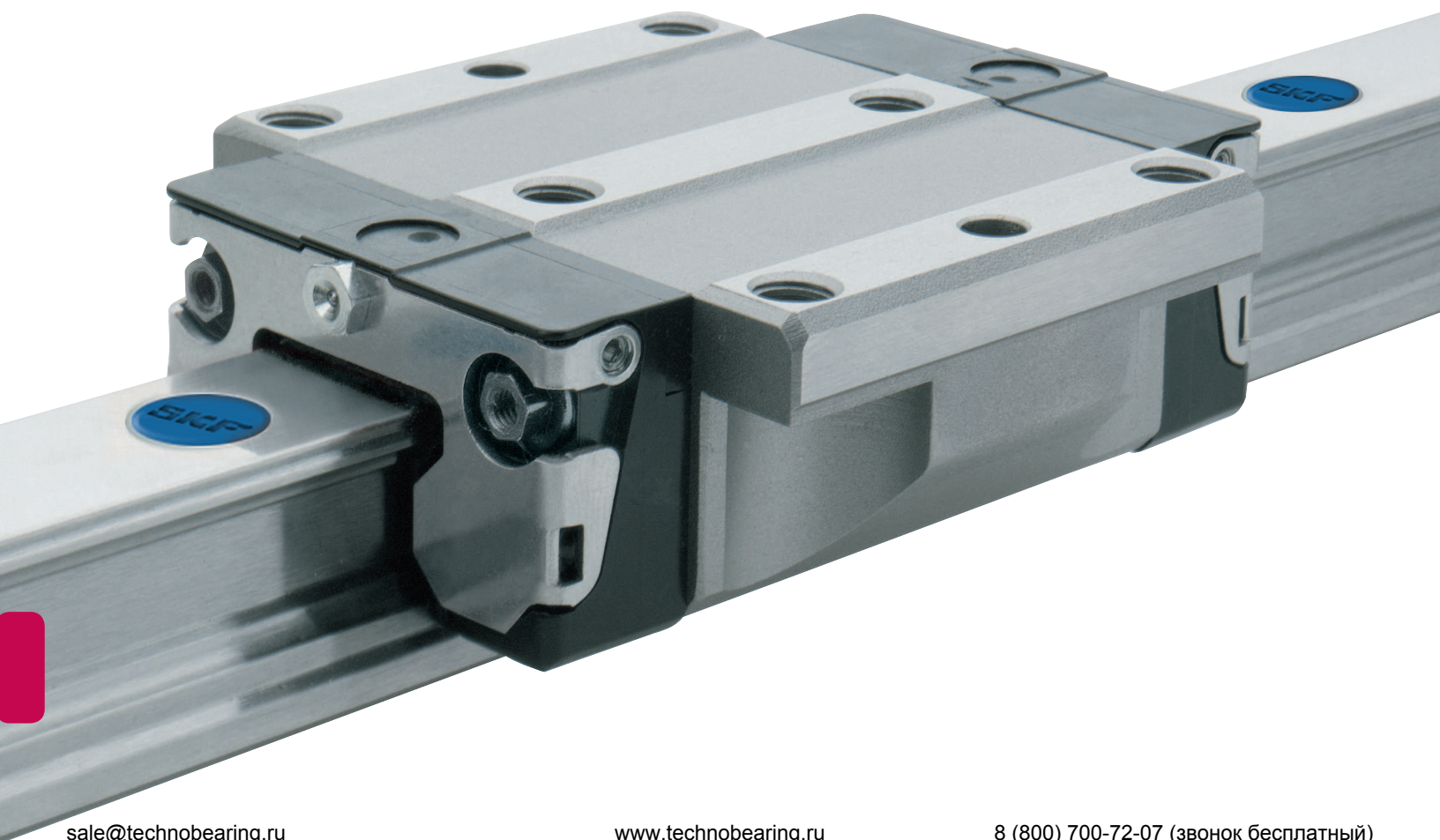


Profile rail guides

LLR





The SKF® brand now stands for more than ever before, and means more to you as a valued customer.

While SKF maintains its leadership as the hallmark of quality bearings throughout the world, new dimensions in technical advances, product support and services have evolved SKF into a truly solutions-oriented supplier, creating greater value for customers.

These solutions encompass ways to bring greater productivity to customers, not only with breakthrough application-specific products, but also through leading-edge design simulation tools and consultancy services, plant asset efficiency maintenance programmes, and the industry's most advanced supply management techniques.

The SKF brand still stands for the very best in rolling bearings, but it now stands for much more.

