.2 The influence of hardness, coefficient $f_h$

The load rating of the rolling element assembly can only be fully utilized (coefficients = 1) if the surface hardness of the rails is at least 58 HRC. If rails made of corrosion- or acid-resistant steel with a lower surface hardness are used, the values for $f_h$ and $f_{h0}$ should be used. This also applies to rolling elements with lower hardness, for example those made of corrosion-resistant steel.

! The static and dynamic load ratings in the product tables have already been reduced for rolling element assemblies with ACSM, as they are supplied with rail guides made of corrosion-resistant steel as standard. It is therefore not necessary to re-apply the coefficients.

8 Coefficient $f_h$ for the influence of hardness




| | | | |
|---|---|---|---|
| 1 | Coefficient $f_h$ | 2 | Hardness |
| 3 | $f_{h0}$ | 4 | $f_h$ |

### 1.1.10.3 The influence of stroke length, coefficient $f_s$

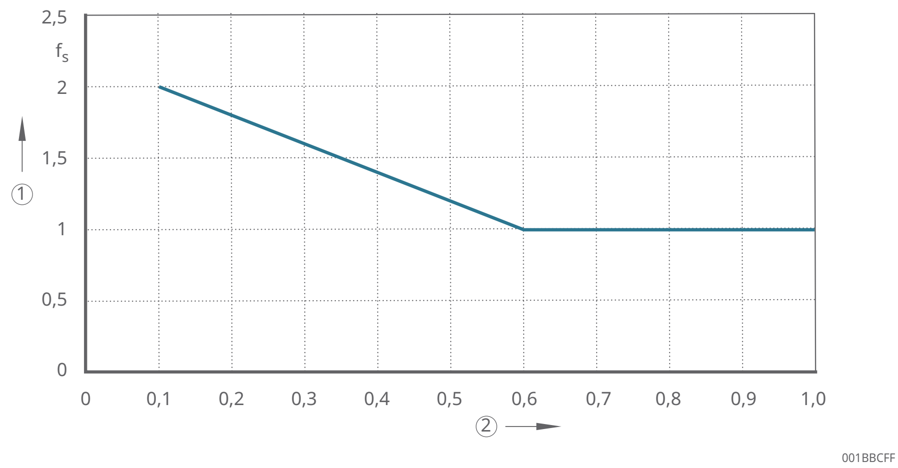
When determining the operating conditions to calculate the basic rating life, it is assumed that the reference stroke of the rail guide corresponds to the length of the rolling element assembly. However, this is rarely the case with precision rail guides. Extensive tests have shown that the rating life is reduced for precision rail guides operated under short-stroke conditions. The ratio of the individual stroke length to the length of the rolling element assembly and its influence on the coefficient $f_S$ is shown in the graph below. If there are multiple load phases with the same moving direction, the individual strokes must be added together.

23

$$\sum_{j=A}^{B} S_j / (L_T - t_3)$$

| | | |
|---|---|---|
| A | – | Starting point of movement in one direction |
| B | – | Next reversal point |
| j | – | Index for load phases |
| $L_T$ | mm | Load-carrying length |
| $S_j$ | mm | Individual stroke length of a specific load phase |
| $t_3$ | mm | Length of the ACS-system |

9 Coefficient $f_S$ for the influence of the stroke length




| | | | |
|---|---|---|---|
| 1 | Coefficient $f_S$ | 2 | ➤19 \| 23 |

Up to a stroke length to cage length ratio of 0.6, the decrease in rating life is insignificant. For lower values , the equivalent dynamic load is adjusted using the coefficient $f_S$. For values smaller than 0.1, it is no longer possible to calculate the rating life due to the unfavorable tribological conditions. The basic rating life under these conditions is essentially determined by the sliding conditions in the contact zone.

### 1.1.10.4 The influence of the load direction, coefficient $f_1$

Precision rail guides can be installed in different arrangements according to requirements. The influence of the arrangement on the load ratings is taken into account using coefficient $f_1$ for the load direction.

## Clamped arrangement

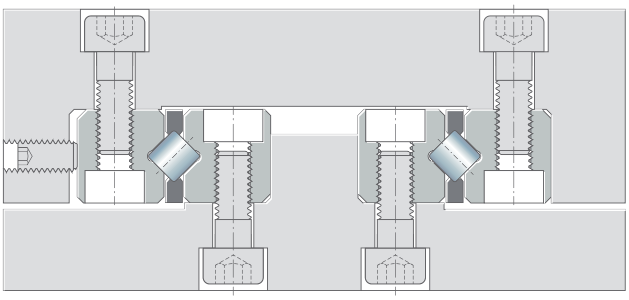
Precision rail guide systems are primarily installed in a clamped arrangement, as this has the following advantages:

- The preload of the system can be adjusted according to the requirements for system rigidity and running accuracy.
- The system can absorb loads and torques from any direction.
- The small cross-section allows for a compact design.

Clamped rail guide systems usually consist of two identical precision rail guides, a total of four precision rails, two rolling element assemblies and, if necessary, eight end pieces.

Coefficient for load direction $f_1 = 2$.

10 Clamped arrangement

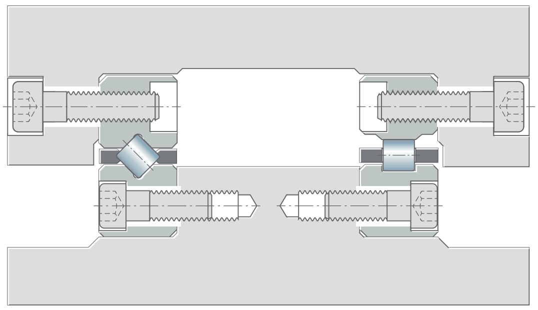



## Floating arrangement

A floating rail guide system consists of a locating bearing, e.g. an LWR rail guide, which serves as the guide in the longitudinal and transverse directions, and an additional rail guide with two level raceways, which is mounted as a floating bearing. In this type of arrangement, it must be ensured that both guide systems have the same load rating and rigidity. Floating rail guide systems can only absorb loads that predominantly act perpendicular to the guide. However, they can withstand high loads and are easy to assemble. They are particularly well suited to applications in which thermal length changes need to be compensated for or those with large support distances.

Coefficient for load direction $f_1 = 1$.

11 Floating arrangement



1

1.1.10.5 The influence of the rail guide kinematics

Precision rail guides can be designed to suit the application and taking into account the spatial conditions, stroke length and ambient conditions.

When designing a rail guide and rolling element assembly, the focus is on either the requirements for geometry and installation space or the requirements for load rating and rigidity. In the first case, the maximum usable cage length is calculated based on the stroke and rail length. However, if the load rating or rigidity requirements determine the length of the rolling element assembly, the equations are converted. In this case, the length of the rails is calculated based on the length of the cage and the stroke length.

## Not-overrunning rail system without wiper

The rolling element assembly always moves half the distance travelled by the moving rail and remains between the two rails.

If the geometry is specified:

24

$$L_{cage,\ max} = L_{rail} - 0.5 \cdot S - t_4$$

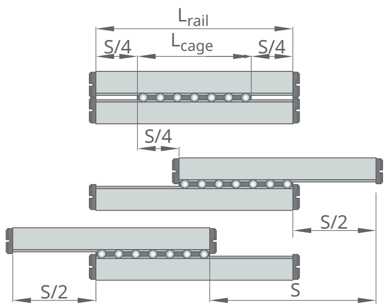
If the length of the rolling element assembly is defined by its basic rating life and rigidity:

25

$$L_{rail,\ min} = L_{cage} + t_4 + 0.5 \cdot S$$

| | | |
|---|---|---|
| $L_{cage}$ | mm | Length of the rolling element assembly |
| $L_{cage,\ max}$ | mm | Maximum length of the rolling element assembly |
| $L_{rail}$ | mm | Rail length |
| $L_{rail,\ min}$ | mm | Minimum rail length |
| S | mm | Stroke |
| $t_4$ | mm | ACS-reserve |

12 Kinematics for a not-overrunning rail system without wiper: Central position (top), right end position (middle), left end position (bottom)



1

## Rail system with wiper

If the system needs to be sealed using wipers, it must be ensured that the lips of the wipers are in contact with the raceways of the opposing rail along the entire travel path. These rail guides usually have two rails of different lengths. The wipers are fitted to the shorter rail, and the length of said rail is determined using the formulas in the previous section.

The minimum length of the long rail is:

ƒ 26

$$L_{rail,\ long,\ min} = L_{cage} + t_4 + 1.5 \cdot S + 2 \cdot L_1$$

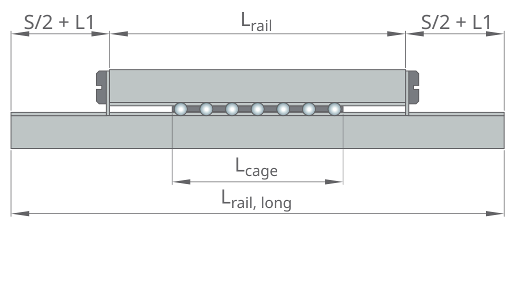
If the geometry is specified:

ƒ 27

$$L_{cage,\ max} = L_{rail,\ long} - 1.5 \cdot S - 2 \cdot L_1 - t_4$$

| | | |
|---|---|---|
| $L_{cage}$ | mm | Length of the rolling element assembly |
| $L_{cage,\ max}$ | mm | Maximum length of the rolling element assembly |
| $L_{rail,\ long}$ | mm | Length of the long rail |
| $L_{rail,\ long,\ min}$ | mm | Minimum length of the long rail |
| $L_1$ | mm | Thickness of the end piece with wiper |
| S | mm | Stroke |
| $t_4$ | mm | ACS-reserve |

13 Kinematics for a rail system with wiper




## Overrunning rail system without wiper

Overrunning rolling element assemblies are recommended for installations in which a short precision rail runs on a long rail. It is important to provide a lead-in radius for the short rail at both ends (please specify the suffix EG when ordering) so that the overrunning rolling element assembly causes as little pulsation as possible. Not every cage is suitable for this. The maximum cage overrun (free cage length) depends on the orientation of the rails and the cage material. If the installation space is the highest priority, the length of the components is calculated as follows:

f 28

$$L_{cage,\ max} = L_{rail,\ long} - 0.5 \cdot S - t_4$$

and

f 29

$$L_{rail,\ short} = L_{rail,\ long} - S$$

If the rigidity or load rating of the rail system is most important, the following formulas should be used:

f 30

$$L_{rail,\ long} = L_{cage} + t_4 + 0.5 \cdot S$$

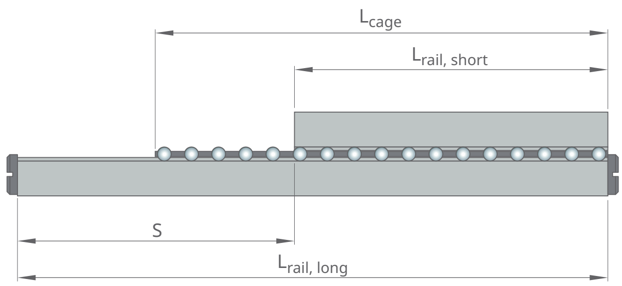
and

f 31

$$L_{rail,\ short} = L_{rail,\ long} - S$$

| | | |
|---|---|---|
| $L_{cage}$ | mm | Length of the rolling element assembly |
| $L_{cage,\ max}$ | mm | Maximum length of the rolling element assembly |
| $L_{rail,\ long}$ | mm | Length of the long rail |
| $L_{rail,\ short}$ | mm | Length of the short rail |
| S | mm | Stroke |
| $t_4$ | mm | ACS-reserve |

14 Kinematics for an overrunning rail system without wiper




The exact position of the ACS rack varies slightly from rail to rail. If two rails with an ACS rack are positioned centrally to each other, the following may occur:

- The teeth of both racks are aligned.
- The tooth of one rack is aligned with a gap on the other.
- Every position between these two cases.

To account for the resulting eccentricity of the ACS control gear, the dimension $t_4$ is used in the equations for the rail guide design. For guides without ACS(x), $t_4 = 0$.

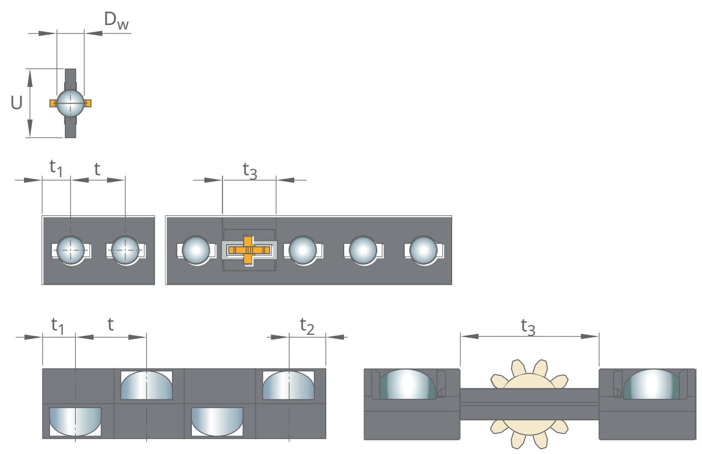
### 1.1.10.6 Number of rolling elements z and $z_T$

After calculating the maximum cage length $L_{cage, max}$ and the rail length based on the required geometry, the number of rolling elements z must be calculated so that the correct rolling element assembly length can be ordered. Depending on the different kinematics , the number of load-carrying rolling elements $z_T$ must be defined to calculate the rating life.

The following overview provides the formulas for calculating the values z and $z_T$. For kinematics in which the rolling element assembly remains always between the rails (not-overrunning rail guide without wiper and rail guide with wiper) and all rolling elements are subjected to loads, $z = z_T$. In overrunning rail systems, only the rolling elements under the short rail can be loaded, so $z_T$ must be calculated differently. The formulas use the truncate (TRUNC) function to obtain an integer for the number of rolling elements. This can be used to determine the real rolling element assembly length $L_{cage}$ to be ordered and the load-carrying length $L_T$, defined as the distance between the center of the first load-carrying rolling element and the center of the last rolling element. The formulas for the installation length $L_{install}$ are also provided.

Values for t, $t_1$, $t_2$ and $t_3$ for the different rolling element assemblies are given in the product tables. If no value is given for $t_2$, $t_2 = t_1$. If no value is given for $t_3$, $t_3 = 0$

15 Dimensions of the rolling element assembly

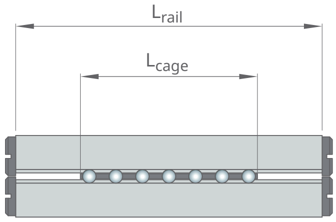


1

## Not-overrunning rail guide without wiper (standard)

16 Rolling element in kinematics with not-overrunning rail guide without wiper (standard)




32

$$z = TRUNC \cdot \left( \frac{L_{cage,\ max} - t_1 - t_2 - t_3}{t} \right) + 1$$

33

$$z_T = TRUNC \cdot \left( \frac{L_{cage,\ max} - t_1 - t_2 - t_3}{t} \right) + 1$$

34

$$L_{cage} = (z - 1) \cdot t + t_1 + t_2 + t_3$$

35

$$L_T = (z_T - 1) \cdot t + t_3$$

36

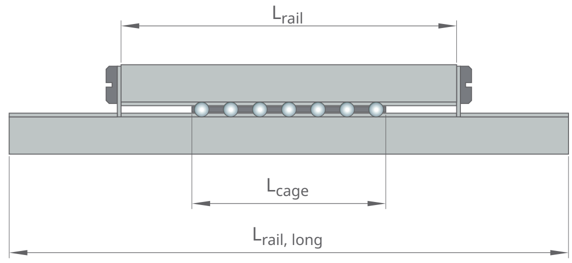
$$L_{install} = L_{rail} + S + 2 \cdot L$$

| | | |
|---|---|---|
| $L$ | mm | Thickness of the end piece |
| $L_{cage}$ | mm | Length of the rolling element assembly |
| $L_{cage,\ max}$ | mm | Maximum length of the rolling element assembly |
| $L_{install}$ | mm | Length of the overall installation space |
| $L_{rail}$ | mm | Rail length |
| $L_T$ | mm | Load-carrying length |
| $t$ | mm | Pitch of rolling elements in a cage |
| $t_1$ | mm | Distance from the end of the cage to the center of the first rolling element |
| $t_2$ | mm | Distance from the end of the cage to the center of the first rolling element |
| $t_3$ | mm | Length of the ACS-system |
| $z_T$ | – | Number of load-carrying rolling elements |
| $z$ | – | Number of rolling elements |

1

## Rail guide with wiper

17 Rolling element in kinematics with rail guide with wiper

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37

$$z = \mathrm{TRUNC} \cdot \left( \frac{L_{cage,\,max} - t_1 - t_2 - t_3}{t} \right) + 1$$

38

$$z_T = \mathrm{TRUNC} \cdot \left( \frac{L_{cage,\,max} - t_1 - t_2 - t_3}{t} \right) + 1$$

39

$$L_{cage} = (z - 1) \cdot t + t_1 + t_2 + t_3$$

40

$$L_T = (z_T - 1) \cdot t + t_3$$

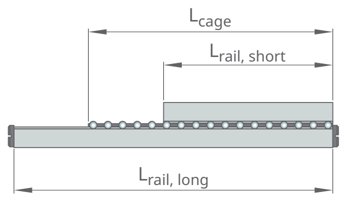
41

$$L_{install} = L_{rail,\,long}$$

| | | |
|---|---|---|
| $L_{cage}$ | mm | Length of the rolling element assembly |
| $L_{cage,\,max}$ | mm | Maximum length of the rolling element assembly |
| $L_{install}$ | mm | Length of the overall installation space |
| $L_{rail,\,long}$ | mm | Length of the long rail |
| $L_T$ | mm | Load-carrying length |
| t | mm | Pitch of rolling elements in a cage |
| $t_1$ | mm | Distance from the end of the cage to the center of the first rolling element |
| $t_2$ | mm | Distance from the end of the cage to the center of the first rolling element |
| $t_3$ | mm | Length of the ACS-system |
| $z_T$ | – | Number of load-carrying rolling elements |
| z | – | Number of rolling elements |

## Overrunning rail guide without wiper

18 Rolling element in kinematics with overrunning rail guide without wiper




42

$$z = \mathrm{TRUNC} \cdot \left( \frac{L_{cage,\ max} - t_1 - t_2 - t_3}{t} \right) + 1$$

43

$$z_T = \mathrm{TRUNC} \cdot \left( \frac{L_{rail,\ short} - t_3 - 2 \cdot EG}{t} \right) + 1$$

44

$$L_{cage} = (z - 1) \cdot t + t_1 + t_2 + t_3$$

45

$$L_T = (z_T - 1) \cdot t + t_3$$

46

$$L_{install} = L_{rail,\ long} + 2 \cdot L$$

| | | |
|---|---|---|
| EG | mm | Length of the lead-in radius at each end |
| L | mm | Thickness of the end piece |
| $L_{cage}$ | mm | Length of the rolling element assembly |
| $L_{cage,\ max}$ | mm | Maximum length of the rolling element assembly |
| $L_{install}$ | mm | Length of the overall installation space |
| $L_{rail,\ long}$ | mm | Length of the long rail |
| $L_{rail,\ short}$ | mm | Length of the short rail |
| $L_T$ | mm | Load-carrying length |
| t | mm | Pitch of rolling elements in a cage |
| $t_1$ | mm | Distance from the end of the cage to the center of the first rolling element |
| $t_2$ | mm | Distance from the end of the cage to the center of the first rolling element |
| $t_3$ | mm | Length of the ACS-system |
| $z_T$ | – | Number of load-carrying rolling elements |
| z | – | Number of rolling elements |

1

### 1.1.10.7 The influence of the geometry of the rail guide system

The following is generally recommended with regard to the length of the rolling element assembly:

- Clamped arrangement $L_{cage} = S$
- Floating arrangement $L_{cage} = 1.5 \cdot S$

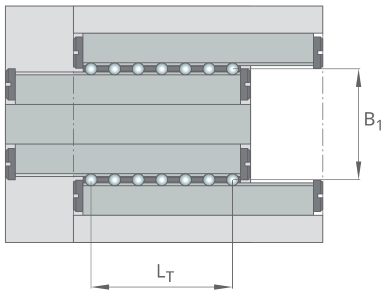
However, it should be noted that in the case of heavy loads, off-center loads or torque loads, the longest-possible rolling element assembly should be selected to ensure even load distribution and high system rigidity. In addition, the mean distance between the rolling element assemblies $B_1$ should not exceed the load-carrying length $L_T$.

ƒ47

$$L_T > B_1$$

| | | |
|---|---|---|
| $B_1$ | mm | Average distance between the rolling element assemblies |
| $L_T$ | mm | Load-carrying length |

19 The influence of the geometry of the rail guide system

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## 1.2 Calculation program

The online **Linear Guide Calculator** from Schaeffler can be used to aid the entire selection process. The in-browser program guides the user through the individual input screens and automatically generates a report with the inputs and calculation results. The program is free to use.

20 Linear Guide Calculator


001C44C2

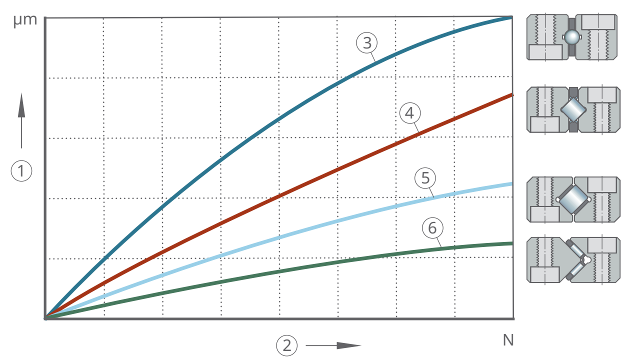
### Further information

Linear Guide Calculator | Calculation program
https://www.schaeffler.de/std/2209

## 1.3 Rigidity

The rigidity of a precision rail guide is defined as the ratio between the external load acting on the guide and the resulting elastic deflection of the guide. Alongside the load rating, the rigidity of a precision rail guide is one of the most important criteria when selecting a guide. The elastic deflection of a system depends on the size and direction of the external load, the preload and the type of rail guide, including the size and length of the rolling element assembly, as well as the mechanical properties of the adjacent construction, including screw connections and joints between the components. The deflection under load of a preloaded rail guide system is less than that of a non-preloaded rail guide system within a given load range. Differences in the contact geometry are the main factors that influence the general rigidity behavior of the different rolling element assemblies.

21 Rigidity behavior of different types of rolling element




| | | | |
|---|---|---|---|
| 1 | Deflection | 2 | Load |
| 3 | LWRB | 4 | LWR |
| 5 | LWRE | 6 | LWRM with LWRV |

### 1.3.1 Calculating the rigidity

For precision rail guides, it is particularly important to know the elastic deflection of the assembly at the loading point. To obtain an approximate value for this parameter, the elastic deformation of the raceway $\delta$ caused by the rolling elements must first be determined using the diagrams. The calculated value must be multiplied by the correction factor $f_k$ to obtain an approximate value for the resulting deflection $\delta_{res}$ of the precision rail system, including the surrounding steel parts.

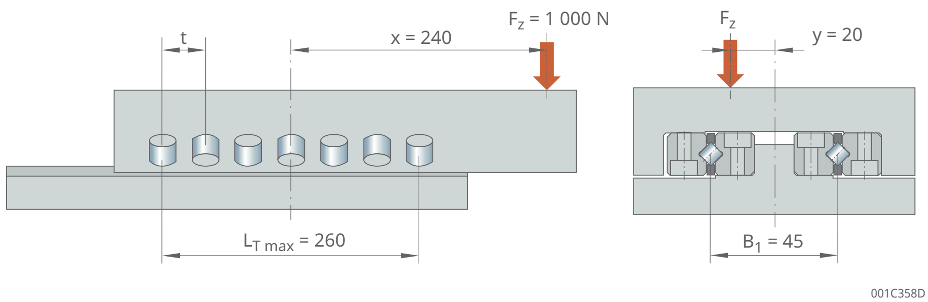
#### 1.3.1.1 Determining the elastic deformation using nomograms

Before using the nomograms provided, it is necessary to determine the load conditions in relation to the mechanical dimensions and to define for which load phase and dominating single load in the Z direction the elastic deformation should be calculated. The rolling element diameter $D_w$ and the contact length of the rolling element $L_{w\ eff}$ can be found in the table. These calculations can be used to obtain the elastic deformation at the loading point from the nomogram. The nomograms are based on clamped guides and are assigned to the individual types of precision rail guide.

3 Contact length and diameter of the rolling element

| Designation | $D_w$ | $L_{w\ eff}$ | Precision rail guide |
|---|---|---|---|
| | mm | mm | |
| LWJK 1.588 | 1.588 | – | LWR |
| LWJK 2 | 2 | – | LWR |
| LWAK 3 | 3 | 1.1 | LWR |
| LWAL 6 | 6 | 2.4 | LWR |
| LWAL 9 | 9 | 3.6 | LWR |
| LWAL 12 | 12 | 5.4 | LWR |
| LWAKE 3 | 4 | 2.3 | LWRE |
| LWAKE 4 | 6.5 | 3.2 | LWRE |
| LWAKE 6 | 8 | 4.7 | LWRE |
| LWAKE 9 | 12 | 8.2 | LWRE |
| LWHV 10 | 2 | 4.4 | LWRM, LWRV, LWM, LWV |
| LWHW 10 | 2 | 4.4 | LWRM, LWRV, LWM, LWV |
| LWHV 15 | 2 | 7.4 | LWRM, LWRV, LWM, LWV |
| LWHW 15 | 2 | 6.4 | LWRM, LWRV, LWM, LWV |
| LWHV 20 | 2.5 | 11.4 | LWRM, LWRV, LWM, LWV |
| LWHW 20 | 2.5 | 9.4 | LWRM, LWRV, LWM, LWV |
| LWHV 25 | 3 | 13.4 | LWRM, LWRV, LWM, LWV |
| LWHW 25 | 3.5 | 17.4 | LWRM, LWRV, LWM, LWV |

22 Required parameters for calculating the coefficients




## Preparation

Determining the number of load-carrying rolling elements as control parameters for the nomograms:

**Crossed roller cages**

48

$$z_{Tnomo} = 2 \cdot \left( \frac{L_T}{t} + 1 \right)$$

**Ball cages and needle roller cages**

49

$$z_{Tnomo} = \frac{L_T}{t} + 1$$

Calculating the average rolling element load:

**Crossed roller cages**

ƒ 50

$$Q = \frac{2 \cdot F_z}{z_{Tnomo}}$$

**Ball cages and needle roller cages**

ƒ 51

$$Q = \frac{F_z}{2 \cdot z_{Tnomo}}$$

Calculating the leverage ratio $R_x$:

ƒ 52

$$R_x = \frac{x}{t}$$

Calculating the leverage ratio $R_y$:

ƒ 53

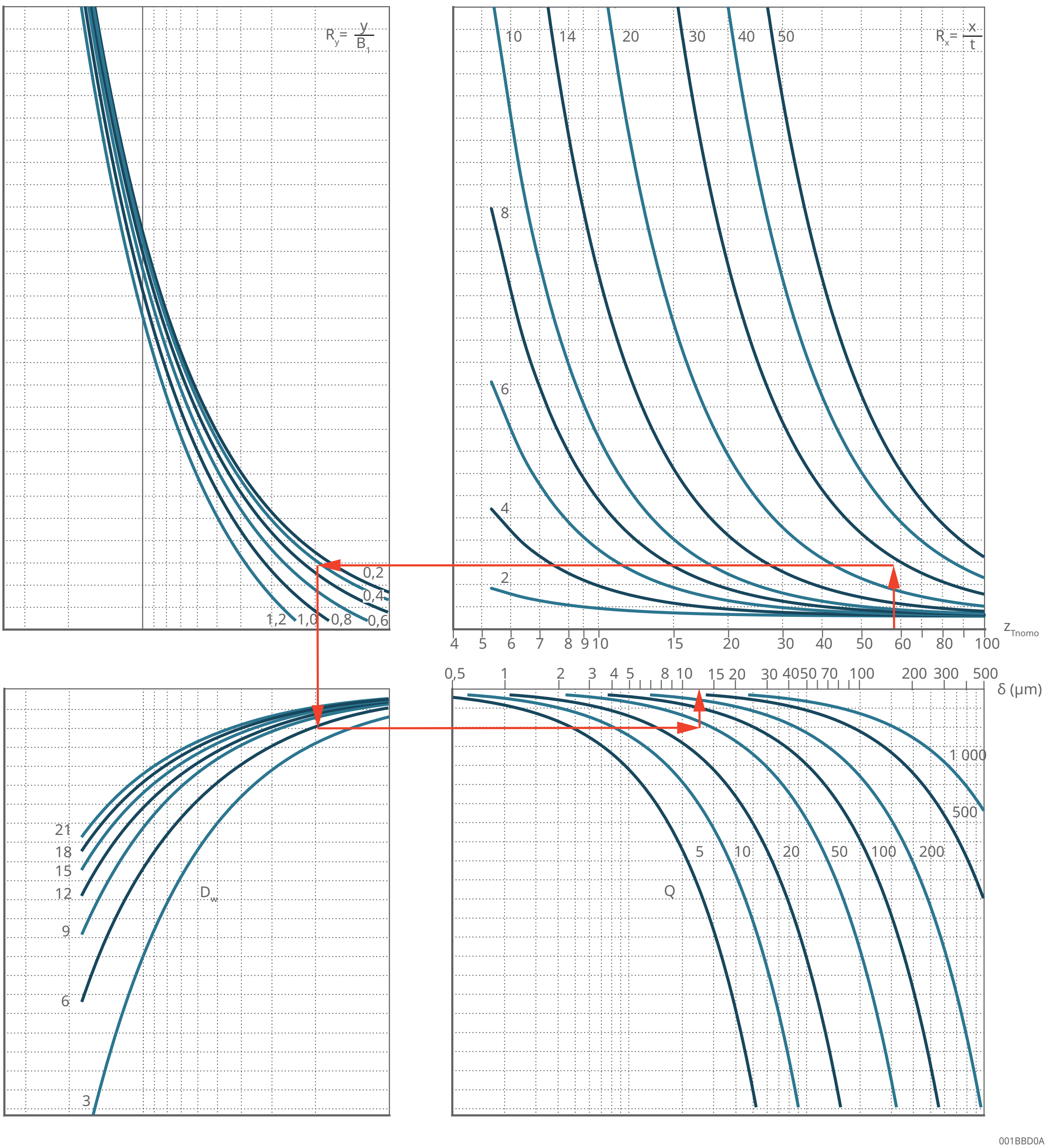
$$R_y = \frac{y}{B_1}$$

| | | |
|---|---|---|
| $B_1$ | mm | Average distance between the rolling element assemblies |
| $D_w$ | mm | Rolling element diameter |
| $F_z$ | N | Bearing load in z-direction |
| t | mm | Pitch of rolling elements in a cage |
| $L_T$ | mm | Load-carrying length |
| $L_{w\ eff}$ | mm | Rolling element contact length |
| Q | N | Average load per rolling element |
| x | mm | Distance from the center of the rolling element assembly to the loading point |
| y | mm | Distance from the center of the rail guide assembly to the loading point |
| $z_{Tnomo}$ | – | Number of load-carrying rolling elements (per cage or for needle rollers per row) |

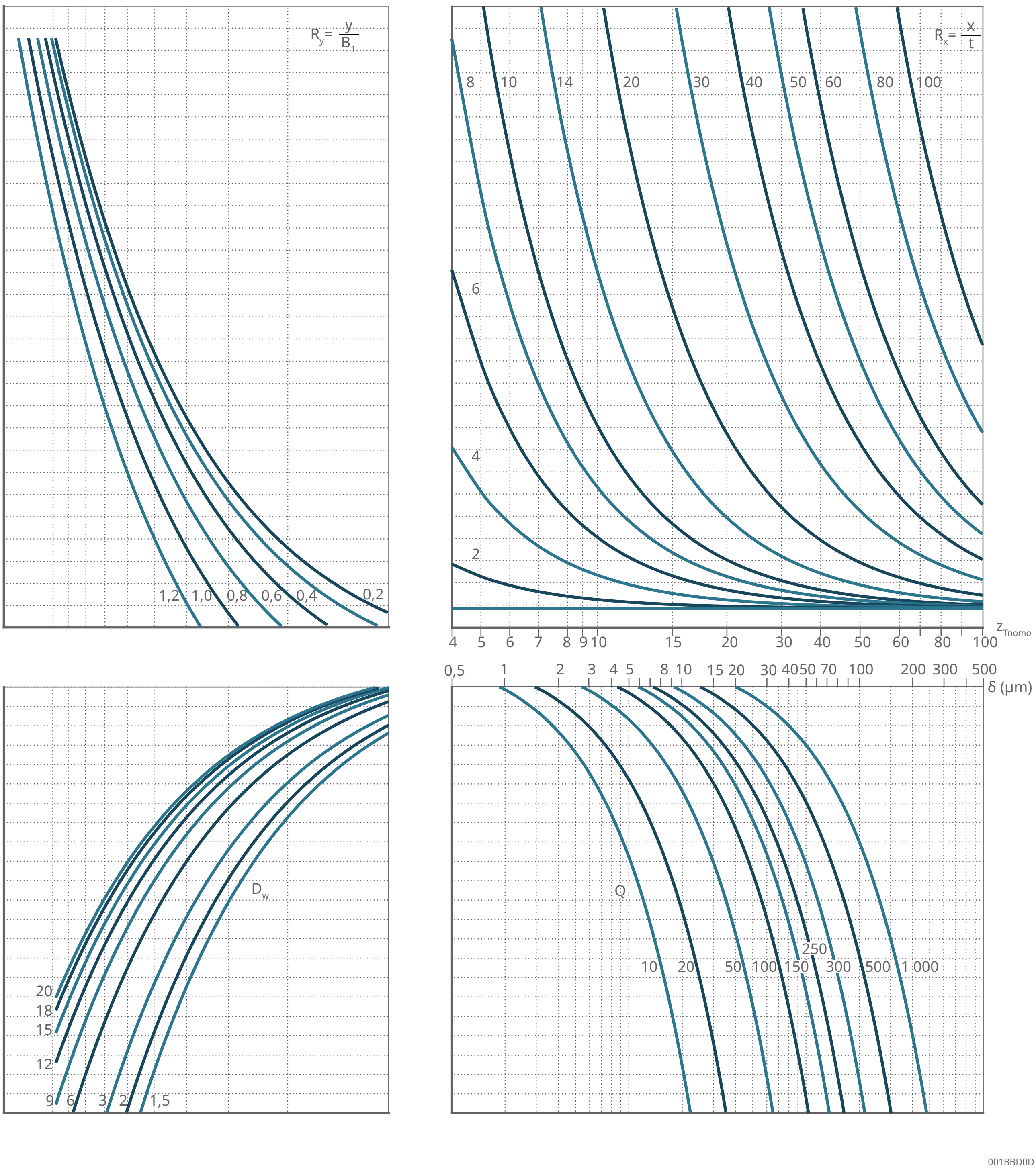
## Obtaining the elastic deformation from the nomogram

The elastic deformation δ can now be obtained from the nomogram using the values determined in the previous section.

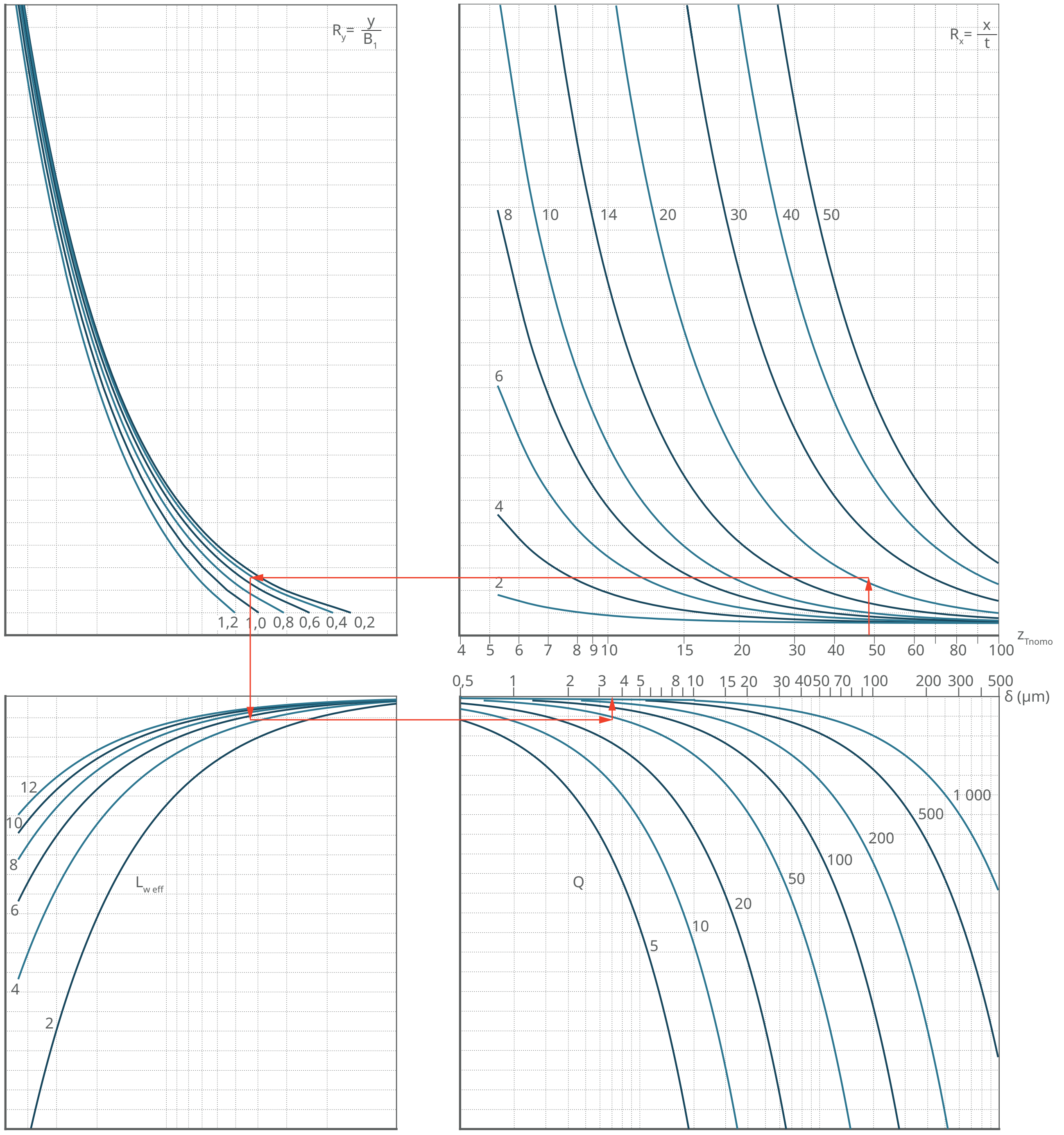
23 Elastic deformation for LWR rail guides with crossed roller cages



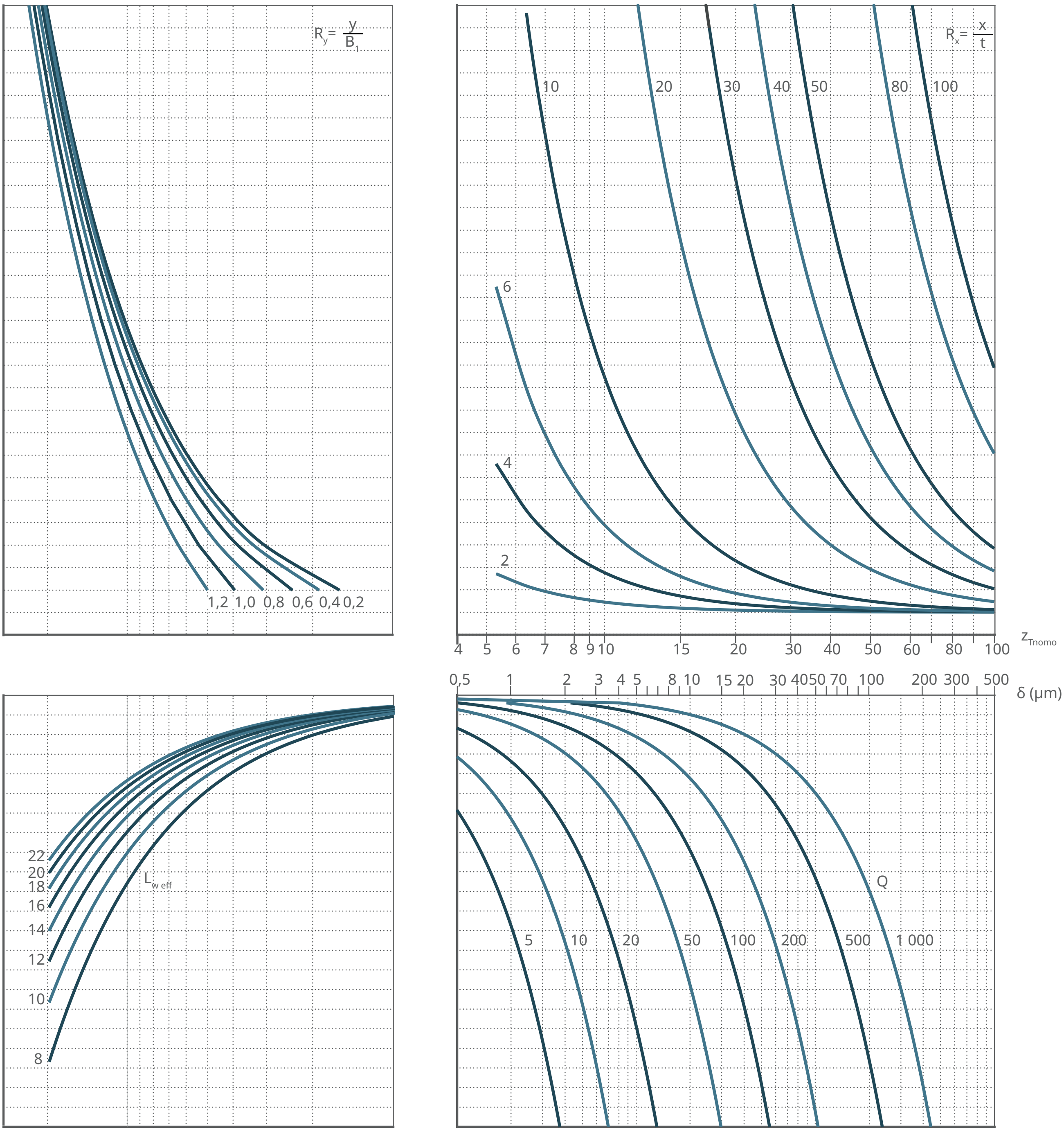
24 Elastic deformation for LWR rail guides with ball cages



25 Elastic deformation for LWRE rail guides with high-capacity crossed roller cages



26 Elastic deformation for LWRM, LWRV, LWM and LWV rail guides with needle roller cages

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### 1.3.1.2 Determining the resulting deflection of a rail guide system

When the measured elastic deflection of a complete slide system is compared with the values from the nomograms, the rigidity of the complete slide system will be significantly lower. This discrepancy is mainly due to the uneven load distribution along the guide as a result of, for example, form deviations, parallelism deviations or improper assembly. This in turn can lead to variations of the loads on the individual rolling elements along the rail guide. This is taken into account by using the correction factor $f_k$, which is based on the control parameter $z_{Tnomo}$ and the specific load of a rolling element k.

The corresponding correction factors are shown in diagrams ➤37 | 28 and ➤37 | 27. For LWR rail guides with ball cages, the calculated values correspond to the measurements and factor $f_k$ is not required.

Determining the specific load per rolling element:

**LWR crossed roller cages**

ƒ54

$$k = \frac{2 \cdot F_z}{z_{Tnomo} \cdot D_w^2}$$

**LWRE crossed roller cages**

ƒ55

$$k = \frac{2 \cdot F_z}{z_{Tnomo} \cdot D_w \cdot L_{w\ eff}}$$

**Needle roller cages**

ƒ56

$$k = \frac{F_z}{2 \cdot z_{Tnomo} \cdot D_w \cdot L_{w\ eff}}$$

| | | |
|---|---|---|
| $D_w$ | mm | Rolling element diameter |
| $F_z$ | N | Bearing load in z-direction |
| k | $N/mm^2$ | Specific load per rolling element |
| $L_{w\ eff}$ | mm | Rolling element contact length |
| $z_{Tnomo}$ | – | Number of rolling elements as a control parameter for the nomogram |

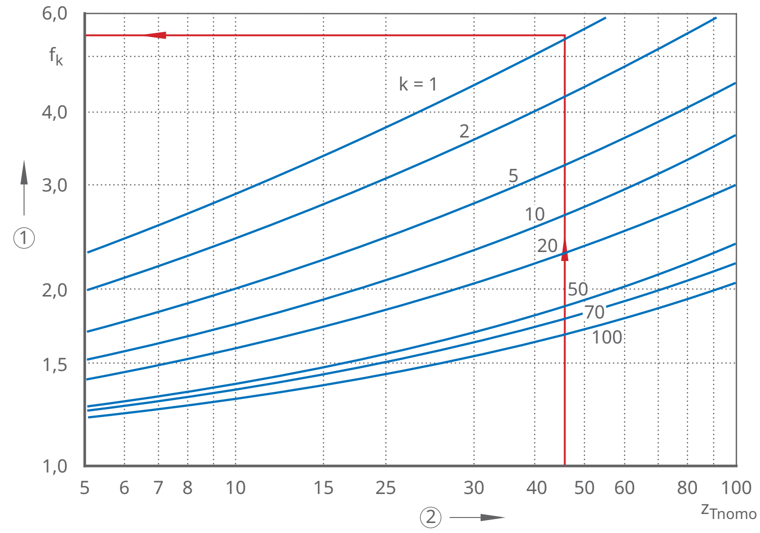
Calculating the resulting deflection:

ƒ57

$$\delta_{res} = f_k \cdot \delta$$

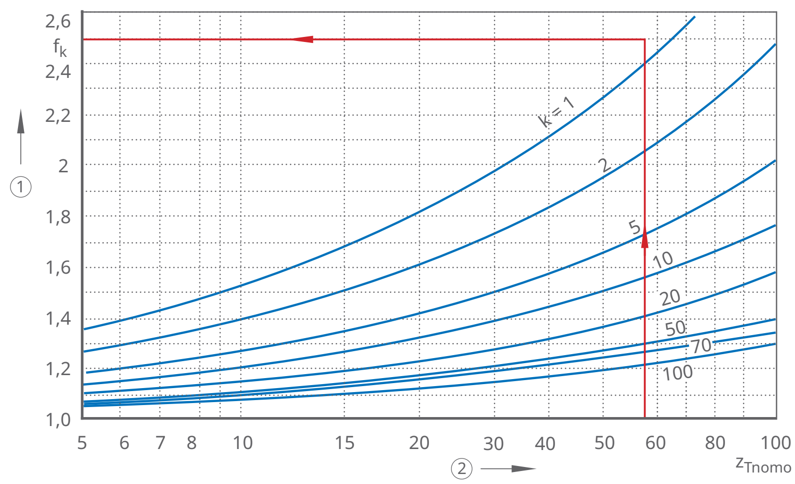
| | | |
|---|---|---|
| $f_k$ | – | Correction factor |
| $\delta$ | μm | Elastic deformation |
| $\delta_{res}$ | μm | Resulting deflection |

27 Correction factor $f_k$ for LWRE, LWRM, LWRV, LWM and LWV




| | | | |
|---|---|---|---|
| 1 | Correction factor $f_k$ | 2 | Control parameter $z_{T\ nomo}$ |

28 Correction factor $f_k$ for LWR




| | | | |
|---|---|---|---|
| 1 | Correction factor $f_k$ | 2 | Control parameter $z_{T\ nomo}$ |

### 1.3.1.3 Calculation example

GCL 6400 precision rail guide slide is loaded with a force of 1000 N in the extended position. Calculations are required to determine the resulting deflection of LWR or LWRE rail guides in size 6 at the loading point.

The characteristic values and curves for the calculation example are marked in red in the diagrams ➤30 | 22 ➤32 | 23 ➤34 | 25.

1

4 Calculation example

| Parameter | | Unit | LWR | LWRE |
|---|---|---|---|---|
| Load-carrying length | $L_T$ | mm | 252 | 253 |
| Pitch of rolling elements in a cage | t | mm | 9 | 11 |
| Number of load-carrying rolling elements | $z_{Tnomo}$ | – | 58 | 48 |
| Leverage ratio | $R_x = x : t$ | – | 26.7 | 21.8 |
| Leverage ratio | $R_y = y : B_1$ | – | 0.44 | 0.44 |
| Rolling element diameter | $D_W$ | mm | 6 | 8 |
| Rolling element contact length | $L_{W\,eff}$ | mm | 2.4 | 4.7 |
| Average load per rolling element | Q | N | 34.5 | 41.7 |
| Elastic deformation | δ | μm | 13 | 3.5 |
| Specific load per rolling element | k | N/mm² | 0.96 | 1.1 |
| Correction factor | $f_k$ | – | 2.5 | 5.4 |
| Resulting deflection | $\delta_{res}$ | μm | 32.5 | 18.9 |

## 1.4 Friction

The friction in a precision rail guide system with rolling elements is influenced by a number of other factors in addition to the load, in particular the type of guide and its size, the running speed and the properties of the lubricant used. The total running resistance of a rail guide consists of the rolling friction and sliding friction in the contact zone of the rolling elements, sliding friction between cage and rolling elements, as well as the lubricant friction and the sliding friction of contact seals or wipers. Under normal operating conditions with grease lubrication and good installation accuracy, the coefficients of friction are between 0.0005 and 0.004.

Rail guides with wipers have significantly higher coefficients of friction and an increased starting friction, as the contact wipers also produce friction.

## 1.5 Load capacity

### 1.5.1 Required minimum load

To avoid the raceway being damaged by sliding movements by the rolling elements at higher speeds or with high accelerations, there must always be a minimum load of 2 % of the dynamic load rating acting on the guide system during the movement. This is particularly important for applications that have highly dynamic cycles. Precision rail guides preloaded with the approximate torque values for the set screw ➤50 | 1.10.12 generally meet these minimum load requirements.

### 1.5.2 Maximum permissible load

ISO 14728-1 stipulates that the equivalent dynamic mean load $P_m$ of a precision rail guide system must not exceed 50 % of the dynamic load rating C in the calculation of the bearing rating life. Higher values during operation lead to uneven load distribution and can significantly reduce the rating life of the bearings. ISO 14728-2 stipulates that the maximum load must not exceed 50 % of the static load rating $C_0$.

## 1.6 Acceleration and speed

Precision rail guides that are installed properly and with the correct preload are suitable for accelerations up to 25 $m/s^2$. Needle roller cages are suitable for accelerations up to a maximum of 100 $m/s^2$. The maximum acceleration for rolling element assemblies with ACSM is 160 $m/s^2$, and 100 $m/s^2$ for rolling element assemblies with ACSZ. Higher acceleration values may be possible depending on the bearing type, bearing size, applied load, lubricant and preload. In such cases, please contact Schaeffler. The maximum running speed is determined by the specified maximum acceleration values and the stroke limitations due to kinematics.

## 1.7 Temperature range

The permissible temperature range for the operation of precision rail guides depends largely on the type of cage used. Rail guides with metal cages and end pieces without wipers can generally be used at temperatures up to +120 °C. For rail guides with plastic components, the permissible temperature range is between −30 °C and +80 °C. The permissible temperature range of the lubricant must also be checked before use.

Permanently higher temperatures are possible for precision rail guides without plastic components, but result in a lower material hardness and therefore a lower load rating ➤17|1.1.10.1. The running accuracy of a rail guide decreases as the temperature increases due to changes in the material structure and resulting changes in dimensions.

For rail guides with an ACSZ rack, the maximum operating temperature is 180 °C.

## 1.8 Materials

Precision rail guides are made of 90MnCrV8 (1.2842) tool steel with a hardness between 58 and 62 HRC as standard. Rails made of corrosion-resistant steel, such as X90CrMoV18 (1.4112), are also available on request. Specify the suffix HV when ordering. Rails from the LWRE ACSM series are always made of X46Cr13 (1.4034) or X65Cr13 (1.4037) corrosion-resistant steel. The hardness of rails made of corrosion-resistant steel is between 54 and 58 HRC.

The balls, rollers or needle rollers used in the various rolling element assemblies are made of 100Cr6 (1.3505) bearing steel with a hardness between 58 and 68 HRC . Some of the rolling elements are available in corrosion-resistant steel on request.

The cages of rolling element assemblies are made of plastic or aluminum. The cages of LWAKE crossed roller assemblies are made of POM . All other rolling element assemblies are made of PA12 or a comparable material and are partially glass-fiber reinforced. Aluminum cages are made of AlMgSi0.5 (EN AW-6060). For other cage materials such as PEEK, steel or brass, contact Schaeffler.

End pieces are made of blackened steel as standard. Standard end pieces are also available as nickel-plated variants. Specify the suffix HV when ordering. End pieces with wipers are made of felt, thermoplastic polyurethane (TPUR) or thermoplastic polyester elastomer (TPC-ET).

### 1.8.1 Coating

A special TDC coating can be applied to the rails for use in corrosive environments. This coating provides significantly increased corrosion resistance at a hardness of 900 to 1300 HV and thus improves wear resistance under critical operating conditions. The salt spray test in accordance with DIN EN ISO 9227 demonstrated corrosion protection over a period of 72 h. The matte-gray coating complies with the requirements of the RoHS directives. It does not affect the load rating of the rail system. Due to the electrolytic process, the mounting holes and other grooves or holes may not be fully coated. Specify the suffix HD when ordering.

## 1.9 Tolerances

### 1.9.1 Accuracy classes for precision rail guides

To meet the different requirements for rail guide accuracy, they are manufactured in the following 3 accuracy classes, which are based on the parallelism of the raceways to the reference surfaces.

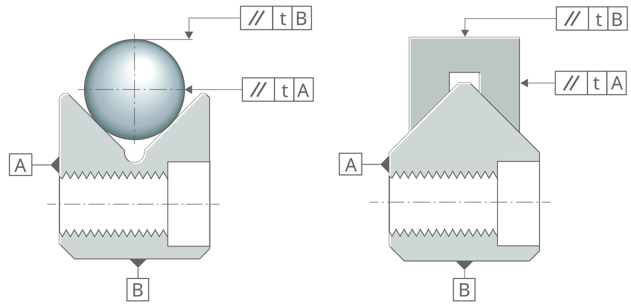
- **P10**
  Rails in this accuracy class meet the requirements of general mechanical engineering. The tolerance of parallelism for a 1000 mm-long rail is maximum 9 μm.
- **P5**
  Accuracy class P5 meets the standard requirements for running accuracy in machine tool manufacturing. The tolerance of parallelism for a 1000 mm-long rail is maximum 5 μm.
- **P2**
  Accuracy class P2 meets the highest requirements for running accuracy. Rails of this quality should only be used where the adjacent construction also has a correspondingly high level of accuracy. Rails in accuracy class P2 are manufactured by Schaeffler on request.

If no accuracy class is specified when ordering, rails are supplied in the standard accuracy class of P10.

5 Tolerance t of parallelism of the raceways to the reference surfaces

| **Rail length** | **Accuracy class** | | |
|---|---|---|---|
| **L** | **P10** | **P5** | **P2** |
| **mm** | **μm** | **μm** | **μm** |
| L ≤ 100 | 2 | 1 | 1 |
| 100 < L ≤ 200 | 3 | 2 | 1 |
| 200 < L ≤ 300 | 4 | 2 | 1 |
| 300 < L ≤ 400 | 5 | 2 | 2 |
| 400 < L ≤ 500 | 6 | 3 | 2 |
| 500 < L ≤ 600 | 6 | 3 | 2 |
| 600 < L ≤ 700 | 7 | 4 | 2 |
| 700 < L ≤ 800 | 8 | 4 | 2 |
| 800 < L ≤ 900 | 8 | 5 | 2 |
| 900 < L ≤ 1000 | 9 | 5 | 2 |
| 1000 < L ≤ 1200 | 10 | 6 | 3 |
| 1200 < L ≤ 1400 | 11 | 6 | 3 |
| 1400 < L ≤ 1600 | 12 | 7 | 3 |

29 Parallelism of the raceways to the reference surfaces




## 1.9.2 Rolling element accuracy

The rolling elements used in precision rail guide cages are of very high quality and are supplied as standard in specific quality classes. Needle roller cages are also available in quality class G1 on request. Specify the suffix G1 when ordering.

6 Rolling element accuracy

| Rolling element | Standard | Quality class | Roundness | Sorting |
|---|---|---|---|---|
| | – | – | μm | μm |
| Needle rollers | Not specified in DIN | G1 | 0.5 | 1 |
| | DIN 5402-3 | G2 | 1 | 2 |
| Cylinder rollers | DIN 5402-1 | G1 | 0.5 | 1 |
| Balls | DIN 5401-1 | G10 | 0.25 | 1 |

## 1.9.3 Dimensional accuracy

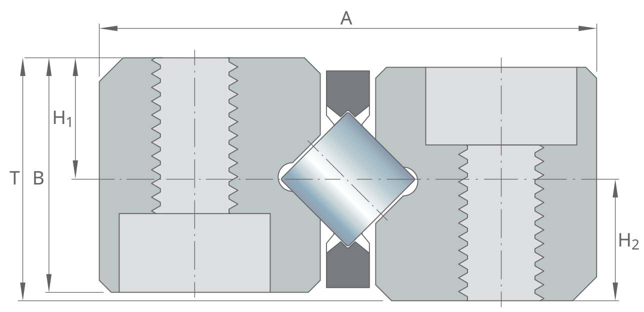
Precision rail guides are manufactured with the following tolerances. The specifications for center height and installation width apply to rail lengths < 1000 mm.

7 Tolerance specifications for precision rail guides

| Installation height A | | Width B | | Center height H1, H2 | | Installation width T | |
|---|---|---|---|---|---|---|---|
| U | L | U | L | U | L | U | L |
| mm | mm | mm | mm | μm | μm | μm | μm |
| +0 | -0.3 | +0 | -0.2 | +5 | -5 | +10 | -10 |

| | | |
|---|---|---|
| L | mm | Lower limit deviation |
| U | mm | Upper limit deviation |

30 Tolerance specifications for precision rail guides



The following values apply to the rail length:

8 Length accuracy for rails

| L ≤ 300 | | L> 300 | |
|---|---|---|---|
| U | L | U | L |
| mm | mm | mm | mm |
| +0.3 | -0.3 | +0.001 · L | –0.001 · L |

| | | |
|---|---|---|
| L | mm | Lower limit deviation |
| U | mm | Upper limit deviation |

### 1.9.4 Rail grading

A typical clamped arrangement requires four rails. To achieve the best possible rating life, rigidity and running behavior, it is important that the center height of the four rails has a low tolerance.

For this reason, rails are matched and packaged according to the following principle:

- Rails for crossed roller cages or ball cages:
  Four rails are matched and supplied as a set.
- Rails for needle roller cages or slide coatings:
  Two M-shape rails and two V-shape rails matched and supplied in pairs.

Because of the very close standard tolerance of the center height, it would also be possible to pair any rail for a standard application (precision class P10), if necessary.

## 1.10 Design rules

### 1.10.1 Typical use in a clamped arrangement

Precision rail guide are primarily installed in a clamped arrangement, as this has numerous advantages ➤19 | 1.1.10.4. Alternatively, the system can be installed as a floating guide.

### 1.10.2 Kit packaging

To simplify ordering and storage for customers, Schaeffler offers precision rail guides in pre-defined kit packaging. Each kit consists of 4 precision rails in accuracy class P10, 2 rolling element assemblies and 8 end pieces (ACSMkits without end pieces). The available kits are specified in the respective product tables. Kits for “overrunning rail system” kinematics, consisting of 2 standard-length rails and 2 short rails with lead-in radius, are also available on request. The number of rolling elements can also be adjusted ➤127 | 65.

31 Kit packaging

001C44BD

Advantages of kit packaging:

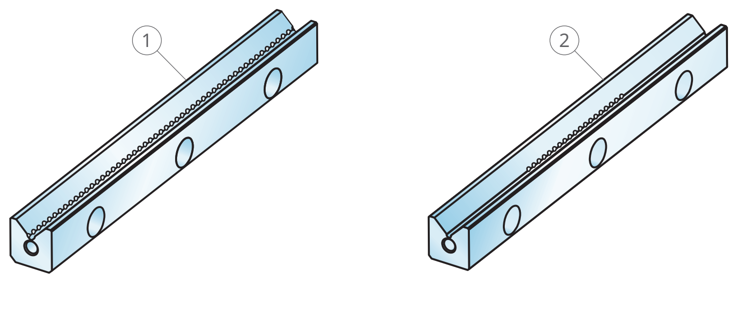
- All required parts are provided ready for installation and can be ordered with a single order number.
- Variants with ACS and ACSM are available for long-term prevention of cage-creeping.
- The length of the rolling element assembly can be easily adjusted, but should still be at least $^2/_3$ of the entire rail length after cutting. When adjusting the length, consider also reducing the load rating.
- The load rating for the kit is calculated in advance based on the specified stroke and clamped arrangement.

### 1.10.3 Anti-creeping system (ACS)

The anti-creeping system (ACS) keeps the rolling element assembly in position in the loaded zone. It prevents cage-creeping at high running speeds and with fast accelerations, or in the case of uneven load distribution or a weaker adjacent construction. This avoids unplanned downtimes and additional maintenance work. Due to the defined cage position, precision rail guides with ACS also enable higher running accuracy, faster accelerations (tested up to 160 $m/s^2$) and safe operation in vertical installations.

All rails for anti-creeping cages are toothed along their entire length as standard. To reduce costs, a specific stroke length can be defined for ACS and ACSZ rails and the rack can be adjusted accordingly. However, the rolling element assemblies must never move beyond the specified stroke length. The rack is inserted symmetrically to the rail length. The specific stroke length must be specified in mm when ordering.

32 Anti-creeping system (ACS)

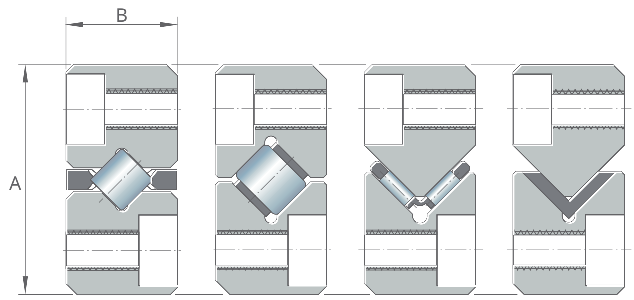



| | | | |
|---|---|---|---|
| 1 | Standard stroke length | 2 | Specific stroke length |

### 1.10.4 Modular Range

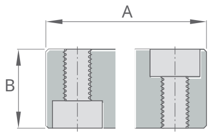
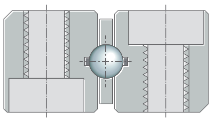
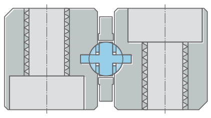
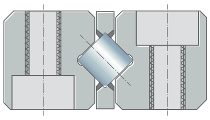
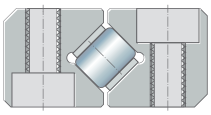
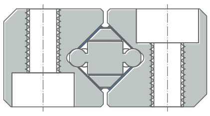
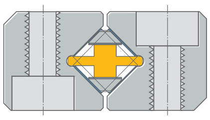
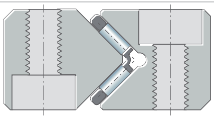
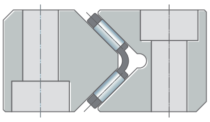
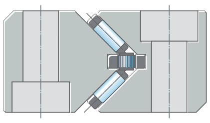
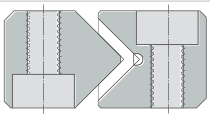
Precision rail guides are available in the Modular Range, where the outer rail dimensions are the same but the rolling elements can be freely selected. This allows customers to easily increase the load rating of a bearing or extend the rating life without needing to modify the design. The Modular Range covers 80 % of all sizes of precision rail guides commonly available on the market. Within these sizes, the customer can choose between ball cages, crossed roller cages with ACS or ACSM, needle roller cages and slide coatings.

33 Same external dimensions in the Modular Range



1

9 Rail type options

| Rail type |  | Size | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 2211 | 4 | 3015 | 6 | 4020 | 9 | 5025 | 12 | 6035 | 7040 | 15 | 8050 |
| A × B | mm | 8.5 × 4 | 12 × 6 | 18 × 8 | 22 × 11 | 25 × 12 | 30 × 15 | 31 × 15 | 40 × 20 | 44 × 22 | 50 × 25 | 58 × 28 | 60 × 35 | 70 × 40 | 71 × 36 | 80 × 50 |
| LWRB |  | ✓ | ✓ | – | – | – | – | – | – | – | – | – | – | – | – | – |
| LWRB ACSM |  | – | o | – | – | – | – | – | – | – | – | – | – | – | – | – |
| LWR |  | – | – | ✓ M | – | – | – | ✓ M | – | ✓ M | – | o | – | – | – | – |
| LWRE |  | – | – | ✓ M | o | ✓ | – | ✓ M | – | ✓ M | – | – | – | – | – | – |
| LWRE ACS |  | – | – | ✓ M | o | o | – | ✓ M | – | o M | – | – | – | – | – | – |
| LWRE ACSM |  | – | – | ✓ M | o | o | – | ✓ M | – | o M | – | – | – | – | – | – |
| LWRM, LWRV |  | – | – | – | – | – | – | ✓ M | – | ✓ M | – | – | – | – | – | – |
| LWM, LWV |  | – | – | – | – | – | ✓ | – | ✓ | – | ✓ | – | o | o | – | o |
| LWM, LWV ACSZ |  | – | – | – | – | – | o | – | o | – | o | – | o | o | – | o |
| LWRPM, LWRPV |  | – | – | ✓ M | – | – | – | ✓ M | – | ✓ M | – | – | – | – | – | – |

✓ Size with preferred lengths
o Standard length available on request
– not available
M Modular Range

## 1.10.5 Accuracy of mounting surfaces

An important prerequisite for the proper function of a rail guide system is the accuracy of the mounting surfaces. The higher the requirements for accuracy and smooth operation of the guide, the higher the requirements for the form accuracy and position accuracy of the adjacent construction. Characteristic values for the roughness, perpendicularity and parallelism of the mounting surfaces are shown for each accuracy class. The values for perpendicularity are given in relation to the height of the mounting surface. To ensure even load distribution over the entire length of the rolling element, the maximum height offset of the mounting surfaces should not exceed the value Δh.