SKF – the knowledge engineering company

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General

Introduction

As the world's leading manufacturer of rolling bearings, SKF supplies practically every type of rolling bearing for rotary and linear movements. The standard profile rail guides produced by SKF are brought together in this catalogue. SKF profile rail guides are accuracy rolling bearings for linear movements and are therefore suitable for use in most types of machinery. With these profile rail guides it is possible for SKF to offer a guide system which achieves a good price/performance ratio.

Profile rail guides from SKF are available in many designs and sizes, and thanks to their unlimited stroke they can be adapted to any linear movement. They consist of a rail guide with ground raceways on which one or several guide carriages can

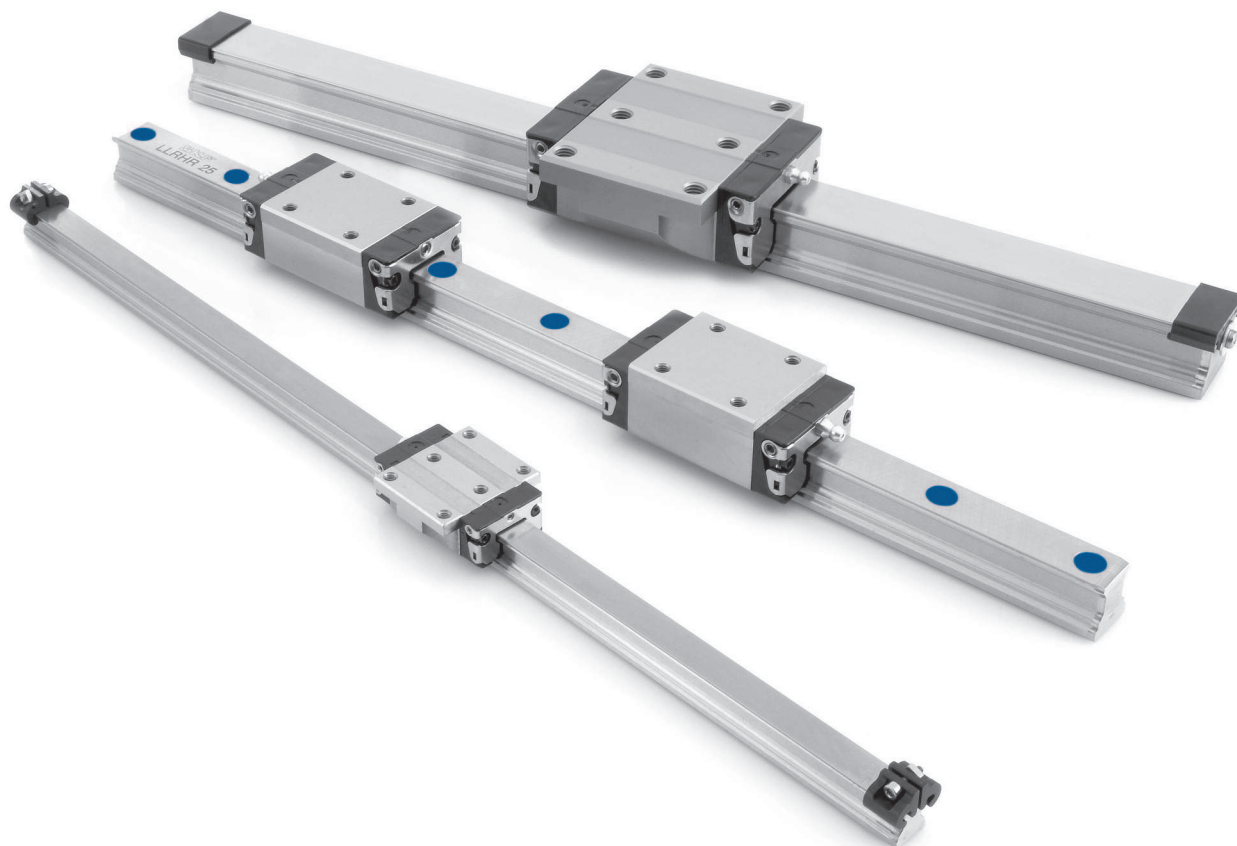
be moved with an unlimited stroke. The guide carriages are made of tempered bearing steel into which the hardened raceways of the ball circuits are inserted. Fixing holes in the attachment surfaces enable machine parts to be directly mounted onto the carriages. Fundamentally, profile rail guides constitute a coupled angular ball bearing in back-to-back arrangement and, depending on the application, are available in different preload classes. The raceways of the profile rail and of the carriage are arranged at an angle of 45° . As a result, the system has the same load capacity in the four main load directions as well as a high moment load capacity.