58

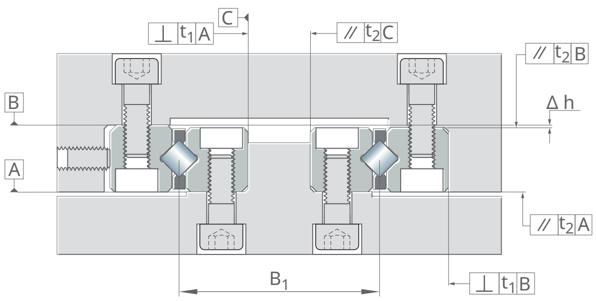
$$\Delta h = 0.1 \cdot B_1$$

| | | |
|---|---|---|
| $B_1$ | mm | Average distance between the rolling element assemblies |
| $\Delta h$ | μm | Max. height offset |

10 Permissible tolerances for mounting surfaces

| Characteristic | Tolerance | Unit | Accuracy class | | |
|---|---|---|---|---|---|
| | | | **P10** | **P5** | **P2** |
| Roughness Ra | – | μm | 1.6 | 0.8 | 0.2 |
| Perpendicularity | | | | | |
| Crossed rollers and balls | $t_1$ | μm/m | 0.3 | 0.3 | 0.3 |
| Needle rollers | $t_1$ | μm/m | 0.1 | 0.1 | 0.1 |
| Parallelism | | | | | |
| Rail length ≤ 200 mm | $t_2$ | μm | 3 | 2 | 1 |
| Rail length ≤ 500 mm | $t_2$ | μm | 6 | 4 | 2 |
| Rail length ≤ 1000 mm | $t_2$ | μm | 10 | 6 | 3 |
| Rail length ≤ 1600 mm | $t_2$ | μm | 12 | 7 | 3 |

34 Reference dimensions for accuracy

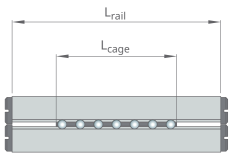
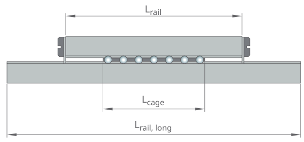
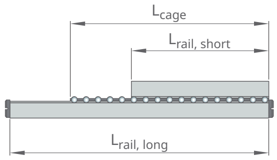



## 1.10.6 End piece options

The end pieces must also be selected according to the chosen kinematics.

11 End piece options

| Description of kinematics | | Not-overrunning rail guide without wiper (standard) | Rail guide with wiper | | Overrunning rail guide without wiper | |
|---|---|---|---|---|---|---|
| | |   |   | |   | |
| **Designation** | **ACS type** | | **Long rail** | **Short rail** | **Long rail** | **Short rail** |
| LWR, LWRB, LWRE | No ACS | ✓ | – | ✓ | ✓ | – |
| LWRE | ACS | – 1) | – | ✓ | – 1) | – |
| LWRB, LWRE | ACSM | – | – | ✓ | – | – |
| LWM, LWV, LWRM, LWRV | No ACS | ✓ 2) | – | ✓ | ✓ | – |
| LWM, LWV | ACSZ | – 1) | – | ✓ 3) | – 1) | – |

✓ With end pieces
\- Without end pieces

1) No end pieces required. There are mounting threads on the front faces of the rails so that end pieces can be installed by the customer

2) End pieces only on one rail (M-shaped or V-shaped rail)

3) End pieces with wiper only available for M-shaped rails

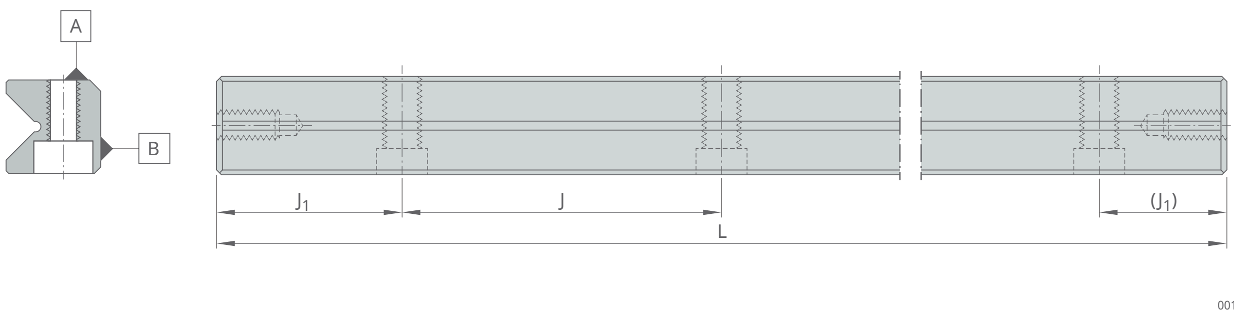
## 1.10.7 Calculating $J_1$

As a rule, dimension $J_1$ is selected so that the distance at either end of the rail is symmetrical. In this case, the symmetrical $J_1$ dimension can be calculated using the formula given below. The minimum value for $J_1$, given in the product tables as $J_{1min}$, must be taken into account. If an asymmetrical $J_1$ dimension is required, this must be specified in the ordering key and the definition as per ➤47 | 35 must be taken into account.

59

$$J_1 = \frac{L - \sum J}{2}$$

35 Asymmetrical $J_1$ dimension

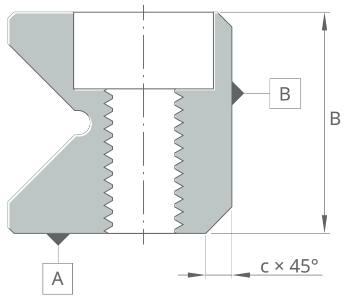


### 1.10.8 Chamfers on the precision rails

When designing the surrounding construction, the tolerance for the chamfer between the two reference surfaces of the precision rail must be taken into account. The chamfer width c depends on the width B.

- Width B ≤ 8 mm: c ≥ 0.3 mm
- Width B > 8 mm: c ≥ 0.9 mm

36 Chamfer dimensions



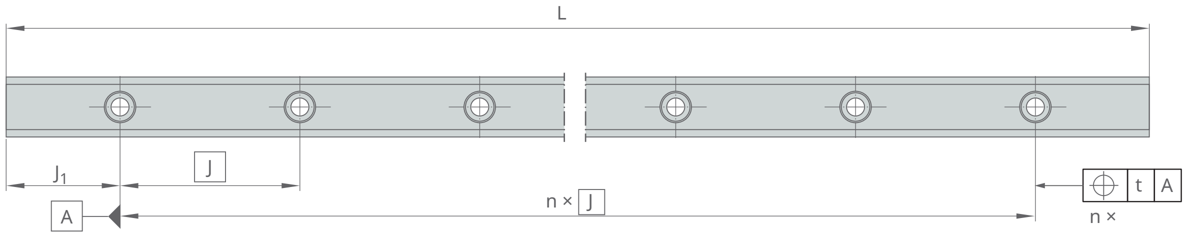

### 1.10.9 Tolerance for the distance between the mounting holes

The tolerance for the distance between the mounting holes depends on the rail length L. The values provided apply to all mounting holes on the rail. Rails with narrower distance tolerances are available on request. For longer rails, it is recommended to use special mounting screws (LWGD).

L ≤ 300: t = 0.6 mm

L > 300: t = 0.0016 mm × L

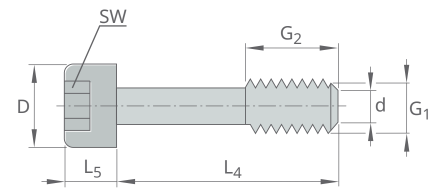
37 Tolerance for the distance between the mounting holes




### 1.10.10 LWGD special mounting screws

LWGD special mounting screws can be used to compensate for production tolerances in the distance between the mounting holes. These special screws comply with strength class 8.8 as a minimum. The respective LWGD special mounting screw fits all rail types of the same size.

38 Special mounting screws



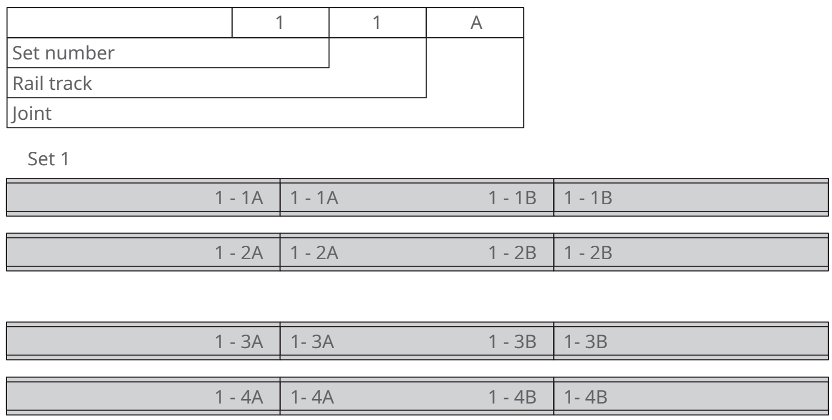

12 Special mounting screws

| Desig-nation | Dimensions | | | | | | | Appropriate rail size |
|---|---|---|---|---|---|---|---|---|
| | G1 | G2 | L4 | L5 | D | d | AF | |
| | – | mm | mm | mm | mm | mm | – | |
| LWGD 3 | M3 | 5 | 12 | 3 | 5 | 2.3 | 2.5 | 3 |
| LWGD 4 | M3 | 5 | 16 | 3 | 5 | 2.3 | 2.5 | 4 |
| LWGD 2211 | M4 | 5 | 14 | 4 | 6 | 3 | 3 | 2211 |
| LWGD 6 | M5 | 8 | 20 | 5 | 8 | 3.9 | 4 | 6 |
| LWGD 9 | M6 | 12 | 30 | 6 | 8.5 | 4.6 | 5 | 9 |
| LWGD 12 | M8 | 17 | 40 | 8 | 11.3 | 6.25 | 6 | 12 |
| LWGD 4020 | M6 | 10 | 25 | 6 | 9.4 | 4.6 | 5 | 4020 |
| LWGD 5025 | M6 | 10 | 30 | 6 | 9.4 | 4.6 | 5 | 5025 |
| LWGD 6035 | M8 | 12 | 40 | 8 | 12.5 | 6.3 | 6 | 6035 |
| LWGD 7040 | M10 | 17 | 50 | 10 | 15.2 | 7.9 | 8 | 7040 |
| LWGD 8050 | M12 | 20 | 60 | 12 | 17.2 | 9.6 | 10 | 8050 |

### 1.10.11 Jointed rails

Jointed rails are available on request and are always supplied sorted to ensure smooth running. They are marked. For rail guides made up of two or more sections, the tolerance for the total length is within ±2 mm. Jointed rails are not suitable for LWRE ACS and LWRE ACSM precision rails.

39 Track markings on jointed rails



1

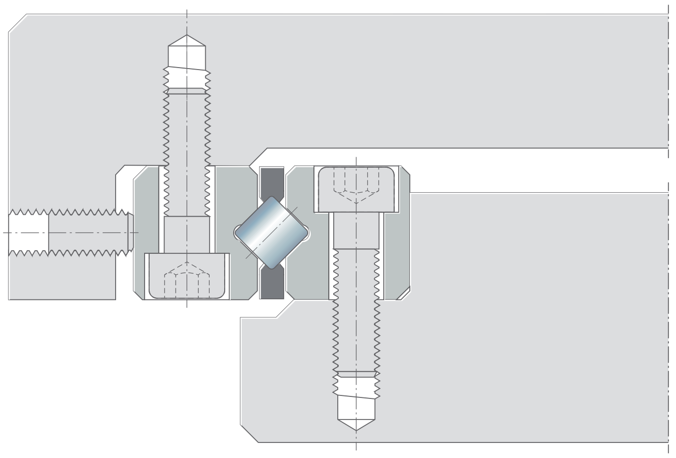
## 1.10.12 Preloading

Clamped rail guides should always be installed without clearance and with a defined preload. Preloading increases the system rigidity and the running accuracy of the rail guide. It also reduces peak loads at the ends of the rolling element assemblies caused by torque loads $M_y$ and $M_z$. The height of the adjustable preload depends on the application and can be up to 20 % of the dynamic load rating of the rail guide. When preloading is used, the load acting on the rolling elements must be reduced. This must be taken into account in particular if the operating conditions require a high preload. The adjacent construction must have an appropriate level of rigidity. There are several methods for preloading precision rail guides ➤50 | 40 ➤51 | 41 ➤51 | 42.
The most common method is to preload with set screws. The number of screws should at least correspond to the number of mounting screw holes in the rail.

The following tables provide approximate values for the torque of the set screws in a guide system in which the ratio of stiffness to friction is balanced. These values apply to dry, non-lubricated set screws. The same values can be used as a basis for preloading roller element assemblies with the ACS-system. The use of adjustment bars or wedges is recommended for large preloads or high requirements for running accuracy. For needle roller cages, Schaeffler also offers type LWML rails, which are equipped with an integrated adjustment wedge.

! Precision rail guides with slide coating should not be preloaded.

40 Preloading using set screws



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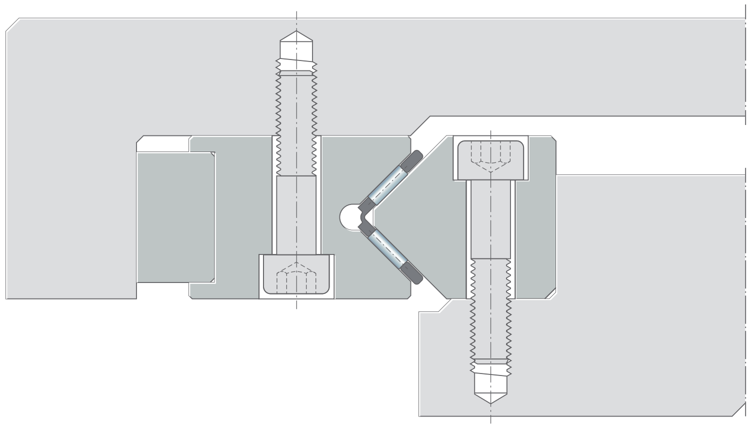
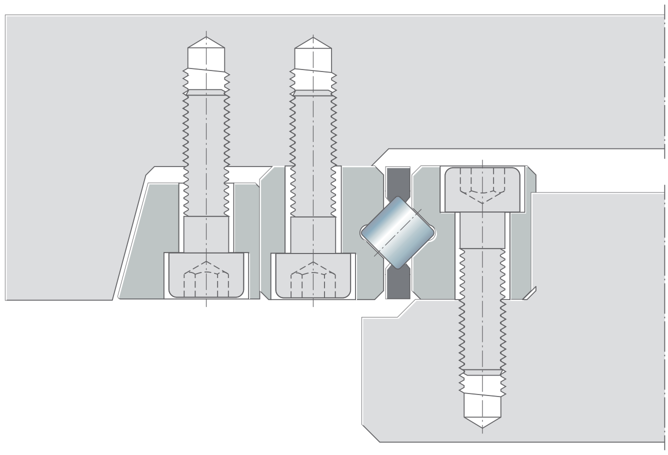
41 Preloading using the LWML rail with adjustment wedge




42 Preloading using a lateral adjustment wedge




13 Tightening torques $M_A$ for set screws for LWR and LWRB

| Designation | | Set screw | | Coefficient for preload | $M_A$ |
|---|---|---|---|---|---|
| | | Distance | – | | |
| Rail type | Cage | mm | | % | Ncm |
| LWRB 1 | LWJK 1,588 | 10 | M2 | 20 | 1.8 |
| LWRB 2 | LWJK 2 | 15 | M3 | 10 | 1.7 |
| LWR 3 | LWAK 3 | 25 | M3 | 13 | 3 |
| | LWAK 3 | 25 | M4 | 13 | 4 |
| LWR 6 | LWAL 6 | 50 | M5 | 9 | 17 |
| | LWAL 6 | 50 | M6 | 9 | 20.4 |
| LWR 9 | LWAL 9 | 100 | M6 | 8 | 67.9 |
| | LWAL 9 | 100 | M8 | 8 | 90 |
| LWR 12 | LWAL 12 | 100 | M10 | 8 | 153.6 |

14 Tightening torques $M_A$ for set screws for LWRE

| Designation | | Set screw | | Coefficient for preload | $M_A$ |
| --- | --- | --- | --- | --- | --- |
| | | Distance | – | | |
| Rail type | Cage | mm | | % | Ncm |
| LWRE 3 | LWAKE 3 | 25 | M3 | 7 | 6.2 |
| | LWAKE 3 | 25 | M4 | 7 | 8.3 |
| LWRE 2211 | LWAKE 3 | 40 | M3 | 7 | 9.9 |
| | LWAKE 3 | 40 | M4 | 7 | 13.2 |
| LWRE 4 | LWAKE 4 | 25 | M3 | 5 | 9.5 |
| | LWAKE 4 | 25 | M4 | 5 | 12.7 |
| LWRE 6 | LWAKE 6 | 50 | M5 | 3 | 26.9 |
| | LWAKE 6 | 50 | M6 | 3 | 32.4 |
| LWRE 9 | LWAKE 9 | 100 | M6 | 3 | 102.2 |
| | LWAKE 9 | 100 | M8 | 3 | 135.4 |

15 Tightening torques $M_A$ for set screws for LWRM and LWRV

| Designation | | Set screw | | Coefficient for preload | $M_A$ |
| --- | --- | --- | --- | --- | --- |
| | | Distance | – | | |
| Rail type | Cage | mm | | % | Ncm |
| LWRM 6, LWRV 6 | LWHV 10, LWHW 10 | 50 | M6 | 5 | 96.9 |
| LWRM 9, LWRV 9 | LWHV 15 | 100 | M8 | 2 | 161 |
| | LWHW 15 | 100 | M8 | 2 | 120.2 |

16 Tightening torques $M_A$ for set screws for LWM and LWV

| Designation | | Set screw | | Coefficient for preload | $M_A$ |
| --- | --- | --- | --- | --- | --- |
| | | Distance | – | | |
| Rail type | Cage | mm | | % | Ncm |
| LWM 3015, LWV 3015 | LWHV 10, LWHW 10 | 40 | M6 | 5 | 77.5 |
| LWM 4020, LWV 4020 | LWHV 15 | 80 | M8 | 2 | 128.8 |
| | LWHW 15 | 80 | M8 | 2 | 96.1 |
| LWM 5025, LWV 5025 | LWHV 15 | 80 | M8 | 2 | 128.8 |
| | LWHW 15 | 80 | M8 | 2 | 96.1 |
| LWM 6035, LWV 6035 | LWHV 20 | 100 | M10 | 2 | 294.9 |
| | LWHW 20 | 100 | M10 | 2 | 217.8 |
| LWM 7040, LWV 7040 | LWHW 25 | 100 | M12 | 2 | 395.9 |
| LWM 8050, LWV 8050 | LWHW 30 | 100 | M12 | 2 | 507.5 |

## 1.10.13 Tightening torques for mounting screws

Depending on the materials used for the adjacent construction and the size of the mounting screws, different tightening torques are used when assembling a precision rail guide. The values provided apply to mounting screws in strength class 8.8 and to LWGD special mounting screws.

17 Tightening torques $M_A$ for mounting screws

| Mounting screws | Aluminum | | Cast iron | | Steel | |
| --- | --- | --- | --- | --- | --- | --- |
| | $M_A$ | Min. screw-in depth | $M_A$ | Min. screw-in depth | $M_A$ | Min. screw-in depth |
| | Nm | mm | Nm | mm | Nm | mm |
| M2 | 0.21 | 3.2 | 0.25 | 3 | 0.3 | 2.4 |
| M2.5 | 0.44 | 4 | 0.52 | 3.8 | 0.61 | 3 |
| M3 | 0.77 | 4.8 | 0.92 | 4.5 | 1.1 | 3.6 |
| M3.5 | 1.2 | 5.6 | 1.4 | 5.3 | 1.6 | 4.2 |
| M4 | 1.7 | 6.4 | 2.1 | 6 | 2.4 | 4.8 |

| Mounting screws | Aluminum | | Cast iron | | Steel | |
|---|---|---|---|---|---|---|
| | $M_A$ | Min. screw-in depth | $M_A$ | Min. screw-in depth | $M_A$ | Min. screw-in depth |
| | Nm | mm | Nm | mm | Nm | mm |
| M5 | 3.4 | 8 | 4.1 | 7.5 | 4.8 | 6 |
| M6 | 6 | 10 | 7 | 9 | 8 | 7.2 |
| M8 | 15 | 13 | 17 | 12 | 20 | 10 |
| M10 | 29 | 16 | 34 | 15 | 40 | 12 |
| M12 | 50 | 19 | 60 | 18 | 69 | 14 |
| M14 | 80 | 22 | 94 | 21 | 110 | 17 |

## 1.11 Installation

### 1.11.1 Basic information

Expertise and cleanliness are essential when installing precision rail guides to ensure optimal guide function and prevent failure due to assembly.

- Read the instructions carefully before starting assembly work.
- Install in a dry, dust-free room. The mounting site must not be located near machines that produce chips or generate dust.
- Have all required parts and aids ready before starting assembly work.
- Use suitable tools and measuring devices.
- The rail guides are precision products. Take care when handling them during installation.
- Failure to observe these instructions can reduce the rating life of the guide system or lead to a safety risk.

### 1.11.2 General assembly instructions

Before installation, the following tasks must be performed for all components in the linear guide system:

- Clean carefully
- Remove any burrs
- Demagnetize
- Check the form accuracy and dimensional accuracy of all connecting components

Do not remove the rails from their original packaging until immediately before installing to minimize the risk of contamination. After unpacking, remove the corrosion inhibitor. The reference surfaces of the rails and the mounting surfaces of the connecting parts must be carefully cleaned and lightly oiled to prevent contact corrosion during subsequent operation. Reference surface A is generally located opposite the marking. Apply lubricant to the raceways and rolling element assemblies before installation.

! To guarantee the high performance of precision rail guides, do not mix individual rails from different packaging.

### 1.11.3 Installation of rail guides without an ACS-system

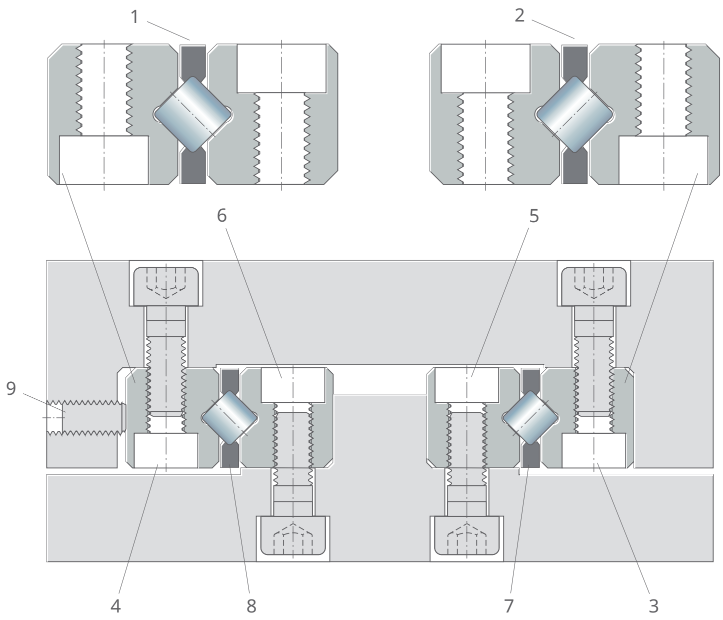
Follow the steps below to install a clamped rail guide system ➤55 | 43:

1. Press the inner rails against the mounting surfaces and tighten to the prescribed torque.
2. Press the fixed rail in the counterpart onto the mounting surface and tighten to the prescribed torque.
3. Press the outer rail into the counterpart and tighten the screws slightly.
4. Insert the lubricated rolling element assemblies and move them into the desired position (normally in the center position).
5. The outer rail is used to adjust the preload, as a clamped system must be operated without clearance or with preload, depending on the application. The preload is adjusted using the set screws and a torque wrench in a specific order ➤56 | 44. Tighten the set screws from the inside to the outside, always with the rolling elements underneath the respective set screws. Use the values provided as a guideline for the tightening torques ➤50 | 1.10.12.
6. Tighten the mounting screws on the outer rail to the prescribed torque.
7. Check the running accuracy of the slide assembly.
8. Take suitable measures to prevent the set screws from coming loose and being lost. Possible measures:

› Secure the screws with adhesive.
› Install a cover to prevent screws from being lost.

9. Install the end pieces, if applicable.
10. Install the end stops for the slide assembly. The rolling element assemblies must not be used for mechanical stroke limitation.

43 Installation of the rail guides




| | | | |
|---|---|---|---|
| 1 | Unit 1 | 2 | Unit 2 |
| 3 | Fixed rail | 4 | Outer rail |
| 5 | Inner rail | 6 | Inner rail |
| 7 | Rolling element assembly | 8 | Rolling element assembly |
| 9 | Set screw | | |

### 1.11.4 Installation of rail guides with an ACS-system

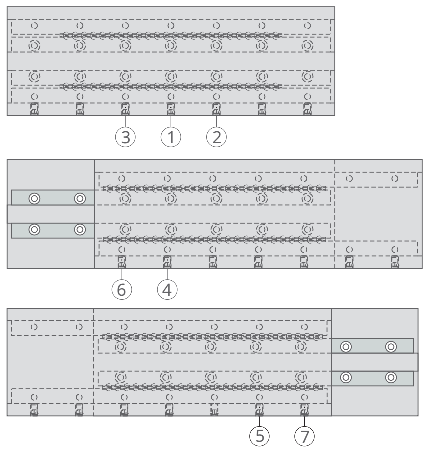
To prevent damage to the ACS-system, the rails must be installed as a pre-assembled unit with the rolling element assemblies in the correct position. Any direct or indirect force on the ACS-system will damage the control gear. The following assembly instructions apply to all rail guides with anti-creeping cage (ACS, ACSM, ACSZ).

! Different to precision rails without ACS, rolling element assemblies with ACS must not be inserted or pushed in.

1. The fixed rail, inner rail and lubricated rolling element assembly are assembled to Unit 2, with the rolling element assembly in the correct position (normally in the center position).
2. Assembly 1 is assembled in the same way with the inner rail, outer rail and rolling element assembly.
3. Push both assemblies from the front into the desired position between the bottom part and the top part.
4. Press Assembly 2 against the mounting surfaces and tighten to the prescribed torque.
5. Press the inner rails (6) against the mounting surfaces and tighten to the prescribed torque.
6. Mount the outer rail on the counterpart and tighten the screws slightly.

7. The outer rail is used to adjust the preload, as a clamped system must be operated without clearance or without preload, depending on the application. The preload is adjusted using the set screws and a torque wrench in a specific order ➤56 | 44. Tighten the set screws from the inside to the outside, always with the rolling elements underneath the respective set screws. Use the values provided as a guideline for the tightening torques ➤50 | 1.10.12.
8. Tighten the mounting screws on the outer rail to the prescribed torque.
9. Check the running accuracy of the slide assembly.
10. Take suitable measures to prevent the set screws from coming loose and being lost. Possible measures:
   - Secure the screws with adhesive.
   - Install a cover to prevent screws from being lost.
11. Install the end pieces, if applicable.
12. Install the end stops for the slide assembly. The rolling element assemblies must not be used for mechanical stroke limitation.

44 Sequence for preloading




| | | | |
|---|---|---|---|
| 1 | Center position, screws 1, 2, 3 | 2 | Right end position, screws 4, 6 |
| 3 | Left end position, screws 5, 7 | | |

## 1.12 Transport and storage

If a precision rail guide that is stationary for a prolonged period of time is exposed to external vibrations, the surfaces of rolling elements and raceways will be damaged by micro-movements in the contact zones. This can lead to a significant increase in vibrations and thus to running noises and premature failure due to material fatigue. Such damage must therefore be avoided, for example by decoupling the guide from external vibrations and taking suitable precautions during transport.

Precision rail guides must be stored in a cool, dry indoor space and in their original packaging, which must remain sealed until use. The temperature of the room must be kept as constant as possible between 0 °C and 30 °C (32 and 86 °F). The relative humidity in the room must not exceed 60 %. Do not store directly near a heat source and avoid exposure to direct sunlight.

## 1.13 Maintenance

### 1.13.1 Lubrication

Precision rail guides generally require only very small quantities of lubricant. Lubricating greases and lubricating oils can be used. Lubricants with solid lubricant additives, grinding emulsions and coolants are not suitable for use.

Under normal operating conditions, the rail guides can be lubricated with grease. The advantage of lubricating grease is that, unlike lubricating oil, it is less prone to running out of the guide, especially if the rail guide is installed at an angle or vertically. Lubricating grease also helps seal the guide against dirt and moisture. Since rail guides run almost exclusively in borderline friction or mixed friction conditions, especially at low speeds, it is recommended to use lubricating greases with EP additives. Good results have been achieved with a mineral oil-based lithium soap grease of consistency class NLGI 2 with a kinematic viscosity of 200 $mm^2/s$ and EP additives.

Oil lubrication is generally used where adjacent machine parts are already lubricated with oil or in installations with high running speeds. Drip feed oil lubrication, for example, is recommended as a simple method of lubrication. Mineral oils with EP additives in the viscosity range of ISO VG 45 to 200 should be used for lubrication.

The rail guides can be easily lubricated through the lateral gap between the two rails. If this is not possible due to the application, the rails can also be provided with lubrication holes on request. In this case, the arrangement and size of the lubrication holes must be specified in an order drawing. Alternatively, the system can be connected to an available central lubrication unit. Please note that the ACS control gear and its shaft must also be lubricated.

### 1.13.2 Relubrication intervals

There are no general rules regarding relubrication intervals for precision rail guides, as these must be defined individually for each application. However, we recommend relubricating at least once a year.

### 1.13.3 Repairs

If a precision rail guide system has reached the end of its service life and needs to be replaced, we recommend replacing the entire system. Please specify the size, rail length, dimension $J_1$ (distance from rail end to first mounting hole), hole type, stroke length and length of the rolling element assembly when ordering.

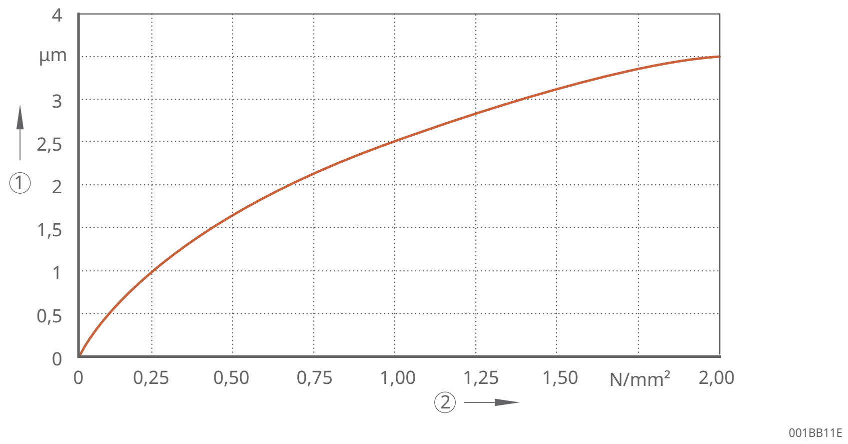
## 1.14 Technical information on precision rail guides with slide coating

### 1.14.1 Surface pressure

To provide a realistic contact deformation value, the surface pressure of guides with slide coating is usually between 0.2 and 1 $N/mm^2$. The figure shows the surface deformation of Turcite-B rails in relation to surface pressure. In the event of overload up to 6 $N/mm^2$, the contact deformation increases to 5 μm, but returns to the original value when the load is removed.

1

45 Contact deformation as a function of surface pressure

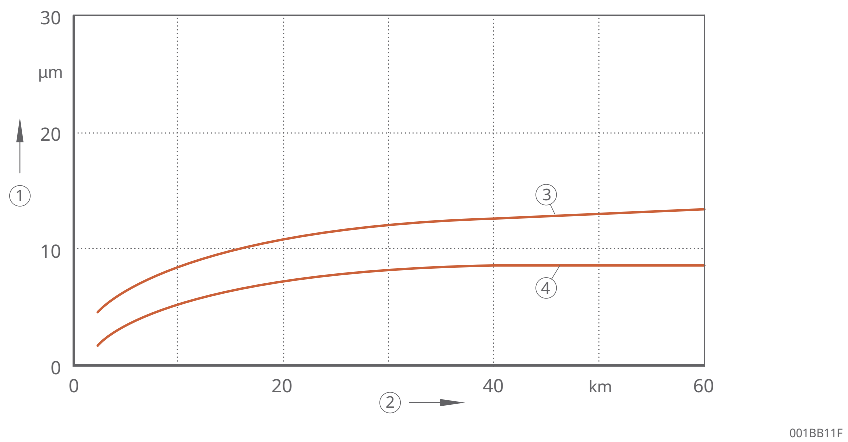



| | | | |
|---|---|---|---|
| 1 | Contact deformation | 2 | Surface pressure |

## 1.14.2 Wear

LWRPM and LWRPV rail guides are highly resistant to wear. The ground surface of LWRPV guides is optimally matched to the Turcite-B slide coating to minimize wear. Even a certain amount of dirt has no effect on the sliding properties, as the sliding material is able to absorb and embed smaller dirt particles. For optimal use, however, it is recommended to lubricate LWRPM and LWRPV rail guides. The oil-lubricated rail guide (curve 1) shows less wear in relation to the distance traveled than the guide operated without lubrication (curve 2). The values given are based on an average surface pressure of 0.4 N/mm².

46 Wear as a function of travel distance

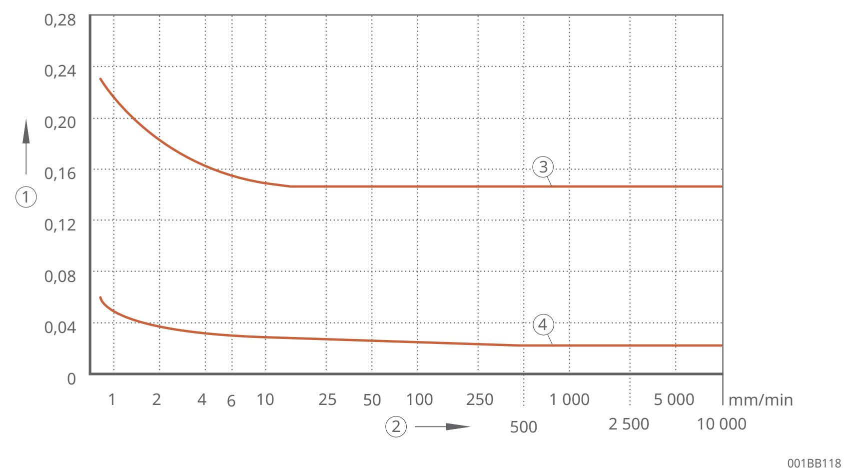



| | | | |
|---|---|---|---|
| 1 | Wear | 2 | Distance |
| 3 | Dry | 4 | Lubricated |

## 1.14.3 Friction

The good sliding properties of the Turcite-B slide coating mean that for precision rail guides with slide coating, speed only has a minor influence on the coefficient of friction. This largely prevents the stick-slip effect.

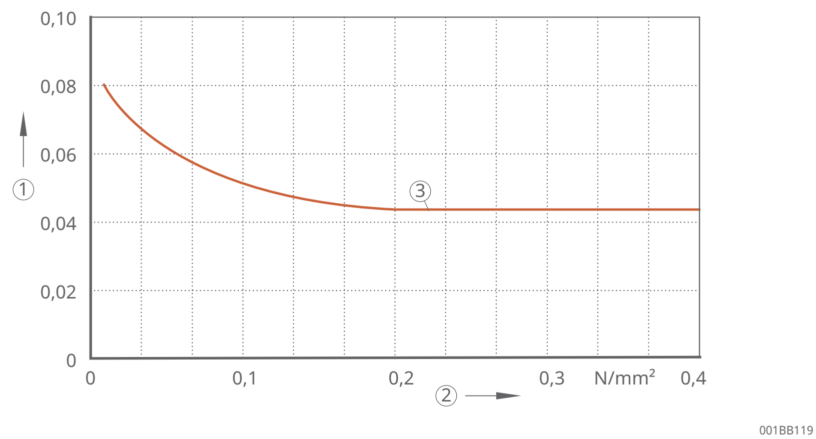
47 Coefficient of friction as a function of sliding speed




| | | | |
|---|---|---|---|
| 1 | Coefficient of friction | 2 | Speed |
| 3 | Dry | 4 | Lubricated |

The figure shows the coefficient of friction of LWRPM and LWRPV rail guides as a function of the sliding speed. Curve 1 applies to oil-lubricated rail guides, and curve 2 to unlubricated applications. The coefficient of friction decreases during a smoothing phase and then remains essentially constant. The values given are based on an average surface pressure of 0.2 N/mm.

48 Coefficient of friction as a function of surface pressure




| | | | |
|---|---|---|---|
| 1 | Coefficient of friction | 2 | Surface pressure |
| 3 | Lubricated | | |

The figure represents the coefficient of friction of LWRPM and LWRPV oil-lubricated rail guides in relation to the surface pressure. It shows that the coefficient of friction is relatively high under low loads, but drops to a minimum at a surface pressure of 0.2 N/mm² and remains constant.

## 1.14.4 Temperature range

The operating temperature of precision rail guides with slide coating should be between −40 °C and +80 °C . As the temperature increases, the compressive strength decreases. To compensate for this, sufficient heat dissipation can be achieved in many cases by using lubricating oil.

### 1.14.5 Resistance

Turcite-B slideways have very good chemical resistance. The maximum moisture absorption is 0.01 % and does not cause any significant changes in dimension. Turcite-B slide coatings are resistant to coolants and lubricants.

# 2 LWR and LWRB precision rail guides

## 2.1 Product design

### 2.1.1 Rail guides

LWRand LWRB rail guides perform well in numerous applications with limited travel distance. They are available with a crossed roller cage or ball cage as required.

49 LWR 6 precision rail guide


001BCD5F

50 LWRB 2 precision rail guide


001BCD64

LWR rail guides with crossed roller cage are best suited to applications that require a high load rating and good rigidity behavior. LWRB rail guides with ball cage are recommended for light loads and applications that require smooth running. Due to their small cross-section, both rail guides are suitable for applications with limited installation space. In addition to those listed, sizes 15, 18 and 24 are available on request.

18 Available lengths for LWRB

| Designation | L | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 20 | 30 | 40 | 45 | 50 | 60 | 70 | 75 | 80 | 90 | 100 | 105 | 120 | 125 | 135 | 150 |
| | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm |
| LWRB 1 | ✓ | ✓ | ✓ | – | ✓ | ✓ | o | – | o | o | o | – | – | – | – | – |
| LWRB 2 | – | ✓ | – | ✓ | – | ✓ | – | ✓ | – | ✓ | – | ✓ | ✓ | – | o | o |

19 Available lengths for LWR

| Designation | L | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 50 | 75 | 100 | 125 | 150 | 175 | 200 | 225 | 250 | 275 | 300 | 350 | 400 | 450 | 500 | 550 | 600 | 650 | 700 | 800 | 900 | 1000 |
| | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm |
| LWR 3 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | o | ✓ | o | ✓ | – | – | – | – | – | – | – | – | – | – | – |
| LWR 6 | – | – | ✓ | o | ✓ | – | ✓ | – | ✓ | – | ✓ | ✓ | ✓ | ✓ | ✓ | o | o | o | o | – | – | – |
| LWR 9 | – | – | – | – | – | – | ✓ | – | – | – | ✓ | – | ✓ | – | ✓ | – | o | – | o | o | o | o |
| LWR 12 | – | – | – | – | – | – | o | – | – | – | o | o | o | o | o | o | o | o | o | o | o | o |

✓ Preferred length
o Standard length available on request
– On request

For maximum rail length $L_{max}$, see product tables

### 2.1.2 Rolling element assemblies

LWJK ball cages are used in conjunction with LWRB rail guides and equipped with a plastic cage which retains the balls. These assemblies are available in sizes 1 and 2. LWAK crossed roller cages are equipped with a plastic cage for size 3 as standard which retains the cylindrical rollers. LWAL crossed roller cages are available with aluminum cages for sizes 6 to 12 which retain the rollers.

### 2.1.3 End pieces

End pieces prevent the rolling element assembly from moving beyond the end of the rail. The LWERA, LWERB and LWERC variants (with wiper) are available as standard. All end pieces are supplied with appropriate mounting screws.

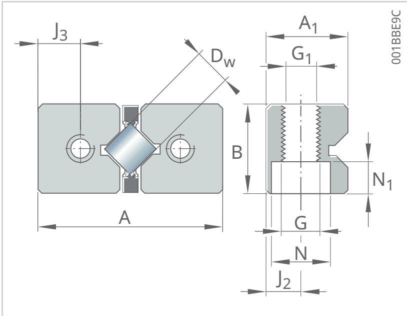
# 2.2 Product tables

## 2.2.1 Explanations

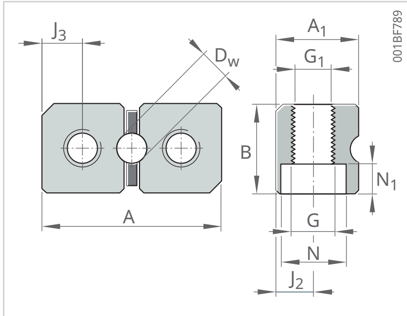
| | | |
|---|---|---|
| A | mm | Installation height |
| $A_1$ | mm | Rail height |
| B | mm | Width |
| C | N | Basic dynamic load rating |
| $C_0$ | N | Basic static load rating |
| $C_{0\,10}$ | N | Static load rating for ten rolling elements |
| $C_{10}$ | N | Dynamic load rating for ten rolling elements |
| $D_w$ | mm | Rolling element diameter |
| G | - | Mounting hole thread |
| $G_1$ | mm | Mounting hole diameter |
| $G_2$ | – | End face thread |
| $G_3$ | mm | Thread depth |
| J | mm | Distance between mounting holes |
| $J_1$ | mm | Distance from end of rail to center of first mounting hole |
| $J_{1\,min}$ | mm | Minimum distance from end of rail to center of first mounting hole |
| $J_2$ | mm | Distance |
| $J_3$ | mm | Distance |
| L | mm | Rail length |
| L | mm | Thickness of the end piece |
| $L_1$ | mm | Thickness of the end piece with wiper |
| $L_{max}$ | mm | Max. rail length |
| m | kg/m | Mass |
| m | g/Rolling element | Mass of rolling element assembly |
| m | g | Mass |
| N | mm | Countersink diameter |
| $N_1$ | mm | Countersink depth |
| S | mm | Stroke |
| t | mm | Pitch of rolling elements in a cage |
| $t_1$ | mm | Distance from the end of the cage to the center of the first rolling element |
| U | mm | Cage width |
| $U_1$ | mm | Cage thickness |

2

## 2.2.2 LWR and LWRB

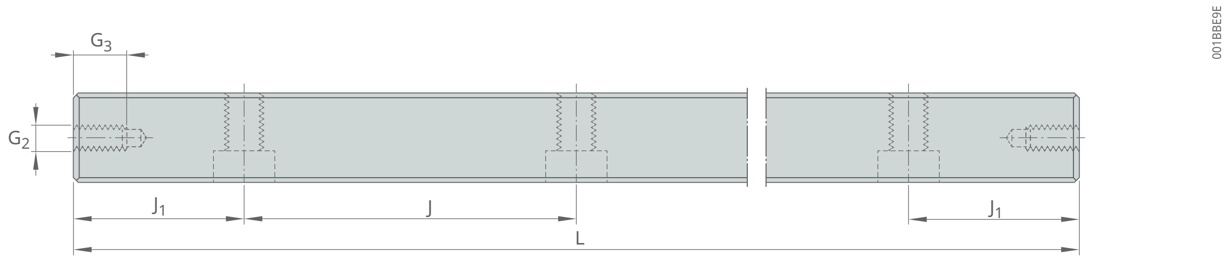



LWR




LWRB

| Designation | m | A | B | $A_1$ | $D_w$ | J | $J_1$ | $J_{1\,min}$ |
|---|---|---|---|---|---|---|---|---|
| – | kg/m | mm | mm | mm | mm | mm | mm | mm |
| **LWRB 1** | 0.11 | 8.5 | 4 | 3.9 | 1.6 | 10 | 5 | 5 |
| **LWRB 2** | 0.23 | 12 | 6 | 5.5 | 2 | 15 | 8 | 8 |
| **LWR 3** | 0.45 | 18 | 8 | 8.2 | 3 | 25 | 13 | 13 |
| **LWR 6** | 1.46 | 31 | 15 | 13.9 | 6 | 50 | 25 | 20 |
| **LWR 9** | 3.14 | 44 | 22 | 19.7 | 9 | 100 | 50 | 20 |
| **LWR 12** | 5.23 | 58 | 28 | 25.9 | 12 | 100 | 50 | 25 |

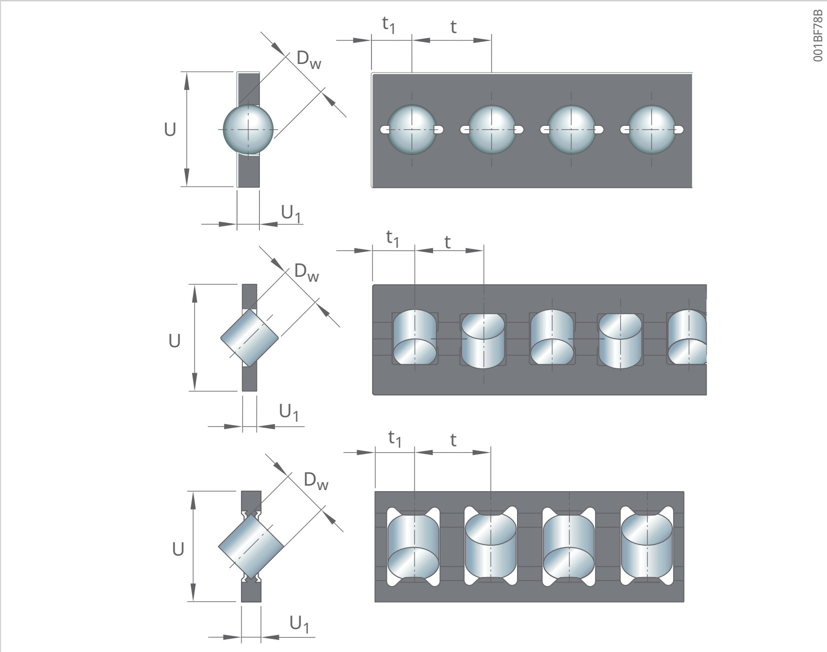



LWR and LWRB



| $J_2$ | G | $G_1$ | N | $N_1$ | $J_3$ | $G_2$ | $G_3$ | $L_{max}$ |
|---|---|---|---|---|---|---|---|---|
| mm | - | mm | mm | mm | mm | - | mm | mm |
| 1.8 | M2 | 1.65 | 3.0 | 1.4 | 1.9 | M1.6 | 2 | 150 |
| 2.5 | M3 | 2.55 | 4.4 | 2.0 | 2.7 | M2.5 | 3 | 200 |
| 3.5 | M4 | 3.30 | 6.0 | 3.1 | 4.0 | M3 | 6 | 400 |
| 6.0 | M6 | 5.20 | 9.5 | 5.2 | 7.0 | M5 | 9 | 1200 |
| 9.0 | M8 | 6.80 | 10.5 | 6.2 | 10.0 | M6 | 9 | 1500 |
| 12.0 | M10 | 8.50 | 13.5 | 8.2 | 13.0 | M8 | 12 | 1500 |

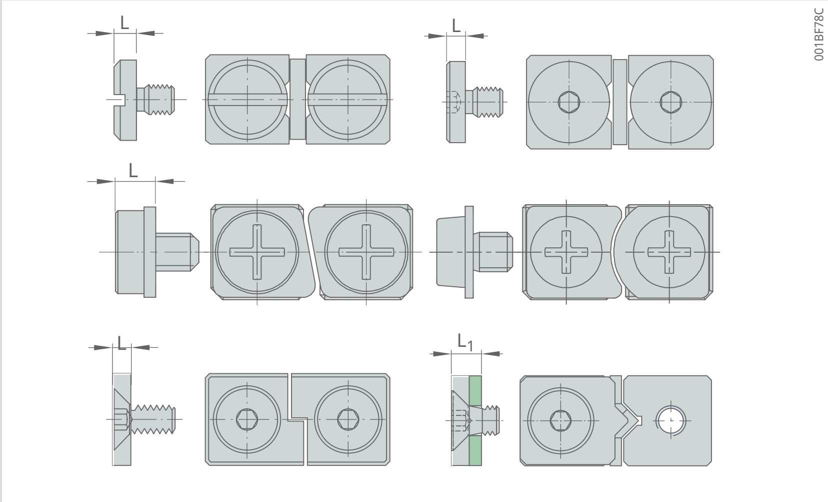
## 2.2.3 Rolling element assemblies




LWJK (top), LWAK (middle), LWAL (bottom)

| Desig-nation | m | $D_W$ | U | $U_1$ | t | $t_1$ | $C_{10}$ | $C_{0\,10}$ | Max. cage length | Rail |
|---|---|---|---|---|---|---|---|---|---|---|
| – | g/Rolling element | mm | mm | mm | mm | mm | N | N | Rolling element | - |
| **LWJK 1,588** | 0.02 | 1.6 | 3.5 | 0.50 | 2.2 | 1.4 | 410 | 580 | 38 | LWRB 1 |
| **LWJK 2** | 0.05 | 2.0 | 5.0 | 0.75 | 3.9 | 2.9 | 640 | 720 | 25 | LWRB 2 |
| **LWAK 3** | 0.17 | 3.0 | 7.5 | 1.00 | 5.0 | 3.5 | 1320 | 1600 | 200 | LWR 3 |
| **LWAL 6** | 2.00 | 6.0 | 14.8 | 2.70 | 9.0 | 6.0 | 5850 | 6800 | 166 | LWR 6 |
| **LWAL 9** | 6.00 | 9.0 | 20.0 | 4.00 | 14.0 | 9.4 | 17000 | 18300 | 106 | LWR 9 |
| **LWAL 12** | 14.00 | 12.0 | 25.0 | 5.00 | 18.0 | 12.0 | 30000 | 30500 | 83 | LWR 12 |

## 2.2.4 End pieces




LWERA 1 LWERA 2 (top left), LWERA 3 to LWERA 12 (top right),
LWERB 1 (center left), LWERB 2 (center right),
LWERB 3 to LWERB 12 (bottom left), LWERC 3 to LWERC 12 (bottom right)

| Designation [1] | m | L | $L_1$ | Mounting screw | | Rail |
|---|---|---|---|---|---|---|
| | | | | - | ISO 10642 | |
| – | g | mm | mm | - | - | - |
| **LWERA 1** | 0.0001 | 1.0 | – | – | – | LWRB 1 |
| **LWERB 1** | 0.0001 | 1.7 | – | M1.6 | – | LWRB 1 |
| **LWERA 2** | 0.0003 | 1.5 | – | – | – | LWRB 2 |
| **LWERB 2** | 0.0003 | 2.3 | – | M2.5 | – | LWRB 2 |
| **LWERA 3** | 0.001 | 2.5 | – | – | – | LWR 3 |
| **LWERB 3** | 0.001 | 2.0 | – | – | M3 | LWR 3 |
| **LWERC 3** | 0.001 | – | 5 | – | M3 | LWR 3 |
| **LWERA 6** | 0.004 | 3.0 | – | – | – | LWR 6 |
| **LWERB 6** | 0.004 | 3.0 | – | – | M5 | LWR 6 |
| **LWERC 6** | 0.006 | – | 6 | – | M5 | LWR 6 |
| **LWERA 9** | 0.008 | 4.0 | – | – | – | LWR 9 |
| **LWERB 9** | 0.009 | 4.0 | – | – | M6 | LWR 9 |
| **LWERC 9** | 0.015 | – | 7 | – | M6 | LWR 9 |
| **LWERA 12** | 0.034 | 5.0 | – | – | – | LWR 12 |
| **LWERB 12** | 0.007 | 5.0 | – | – | M8 | LWR 12 |
| **LWERC 12** | 0.033 | – | 8 | – | M8 | LWR 12 |

1) LWERC with felt wipers

## 2.2.5 LWR in kit packaging



| Designation | C | $C_0$ | S | Rail | Cage | End piece |
|---|---|---|---|---|---|---|
| | Dynamic | Static | | 4× | 2× | 8× |
| – | N | N | mm | – | – | – |
| **LWR 3050 - Kit** | 999 | 1120 | 26 | LWR 3050 | LWAK 3×7 | LWERA 3 |
| **LWR 3075 - Kit** | 422 | 1760 | 36 | LWR 3075 | LWAK 3×11 | LWERA 3 |
| **LWR 3100 - Kit** | 811 | 2400 | 46 | LWR 3100 | LWAK 3×15 | LWERA 3 |
| **LWR 3125 - Kit** | 88 | 2880 | 66 | LWR 3125 | LWAK 3×18 | LWERA 3 |
| **LWR 3150 - Kit** | 442 | 5520 | 76 | LWR 3150 | LWAK 3×22 | LWERA 3 |
| **LWR 3175 - Kit** | 781 | 4160 | 86 | LWR 3175 | LWAK 3×26 | LWERA 3 |
| **LWR 3200 - Kit** | 110 | 4800 | 96 | LWR 3200 | LWAK 3×30 | LWERA 3 |
| **LWR 6100 - Kit** | 915 | 5440 | 50 | LWR 6100 | LWAL 6×8 | LWERA 6 |
| **LWR 6150 - Kit** | 744 | 8160 | 78 | LWR 6150 | LWAL 6×12 | LWERA 6 |
| **LWR 6200 - Kit** | 441 | 10880 | 106 | LWR 6200 | LWAL 6×16 | LWERA 6 |
| **LWR 6250 - Kit** | 45 | 13600 | 134 | LWR 6250 | LWAL 6×20 | LWERA 6 |
| **LWR 6300 - Kit** | 955 | 17000 | 144 | LWR 6300 | LWAL 6×25 | LWERA 6 |
| **LWR 6350 - Kit** | 422 | 19720 | 172 | LWR 6350 | LWAL 6×29 | LWERA 6 |
| **LWR 6400 - Kit** | 846 | 22440 | 200 | LWR 6400 | LWAL 6×33 | LWERA 6 |

# 3 LWRE precision rail guides

## 3.1 Product design

### 3.1.1 Rail guides

LWRE rail guides are an improvement on the popular LWR rail guides.

In addition to the familiar features of LWR rail guides, LWRE rail guides offer 5-times the load rating and twice the rigidity. This means that the bearing size can be reduced by 50 % compared to the standard LWR rail guide with the same load rating.

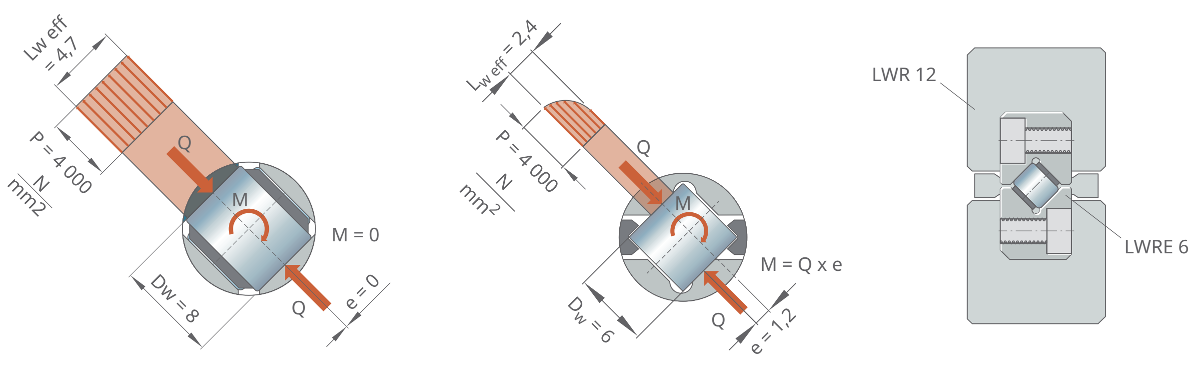
51 LWRE 6 precision rail guide


001BCD73

Alternatively, keeping the same external dimensions significantly increases the static safety factor and rating life. These improvements are due to an optimized internal geometry combined with increased roller diameters. In addition, LWRE rail guides make use of the entire roller length, which prevents tilting torques and edge loading.

The installation dimensions and interface dimensions of LWRE rail guides are the same as the Modular Range rail guides.

52 Comparison of LWRE 6 with LWR 6




001C358B

20 Available lengths for LWRE

| Desig-nation | L | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 50 | 75 | 100 | 125 | 150 | 175 | 200 | 225 | 250 | 275 | 300 | 350 | 400 | 450 | 500 | 550 | 600 | 650 | 700 | 800 | 900 | 1000 |
| | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm |
| LWRE 3 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | o | o | o | o | – | – | – | – | – | – | – | – | – | – | – |
| LWRE 4 | – | – | ✓ | – | ✓ | – | ✓ | – | ✓ | – | ✓ | – | ✓ | o | o | o | o | – | o | – | – | – |
| LWRE 6 | – | – | ✓ | – | ✓ | – | ✓ | – | ✓ | – | ✓ | o | ✓ | o | o | o | o | o | o | – | – | – |
| LWRE 9 | – | – | – | – | – | – | ✓ | – | – | – | ✓ | – | ✓ | – | ✓ | – | o | – | o | o | o | o |

21 Available lengths for LWRE

| Designation | L | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 80 | 120 | 160 | 200 | 240 | 280 | 320 | 360 | 400 |
| | mm | mm | mm | mm | mm | mm | mm | mm | mm |
| LWRE 2211 | o | o | o | o | o | o | o | o | o |

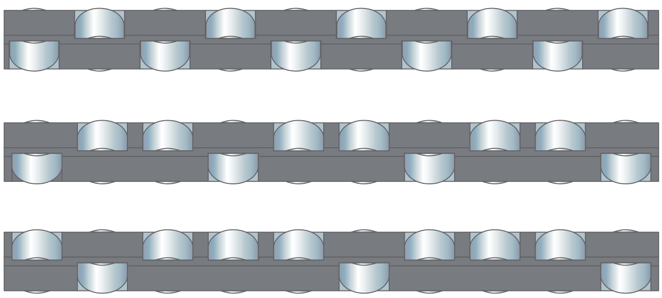
✓ Preferred length
o Standard length available on request
– On request

For maximum rail length $L_{max}$, see product tables

## 3.1.2 Rolling element assemblies

LWAKE crossed roller cages are made of individual plastic cage elements. In the LWAKE 3, LWAKE 6 and LWAKE 9 cages, these elements are assembled using a snap-in mechanism. Each individual element can be manually rotated around the longitudinal axis 90° to the adjacent cage elements. Rotating the rollers in the main load direction increases the load rating and rigidity. As standard, the rollers are arranged alternately with each other.

53 Possible arrangement of the crossed rollers in LWAKE




The cage encloses the individual rollers while filling the space between the two rails almost entirely. This provides additional protection against contamination. LWAKE 4 cages consist of roller segments manufactured to the length required by the customer. The individual cage elements cannot be rotated in size 4.

## 3.1.3 End pieces

End pieces prevent the rolling element assemblies from moving beyond the end of the rail. LWERE end pieces must be used in horizontal and vertical installations as standard. The LWEREC end piece with wiper is also available. All end pieces are supplied with appropriate mounting screws.

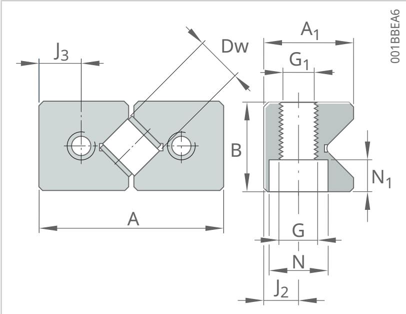
## 3.2 Product tables

### 3.2.1 Explanations

| | | |
|---|---|---|
| A | mm | Installation height |
| $A_1$ | mm | Rail height |
| B | mm | Width |
| C | N | Basic dynamic load rating |
| $C_0$ | N | Basic static load rating |
| $C_{0\ 10}$ | N | Static load rating for ten rolling elements |
| $C_{10}$ | N | Dynamic load rating for ten rolling elements |
| $D_w$ | mm | Rolling element diameter |
| G | - | Mounting hole thread |
| $G_1$ | mm | Mounting hole diameter |
| $G_2$ | – | End face thread |
| $G_3$ | mm | Thread depth |
| J | mm | Distance between mounting holes |
| $J_1$ | mm | Distance from end of rail to center of first mounting hole |
| $J_{1\ min}$ | mm | Minimum distance from end of rail to center of first mounting hole |
| $J_2$ | mm | Distance |
| $J_3$ | mm | Distance |
| L | mm | Rail length |
| L | mm | Thickness of the end piece |
| $L_1$ | mm | Thickness of the end piece with wiper |
| $L_{max}$ | mm | Max. rail length |
| m | kg/m | Mass |
| m | g/Rolling element | Mass of rolling element assembly |
| m | g | Mass |
| N | mm | Countersink diameter |
| $N_1$ | mm | Countersink depth |
| S | mm | Stroke |
| t | mm | Pitch of rolling elements in a cage |
| $t_1$ | mm | Distance from the end of the cage to the center of the first rolling element |
| $t_2$ | mm | Distance from the end of the cage to the center of the first rolling element |

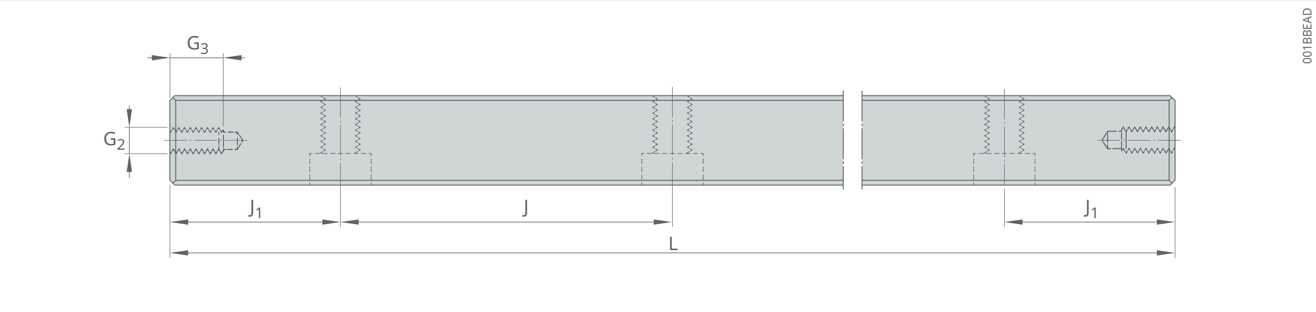
3

## 3.2.2 LWRE




LWRE

| Designation | m | A | B | $A_1$ | $D_w$ | J | $J_1$ | $J_{1\ min}$ |
|---|---|---|---|---|---|---|---|---|
| – | kg/m | mm | mm | mm | mm | mm | mm | mm |
| **LWRE 3** | 0.44 | 18.0 | 8 | 8.7 | 4.0 | 25 | 12.5 | 12.5 |
| **LWRE 2211** | 0.80 | 22.0 | 11 | 10.7 | 4.0 | 40 | 20.0 | 15.0 |
| **LWRE 4** | 0.93 | 25.0 | 12 | 12.0 | 6.5 | 25 | 12.5 | 12.5 |
| **LWRE 6** | 1.44 | 31.0 | 15 | 15.2 | 8.0 | 50 | 25.0 | 20.0 |
| **LWRE 9** | 3.09 | 44.0 | 22 | 21.7 | 12.0 | 100 | 50.0 | 20.0 |

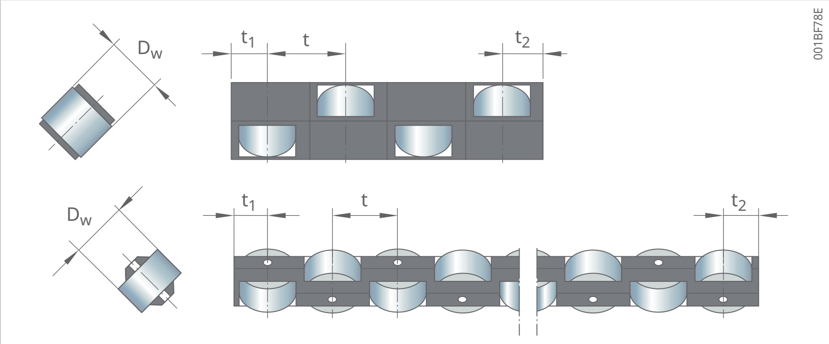



LWRE

| $J_2$ | G | $G_1$ | N | $N_1$ | $J_3$ | $G_2$ | $G_3$ | $L_{max}$ |
|---|---|---|---|---|---|---|---|---|
| mm | - | mm | mm | mm | mm | - | mm | mm |
| 3.5 | M4 | 3.30 | 6.0 | 3.0 | 4.0 | M3 | 6 | 400 |
| 4.5 | M5 | 4.30 | 7.5 | 4.1 | 6.0 | M3 | 6 | 500 |
| 5.0 | M4 | 3.30 | 6.0 | 3.2 | 5.0 | M3 | 6 | 700 |
| 6.0 | M6 | 5.20 | 9.5 | 5.2 | 6.75 | M5 | 9 | 1200 |
| 9.0 | M8 | 6.80 | 10.5 | 6.2 | 9.75 | M6 | 9 | 1500 |

3

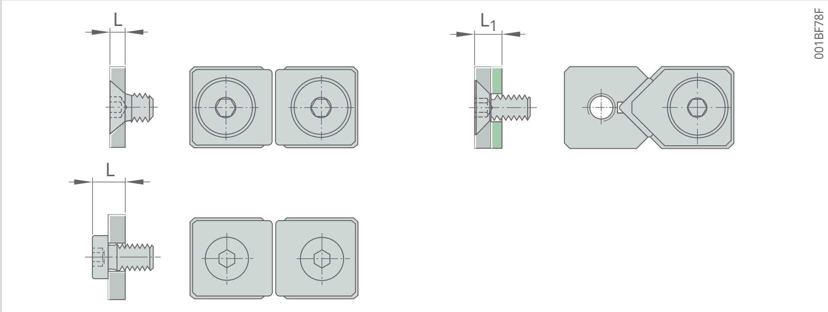
### 3.2.3 Rolling element assemblies




LWAKE 3, 6, 9 (top), LWAKE 4 (bottom)

| Designation | m | $D_w$ | t | $t_1$ | $t_2$ | $C_{10}$ | $C_{0\ 10}$ | Max. cage length | Rail |
|---|---|---|---|---|---|---|---|---|---|
| – | g/Rolling element | mm | mm | mm | mm | N | N | mm | - |
| **LWAKE 3** | 0.40 | 4.00 | 6.25 | 2.65 | 3.60 | 6300 | 8500 | 400 | LWRE 3, LWRE 2211 |
| **LWAKE 4** | 1.20 | 6.50 | 8.00 | 4.30 | 4.30 | 17300 | 20800 | 700 | LWRE 4 |
| **LWAKE 6** | 2.60 | 8.00 | 11.00 | 5.00 | 6.00 | 34000 | 39000 | 1000 | LWRE 6 |
| **LWAKE 9** | 9.20 | 12.00 | 16.00 | 7.35 | 8.65 | 78000 | 78000 | 1000 | LWRE 9 |