Depending on the load conditions and the required service life, a

selection can also be made between two design versions. In addition to the standard carriage length, a series with extended carriages is available which exhibits higher load rating. To meet the requirements of operating practice, a range of different guide systems is offered. Their main features are load capacity, screw connections to provide the fastening points on the carriage and the sectional height.

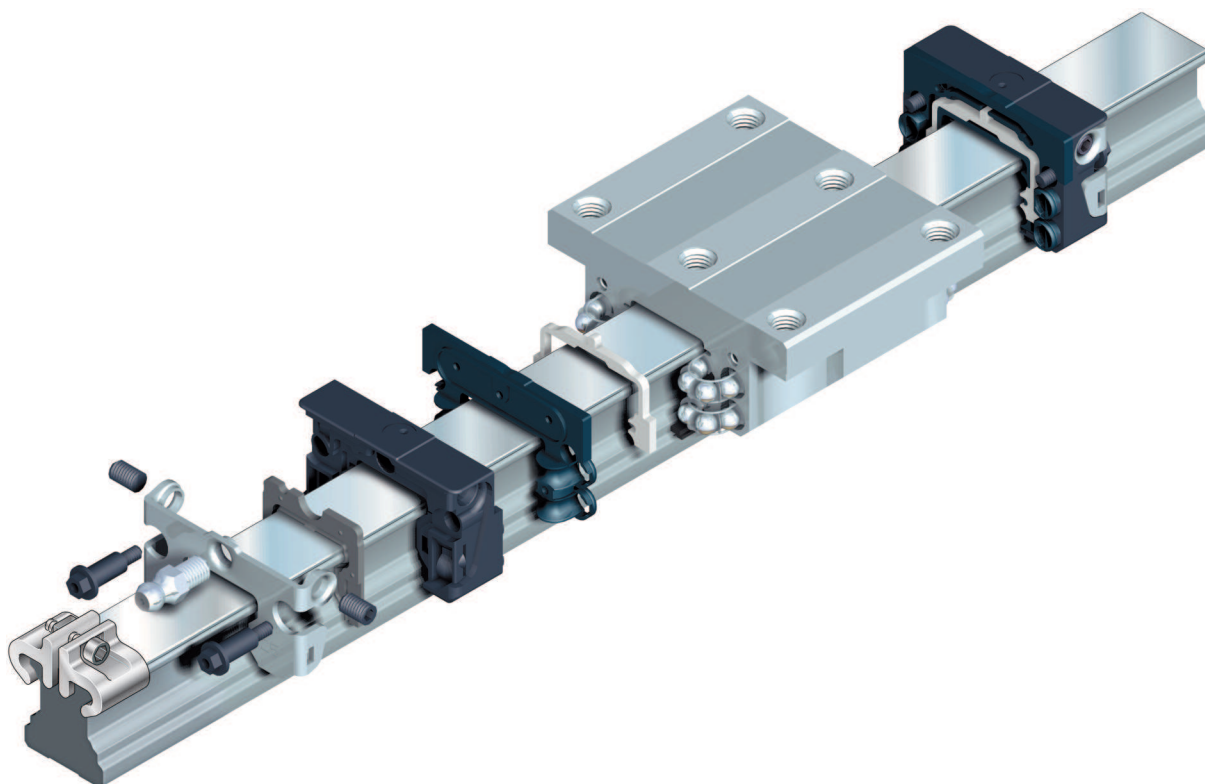
Thanks to the modular design of the systems, subsequent changes are not a problem. This catalogue brings together all the data which we feel is relevant.

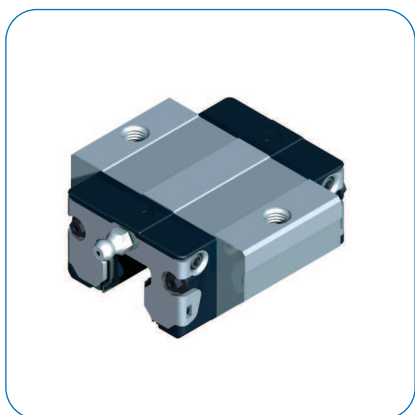
If you require additional information please get in touch with one of our sales companies.