## 3.2.4 End pieces




LWERE 3, 6, 9 (top left), LWEREC 3, 6, 9 (top right), LWERE 4 (bottom)

| Designation [1) 2)] | m | L | $L_1$ | Mounting screw | Rail |
|---|---|---|---|---|---|
| | | | | ISO 10642 | |
| – | g | mm | mm | - | - |
| **LWERE 3** | 0.001 | 2.0 | – | M3 | LWRE 3, LWRE 2211 |
| **LWEREC 3** | 0.0001 | – | 4 | M3 | LWRE 3, LWRE 2211 |
| **LWERE 4** | 0.002 | 4.0 | – | M3 | LWRE 4 |
| **LWERE 6** | 0.004 | 3.0 | – | M5 | LWRE 6 |
| **LWEREC 6** | 0.004 | – | 5 | M5 | LWRE 6 |
| **LWERE 9** | 0.01 | 3.0 | – | M6 | LWRE 9 |
| **LWEREC 9** | 0.012 | – | 6 | M6 | LWRE 9 |

1) LWEREC with TPUR wipers

2) LWERE 4 with mounting screws in accordance with DIN 7984

### 3.2.5 LWRE in kit packaging

3

| Designation | C | $C_0$ | S | Rail | Cage | End piece |
|---|---|---|---|---|---|---|
| | Dynamic | Static | | 4× | 2× | 8× |
| – | N | N | mm | – | – | – |
| **LWRE 3050 - Kit** | 4 230 | 5 100 | 25 | LWRE 3050 | LWAKE 3×6 | LWERE 3 |
| **LWRE 3075 - Kit** | 5 803 | 7 650 | 37.5 | LWRE 3075 | LWAKE 3×9 | LWERE 3 |
| **LWRE 3100 - Kit** | 7 263 | 10 200 | 50 | LWRE 3100 | LWAKE 3×12 | LWERE 3 |
| **LWRE 3125 - Kit** | 8 644 | 12 750 | 62.5 | LWRE 3125 | LWAKE 3×15 | LWERE 3 |
| **LWRE 3150 - Kit** | 9 964 | 15 300 | 75 | LWRE 3150 | LWAKE 3×18 | LWERE 3 |
| **LWRE 3175 - Kit** | 11 238 | 17 850 | 87.5 | LWRE 3175 | LWAKE 3×21 | LWERE 3 |
| **LWRE 3200 - Kit** | 12 471 | 20 400 | 100 | LWRE 3200 | LWAKE 3×24 | LWERE 3 |
| **LWRE 4100 - Kit** | 17 300 | 20 800 | 38.8 | LWRE 4100 | LWAKE 4×10 | LWERE 4 |
| **LWRE 4150 - Kit** | 23 735 | 31 200 | 58.8 | LWRE 4150 | LWAKE 4×15 | LWERE 4 |
| **LWRE 4200 - Kit** | 28 541 | 39 520 | 94.8 | LWRE 4200 | LWAKE 4×19 | LWERE 4 |
| **LWRE 4250 - Kit** | 34 246 | 49 920 | 114.8 | LWRE 4250 | LWAKE 4×24 | LWERE 4 |
| **LWRE 4300 - Kit** | 38 622 | 58 240 | 150.8 | LWRE 4300 | LWAKE 4×28 | LWERE 4 |
| **LWRE 4350 - Kit** | 43 902 | 68 640 | 170.8 | LWRE 4350 | LWAKE 4×33 | LWERE 4 |
| **LWRE 4400 - Kit** | 49 009 | 79 040 | 190.8 | LWRE 4400 | LWAKE 4×38 | LWERE 4 |
| **LWRE 6100 - Kit** | 25 743 | 27 300 | 46 | LWRE 6100 | LWAKE 6×7 | LWERE 6 |
| **LWRE 6150 - Kit** | 34 000 | 39 000 | 80 | LWRE 6150 | LWAKE 6×10 | LWERE 6 |
| **LWRE 6200 - Kit** | 44 204 | 54 600 | 92 | LWRE 6200 | LWAKE 6×14 | LWERE 6 |
| **LWRE 6250 - Kit** | 51 431 | 66 300 | 126 | LWRE 6250 | LWAKE 6×17 | LWERE 6 |
| **LWRE 6300 - Kit** | 58 382 | 78 000 | 160 | LWRE 6300 | LWAKE 6×20 | LWERE 6 |
| **LWRE 6350 - Kit** | 67 304 | 93 600 | 172 | LWRE 6350 | LWAKE 6×24 | LWERE 6 |
| **LWRE 6400 - Kit** | 73 781 | 105 300 | 206 | LWRE 6400 | LWAKE 6×27 | LWERE 6 |

# 4 LWRE ACS precision rail guides

## 4.1 Product design

### 4.1.1 Rail guides



LWRE ACS rail guides are based on the LWRE, but are designed for a LWAKE ACS anti-creeping cage.

54 LWRE ACS precision rail guide


001BCD83

The anti-creeping system (ACS) prevents cage-creeping caused by factors such as high acceleration, uneven load distribution or vertical installation. The system is controlled by a patented control gear which is attached to the cage. On LWRE rail guides with ACS, the control gear engages to keep the rolling element assembly in its defined position. As standard, the rack spans the entire length of the rail.

Advantages:

- No cage-creeping
- Suitable for high accelerations, uneven load distribution and vertical installation
- Defined cage position increases accuracy
- Identical external dimensions make it easy to replace with standard rail guides
- Reduced downtimes and maintenance costs

22 Available lengths for LWRE ACS

| Designation | L | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 50 | 75 | 100 | 125 | 150 | 175 | 200 | 225 | 250 | 275 | 300 | 350 | 400 | 450 | 500 | 550 | 600 | 650 | 700 | 800 | 900 | 1000 |
| | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm |
| LWRE 3 ACS | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | o | o | o | o | – | – | – | – | – | – | – | – | – | – | – |
| LWRE 4 ACS | – | – | o | – | o | – | o | – | o | – | o | – | o | o | o | o | o | – | o | – | – | – |
| LWRE 6 ACS | – | – | ✓ | – | ✓ | – | ✓ | – | o | – | ✓ | o | ✓ | o | ✓ | o | o | o | o | – | – | – |
| LWRE 9 ACS | – | – | – | – | – | – | o | – | – | – | o | – | o | – | o | – | o | – | o | o | o | o |

23 Available lengths for LWRE ACS

| Designation | L | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 80 | 120 | 160 | 200 | 240 | 280 | 320 | 360 | 400 |
| | mm | mm | mm | mm | mm | mm | mm | mm | mm |
| LWRE 2211 ACS | o | o | o | o | o | o | o | o | o |

✓ Preferred length
o Standard length available on request
– On request

For maximum rail length $L_{max}$, see product tables

### 4.1.2 Rolling element assemblies

The design principle of the LWAKE ACS cages is the same as that of LWAKE. The key difference, however, is that LWAKE ACS crossed roller cages feature a control gear mounted in the middle of the cage. The load rating of the LWAKE ACS is also the same as standard LWAKE crossed roller cages with the same number of rolling elements. However, it should be noted that even with the same number of rollers, LWAKE ACS cages are longer than their LWAKE counterparts due to the additional control gear. Overrunning rolling element assemblies should be used only after consultation with Schaeffler.

### 4.1.3 End pieces

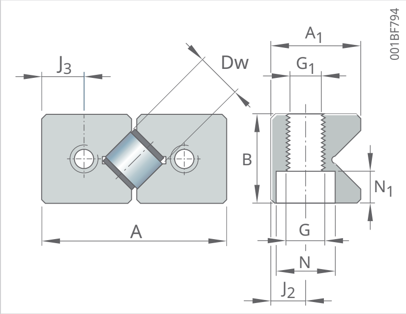
Although end pieces are usually not required, for production reasons, there are threaded holes for mounting end pieces on the end face of the rail. LWERE end pieces are used in horizontal and vertical installations. The LWEREC end piece with wiper is also available. All end pieces are supplied with appropriate mounting screws. The end pieces for LWRE rail guides are also suitable for LWRE ACS rail guides.

## 4.2 Product tables

### 4.2.1 Explanations

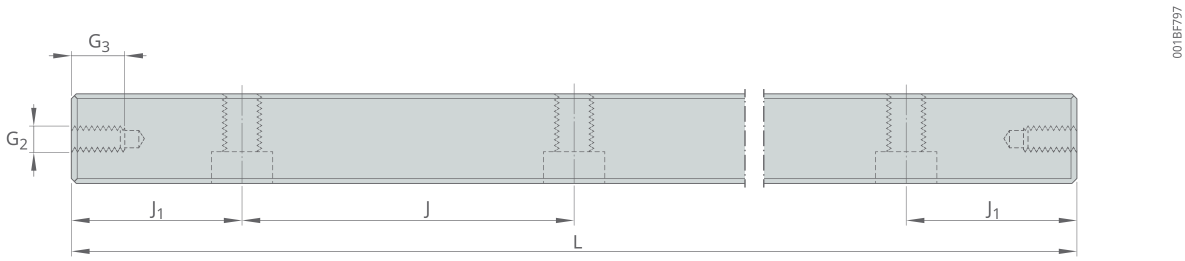
| | | |
|---|---|---|
| A | mm | Installation height |
| $A_1$ | mm | Rail height |
| B | mm | Width |
| C | N | Basic dynamic load rating |
| $C_0$ | N | Basic static load rating |
| $C_{0\ 10}$ | N | Static load rating for ten rolling elements |
| $C_{10}$ | N | Dynamic load rating for ten rolling elements |
| $D_w$ | mm | Rolling element diameter |
| G | - | Mounting hole thread |
| $G_1$ | mm | Mounting hole diameter |
| $G_2$ | – | End face thread |
| $G_3$ | mm | Thread depth |
| J | mm | Distance between mounting holes |
| $J_1$ | mm | Distance from end of rail to center of first mounting hole |
| $J_{1\ min}$ | mm | Minimum distance from end of rail to center of first mounting hole |
| $J_2$ | mm | Distance |
| $J_3$ | mm | Distance |
| L | mm | Rail length |
| L | mm | Thickness of the end piece |
| $L_1$ | mm | Thickness of the end piece with wiper |
| $L_{max}$ | mm | Max. rail length |
| m | kg/m | Mass |
| m | g/Rolling element | Mass of rolling element assembly |
| m | g | Mass |
| N | mm | Countersink diameter |
| $N_1$ | mm | Countersink depth |
| S | mm | Stroke |
| t | mm | Pitch of rolling elements in a cage |
| $t_1$ | mm | Distance from the end of the cage to the center of the first rolling element |
| $t_2$ | mm | Distance from the end of the cage to the center of the first rolling element |
| $t_3$ | mm | Length of the ACS-system |
| $t_4$ | mm | ACS-reserve |

## 4.2.2 LWRE ACS




LWRE ACS

| Designation | m | A | B | $A_1$ | $D_w$ | J | $J_1$ | $J_{1\,min}$ |
|---|---|---|---|---|---|---|---|---|
| – | kg/m | mm | mm | mm | mm | mm | mm | mm |
| **LWRE 3 ACS** | 0.44 | 18.0 | 8.0 | 8.7 | 4.0 | 25 | 12.5 | 12.5 |
| **LWRE 2211 ACS** | 0.80 | 22.0 | 11.0 | 10.7 | 4.0 | 40 | 20.0 | 15.0 |
| **LWRE 4 ACS** | 0.92 | 25.0 | 12.0 | 12.0 | 6.5 | 25 | 12.5 | 12.5 |
| **LWRE 6 ACS** | 1.44 | 31.0 | 15.0 | 15.2 | 8.0 | 50 | 25.0 | 20.0 |
| **LWRE 9 ACS** | 3.08 | 44.0 | 22.0 | 21.7 | 12.0 | 100 | 50.0 | 20.0 |

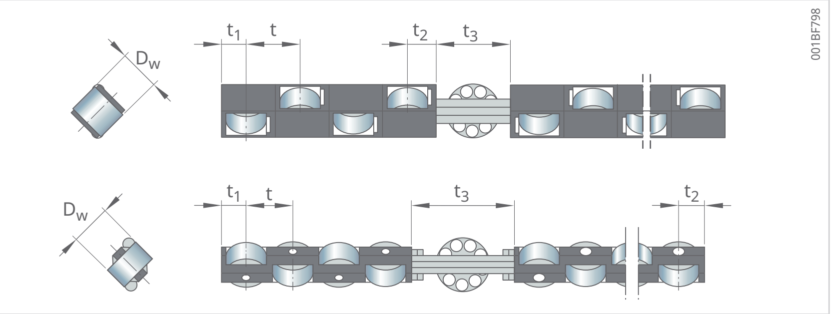



LWRE ACS

| $J_2$ | G | $G_1$ | N | $N_1$ | $J_3$ | $G_2$ | $G_3$ | $L_{max}$ |
|---|---|---|---|---|---|---|---|---|
| mm | - | mm | mm | mm | mm | - | mm | mm |
| 3.5 | M4 | 3.3 | 6.0 | 3.0 | 4.00 | M3 | 6 | 400 |
| 4.5 | M5 | 4.3 | 7.5 | 4.1 | 6.00 | M3 | 6 | 500 |
| 5.0 | M4 | 3.3 | 6.0 | 3.2 | 5.00 | M3 | 6 | 700 |
| 6.0 | M6 | 5.2 | 9.5 | 5.2 | 6.75 | M5 | 9 | 1200 |
| 9.0 | M8 | 6.8 | 10.5 | 6.2 | 9.75 | M6 | 9 | 1500 |

4

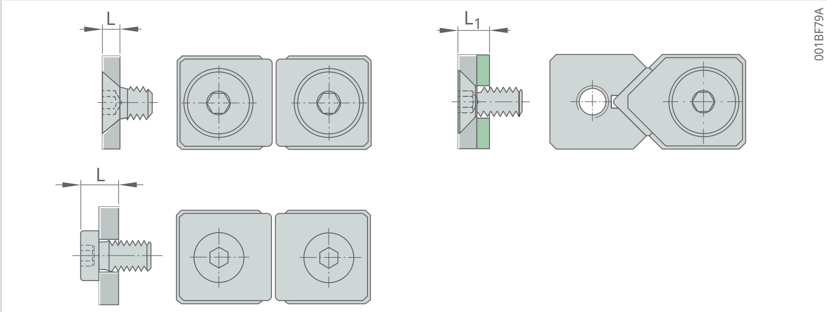
### 4.2.3 Rolling element assemblies




LWAKE 3 ACS, LWAKE 6 ACS, LWAKE 9 ACS (top), LWAKE 4 ACS (bottom)

| Designation | m | $D_w$ | t | $t_1$ | $t_2$ | $t_3$ | $t_4$ | $C_{10}$ | $C_{0\ 10}$ | Max. cage length | Rail |
|---|---|---|---|---|---|---|---|---|---|---|---|
| – | g/Rolling element | mm | mm | mm | mm | mm | mm | N | N | mm | - |
| **LWAKE 3 ACS** | 0.4 | 4.0 | 6.25 | 2.65 | 3.60 | 9.0 | 0.9 | 6300 | 8500 | 400 | LWRE 3 ACS, LWRE 2211 ACS |
| **LWAKE 4 ACS** | 1.2 | 6.5 | 8.00 | 4.30 | 4.30 | 17.0 | 1.4 | 17300 | 20800 | 700 | LWRE 4 ACS |
| **LWAKE 6 ACS** | 2.6 | 8.0 | 11.00 | 5.00 | 6.00 | 15.0 | 1.8 | 34000 | 39000 | 1000 | LWRE 6 ACS |
| **LWAKE 9 ACS** | 9.2 | 12.0 | 16.00 | 7.35 | 8.65 | 21.5 | 2.5 | 78000 | 78000 | 1000 | LWRE 9 ACS |

## 4.2.4 End pieces



LWERE 3, 6, 9 (top left), LWEREC 3, 6, 9 (top right), LWERE 4 (bottom)

| Designation [1) 2)] | m | L | $L_1$ | Mounting screw<br>ISO 10642 | Rail |
|---|---|---|---|---|---|
| – | g | mm | mm | - | - |
| **LWERE 3** | 0.001 | 2.0 | – | M3 | LWRE 3 ACS, LWRE 2211 ACS |
| **LWEREC 3** | 0.0001 | – | 4 | M3 | LWRE 3 ACS, LWRE 2211 ACS |
| **LWERE 4** | 0.002 | 4.0 | – | M3 | LWRE 4 ACS |
| **LWERE 6** | 0.004 | 3.0 | – | M5 | LWRE 6 ACS |
| **LWEREC 6** | 0.004 | – | 5 | M5 | LWRE 6 ACS |
| **LWERE 9** | 0.01 | 3.0 | – | M6 | LWRE 9 ACS |
| **LWEREC 9** | 0.012 | – | 6 | M6 | LWRE 9 ACS |

1) LWEREC with TPUR wipers

2) LWERE 4 with mounting screws in accordance with DIN 7984

## 4.2.5 LWRE ACS in kit packaging

4

| Designation | C | $C_0$ | S | Rail | Cage | End piece |
|---|---|---|---|---|---|---|
| | Dynamic | Static | | 4× | 2× | 8× |
| – | N | N | mm | – | – | – |
| **LWRE 3050 ACS - Kit** | 3 465 | 4 250 | 17.7 | LWRE 3050 ACS | LWAKE 3×5 ACS | LWERE 3 |
| **LWRE 3075 ACS - Kit** | 4 230 | 5 100 | 55.2 | LWRE 3075 ACS | LWAKE 3×6 ACS | LWERE 3 |
| **LWRE 3100 ACS - Kit** | 6 300 | 8 500 | 55.2 | LWRE 3100 ACS | LWAKE 3×10 ACS | LWERE 3 |
| **LWRE 3125 ACS - Kit** | 7 731 | 11 050 | 67.7 | LWRE 3125 ACS | LWAKE 3×13 ACS | LWERE 3 |
| **LWRE 3150 ACS - Kit** | 9 090 | 13 600 | 80.2 | LWRE 3150 ACS | LWAKE 3×16 ACS | LWERE 3 |
| **LWRE 3175 ACS - Kit** | 9 964 | 15 300 | 105.2 | LWRE 3175 ACS | LWAKE 3×18 ACS | LWERE 3 |
| **LWRE 3200 ACS - Kit** | 11 653 | 18 700 | 105.2 | LWRE 3200 ACS | LWAKE 3×22 ACS | LWERE 3 |
| **LWRE 4100 ACS - Kit** | 14 536 | 16 640 | 35.2 | LWRE 4100 ACS | LWAKE 4×8 ACS | LWERE 4 |
| **LWRE 4150 ACS - Kit** | 19 944 | 24 960 | 71.2 | LWRE 4150 ACS | LWAKE 4×12 ACS | LWERE 4 |
| **LWRE 4200 ACS - Kit** | 26 170 | 35 360 | 91.2 | LWRE 4200 ACS | LWAKE 4×17 ACS | LWERE 4 |
| **LWRE 4250 ACS - Kit** | 30 859 | 43 680 | 127.2 | LWRE 4250 ACS | LWAKE 4×21 ACS | LWERE 4 |
| **LWRE 4300 ACS - Kit** | 36 452 | 54080 | 147.2 | LWRE 4300 ACS | LWAKE 4×26 ACS | LWERE 4 |
| **LWRE 4350 ACS - Kit** | 41 813 | 64 480 | 167.2 | LWRE 4350 ACS | LWAKE 4×31 ACS | LWERE 4 |
| **LWRE 4400 ACS - Kit** | 45 964 | 72 800 | 203.2 | LWRE 4400 ACS | LWAKE 4×35 ACS | LWERE 4 |
| **LWRE 6100 ACS - Kit** | 22 826 | 23 400 | 34.4 | LWRE 6100 ACS | LWAKE 6×6 ACS | LWERE 6 |
| **LWRE 6150 ACS - Kit** | 31 318 | 35 100 | 68.4 | LWRE 6150 ACS | LWAKE 6×9 ACS | LWERE 6 |
| **LWRE 6200 ACS - Kit** | 39 196 | 46 800 | 102.4 | LWRE 6200 ACS | LWAKE 6×12 ACS | LWERE 6 |
| **LWRE 6250 ACS - Kit** | 49 056 | 62 400 | 114.4 | LWRE 6250 ACS | LWAKE 6×16 ACS | LWERE 6 |
| **LWRE 6300 ACS - Kit** | 56 093 | 74 100 | 148.4 | LWRE 6300 ACS | LWAKE 6×19 ACS | LWERE 6 |
| **LWRE 6350 ACS - Kit** | 65 107 | 89 700 | 160.4 | LWRE 6350 ACS | LWAKE 6×23 ACS | LWERE 6 |
| **LWRE 6400 ACS - Kit** | 71 640 | 101 400 | 194.4 | LWRE 6400 ACS | LWAKE 6×26 ACS | LWERE 6 |

# 5 LWRE ACSM and LWRB ACSM precision rail guides

## 5.1 Product design

### 5.1.1 Rail guides

LWRE ACSM and LWRB ACSM rail guides have been enhanced with our ACS solution, available on rails up to a length of 400 mm.

55 LWRE ACSM precision rail guide


001BCD8C

56 LWRB ACSM precision rail guide


001BCD69

These rail guides have the same external dimensions as the corresponding versions without ACSM, but are designed for use with LWAKE ACSM anti-creeping cages. This cage has a brass involute-toothed control gear. In combination with the rack directly integrated into the rail, it effectively prevents cage-creeping, making these rail guides particularly suitable for applications with high accelerations. The rails are made of corrosion-resistant steel as standard.

24 Available lengths for LWRB ACSM and LWRE ACSM

| Designation | L | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30 | 45 | 50 | 60 | 75 | 90 | 100 | 105 | 120 | 125 | 135 | 150 | 175 | 200 | 225 | 250 | 275 | 300 | 350 | 400 |
| | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm |
| LWRB 2 ACSM | o | o | – | o | o | o | – | o | o | – | o | o | – | – | – | – | – | – | – | – |
| LWRE 3 ACSM | – | – | ✓ | – | ✓ | – | ✓ | – | – | ✓ | – | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| LWRE 4 ACSM | – | – | – | – | – | – | o | – | – | – | – | o | – | o | – | o | – | o | – | o |
| LWRE 6 ACSM | – | – | – | – | – | – | ✓ | – | – | – | – | ✓ | – | ✓ | – | ✓ | – | ✓ | ✓ | ✓ |
| LWRE 9 ACSM | – | – | – | – | – | – | – | – | – | – | – | – | – | o | – | o | – | o | – | ✓ |

25 Available lengths for LWRE ACSM

| Designation | L | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 80 | 120 | 160 | 200 | 240 | 280 | 320 | 360 | 400 |
| | mm | mm | mm | mm | mm | mm | mm | mm | mm |
| LWRE 2211 ACSM | o | o | o | o | o | o | o | o | o |

✓ Preferred length
o Standard length available on request
– On request

For maximum rail length $L_{max}$, see product tables

## 5.1.2 Rolling element assemblies

The design principle of the LWAKE ACSM cages is the same as that of LWAKE. The key difference, however, is that LWAKE ACSM crossed roller cages feature a brass control gear mounted in the middle of the cage. When determining the length of the rolling element assembly, the additional space required for the control gear must be taken into account. Overrunning crossed roller cages should be used only after consultation with Schaeffler. The use of corrosion-resistant rail guides has already been taken into account in the load ratings for both the rolling element assemblies and the kit packaging, so for rating life calculations the coefficient for hardness $f_h$ = 1.

## 5.1.3 End pieces

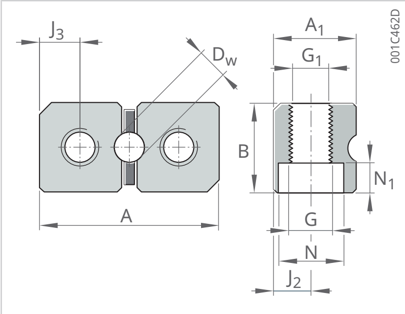
LWRE ACSM rail guides are not designed for use with end pieces. However, if these are required, this must be specified in the ordering code of the rail by using suffix E7. The end pieces for LWRE rail guides are also suitable for LWRE ACSM rail guides.

## 5.2 Product tables

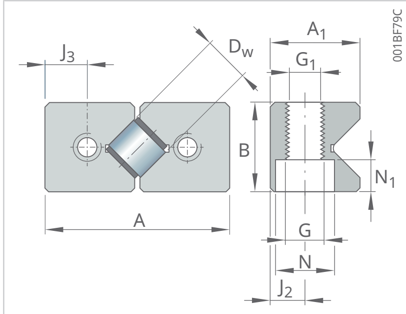
### 5.2.1 Explanations

| | | |
|---|---|---|
| $A$ | mm | Installation height |
| $A_1$ | mm | Rail height |
| $B$ | mm | Width |
| $C$ | N | Basic dynamic load rating |
| $C_0$ | N | Basic static load rating |
| $C_{0\ 10}$ | N | Static load rating for ten rolling elements |
| $C_{10}$ | N | Dynamic load rating for ten rolling elements |
| $D_w$ | mm | Rolling element diameter |
| $G$ | - | Mounting hole thread |
| $G_1$ | mm | Mounting hole diameter |
| $G_2$ | – | End face thread |
| $G_3$ | mm | Thread depth |
| $J$ | mm | Distance between mounting holes |
| $J_1$ | mm | Distance from end of rail to center of first mounting hole |
| $J_{1\ min}$ | mm | Minimum distance from end of rail to center of first mounting hole |
| $J_2$ | mm | Distance |
| $J_3$ | mm | Distance |
| $L$ | mm | Rail length |
| $L_{max}$ | mm | Max. rail length |
| m | kg/m | Mass |
| m | g/Rolling element | Mass of rolling element assembly |
| $N$ | mm | Countersink diameter |
| $N_1$ | mm | Countersink depth |
| $S$ | mm | Stroke |
| $t$ | mm | Pitch of rolling elements in a cage |
| $t_1$ | mm | Distance from the end of the cage to the center of the first rolling element |
| $t_2$ | mm | Distance from the end of the cage to the center of the first rolling element |
| $t_3$ | mm | Length of the ACS-system |
| $t_4$ | mm | ACS-reserve |

## 5.2.2 LWRE ACSM



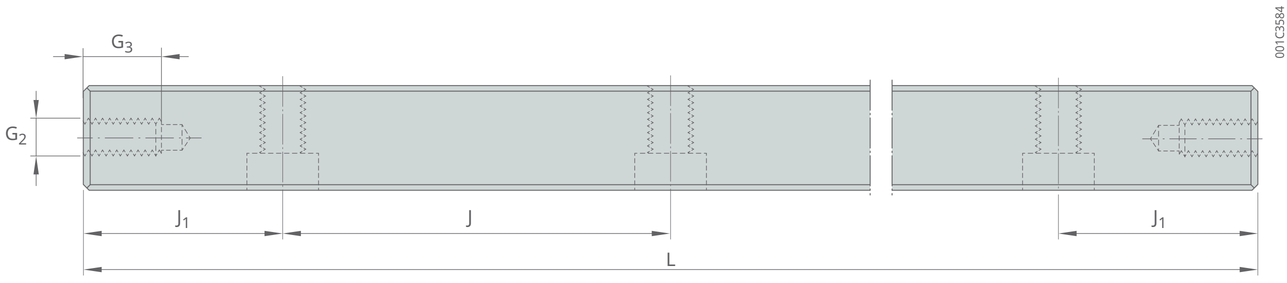

LWRB ACSM [1)]




LWRE ACSM [1)]

| Designation | m | A | B | $A_1$ | $D_w$ | J | $J_1$ | $J_{1\,min}$ |
|---|---|---|---|---|---|---|---|---|
| – | kg/m | mm | mm | mm | mm | mm | mm | mm |
| **LWRB 2 ACSM** | 0.23 | 12.0 | 6 | 5.5 | 2.0 | 15 | 7.5 | 7.5 |
| **LWRE 3 ACSM** | 0.44 | 18.0 | 8.0 | 8.7 | 4.0 | 25 | 12.5 | 12.5 |
| **LWRE 2211 ACSM** | 0.79 | 22.0 | 11.0 | 10.7 | 4.0 | 40 | 20.0 | 15.0 |
| **LWRE 4 ACSM** | 0.91 | 25.0 | 12.0 | 12.0 | 6.5 | 25 | 12.5 | 12.5 |
| **LWRE 6 ACSM** | 1.42 | 31.0 | 15.0 | 15.2 | 8.0 | 50 | 25.0 | 20.0 |
| **LWRE 9 ACSM** | 3.05 | 44.0 | 22.0 | 21.7 | 12.0 | 100 | 50.0 | 20.0 |

1) Optionally available with end face threads (suffix E7)



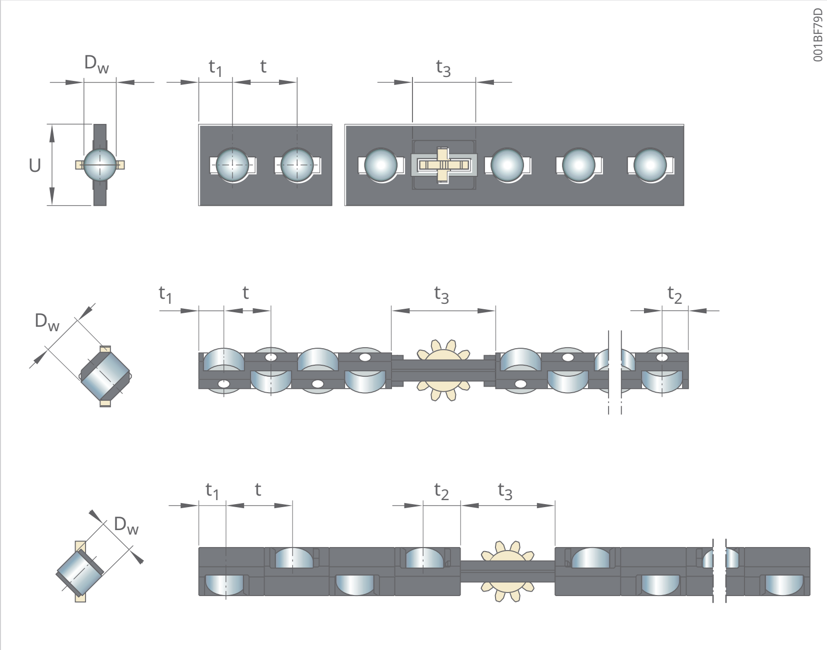

LWRB ACSM, LWRE ACSM 1)



| $J_2$ | G | $G_1$ | N | $N_1$ | $J_3$ 1) | $G_2$ 1) | $G_3$ 1) | $L_{max}$ |
|---|---|---|---|---|---|---|---|---|
| mm | - | mm | mm | mm | mm | - | mm | mm |
| 2.5 | M3 | 2.55 | 4.4 | 2.0 | 2.7 | M2.5 | 3 | 200 |
| 3.5 | M4 | 3.30 | 6.0 | 3.0 | 4.00 | M3 | 6 | 400 |
| 4.5 | M5 | 4.30 | 7.5 | 4.1 | 6.00 | M3 | 6 | 400 |
| 5.0 | M4 | 3.30 | 6.0 | 3.2 | 5.00 | M3 | 6 | 400 |
| 6.0 | M6 | 5.20 | 9.5 | 5.2 | 6.75 | M5 | 9 | 400 |
| 9.0 | M8 | 6.80 | 10.5 | 6.2 | 9.75 | M6 | 9 | 400 |

5

### 5.2.3 Rolling element assemblies




LWJK 2 ACSM (top), LWAKE 4 ACSM (middle), LWAKE 3 ACSM, LWAKE 6 ACSM, LWAKE 9 ACSM (bottom)

| Designation | m | $D_w$ | t | $t_1$ | $t_2$ | $t_3$ | $t_4$ | $C_{10}$ | $C_{0\,10}$ | Max. cage length | | Rail |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| – | g/Rolling element | mm | mm | mm | mm | mm | mm | N | N | mm | Number of balls | - |
| **LWJK 2 ACSM** | 0.05 | 2.00 | 3.90 | 2.90 | – | 3.9 | 0.5 | 510 | 650 | – | 24 | LWRB 2 ACSM |
| **LWAKE 3 ACSM** | 0.40 | 4.00 | 6.25 | 2.65 | 3.60 | 9.0 | 0.8 | 5040 | 8160 | 400 | – | LWRE 3 ACSM, LWRE 2211 ACSM |
| **LWAKE 4 ACSM** | 1.20 | 6.50 | 8.00 | 4.30 | 4.30 | 17.0 | 1.1 | 13840 | 19968 | 400 | – | LWRE 4 ACSM |
| **LWAKE 6 ACSM** | 2.60 | 8.00 | 11.00 | 5.00 | 6.00 | 15.0 | 1.1 | 27200 | 37440 | 400 | – | LWRE 6 ACSM |
| **LWAKE 9 ACSM** | 9.20 | 12.00 | 16.00 | 7.35 | 8.65 | 21.5 | 1.1 | 62400 | 74880 | 400 | – | LWRE 9 ACSM |

## 5.2.4 LWRE ACSM in kit packaging



| Designation | C | $C_0$ | S | Rail | Cage |
|---|---|---|---|---|---|
| | Dynamic | Static | | 4× | 2× |
| – | N | N | mm | – | – |
| **LWRE 3050 ACSM - Kit** | 2 940 | 4 080 | 17.9 | LWRE 3050 ACSM | LWAKE 3×5 ACSM |
| **LWRE 3075 ACSM - Kit** | 3 380 | 4 900 | 55.4 | LWRE 3075 ACSM | LWAKE 3×6 ACSM |
| **LWRE 3100 ACSM - Kit** | 5 040 | 8 160 | 55.4 | LWRE 3100 ACSM | LWAKE 3×10 ACSM |
| **LWRE 3125 ACSM - Kit** | 6 180 | 10 610 | 67.9 | LWRE 3125 ACSM | LWAKE 3×13 ACSM |
| **LWRE 3150 ACSM - Kit** | 7 270 | 13 060 | 80.4 | LWRE 3150 ACSM | LWAKE 3×16 ACSM |
| **LWRE 3175 ACSM - Kit** | 7 970 | 14 690 | 105.4 | LWRE 3175 ACSM | LWAKE 3×18 ACSM |
| **LWRE 3200 ACSM - Kit** | 9 320 | 17 950 | 105.4 | LWRE 3200 ACSM | LWAKE 3×22 ACSM |
| **LWRE 6100 ACSM - Kit** | 18 260 | 22 460 | 35.8 | LWRE 6100 ACSM | LWAKE 6×6 ACSM |
| **LWRE 6150 ACSM - Kit** | 25 050 | 33 700 | 69.8 | LWRE 6150 ACSM | LWAKE 6×9 ACSM |
| **LWRE 6200 ACSM - Kit** | 31 360 | 44 930 | 103.8 | LWRE 6200 ACSM | LWAKE 6×12 ACSM |
| **LWRE 6250 ACSM - Kit** | 39 240 | 59 900 | 115.8 | LWRE 6250 ACSM | LWAKE 6×16 ACSM |
| **LWRE 6300 ACSM - Kit** | 44 870 | 71 140 | 149.8 | LWRE 6300 ACSM | LWAKE 6×19 ACSM |
| **LWRE 6350 ACSM - Kit** | 52 090 | 86 110 | 161.8 | LWRE 6350 ACSM | LWAKE 6×23 ACSM |
| **LWRE 6400 ACSM - Kit** | 57 310 | 97 340 | 195.8 | LWRE 6400 ACSM | LWAKE 6×26 ACSM |

# 6 LWRM and LWRV precision rail guides

## 6.1 Product design

### 6.1.1 Rail guides

LWRM and LWRV rail guides enable linear guide systems that can withstand high loads with maximum rigidity. The installation dimensions and connecting dimensions of LWRM and LWRV rail guides are the same as the Modular Range rail guides in this catalog.

57 LWRM 6 and LWRV 6 precision rail guides


001BCD9B

26 Available lengths for LWRM and LWRV

| Designation | L | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 100 | 150 | 200 | 250 | 300 | 350 | 400 | 500 | 600 | 700 | 800 | 900 | 1000 |
| | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm |
| LWRM 6 | ✓ | ✓ | ✓ | ✓ | ✓ | o | ✓ | o | o | o | – | – | – |
| LWRV 6 | ✓ | ✓ | ✓ | ✓ | ✓ | o | ✓ | o | o | o | – | – | – |
| LWRM 9 | – | – | ✓ | – | ✓ | – | ✓ | ✓ | o | o | o | o | o |
| LWRV 9 | – | – | ✓ | – | ✓ | – | ✓ | ✓ | o | o | o | o | o |

✓ Preferred length
o Standard length available on request
– On request

For maximum rail length $L_{max}$, see product tables

### 6.1.2 Rolling element assemblies

In LWHW needle roller cages, the needle rollers are retained in an aluminum cage. LWHV needle roller cages are equipped with a plastic cage which retains the needle rollers. They are available for sizes 6 and 9. When ordering, the cage length in mm must be specified after the rolling element assembly designation, e.g. LWHW 10 x 225.

### 6.1.3 End pieces

End pieces prevent the rolling element assembly from moving beyond the end of the rail. Due to the design of the LWRM and LWRV rail guides and end pieces, the end pieces only need to be fitted on either the M-shaped or V-shaped rail. LWEARM and LWEARV end pieces are equipped with a plastic wiper with sealing lip to prevent dirt from entering the raceway. All end pieces are supplied with appropriate mounting screws.

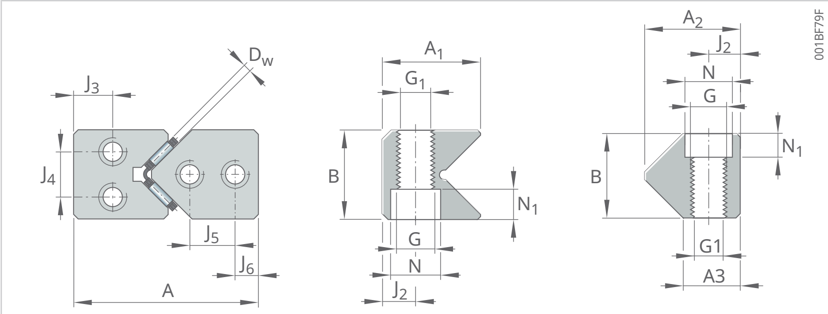
## 6.2 Product tables



### 6.2.1 Explanations

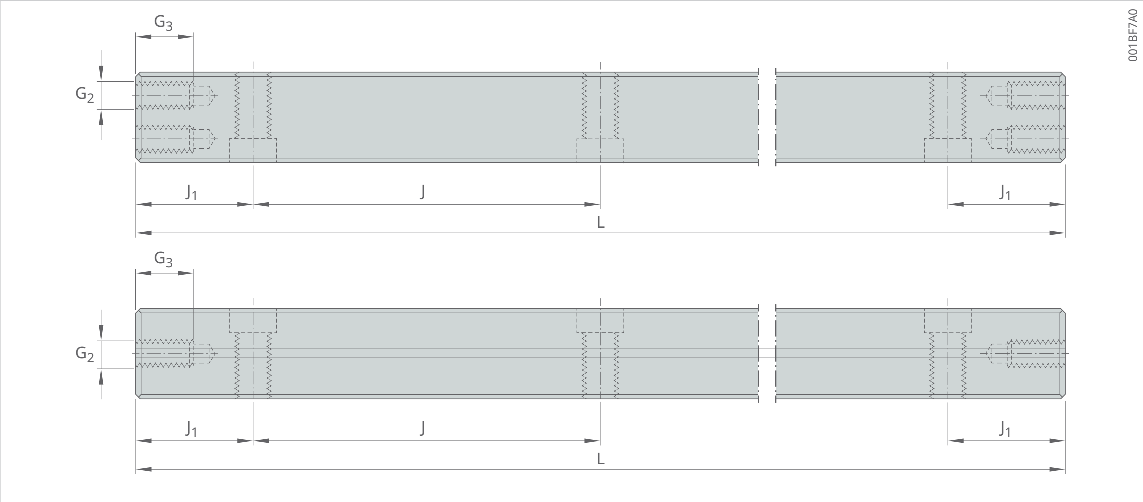
| | | |
|---|---|---|
| A | mm | Installation height |
| $A_1$ | mm | Rail height |
| $A_2$ | mm | Rail height |
| $A_3$ | mm | Height |
| b | - | Bending direction |
| B | mm | Width |
| $C_{0\ 10}$ | N | Static load rating for ten rolling elements |
| $C_{10}$ | N | Dynamic load rating for ten rolling elements |
| $D_w$ | mm | Rolling element diameter |
| G | - | Mounting hole thread |
| $G_1$ | mm | Mounting hole diameter |
| $G_2$ | – | End face thread |
| $G_3$ | mm | Thread depth |
| J | mm | Distance between mounting holes |
| $J_1$ | mm | Distance from end of rail to center of first mounting hole |
| $J_{1\ min}$ | mm | Minimum distance from end of rail to center of first mounting hole |
| $J_2$ | mm | Distance |
| $J_3$ | mm | Distance |
| $J_4$ | mm | Distance |
| $J_5$ | mm | Distance |
| $J_6$ | mm | Distance |
| L | mm | Rail length |
| L | mm | Thickness of the end piece |
| $L_1$ | mm | Thickness of the end piece with wiper |
| $L_{max}$ | mm | Max. rail length |
| $L_w$ | mm | Rolling element length |
| m | kg/m | Mass |
| m | g/Rolling element | Mass of rolling element assembly |
| m | g | Mass |
| N | mm | Countersink diameter |
| $N_1$ | mm | Countersink depth |
| t | mm | Pitch of rolling elements in a cage |
| $t_1$ | mm | Distance from the end of the cage to the center of the first rolling element |
| U | mm | Cage width |

## 6.2.2 LWRM and LWRV




LWRM, LWRV (left), LWRM (middle), LWRV (right)

| Designation | m | A | B | $A_1$ | $A_2$ | $A_3$ | $D_w$ | J | $J_1$ | $J_{1\,min}$ |
|---|---|---|---|---|---|---|---|---|---|---|
| – | kg/m | mm | mm | mm | mm | mm | mm | mm | mm | mm |
| **LWRM 6** | 1.48 | 31 | 15 | 16.5 | – | – | 2.0 | 50 | 25 | 20 |
| **LWRV 6** | 1.61 | 31 | 15 | – | 17.8 | 10.8 | 2.0 | 50 | 25 | 20 |
| **LWRM 9** | 3.14 | 44 | 22 | 23.1 | – | – | 2.0 | 100 | 50 | 20 |
| **LWRV 9** | 3.71 | 44 | 22 | – | 26.9 | 16.6 | 2.0 | 100 | 50 | 20 |



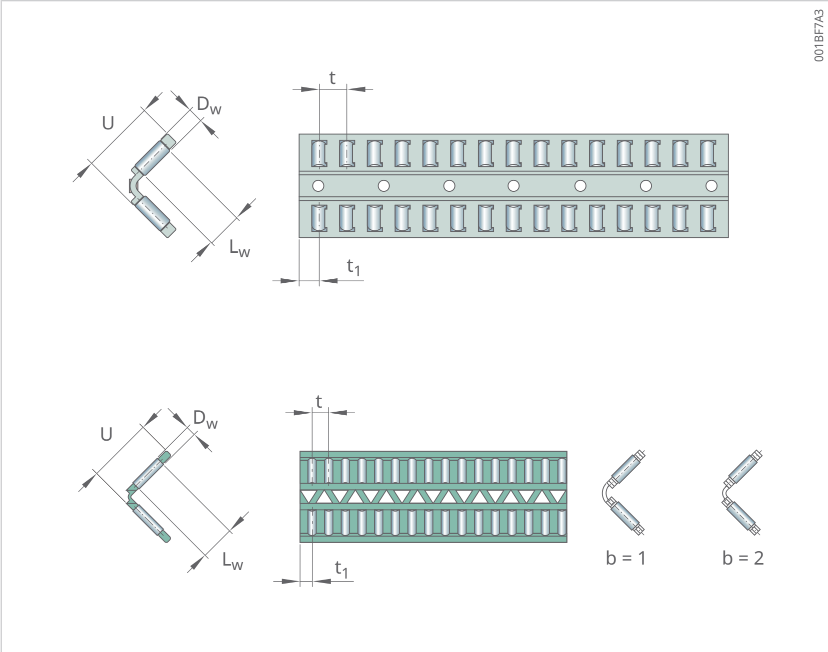

LWRM (top), LWRV (bottom)



| $J_2$ | G | $G_1$ | N | $N_1$ | $J_3$ | $J_4$ | $J_5$ | $J_6$ | $G_2$ | $G_3$ | $L_{max}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | - | mm | mm | mm | mm | mm | mm | mm | - | mm | mm |
| 6 | M6 | 5.2 | 9.5 | 5.2 | 8.5 | 7.0 | – | – | M3 | 6 | 1000 |
| 6 | M6 | 5.2 | 9.5 | 5.2 | – | – | 7.0 | 6.0 | M3 | 6 | 1000 |
| 9 | M8 | 6.8 | 10.5 | 6.2 | 10.0 | 11.0 | – | – | M5 | 8 | 1700 |
| 9 | M8 | 6.8 | 10.5 | 6.2 | – | – | 10.0 | 6.0 | M5 | 8 | 1700 |

6

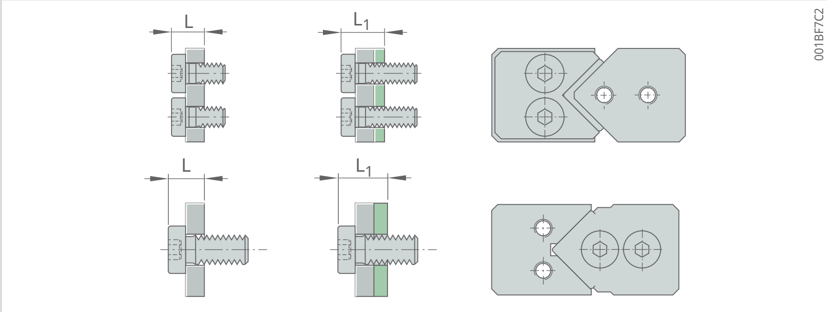
## 6.2.3 Rolling element assemblies




LWHW (top), LWHV, bending direction 1 and 2 (bottom)

| Designation | m | $D_w$ | $L_w$ | U | t | $t_1$ | $C_{10}$ | $C_{0\,10}$ | Max. cage length | b [1)] | Rail |
|---|---|---|---|---|---|---|---|---|---|---|---|
| – | g/m | mm | mm | mm | mm | mm | N | N | mm | - | - |
| **LWHV 10** | 76 | 2.0 | 4.8 | 10 | 3.75 | 2.7 | 10400 | 25500 | 2000 | 1 | LWRM 6, LWRV 6 |
| **LWHW 10** | 105 | 2.0 | 4.8 | 10 | 4.00 | 2.7 | 10400 | 25500 | 2000 | – | LWRM 6, LWRV 6 |
| **LWHV 15** | 120 | 2.0 | 7.8 | 15 | 3.75 | 2.7 | 16300 | 45000 | 2000 | 2 | LWRM 9, LWRV 9 |
| **LWHW 15** | 138 | 2.0 | 6.8 | 15 | 4.50 | 3.5 | 14600 | 42500 | 2000 | – | LWRM 9, LWRV 9 |

## 6.2.4 End pieces




LWERM (top left), LWEARM (top center), front view (top right),
LWERV (bottom left), LWEARV (bottom center), front view (bottom right)



| Designation [1)] | m | L | $L_1$ | Mounting screw | Rail |
|---|---|---|---|---|---|
| | | | | DIN 7984 | |
| – | g | mm | mm | - | - |
| **LWERM 6** | 0.003 | 4.0 | – | M3 | LWRM 6 |
| **LWERV 6** | 0.003 | 4.0 | – | M3 | LWRV 6 |
| **LWEARM 6** | 0.004 | – | 6 | M3 | LWRM 6 |
| **LWEARV 6** | 0.004 | – | 6 | M3 | LWRV 6 |
| **LWERM 9** | 0.01 | 6.5 | – | M5 | LWRM 9 |
| **LWERV 9** | 0.014 | 6.5 | – | M5 | LWRV 9 |
| **LWEARM 9** | 0.011 | – | 8.5 | M5 | LWRM 9 |
| **LWEARV 9** | 0.015 | – | 8.5 | M5 | LWRV 9 |

1) LWEARM and LWEARV with TPC-ET wipers

# 7 LWM and LWV precision rail guides

## 7.1 Product design

### 7.1.1 Rail guides

LWM and LWV rail guides enable linear units that can withstand high loads with maximum rigidity. They have the same internal geometry as the LWRM and LWRV rail guides in the Modular Range and are also operated using needle roller cages. Adapted to the machine tool industry, one of the main sectors using them, the range of available sizes goes up to a cross-section of 80 × 50 mm.

7

58 LWM and LWV precision rail guides


They are supplied with hole type 15 (through bore with countersink) as standard.

There are 2 options available for installations requiring threaded mounting holes:

- Hole type 13 with threaded inserts glued into the rail
- Hole type 03 with directly machined threads Please inquire for lead times.

For new constructions, we recommend using LWRM and LWRV rail guides as they can be easily replaced with other rail guides from the Modular Range.

27 Available lengths for LWM and LWV

| Designation | L | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 100 | 150 | 200 | 300 | 400 | 500 | 600 | 700 | 800 | 900 | 1000 |
| | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm |
| LWM 3015 | ✓ | ✓ | ✓ | ✓ | ✓ | o | o | – | – | – | – |
| LWV 3015 | ✓ | ✓ | ✓ | ✓ | ✓ | o | o | – | – | – | – |
| LWM 4020 | ✓ | ✓ | ✓ | ✓ | ✓ | o | o | o | o | o | o |
| LWV 4020 | ✓ | ✓ | ✓ | ✓ | ✓ | o | o | o | o | o | o |
| LWM 5025 | ✓ | – | ✓ | ✓ | ✓ | ✓ | o | o | o | o | o |
| LWV 5025 | ✓ | – | ✓ | ✓ | ✓ | ✓ | o | o | o | o | o |
| LWM 6035 | – | – | o | o | o | o | o | o | o | o | o |
| LWV 6035 | – | – | o | o | o | o | o | o | o | o | o |
| LWM 7040 | – | – | o | o | o | o | o | o | o | o | o |
| LWV 7040 | – | – | o | o | o | o | o | o | o | o | o |
| LWM 8050 | – | – | o | o | o | o | o | o | o | o | o |
| LWV 8050 | – | – | o | o | o | o | o | o | o | o | o |

✓ Preferred length
o Standard length available on request
– On request

For maximum rail length $L_{max}$, see product tables

### 7.1.2 Rolling element assemblies

In LWHW needle roller cages, the needle rollers are retained in an aluminum cage with perpendicular sides. In LWHV needle roller cages, the needle rollers are retained in a plastic cage. They are available in sizes LWHV 10, LWHV 15 LWHV 20.

### 7.1.3 End pieces

End pieces prevent the rolling element assembly from moving beyond the end of the rail. Due to the design of the LWM and LWV rail guides and end pieces, the end pieces only need to be fitted on either the M-shaped or V-shaped rail. LWEAM and LWEAV end pieces are equipped with a plastic wiper with sealing lip to prevent dirt from entering the raceway. All end pieces are supplied with appropriate mounting screws.

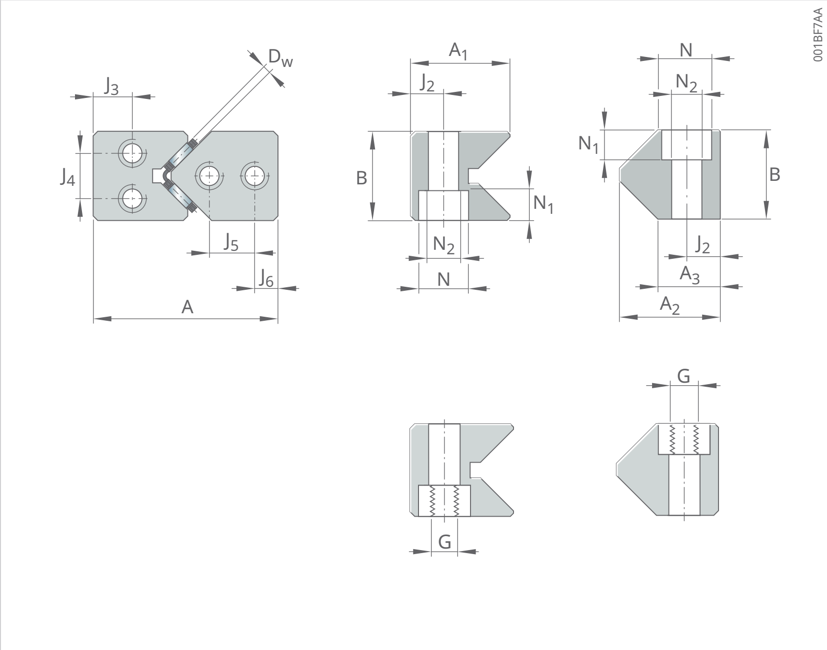
## 7.2 Product tables

### 7.2.1 Explanations

| | | |
|---|---|---|
| A | mm | Installation height |
| $A_1$ | mm | Rail height |
| $A_2$ | mm | Rail height |
| $A_3$ | mm | Height |
| b | - | Bending direction |
| B | mm | Width |
| $C_{0\ 10}$ | N | Static load rating for ten rolling elements |
| $C_{10}$ | N | Dynamic load rating for ten rolling elements |
| $D_w$ | mm | Rolling element diameter |
| G | - | Mounting hole thread |
| $G_2$ | – | End face thread |
| $G_3$ | mm | Thread depth |
| J | mm | Distance between mounting holes |
| $J_1$ | mm | Distance from end of rail to center of first mounting hole |
| $J_{1\ min}$ | mm | Minimum distance from end of rail to center of first mounting hole |
| $J_2$ | mm | Distance |
| $J_3$ | mm | Distance |
| $J_4$ | mm | Distance |
| $J_5$ | mm | Distance |
| $J_6$ | mm | Distance |
| L | mm | Rail length |
| L | mm | Thickness of the end piece |
| $L_1$ | mm | Thickness of the end piece with wiper |
| $L_{max}$ | mm | Max. rail length |
| $L_w$ | mm | Rolling element length |
| m | kg/m | Mass |
| m | g/Rolling element | Mass of rolling element assembly |
| m | g | Mass |
| N | mm | Countersink diameter |
| $N_1$ | mm | Countersink depth |
| $N_2$ | mm | Bore diameter |
| t | mm | Pitch of rolling elements in a cage |
| $t_1$ | mm | Distance from the end of the cage to the center of the first rolling element |
| U | mm | Cage width |

## 7.2.2 LWM and LWV



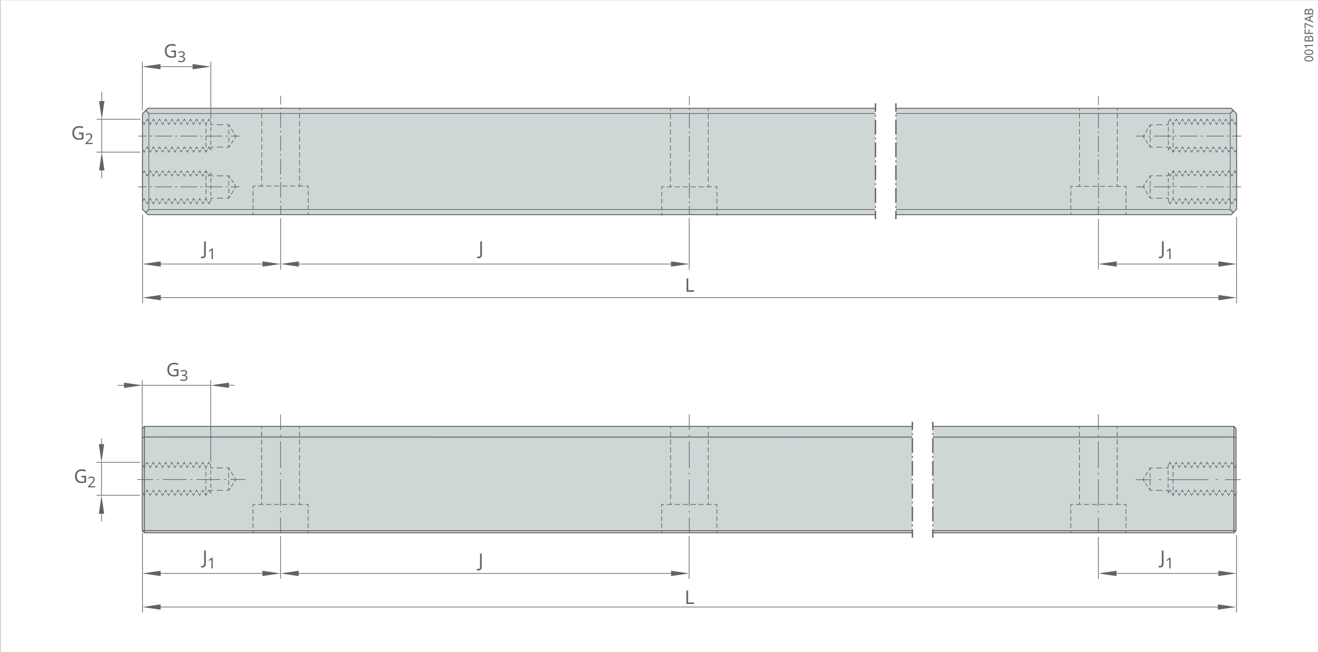



LWM and LWV (top left), LWM with hole type 15 (top center), LWV with hole type 15 (top right), LWM with hole type 13 (bottom center), LWV with hole type 13 (bottom right)

| Designation | m | A | B | $A_1$ | $A_2$ | $A_3$ | $D_w$ | J [1] | $J_{1\,min}$ [2] |
|---|---|---|---|---|---|---|---|---|---|
| – | kg/m | mm | mm | mm | mm | mm | mm | mm | mm |
| **LWM 3015** | 1.40 | 30 | 15 | 16.0 | – | – | 2.0 | 40 | 15 |
| **LWV 3015** | 1.57 | 30 | 15 | – | 17.2 | 10.5 | 2.0 | 40 | 15 |
| **LWM 4020** | 2.75 | 40 | 20 | 22.3 | – | – | 2.0 | 80 | 20 |
| **LWV 4020** | 2.74 | 40 | 20 | – | 22.0 | 13.5 | 2.0 | 80 | 20 |
| **LWM 5025** | 4.39 | 50 | 25 | 28.0 | – | – | 2.0 | 80 | 20 |
| **LWV 5025** | 4.37 | 50 | 25 | – | 28.0 | 17.0 | 2.0 | 80 | 20 |
| **LWM 6035** | 7.23 | 60 | 35 | 35.0 | – | – | 2.5 | 100 | 25 |
| **LWV 6035** | 7.57 | 60 | 35 | – | 36.0 | 20.0 | 2.5 | 100 | 25 |
| **LWM 7040** | 9.30 | 70 | 40 | 40.0 | – | – | 3.0 | 100 | 25 |
| **LWV 7040** | 10.10 | 70 | 40 | – | 42.0 | 24.0 | 3.0 | 100 | 25 |
| **LWM 8050** | 13.40 | 80 | 50 | 45.0 | – | – | 3.5 | 100 | 25 |
| **LWV 8050** | 14.30 | 80 | 50 | – | 48.5 | 26.0 | 3.5 | 100 | 25 |

[1] LWM 3015 and LWV 3015:
For rail lengths L < 110 mm, J = 35 mm. For L < 65 mm, please request a customized solution.
LWM 4020, LWV 4020, LWM 5025 and LWV 5025:
For rail lengths L < 120 mm, J = 50 mm. For L < 90 mm, please request a customized solution.
LWM 6035, LWV 6035, LWM 7040, LWV 7040, LWM 8050 and LWV 8050:
For rail lengths L < 150 mm, J = 50 mm. For L < 100 mm, please request a customized solution.

[2] Calculation for $J_1$ ➤47|1.10.7

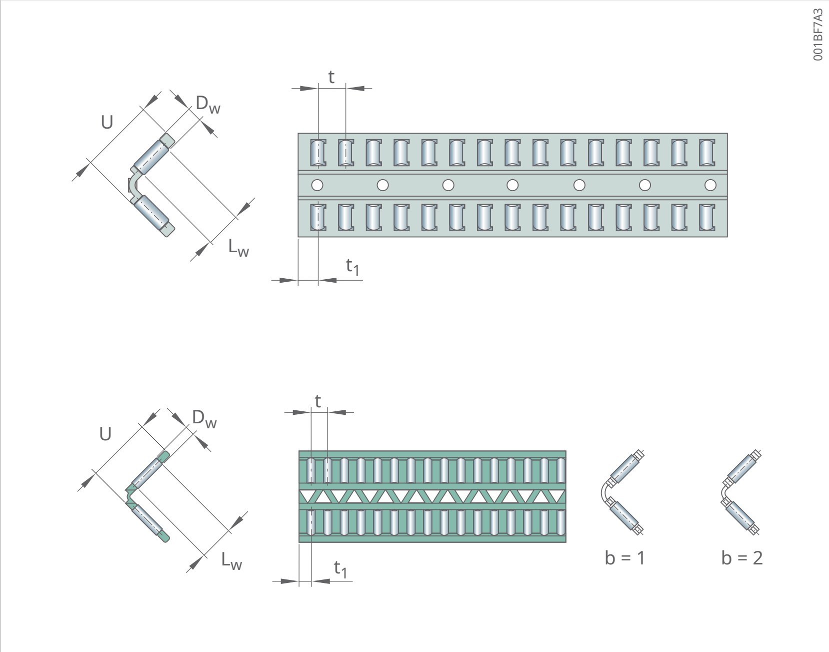



LWM (top), LWV (bottom)

| $J_2$ | G | N | $N_1$ | $N_2$ | $J_3$ | $J_4$ | $J_5$ | $J_6$ | $G_2$ | $G_3$ | $L_{max}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | - | mm | mm | mm | mm | mm | mm | mm | - | mm | mm |
| 5.5 | M4 | 8.5 | 4.5 | 5.25 | 8.0 | 7.0 | – | – | M3 | 6 | 1000 |
| 5.5 | M4 | 8.5 | 4.5 | 5.25 | – | – | 7.0 | 5.5 | M3 | 6 | 1000 |
| 7.5 | M6 | 11.5 | 6.8 | 7.50 | 10.0 | 11.0 | – | – | M5 | 7 | 1700 |
| 7.5 | M6 | 11.5 | 6.8 | 7.50 | – | – | 10.5 | 5.5 | M5 | 7 | 1700 |
| 10.0 | M6 | 11.5 | 6.8 | 7.50 | 12.0 | 13.0 | – | – | M6 | 8 | 1700 |
| 10.0 | M6 | 11.5 | 6.8 | 7.50 | – | – | 13.0 | 7.0 | M6 | 8 | 1700 |
| 11.0 | M8 | 15.0 | 9.0 | 10.00 | 14.0 | 20.0 | – | – | M6 | 8 | 1700 |
| 11.0 | M8 | 15.0 | 9.0 | 10.00 | – | – | 18.0 | 8.0 | M6 | 8 | 1700 |
| 13.0 | M10 | 18.5 | 11.0 | 12.50 | 16.0 | 20.0 | – | – | M6 | 8 | 1700 |
| 13.0 | M10 | 18.5 | 11.0 | 12.50 | – | – | 20.0 | 10.0 | M6 | 8 | 1700 |
| 14.0 | M12 | 20.0 | 13.0 | 14.00 | 20.0 | 30.0 | – | – | M6 | 8 | 1700 |
| 14.0 | M12 | 20.0 | 13.0 | 14.00 | – | – | 25.0 | 10.0 | M6 | 8 | 1700 |

## 7.2.3 Rolling element assemblies



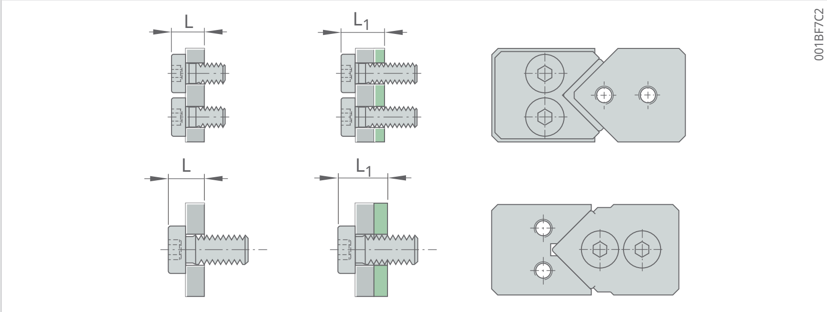



LWHW (top), LWHV, bending direction 1 and 2 (bottom)

| Desig-<br>nation | m | $D_w$ | $L_w$ | U | t | $t_1$ | $C_{10}$ | $C_{0\ 10}$ | Max. cage length | b [1)] | Rail |
|---|---|---|---|---|---|---|---|---|---|---|---|
| – | g/m | mm | mm | mm | mm | mm | N | N | mm | - | - |
| **LWHV 10** | 76 | 2.0 | 4.8 | 10 | 3.75 | 2.7 | 10400 | 25500 | 2000 | 1 | LWM 3015, LWV 3015 |
| **LWHW 10** | 105 | 2.0 | 4.8 | 10 | 4.00 | 2.7 | 10400 | 25500 | 2000 | – | LWM 3015, LWV 3015 |
| **LWHV 15** | 120 | 2.0 | 7.8 | 15 | 3.75 | 2.7 | 16300 | 45000 | 2000 | 1. 2 | LWM 4020, LWV 4020, LWM 5025, LWV 5025 |
| **LWHW 15** | 138 | 2.0 | 6.8 | 15 | 4.50 | 3.5 | 14600 | 42500 | 2000 | – | LWM 4020, LWV 4020, LWM 5025, LWV 5025 |
| **LWHV 20** | 210 | 2.5 | 11.8 | 20 | 5.00 | 3.7 | 32000 | 88000 | 2000 | 2 | LWM 6035, LWV 6035 |
| **LWHW 20** | 239 | 2.5 | 9.8 | 20 | 5.50 | 4.0 | 26000 | 76550 | 2000 | – | LWM 6035, LWV 6035 |
| **LWHW 25** | 408 | 3.0 | 13.8 | 25 | 6.00 | 4.5 | 43100 | 129400 | 2000 | – | LWM 7040, LWV 7040 |
| **LWHW 30** | 598 | 3.5 | 17.8 | 30 | 7.00 | 5.0 | 64500 | 195000 | 2000 | – | LWM 8050, LWV 8050 |

[1)] Bending direction 1 for LWHV 15 with LWM 4020 and LWV 4020 rails
Bending direction 2 for LWHV 15 with LWM 5025 and LWV 5025 rails

## 7.2.4 End pieces




LWEM (top left), LWEAM (top center), front view (top right),
LWEV (bottom left), LWEAV (bottom center), front view (bottom right)



| Designation [1] | m | L | $L_1$ | Mounting screw DIN 7984 | Rail |
|---|---|---|---|---|---|
| – | g | mm | mm | - | - |
| **LWEM 3015** | 0.003 | 4.0 | – | M3 | LWM 3015 |
| **LWEV 3015** | 0.003 | 4.0 | – | M3 | LWV 3015 |
| **LWEAM 3015** | 0.004 | – | 6.0 | M3 | LWM 3015 |
| **LWEAV 3015** | 0.004 | – | 6.0 | M3 | LWV 3015 |
| **LWEM 4020** | 0.01 | 6.5 | – | M5 | LWM 4020 |
| **LWEV 4020** | 0.011 | 6.5 | – | M5 | LWV 4020 |
| **LWEAM 4020** | 0.011 | – | 8.5 | M5 | LWM 4020 |
| **LWEAV 4020** | 0.012 | – | 8.5 | M5 | LWV 4020 |
| **LWEM 5025** | 0.018 | 7.0 | – | M6 | LWM 5025 |
| **LWEV 5025** | 0.018 | 7.0 | – | M6 | LWV 5025 |
| **LWEAM 5025** | 0.018 | – | 9.0 | M6 | LWM 5025 |
| **LWEAV 5025** | 0.019 | – | 9.0 | M6 | LWV 5025 |
| **LWEM 6035** | 0.027 | 7.0 | – | M6 | LWM 6035 |
| **LWEV 6035** | 0.028 | 7.0 | – | M6 | LWV 6035 |
| **LWEAM 6035** | 0.029 | – | 9.0 | M6 | LWM 6035 |
| **LWEAV 6035** | 0.03 | – | 9.0 | M6 | LWV 6035 |
| **LWEM 7040** | 0.034 | 7.0 | – | M6 | LWM 7040 |
| **LWEV 7040** | 0.037 | 7.0 | – | M6 | LWV 7040 |
| **LWEAM 7040** | 0.038 | – | 9.0 | M6 | LWM 7040 |
| **LWEAV 7040** | 0.04 | – | 9.0 | M6 | LWV 7040 |
| **LWEM 8050** | 0.054 | 7.0 | – | M6 | LWM 8050 |
| **LWEV 8050** | 0.051 | 7.0 | – | M6 | LWV 8050 |
| **LWEAM 8050** | 0.058 | – | 9.0 | M6 | LWM 8050 |
| **LWEAV 8050** | 0.056 | – | 9.0 | M6 | LWV 8050 |

1) LWEAM and LWEAV with TPC-ET wipers

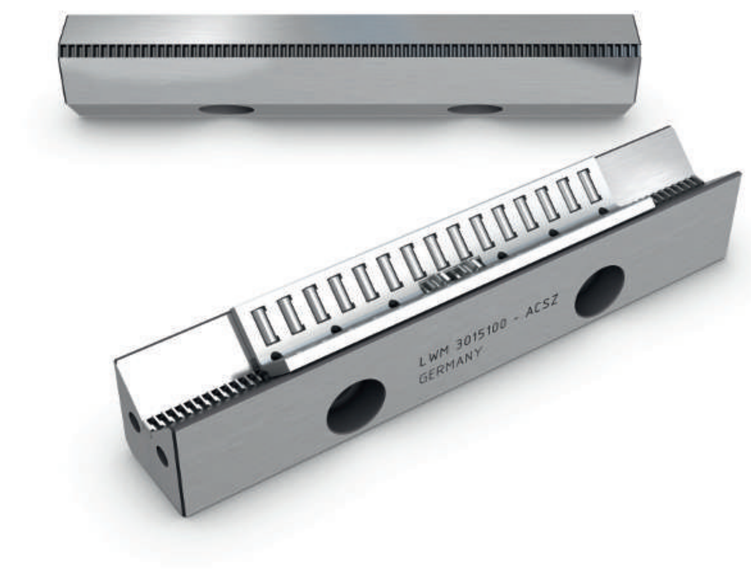
# 8 LWM ACSZ and LWV ACSZ precision rail guides

## 8.1 Product design

### 8.1.1 Rail guides

LWM ACSZ and LWV ACSZ rail guides are based on the LWM and LWV, but are designed for LWHW ACSZ anti-creeping cages.

59 LWM ACSZ and LWV ACSZ precision rail guides




Both rails are therefore fitted with a steel rack. The cage is equipped with two steel control gears that engage in the rack to keep the rolling element assembly in its defined position. As standard, the rack spans the entire length of the rail.

Advantages:

- No cage-creeping
- Suitable for high accelerations, uneven load distribution and vertical installation
- Defined cage position increases accuracy
- Identical external dimensions make it easy to replace with standard rail guides
- Reduced downtimes and maintenance costs

28 Available lengths for LWM ACSZ and LWV ACSZ

| Designation | L | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 100 | 150 | 200 | 300 | 400 | 500 | 600 | 700 | 800 | 900 | 1000 |
| | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm |
| LWM 3015 ACSZ | o | o | o | o | o | o | o | – | – | – | – |
| LWV 3015 ACSZ | o | o | o | o | o | o | o | – | – | – | – |
| LWM 4020 ACSZ | o | o | o | o | o | o | o | o | o | o | o |
| LWV 4020 ACSZ | o | o | o | o | o | o | o | o | o | o | o |
| LWM 5025 ACSZ | o | – | o | o | o | o | o | o | o | o | o |
| LWV 5025 ACSZ | o | – | o | o | o | o | o | o | o | o | o |
| LWM 6035 ACSZ | – | – | o | o | o | o | o | o | o | o | o |
| LWV 6035 ACSZ | – | – | o | o | o | o | o | o | o | o | o |
| LWM 7040 ACSZ | – | – | o | o | o | o | o | o | o | o | o |
| LWV 7040 ACSZ | – | – | o | o | o | o | o | o | o | o | o |
| LWM 8050 ACSZ | – | – | o | o | o | o | o | o | o | o | o |
| LWV 8050 ACSZ | – | – | o | o | o | o | o | o | o | o | o |

✓ Preferred length
o Standard length available on request
– On request

For maximum rail length $L_{max}$, see product tables

8

### 8.1.2 Rolling element assemblies

The design principle of the LWHW ACSZ cages is the same as that of LWHW. The key difference, however, is that LWHW ACSZ needle roller cages are equipped with 2 steel control gears mounted in the middle of the cage. The load rating of the LWHW ACSZ needle roller cage is the same as in the standard LWHW. The length of the cage is also the same. In LWHW ACSZ needle roller cages, the rollers are retained in an aluminum cage.

### 8.1.3 End pieces

End pieces are generally not required for LWM ACSZ and LWV ACSZ rail guides as the ACSZ system prevents cage-creeping. However, for production reasons, the rails still feature threaded holes on the end face for mounting end pieces as standard. Most end pieces that fit on LWM / LWV rail guides are suited here, too, with the exception of LWEAV. If no threaded holes are required on the front face of the rail, this must be specified when ordering using the suffix E1.

# 8.2 Product tables

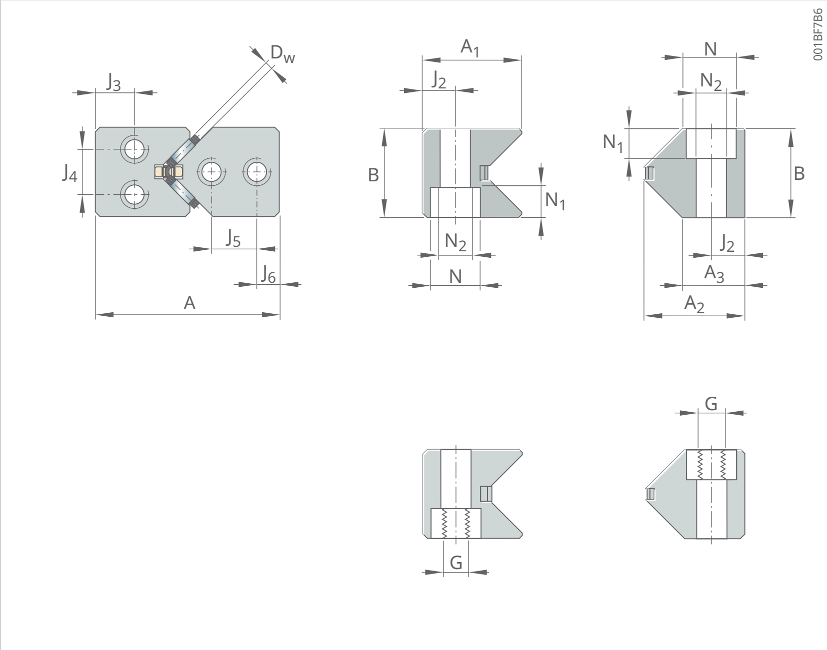
## 8.2.1 Explanations

| | | |
|---|---|---|
| A | mm | Installation height |
| $A_1$ | mm | Rail height |
| $A_2$ | mm | Rail height |
| $A_3$ | mm | Height |
| B | mm | Width |
| $C_{0\,10}$ | N | Static load rating for ten rolling elements |
| $C_{10}$ | N | Dynamic load rating for ten rolling elements |
| $D_w$ | mm | Rolling element diameter |
| G | - | Mounting hole thread |
| $G_2$ | – | End face thread |
| $G_3$ | mm | Thread depth |
| J | mm | Distance between mounting holes |
| $J_1$ | mm | Distance from end of rail to center of first mounting hole |
| $J_{1\,min}$ | mm | Minimum distance from end of rail to center of first mounting hole |
| $J_2$ | mm | Distance |
| $J_3$ | mm | Distance |
| $J_4$ | mm | Distance |
| $J_5$ | mm | Distance |
| $J_6$ | mm | Distance |
| L | mm | Rail length |
| L | mm | Thickness of the end piece |
| $L_1$ | mm | Thickness of the end piece with wiper |
| $L_{max}$ | mm | Max. rail length |
| $L_w$ | mm | Rolling element length |
| m | kg/m | Mass |
| m | g/m | Mass of rolling element assembly |
| m | g | Mass |
| N | mm | Countersink diameter |
| $N_1$ | mm | Countersink depth |
| $N_2$ | mm | Bore diameter |
| t | mm | Pitch of rolling elements in a cage |
| $t_1$ | mm | Distance from the end of the cage to the center of the first rolling element |
| $t_4$ | mm | ACS-reserve |
| U | mm | Cage width |

8

8

## 8.2.2 LWM ACSZ and LWV ACSZ

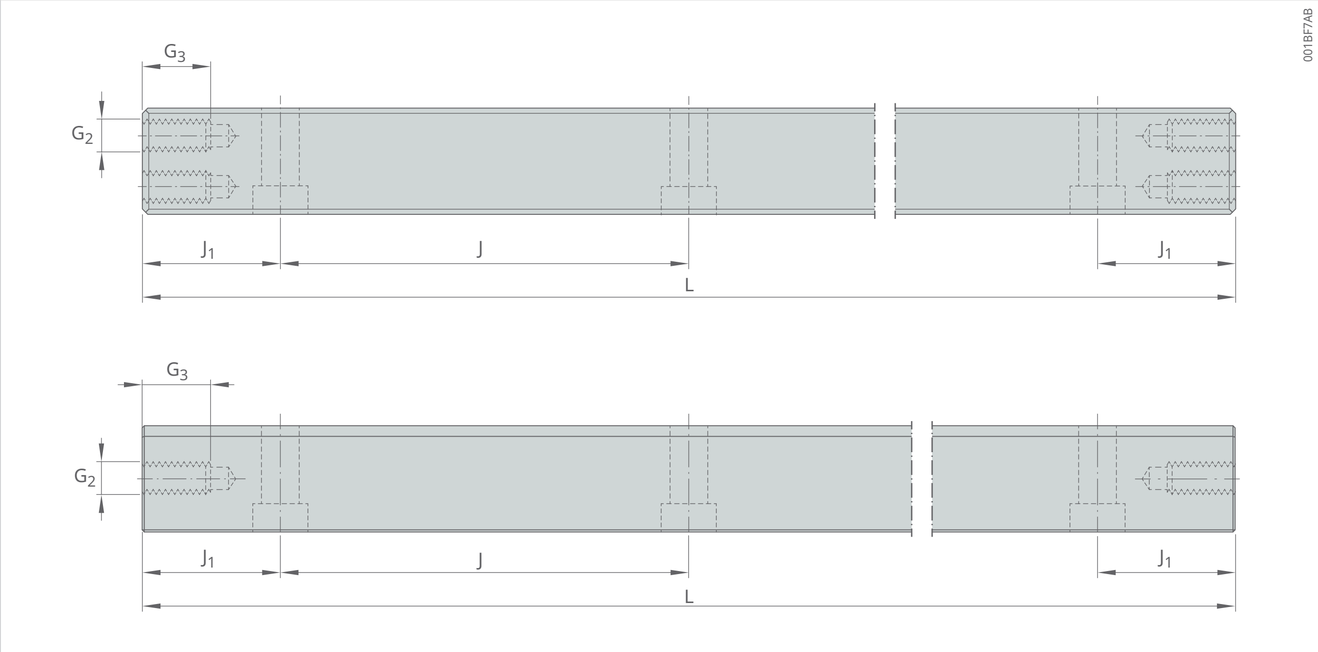



LWM ACSZ and LWV ACSZ (top left), LWM ACSZ with hole type 15 (top center), LWV ACSZ with hole type 15 (top right), LWM ACSZ with hole type 13 (bottom center), LWV ACSZ with hole type 13 (bottom right)

| Designation | m | A | B | $A_1$ | $A_2$ | $A_3$ | $D_w$ | J 1) | $J_{1\ min}$ 2) |
|---|---|---|---|---|---|---|---|---|---|
| – | kg/m | mm | mm | mm | mm | mm | mm | mm | mm |
| **LWM 3015 ACSZ** | 1.4 | 30.0 | 15.0 | 16.0 | – | – | 2.0 | 40 | 15.0 |
| **LWV 3015 ACSZ** | 1.6 | 30.0 | 15.0 | – | 17.2 | 10.5 | 2.0 | 40 | 15.0 |
| **LWM 4020 ACSZ** | 2.8 | 40.0 | 20.0 | 22.3 | – | – | 2.0 | 80 | 20.0 |
| **LWV 4020 ACSZ** | 2.8 | 40.0 | 20.0 | – | 22.0 | 13.5 | 2.0 | 80 | 20.0 |
| **LWM 5025 ACSZ** | 4.5 | 50.0 | 25.0 | 28.0 | – | – | 2.0 | 80 | 20.0 |
| **LWV 5025 ACSZ** | 4.4 | 50.0 | 25.0 | – | 28.0 | 17.0 | 2.0 | 80 | 20.0 |
| **LWM 6035 ACSZ** | 7.3 | 60.0 | 35.0 | 35.0 | – | – | 2.5 | 100 | 25.0 |
| **LWV 6035 ACSZ** | 7.6 | 60.0 | 35.0 | – | 36.0 | 20.0 | 2.5 | 100 | 25.0 |
| **LWM 7040 ACSZ** | 9.4 | 70.0 | 40.0 | 40.0 | – | – | 3.0 | 100 | 25.0 |
| **LWV 7040 ACSZ** | 10.2 | 70.0 | 40.0 | – | 42.0 | 24.0 | 3.0 | 100 | 25.0 |
| **LWM 8050 ACSZ** | 13.5 | 80.0 | 50.0 | 45.0 | – | – | 3.5 | 100 | 25.0 |
| **LWV 8050 ACSZ** | 14.4 | 80.0 | 50.0 | – | 48.5 | 26.0 | 3.5 | 100 | 25.0 |

1) LWM 3015 ACSZ and LWV 3015 ACSZ:
For rail lengths L < 110 mm, J = 35 mm. For L < 65 mm, please request a customized solution.
LWM 4020 ACSZ, LWV 4020 ACSZ, LWM 5025 ACSZ and LWV 5025 ACSZ:
For rail lengths L < 120 mm, J = 50 mm. For L < 90 mm, please request a customized solution.
LWM 6035 ACSZ, LWV 6035 ACSZ, LWM 7040 ACSZ, LWV 7040 ACSZ, LWM 8050 ACSZ and LWV 8050 ACSZ:
For rail lengths L < 150 mm, J = 50 mm. For L < 100 mm, please request a customized solution.

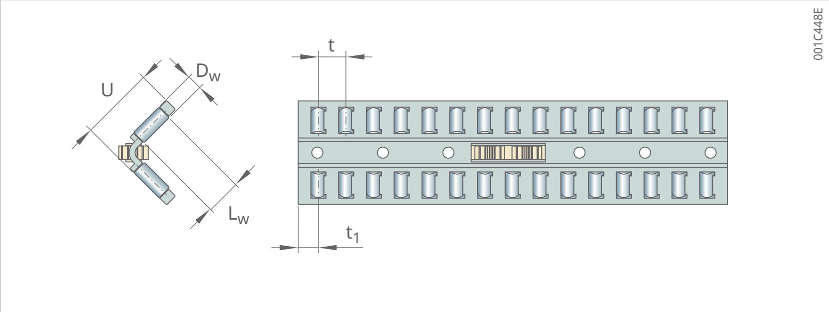
2) Calculation for $J_1$ ➤47 | 1.10.7




LWM ACSZ (top), LWV ACSZ (bottom)

| $J_2$ | G | N | $N_1$ | $N_2$ | $J_3$ | $J_4$ | $J_5$ | $J_6$ | $G_2$ | $G_3$ | $L_{max}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | - | mm | mm | mm | mm | mm | mm | mm | - | mm | mm |
| 5.5 | M4 | 8.5 | 4.5 | 5.25 | 8.0 | 7.0 | – | – | M3 | 6 | 1000 |
| 5.5 | M4 | 8.5 | 4.5 | 5.25 | – | – | 7.0 | 5.5 | M3 | 6 | 1000 |
| 7.5 | M6 | 11.5 | 6.8 | 7.50 | 10.0 | 11.0 | – | – | M5 | 7 | 1700 |
| 7.5 | M6 | 11.5 | 6.8 | 7.50 | – | – | 10.5 | 5.5 | M5 | 7 | 1700 |
| 10.0 | M6 | 11.5 | 6.8 | 7.50 | 12.0 | 13.0 | – | – | M6 | 8 | 1700 |
| 10.0 | M6 | 11.5 | 6.8 | 7.50 | – | – | 13.0 | 7.0 | M6 | 8 | 1700 |
| 11.0 | M8 | 15.0 | 9.0 | 10.00 | 14.0 | 20.0 | – | – | M6 | 8 | 1700 |
| 11.0 | M8 | 15.0 | 9.0 | 10.00 | – | – | 18.0 | 8.0 | M6 | 8 | 1700 |
| 13.0 | M10 | 18.5 | 11.0 | 12.50 | 16.0 | 20.0 | – | – | M6 | 8 | 1700 |
| 13.0 | M10 | 18.5 | 11.0 | 12.50 | – | – | 20.0 | 10.0 | M6 | 8 | 1700 |
| 14.0 | M12 | 20.0 | 13.0 | 14.00 | 20.0 | 30.0 | – | – | M6 | 8 | 1700 |
| 14.0 | M12 | 20.0 | 13.0 | 14.00 | – | – | 25.0 | 10.0 | M6 | 8 | 1700 |

## 8.2.3 Rolling element assemblies

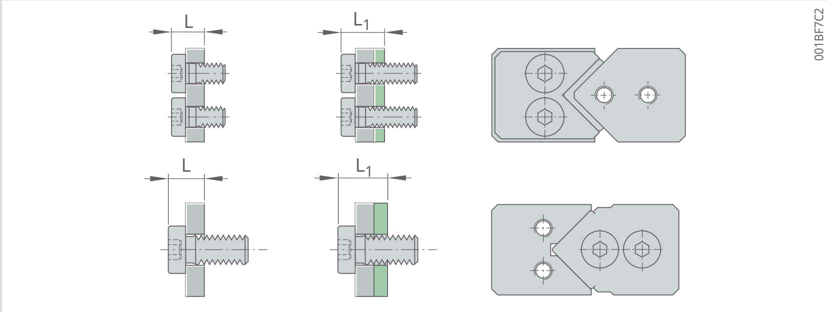



LWHW ACSZ

8

| Designation | m | $D_w$ | $L_w$ | U | t | $t_1$ | $t_4$ | $C_{10}$ | $C_{0\,10}$ | Max. cage length | Rail |
|---|---|---|---|---|---|---|---|---|---|---|---|
| – | g/m | mm | mm | mm | mm | mm | mm | N | N | mm | - |
| **LWHW 10 ACSZ** | 106 | 2.0 | 4.8 | 10 | 4.0 | 2.7 | 0.7 | 10400 | 25500 | 2000 | LWM 3015 ACSZ, LWV 3015 ACSZ |
| **LWHW 15 ACSZ** | 139 | 2.0 | 6.8 | 15 | 4.5 | 3.5 | 0.8 | 14600 | 42500 | 2000 | LWM 4020 ACSZ, LWV 4020 ACSZ, LWM 5025 ACSZ, LWV 5025 ACSZ |
| **LWHW 20 ACSZ** | 240 | 2.5 | 9.8 | 20 | 5.5 | 4.0 | 0.8 | 26000 | 76550 | 2000 | LWM 6035 ACSZ, LWV 6035 ACSZ |
| **LWHW 25 ACSZ** | 412 | 3.0 | 13.8 | 25 | 6.0 | 4.5 | 1.1 | 43100 | 129400 | 2000 | LWM 7040 ACSZ, LWV 7040 ACSZ |
| **LWHW 30 ACSZ** | 602 | 3.5 | 17.8 | 30 | 7.0 | 5.0 | 1.1 | 64500 | 195000 | 2000 | LWM 8050 ACSZ, LWV 8050 ACSZ |

## 8.2.4 End pieces




LWEM (top left), LWEAM (top center), front view (top right),
LWEV (bottom left), LWEAV (bottom center), front view (bottom right)

| Designation [1] | m | L | $L_1$ | Mounting screw DIN 7984 | Rail |
|---|---|---|---|---|---|
| – | g | mm | mm | - | - |
| **LWEM 3015** | 0.003 | 4.0 | – | M3 | LWM 3015 ACSZ |
| **LWEV 3015** | 0.003 | 4.0 | – | M3 | LWV 3015 ACSZ |
| **LWEAM 3015** | 0.004 | – | 6.0 | M3 | LWM 3015 ACSZ |
| **LWEM 4020** | 0.01 | 6.5 | – | M5 | LWM 4020 ACSZ |
| **LWEV 4020** | 0.011 | 6.5 | – | M5 | LWV 4020 ACSZ |
| **LWEAM 4020** | 0.011 | – | 8.5 | M5 | LWM 4020 ACSZ |
| **LWEM 5025** | 0.018 | 7.0 | – | M6 | LWM 5025 ACSZ |
| **LWEV 5025** | 0.018 | 7.0 | – | M6 | LWV 5025 ACSZ |
| **LWEAM 5025** | 0.018 | – | 9.0 | M6 | LWM 5025 ACSZ |
| **LWEM 6035** | 0.027 | 7.0 | – | M6 | LWM 6035 ACSZ |
| **LWEV 6035** | 0.028 | 7.0 | – | M6 | LWV 6035 ACSZ |
| **LWEAM 6035** | 0.029 | – | 9.0 | M6 | LWM 6035 ACSZ |
| **LWEM 7040** | 0.034 | 7.0 | – | M6 | LWM 7040 ACSZ |
| **LWEV 7040** | 0.037 | 7.0 | – | M6 | LWV 7040 ACSZ |
| **LWEAM 7040** | 0.038 | – | 9.0 | M6 | LWM 7040 ACSZ |
| **LWEM 8050** | 0.054 | 7.0 | – | M6 | LWM 8050 ACSZ |
| **LWEV 8050** | 0.051 | 7.0 | – | M6 | LWV 8050 ACSZ |
| **LWEAM 8050** | 0.058 | – | 9.0 | M6 | LWM 8050 ACSZ |

[1] LWEAM with TPC-ET wipers

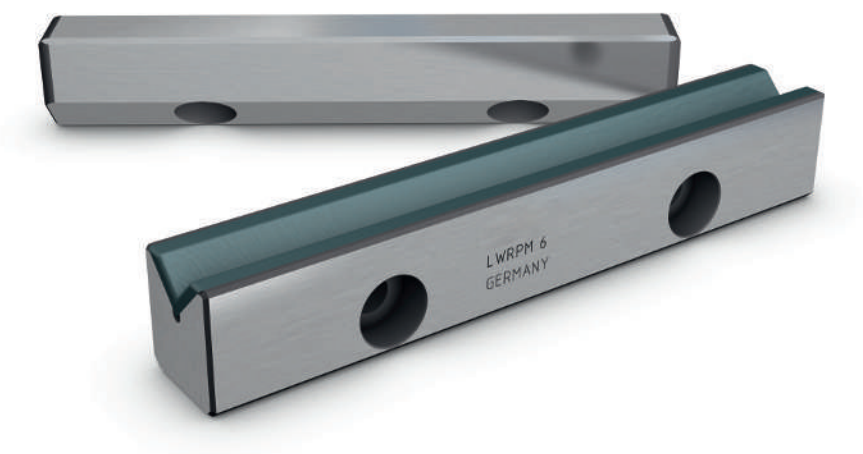
# 9 LWRPM and LWRPV precision rail guides

## 9.1 Product design

### 9.1.1 Rail guides

LWRPM and LWRPV rail guides are linear guides for limited travel distances, which are equipped with a Turcite-B slide coating. This PTFE-based material is self-lubricating and has excellent sliding properties.

60 LWRPM and LWRPV precision rail guides




001BCDA0

The slide coating is bonded to the unhardened LWRPM rail and then ground to size. The slide coating does not need to be ordered separately. The LWRPV rail guide is hardened and polished. The specified load rating of the slide coating is based on a surface pressure of approx. 1 N/mm$^2$. A short-term load of up to 6 N/mm$^2$ is permissible. To prevent damage to the sliding surface of the LWRPM rail, the LWRPV rail is designed with a lead-in radius as standard. The rail guides are only available in accuracy class P10. LWRPM and LWRPV rail guides should be used where rail guides with rolling element assemblies cannot be used due to external conditions such as extremely short strokes, high impact loads or exposure to dust. The installation dimensions and interface dimensions of LWRPM and LWRPV rail guides are the same as the Modular Range rail guides.

Advantages:

- No stick-slip during running
- Smooth operation
- Good emergency running characteristics
- Low wear and high reliability
- Insensitive to dirt
- Very good vibration damping

29 Available lengths for LWRPM and LWRPV

| Designation | L | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 50 | 75 | 100 | 125 | 150 | 175 | 200 | 225 | 250 | 275 | 300 | 350 | 400 | 450 | 500 | 550 | 600 | 650 | 700 | 800 | 900 | 1000 |
| | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm |
| LWRPM 3 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | o | o | o | o | – | – | – | – | – | – | – | – | – | – | – |
| LWRPV 3 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | o | o | o | o | – | – | – | – | – | – | – | – | – | – | – |
| LWRPM 6 | – | – | ✓ | – | ✓ | – | ✓ | – | ✓ | – | ✓ | o | o | o | o | o | o | o | o | – | – | – |
| LWRPV 6 | – | – | ✓ | – | ✓ | – | ✓ | – | ✓ | – | ✓ | o | ✓ | o | o | o | o | o | o | – | – | – |
| LWRPM 9 | – | – | – | – | – | – | ✓ | – | – | – | ✓ | – | ✓ | – | ✓ | – | o | – | o | o | o | o |
| LWRPV 9 | – | – | – | – | – | – | ✓ | – | – | – | ✓ | – | ✓ | – | o | – | o | – | o | o | o | o |

✓ Preferred length
o Standard length available on request
– On request

For maximum rail length $L_{max}$, see product tables

### 9.1.2 End pieces

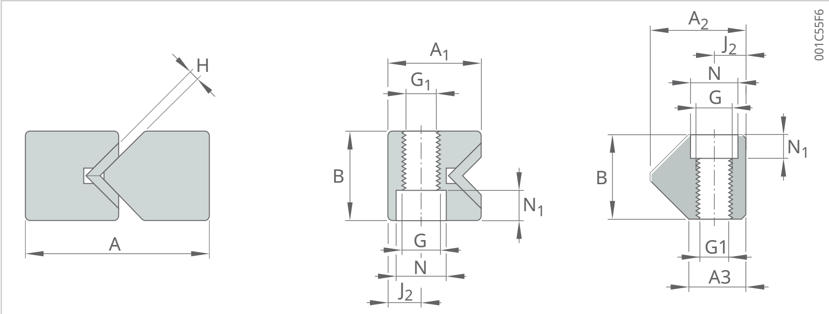
End pieces are not usually required for LWRPM and LWRPVrail guides. Therefore, no threaded holes are required on the end face of the rail. However, for production reasons, some LWRPV rails are supplied with threaded holes.

## 9.2 Product tables

### 9.2.1 Explanations

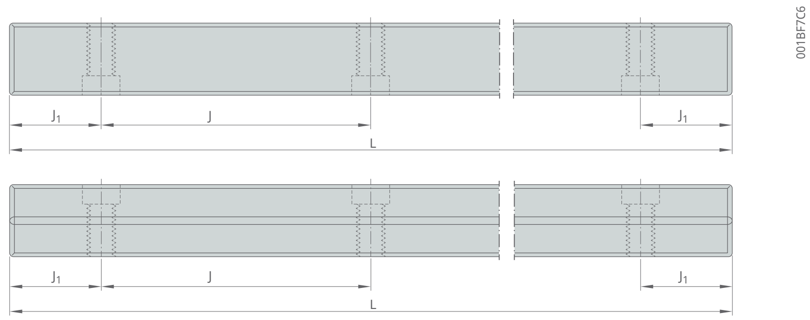
| | | |
|---|---|---|
| A | mm | Installation height |
| $A_1$ | mm | Rail height |
| $A_2$ | mm | Rail height |
| $A_3$ | mm | Height |
| B | mm | Width |
| C | N/100 mm | Load rating |
| G | - | Mounting hole thread |
| $G_1$ | mm | Mounting hole diameter |
| H | mm | Slide coating thickness |
| J | mm | Distance between mounting holes |
| $J_1$ | mm | Distance from end of rail to center of first mounting hole |
| $J_{1\ min}$ | mm | Minimum distance from end of rail to center of first mounting hole |
| $J_2$ | mm | Distance |
| L | mm | Rail length |
| $L_{max}$ | mm | Max. rail length |
| m | kg/m | Mass |
| N | mm | Countersink diameter |
| $N_1$ | mm | Countersink depth |

## 9.2.2 LWRPM and LWRPV




LWRPM and LWRPV

| Designation | m | A | B | $A_1$ | $A_2$ | $A_3$ | J | $J_1$ |
|---|---|---|---|---|---|---|---|---|
| – | kg/m | mm | mm | mm | mm | mm | mm | mm |
| **LWRPM 3** | 0.49 | 18.0 | 8.0 | 9.5 | – | – | 25 | 12.5 |
| **LWRPV 3** | 0.48 | 18.0 | 8.0 | – | 9.6 | 6.45 | 25 | 12.5 |
| **LWRPM 6** | 1.60 | 31.0 | 15.0 | 16.6 | – | – | 50 | 25.0 |
| **LWRPV 6** | 1.61 | 31.0 | 15.0 | – | 17.8 | 10.80 | 50 | 25.0 |
| **LWRPM 9** | 3.35 | 44.0 | 22.0 | 23.1 | – | – | 100 | 50.0 |
| **LWRPV 9** | 3.71 | 44.0 | 22 | – | 26.9 | 16.60 | 100 | 50.0 |




LWRPM (top), LWRPV (bottom)

| $J_{1\,min}$ | $J_2$ | G | $G_1$ | N | $N_1$ | H | C | $L_{max}$ |
|---|---|---|---|---|---|---|---|---|
| mm | mm | - | mm | mm | mm | mm | N/100 mm | mm |
| 12.5 | 3.5 | M4 | 3.3 | 6.0 | 3.2 | 0.7 | 300 | 400 |
| 12.5 | 3.5 | M4 | 3.3 | 6.0 | 3.2 | – | – | 400 |
| 20.0 | 6.0 | M6 | 5.2 | 9.5 | 5.2 | 1.7 | 700 | 1200 |
| 20.0 | 6.0 | M6 | 5.2 | 9.5 | 5.2 | – | – | 1200 |
| 20.0 | 9.0 | M8 | 6.8 | 10.5 | 6.2 | 1.7 | 1200 | 1700 |
| 20.0 | 9.0 | M8 | 6.8 | 10.5 | 6.2 | – | – | 1700 |

# 10 GCL and GCLA precision rail guide slides

## 10.1 Product design

GCL and GCLA slides are pre-assembled units with precision rails that have a steel or aluminum base. They are designed for applications requiring maximum accuracy and rigidity.

61 GCL and GCLA

001C44B9

Properties:

- Top and bottom plate of the GCLA slides made of aluminum
- Top and bottom plate of the GCL slides made of blackened steel (up to size 3) or cast steel (from size 6)
- Standardized mounting holes for convenient installation
- Ground mounting surfaces for high running accuracy
- Reference edge parallel to the slide axis (opposite the set screws for adjusting the preload)
- Available in 2 stroke lengths:
  - Order designation for S1 (standard stroke length): e.g. GCL 2060
  - Order designation for S2 (extended stroke): e.g. GCL 2060/L
- Stroke limitation via internal stop screws
- Very low friction of the rail guides
- Relubrication identical to precision rail guides

30 Product data

| | |
|---|---|
| Precision rail guides | LWRB 2 with LWJK 2, for GCL 2 and GCLA 2<br>LWR 3 with LWAK 3, for GCL 3 and GCLA 3<br>LWR 6 with LWAL 6, for GCL 6 and GCLA 6<br>LWR 9 with LWAL 9, for GCL 9 and GCLA 9<br>Optionally available with ACS or ACSM control gear |
| Operating temperature | –30 to +80 °C |
| Maximum running speed | 2 m/s |
| Maximum acceleration | 25 m/s² |
| Coefficient of friction | 0.003 to 0.005 (with normal, light lubrication) |
| Preload | Preloaded in factory with standard values |
| Accuracy class | P10 |
| Lubrication | Lightly greased during assembly |
| Optional | Customized solutions possible |

31 Accuracy

| **Slide** | **Stroke length** | **mm** | **25** | **50** | **100** | **200** | **300** |
|---|---|---|---|---|---|---|---|
| | | | **μm** | **μm** | **μm** | **μm** | **μm** |
| GCL | Straightness, height $T_z$ | | 2 | 2 | 3 | 3 | 4 |
| | Straightness, side $T_y$ | | 2 | 2 | 2 | 3 | 3 |
| GCLA | Straightness, height $T_z$ | | 4 | 4 | 6 | 7 | 8 |
| | Straightness, side $T_y$ | | 4 | 4 | 5 | 6 | 7 |

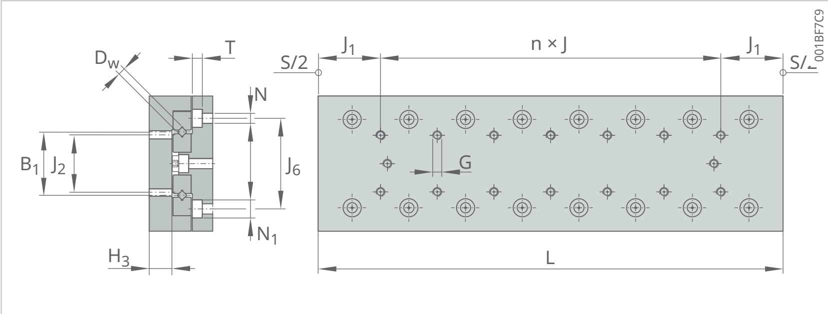


# 10.2 Product tables

## 10.2.1 Explanations

| | | |
|---|---|---|
| B | mm | Installation width |
| $B_1$ | mm | Average distance between the rolling element assemblies |
| $C_{0,\ eff\ slide}$ | N | Effective static load rating of the slide |
| $C_{eff\ slide}$ | N | Effective dynamic load rating of the slide |
| $D_w$ | mm | Rolling element diameter |
| G | – | Thread |
| H | mm | Installation height |
| $H_1$ | mm | Height |
| $H_2$ | mm | Height |
| $H_3$ | mm | Height |
| $J_1$ | mm | Distance |
| $J_2$ | mm | Distance |
| $J_6$ | mm | Distance |
| $J_7$ | mm | Distance |
| $J_8$ | mm | Distance |
| $J_9$ | mm | Distance |
| L | mm | Length |
| m | kg | Mass |
| N | mm | Bore diameter |
| n×J | mm | Number × thread distance |
| $N_1$ | mm | Countersink diameter |
| $S_1$ | mm | Stroke |
| $S_2$ | mm | Extended stroke |
| T | mm | Dimensions |

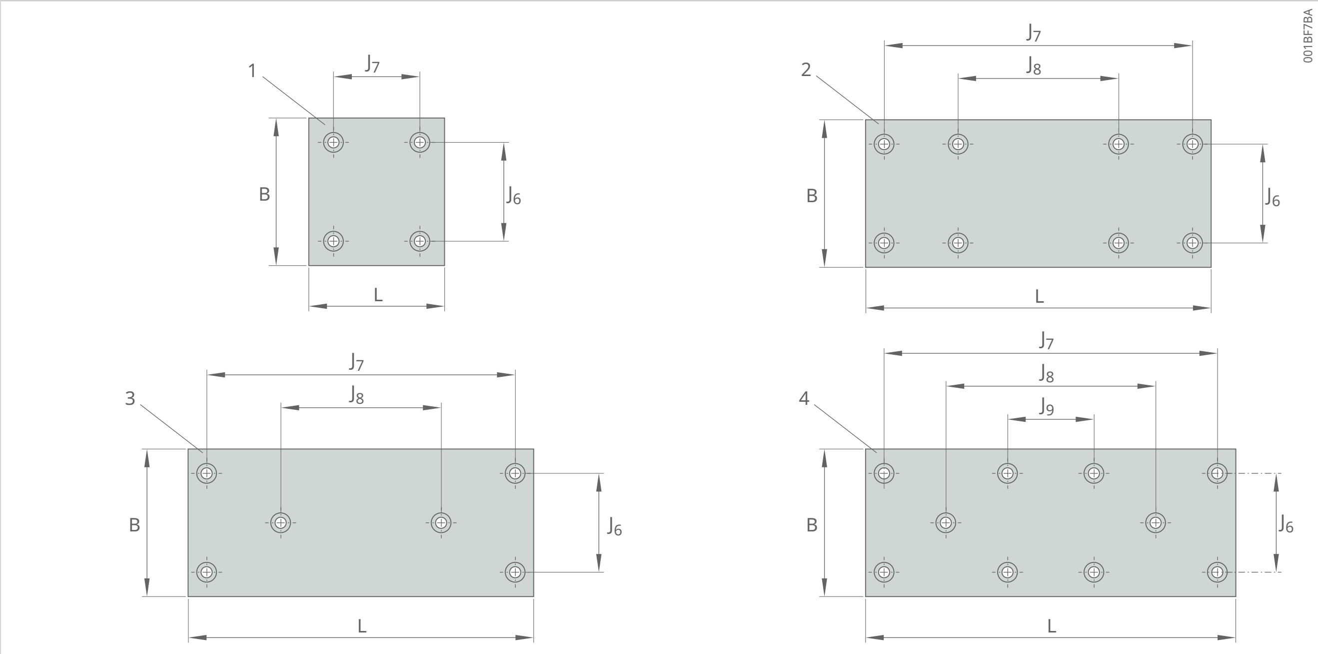
## 10.2.2 GCL




GCL

10

| Designation | m | B | H | L | $S_1$ | $S_2$ | $B_1$ | $D_w$ | G | $H_1$ | $H_2$ | $H_3$ | n×J |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | –0.2<br>–0.4 | ±0.1 | | | | | | | | | | |
| – | kg | mm | mm | mm | mm | mm | mm | mm | - | mm | mm | mm | mm |
| GCL 2030 | 0.18 | 40 | 21 | 35 | 18 | – | 18 | 2 | M3 | 6.5 | 14.0 | 7.5 | – |
| GCL 2045 | 0.26 | 40 | 21 | 50 | 30 | – | 18 | 2 | M3 | 6.5 | 14.0 | 7.5 | 1 × 15 |
| GCL 2060 | 0.34 | 40 | 21 | 65 | 40 | 46 | 18 | 2 | M3 | 6.5 | 14.0 | 7.5 | 2 × 15 |
| GCL 2075 | 0.42 | 40 | 21 | 80 | 50 | 60 | 18 | 2 | M3 | 6.5 | 14.0 | 7.5 | 3 × 15 |
| GCL 2090 | 0.50 | 40 | 21 | 95 | 60 | 75 | 18 | 2 | M3 | 6.5 | 14.0 | 7.5 | 4 × 15 |
| GCL 2105 | 0.58 | 40 | 21 | 110 | 70 | 90 | 18 | 2 | M3 | 6.5 | 14.0 | 7.5 | 5 × 15 |
| GCL 2120 | 0.68 | 40 | 21 | 125 | 80 | 105 | 18 | 2 | M3 | 6.5 | 14.0 | 7.5 | 6 × 15 |
| GCL 3050 | 0.57 | 60 | 28 | 55 | 30 | – | 28 | 3 | M4 | 9.0 | 18.5 | 10 | – |
| GCL 3075 | 0.80 | 60 | 28 | 80 | 45 | 55 | 28 | 3 | M4 | 9.0 | 18.5 | 10 | 1 × 25 |
| GCL 3100 | 1.00 | 60 | 28 | 105 | 60 | 80 | 28 | 3 | M4 | 9.0 | 18.5 | 10 | 2 × 25 |
| GCL 3125 | 1.30 | 60 | 28 | 130 | 75 | 105 | 28 | 3 | M4 | 9.0 | 18.5 | 10 | 3 × 25 |
| GCL 3150 | 1.50 | 60 | 28 | 155 | 90 | 130 | 28 | 3 | M4 | 9.0 | 18.5 | 10 | 4 × 25 |
| GCL 3175 | 1.70 | 60 | 28 | 180 | 105 | 155 | 28 | 3 | M4 | 9.0 | 18.5 | 10 | 5 × 25 |
| GCL 3200 | 2.00 | 60 | 28 | 205 | 130 | 180 | 28 | 3 | M4 | 9.0 | 18.5 | 10 | 6 × 25 |
| GCL 6100 | 3.10 | 100 | 45 | 110 | 60 | 70 | 45 | 6 | M6 | 13.0 | 31.0 | 15.5 | – |
| GCL 6150 | 4.50 | 100 | 45 | 160 | 95 | 120 | 45 | 6 | M6 | 13.0 | 31.0 | 15.5 | 1 × 50 |
| GCL 6200 | 5.90 | 100 | 45 | 210 | 130 | 170 | 45 | 6 | M6 | 13.0 | 31.0 | 15.5 | 2 × 50 |
| GCL 6250 | 7.20 | 100 | 45 | 260 | 165 | 220 | 45 | 6 | M6 | 13.0 | 31.0 | 15.5 | 3 × 50 |
| GCL 6300 | 8.60 | 100 | 45 | 310 | 200 | 270 | 45 | 6 | M6 | 13.0 | 31.0 | 15.5 | 4 × 50 |
| GCL 6400 | 11.40 | 100 | 45 | 410 | 280 | 370 | 45 | 6 | M6 | 13.0 | 31.0 | 15.5 | 6 × 50 |
| GCL 9200 | 11.80 | 145 | 60 | 210 | 130 | – | 72 | 9 | M8 | 16.0 | 43.0 | 20.5 | – |
| GCL 9300 | 17.30 | 145 | 60 | 310 | 180 | – | 72 | 9 | M8 | 16.0 | 43.0 | 20.5 | 1 × 100 |
| GCL 9400 | 22.80 | 145 | 60 | 410 | 350 | – | 72 | 9 | M8 | 16.0 | 43.0 | 20.5 | 2 × 100 |
| GCL 9500 | 28.30 | 145 | 60 | 510 | 450 | – | 72 | 9 | M8 | 16.0 | 43.0 | 20.5 | 3 × 100 |

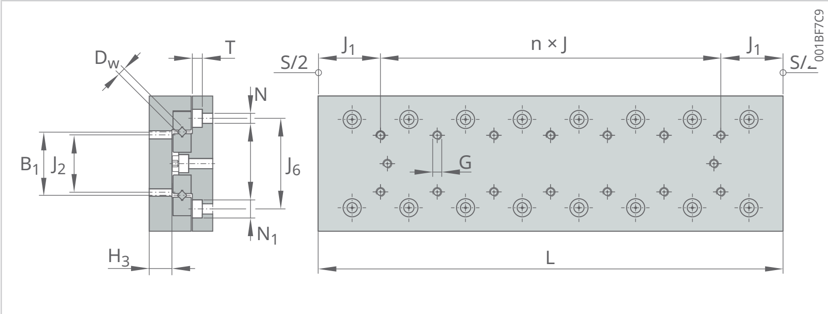



GCL hole patterns



| $J_1$ | $J_2$ | $J_6$ | $J_7$ | $J_8$ | $J_9$ | N | $N_1$ | T | $C_{eff\ slide}$ | | $C_{0\ eff\ slide}$ | | Position |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | For $S_1$ | For $S_2$ | For $S_1$ | For $S_2$ | |
| mm | mm | mm | mm | mm | mm | mm | mm | mm | N | N | N | N | – |
| 17.5 | 15 | 30 | 25 | – | – | 3.4 | 6.0 | 3.4 | 394 | – | 360 | – | 1 |
| 17.5 | 15 | 30 | 40 | – | – | 3.4 | 6.0 | 3.4 | 499 | – | 504 | – | 1 |
| 17.5 | 15 | 30 | 55 | – | – | 3.4 | 6.0 | 3.4 | 640 | 594 | 720 | 648 | 1 |
| 17.5 | 15 | 30 | 70 | 40 | – | 3.4 | 6.0 | 3.4 | 769 | 684 | 936 | 792 | 2 |
| 17.5 | 15 | 30 | 85 | 55 | – | 3.4 | 6.0 | 3.4 | 850 | 769 | 1080 | 936 | 2 |
| 17.5 | 15 | 30 | 100 | 70 | – | 3.4 | 6.0 | 3.4 | 966 | 850 | 1296 | 1080 | 2 |
| 17.5 | 15 | 30 | 115 | 85 | – | 3.4 | 6.0 | 3.4 | 1040 | 928 | 1440 | 1224 | 2 |
| 27.5 | 25 | 40 | 35 | – | – | 4.5 | 8.0 | 4.6 | 886 | – | 960 | – | 1 |
| 27.5 | 25 | 40 | 60 | – | – | 4.5 | 8.0 | 4.6 | 1320 | 1216 | 1600 | 1440 | 1 |
| 27.5 | 25 | 40 | 85 | – | – | 4.5 | 8.0 | 4.6 | 1620 | 1422 | 2080 | 1760 | 1 |
| 27.5 | 25 | 40 | 110 | – | – | 4.5 | 8.0 | 4.6 | 1997 | 1716 | 2720 | 2240 | 1 |
| 27.5 | 25 | 40 | 135 | 85 | – | 4.5 | 8.0 | 4.6 | 2267 | 1905 | 3200 | 2560 | 3 |
| 27.5 | 25 | 40 | 160 | 110 | – | 4.5 | 8.0 | 4.6 | 2613 | 2178 | 3840 | 3040 | 3 |
| 27.5 | 25 | 40 | 185 | 135 | 85 | 4.5 | 8.0 | 4.6 | 2781 | 2355 | 4160 | 3360 | 4 |
| 55.0 | 50 | 60 | 90 | – | – | 6.6 | 11.0 | 6.8 | 4429 | 3927 | 4760 | 4080 | 1 |
| 55.0 | 50 | 60 | 140 | – | – | 6.6 | 11.0 | 6.8 | 6301 | 5388 | 7480 | 6120 | 1 |
| 55.0 | 50 | 60 | 190 | 90 | – | 6.6 | 11.0 | 6.8 | 7606 | 6744 | 9520 | 8160 | 3 |
| 55.0 | 50 | 60 | 240 | 140 | – | 6.6 | 11.0 | 6.8 | 9253 | 8026 | 12240 | 10200 | 3 |
| 55.0 | 50 | 60 | 290 | 190 | – | 6.6 | 11.0 | 6.8 | 10435 | 9253 | 14280 | 12240 | 3 |
| 55.0 | 50 | 60 | 390 | 290 | – | 6.6 | 11.0 | 6.8 | 13060 | 11202 | 19040 | 15640 | 3 |
| 105.0 | 80 | 90 | 100 | – | – | 9.0 | 15.0 | 9.0 | 15659 | – | 16470 | – | 1 |
| 105.0 | 80 | 90 | 200 | – | – | 9.0 | 15.0 | 9.0 | 22102 | – | 25620 | – | 1 |
| 105.0 | 80 | 90 | 300 | 100 | – | 9.0 | 15.0 | 9.0 | 23324 | – | 27450 | – | 3 |
| 105.0 | 80 | 90 | 400 | 200 | – | 9.0 | 15.0 | 9.0 | 28046 | – | 34770 | – | 3 |

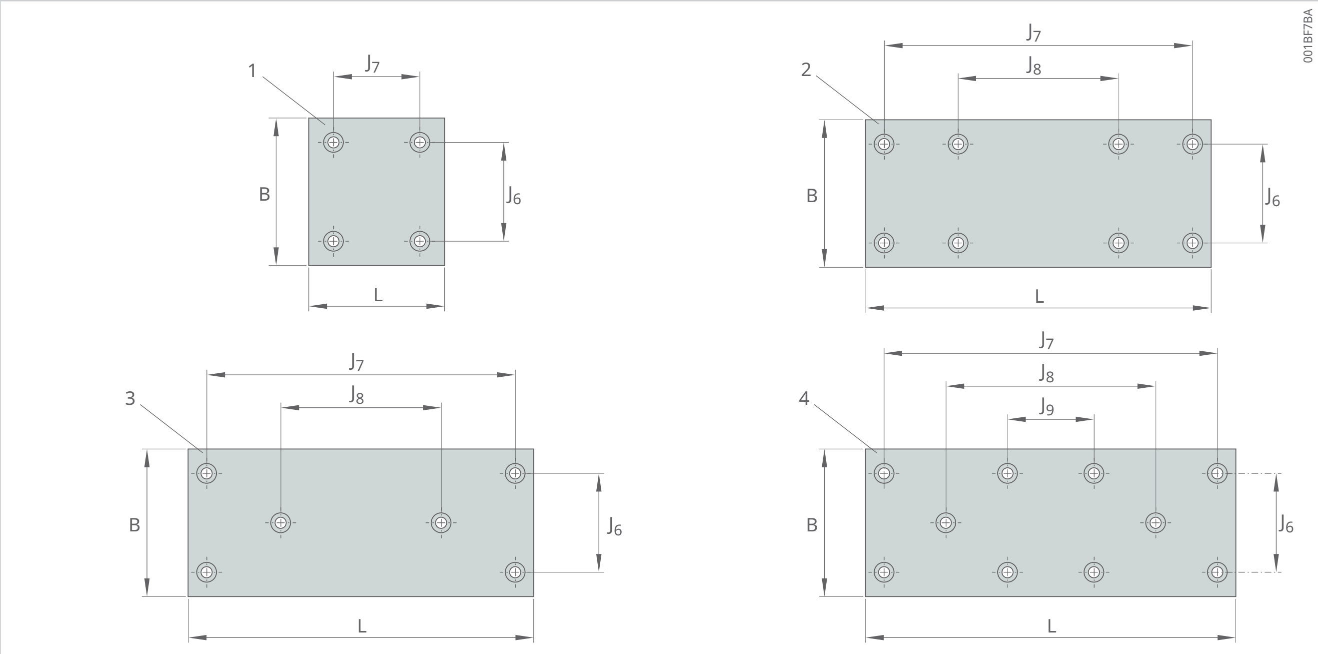
## 10.2.3 GCLA




GCLA

10

| Designation | m | B | H | L | $S_1$ | $S_2$ | $B_1$ | $D_W$ | G | $H_1$ | $H_2$ | $H_3$ | n×J |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | –0.2<br>–0.4 | ±0.1 | | | | | | | | | | |
| – | kg | mm | mm | mm | mm | mm | mm | mm | - | mm | mm | mm | mm |
| GCLA 2030 | 0.11 | 40 | 21 | 35 | 18 | – | 18 | 2 | M3 | 6.5 | 14.0 | 7.5 | – |
| GCLA 2045 | 0.15 | 40 | 21 | 50 | 30 | – | 18 | 2 | M3 | 6.5 | 14.0 | 7.5 | 1 × 15 |
| GCLA 2060 | 0.19 | 40 | 21 | 65 | 40 | 46 | 18 | 2 | M3 | 6.5 | 14.0 | 7.5 | 2 × 15 |
| GCLA 2075 | 0.23 | 40 | 21 | 80 | 50 | 60 | 18 | 2 | M3 | 6.5 | 14.0 | 7.5 | 3 × 15 |
| GCLA 2090 | 0.27 | 40 | 21 | 95 | 60 | 75 | 18 | 2 | M3 | 6.5 | 14.0 | 7.5 | 4 × 15 |
| GCLA 2105 | 0.31 | 40 | 21 | 110 | 70 | 90 | 18 | 2 | M3 | 6.5 | 14.0 | 7.5 | 5 × 15 |
| GCLA 2120 | 0.35 | 40 | 21 | 125 | 80 | 105 | 18 | 2 | M3 | 6.5 | 14.0 | 7.5 | 6 × 15 |
| GCLA 3050 | 0.29 | 60 | 25 | 55 | 30 | – | 28 | 3 | M4 | 8.0 | 16.5 | 8 | – |
| GCLA 3075 | 0.42 | 60 | 25 | 80 | 45 | 55 | 28 | 3 | M4 | 8.0 | 16.5 | 8 | 1 × 25 |
| GCLA 3100 | 0.55 | 60 | 25 | 105 | 60 | 80 | 28 | 3 | M4 | 8.0 | 16.5 | 8 | 2 × 25 |
| GCLA 3125 | 0.68 | 60 | 25 | 130 | 75 | 105 | 28 | 3 | M4 | 8.0 | 16.5 | 8 | 3 × 25 |
| GCLA 3150 | 0.81 | 60 | 25 | 155 | 90 | 130 | 28 | 3 | M4 | 8.0 | 16.5 | 8 | 4 × 25 |
| GCLA 3175 | 0.94 | 60 | 25 | 180 | 105 | 155 | 28 | 3 | M4 | 8.0 | 16.5 | 8 | 5 × 25 |
| GCLA 3200 | 1.10 | 60 | 25 | 205 | 130 | 180 | 28 | 3 | M4 | 8.0 | 16.5 | 8 | 6 × 25 |
| GCLA 6100 | 1.50 | 100 | 40 | 110 | 60 | 70 | 45 | 6 | M6 | 11.5 | 28.0 | 12.5 | – |
| GCLA 6150 | 2.30 | 100 | 40 | 160 | 95 | 120 | 45 | 6 | M6 | 11.5 | 28.0 | 12.5 | 1 × 50 |
| GCLA 6200 | 3.00 | 100 | 40 | 210 | 130 | 170 | 45 | 6 | M6 | 11.5 | 28.0 | 12.5 | 2 × 50 |
| GCLA 6250 | 3.80 | 100 | 40 | 260 | 165 | 220 | 45 | 6 | M6 | 11.5 | 28.0 | 12.5 | 3 × 50 |
| GCLA 6300 | 4.50 | 100 | 40 | 310 | 200 | 270 | 45 | 6 | M6 | 11.5 | 28.0 | 12.5 | 4 × 50 |
| GCLA 6400 | 6.00 | 100 | 40 | 410 | 280 | 370 | 45 | 6 | M6 | 11.5 | 28.0 | 12.5 | 6 × 50 |
| GCLA 9200 | 5.90 | 145 | 50 | 210 | 130 | – | 72 | 9 | M8 | 14.0 | 35.0 | 12.5 | – |
| GCLA 9300 | 8.70 | 145 | 50 | 310 | 180 | – | 72 | 9 | M8 | 14.0 | 35.0 | 12.5 | 1 × 100 |
| GCLA 9400 | 11.40 | 145 | 50 | 410 | 350 | – | 72 | 9 | M8 | 14.0 | 35.0 | 12.5 | 2 × 100 |
| GCLA 9500 | 14.20 | 145 | 50 | 510 | 450 | – | 72 | 9 | M8 | 14.0 | 35.0 | 12.5 | 3 × 100 |




GCLA hole patterns

| $J_1$ | $J_2$ | $J_6$ | $J_7$ | $J_8$ | $J_9$ | N | $N_1$ | T | $C_{eff\ slide}$ For $S_1$ | $C_{eff\ slide}$ For $S_2$ | $C_{0\ eff\ slide}$ For $S_1$ | $C_{0\ eff\ slide}$ For $S_2$ | Position |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | mm | mm | mm | mm | mm | mm | mm | mm | N | N | N | N | – |
| 17.5 | 15 | 30 | 25 | – | – | 3.4 | 6.0 | 3.4 | 394 | – | 360 | – | 1 |
| 17.5 | 15 | 30 | 40 | – | – | 3.4 | 6.0 | 3.4 | 499 | – | 504 | – | 1 |
| 17.5 | 15 | 30 | 55 | – | – | 3.4 | 6.0 | 3.4 | 640 | 594 | 720 | 648 | 1 |
| 17.5 | 15 | 30 | 70 | 40 | – | 3.4 | 6.0 | 3.4 | 769 | 684 | 936 | 792 | 2 |
| 17.5 | 15 | 30 | 85 | 55 | – | 3.4 | 6.0 | 3.4 | 850 | 769 | 1080 | 936 | 2 |
| 17.5 | 15 | 30 | 100 | 70 | – | 3.4 | 6.0 | 3.4 | 966 | 850 | 1296 | 1080 | 2 |
| 17.5 | 15 | 30 | 115 | 85 | – | 3.4 | 6.0 | 3.4 | 1040 | 928 | 1440 | 1224 | 2 |
| 27.5 | 25 | 40 | 35 | – | – | 4.5 | 8.0 | 4.6 | 886 | – | 960 | – | 1 |
| 27.5 | 25 | 40 | 60 | – | – | 4.5 | 8.0 | 4.6 | 1320 | 1216 | 1600 | 1440 | 1 |
| 27.5 | 25 | 40 | 85 | – | – | 4.5 | 8.0 | 4.6 | 1620 | 1422 | 2080 | 1760 | 1 |
| 27.5 | 25 | 40 | 110 | – | – | 4.5 | 8.0 | 4.6 | 1997 | 1716 | 2720 | 2240 | 1 |
| 27.5 | 25 | 40 | 135 | 85 | – | 4.5 | 8.0 | 4.6 | 2267 | 1905 | 3200 | 2560 | 3 |
| 27.5 | 25 | 40 | 160 | 110 | – | 4.5 | 8.0 | 4.6 | 2613 | 2178 | 3840 | 3040 | 3 |
| 27.5 | 25 | 40 | 185 | 135 | 85 | 4.5 | 8.0 | 4.6 | 2781 | 2355 | 4160 | 3360 | 4 |
| 55.0 | 50 | 60 | 90 | – | – | 6.6 | 11.0 | 6.8 | 4429 | 3927 | 4760 | 4080 | 1 |
| 55.0 | 50 | 60 | 140 | – | – | 6.6 | 11.0 | 6.8 | 6301 | 5388 | 7480 | 6120 | 1 |
| 55.0 | 50 | 60 | 190 | 90 | – | 6.6 | 11.0 | 6.8 | 7606 | 6744 | 9520 | 8160 | 3 |
| 55.0 | 50 | 60 | 240 | 140 | – | 6.6 | 11.0 | 6.8 | 9253 | 8026 | 12240 | 10200 | 3 |
| 55.0 | 50 | 60 | 290 | 190 | – | 6.6 | 11.0 | 6.8 | 10435 | 9253 | 14280 | 12240 | 3 |
| 55.0 | 50 | 60 | 390 | 290 | – | 6.6 | 11.0 | 6.8 | 13060 | 11202 | 19040 | 15640 | 3 |
| 105.0 | 80 | 90 | 100 | – | – | 9.0 | 15.0 | 9.0 | 15659 | – | 16470 | – | 1 |
| 105.0 | 80 | 90 | 200 | – | – | 9.0 | 15.0 | 9.0 | 22102 | – | 25620 | – | 1 |
| 105.0 | 80 | 90 | 300 | 100 | – | 9.0 | 15.0 | 9.0 | 23324 | – | 27450 | – | 3 |
| 105.0 | 80 | 90 | 400 | 200 | – | 9.0 | 15.0 | 9.0 | 28046 | – | 34770 | – | 3 |

# 11 Structure of the ordering key

## 62 Ordering key for precision rail guides

LW RE 9 0300 ACS 50 / P5 / - / - / - / - / J1 = 25

**Type**

RB, R, RE, RM, RV, M, V, RPM, RPV

**Size**

e.g. 6, 9, 6035
Dependent on rail type

**Length in mm**

| | |
|---|---|
| 3-digit | For sizes 1, 2, 3, 4, 6, 2211, 3015 |
| 4-digit | For sizes 9, 4020 ... 8050 |

**Anti-creep system**

| | |
|---|---|
| – | Without ACS |
| **ACS** | For LWRE |
| **ACSM** | For LWRB and LWRE |
| **ACSZ** | For LWM and LWV |

**Stroke length, anti-creep system**

| | |
|---|---|
| – | Standard |
| **Value** | In mm (ACS, ACSZ only), always symmetric |

**Accuracy class**

| | |
|---|---|
| – | Standard (P10) |
| **P5** | |
| **P2** | |

**Run-in radius**

| | |
|---|---|
| – | Without run-in radius |
| **EG** | Run-in radius at both rail ends |

**Material / coating**

| | |
|---|---|
| – | Standard |
| **HV** | Rails made of corrosion-resistant steel |
| **HD** | Thin-layer chromium plating |

**End-face holes**

| | |
|---|---|
| – | Standard, as specified in the product tables |
| **E1** | Without end-face holes (standard for ACSM, LWRPM, and LWRPV) |
| **E7** | With end-face holes (for ACSM, LWRPM, and LWRPV) |

**Options for mounting holes (on request)**

| | |
|---|---|
| – | Standard, as specified in the product tables |
| **03** | Threaded hole, |
| **10** | Through hole, |
| **13** | Threaded inserts integrated into the rail (for LWM and LWV only) |
| **15** | Countersunk through hole (standard for LWM and LWV, no code required) |

**Dimension J1 in mm**

| | |
|---|---|
| - | J1 symmetric at both rail ends |
| **Value** | Asymmetric value J1 in mm |

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63 Ordering key for rolling element assemblies

LW AKE 9 x 13 ACS / -

**Type**

| | |
|---|---|
| **JK** | For LWRB |
| **AL, AK** | For LWR |
| **AKE** | For LWRE |
| **HV, HW** | For LWRM, LWRV, LWM, LWV |

**Size**

| | |
|---|---|
| **1, 2** | For LWJK |
| **3** | For LWAK |
| **6, 9, 12** | For LWAL |
| **3, 4, 6, 9** | For LWAKE |
| **10, 15** | For LWHV |
| **10, 15, 20, 25, 30** | For LWHW |

**Length**

| | |
|---|---|
| **13** | Number of rolling elements for ball cages and crossed roller cages<br>Length in mm for needle roller cages |

**Anti-creep system**

| | |
|---|---|
| **–** | Without ACS |
| **ACS** | For LWAKE |
| **ACSM** | For LWJK and LWAKE |
| **ACSZ** | For LWHW |

**Accuracy class**

| | |
|---|---|
| **–** | Standard, as specified in the product tables |
| **G1** | For needle roller cages only |

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## 64 Ordering key for end pieces

**LW ERE 9 / -**

**Type**

| | |
|---|---|
| **ERA** | For LWR, LWRB |
| **ERB** | For LWR, LWRB |
| **ERC** | With wipers for LWR |
| **ERE** | For LWRE |
| **EREC** | With wipers for LWRE |
| **EREM** | For LWRM |
| **ERV** | For LWRV |
| **EARM** | With wipers for LWRM |
| **EARV** | With wipers for LWRV |
| **EM** | For LWM |
| **EV** | For LWV |
| **EAM** | With wipers for LWM |
| **EAV** | With wipers for LWV |

**Size**

| | |
|---|---|
| **1 ... 8050** | Same size as for the guide rail |

**Coating**

| | |
|---|---|
| **–** | Standard, as specified in the product tables |
| **HV** | Chromium-plated end pieces and screws |

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65 Ordering key for precision rail guides in kit packaging

**LW RE 3 300 / 100 EG ACS - KIT / z10**

| | |
|---|---|
| **Type** | |
| **R** | |
| **RE** | |
| **Size** | |
| **3, 6** | For R |
| **3, 4, 6** | For RE |
| **Rail length in mm** | |
| **300** | According to product tables |
| **Length of short rail in mm** | |
| **–** | Standard, 4 rails of equal length |
| **EG** | 2 short rails with specified length and run-in radius, and 2 standard rails |
| **E7** | 2 short rails with specified length and end-face holes, and 2 standard rails |
| **Anti-creep system** | |
| **–** | Without ACS |
| **ACS** | For LWRE 3, 4, 6 |
| **ACSM** | For LWRE 3, 6 |
| **Number of rolling elements z** | |
| **–** | Standard, as specified in the product tables |
| **Value** | Specific number of rolling elements |

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