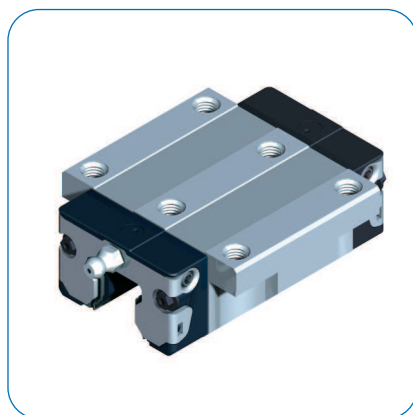
Product overview

- Carriages with and without ball chain
- High load capacities in all main directions and high moment load capacities
- High dynamic performances:
 $v = 5 \text{ m/s}$; $a_{\text{max}} = 500 \text{ m/s}^2$
- Low noise and smooth, light running due to optimised ball recirculation and ideal ball chain geometry
- Long term lubrication system
- Lube ports with metal threads on all sides.
- Full interchangeability due to standardised rail, with or without rail seal cover strip, for all carriage versions
- Various accuracy and preload classes
- Carriages can be screwed from above or below, depending on type.
- Improved stiffness under lift off and side loading conditions when additional mounting screws are used for the holes in the centre of the carriage
- Integrated all-round sealing through front and longitudinal seals
- Wide range of accessories
- Both grease and oil lubrication possible despite initial grease application
- Wide range of accessories
- Worldwide SKF service network
- Both sides of the guide rail can be used as reference edges

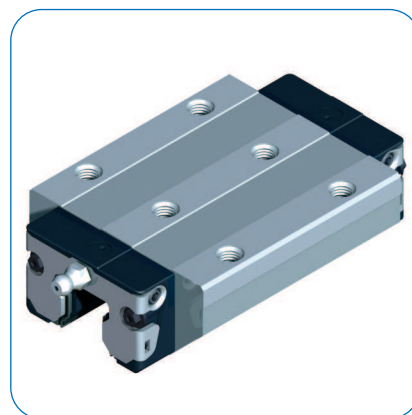




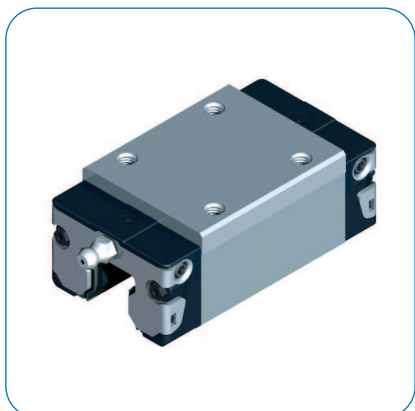
LLRHC xx SA
Flange short. Standard height.



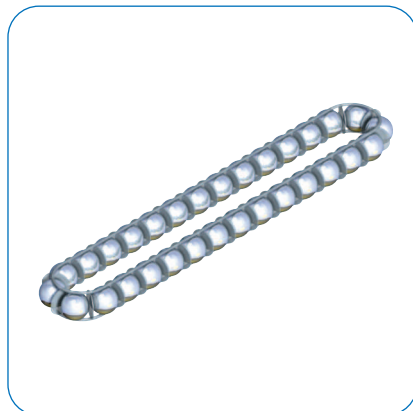
LLRHC xx A
Flange normal. Standard height.



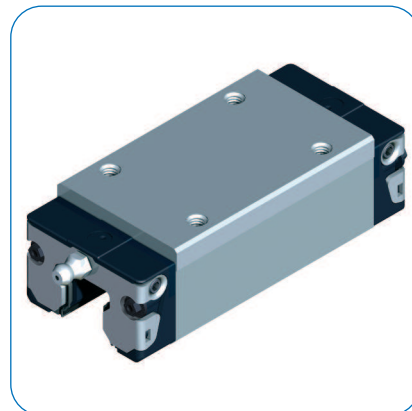
LLRHC xx LA
Flange long. Standard height.



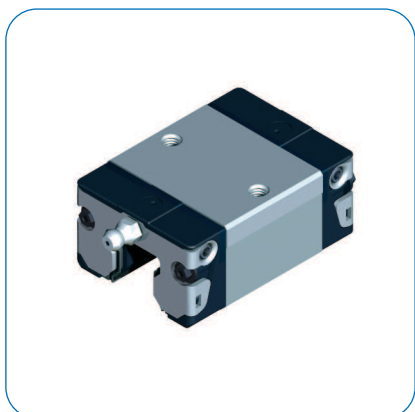
LLRHC xx R
Slim line normal. High.



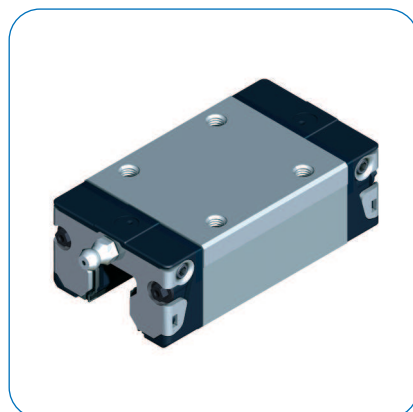
Ball chain
Optimises noise level and running behaviour



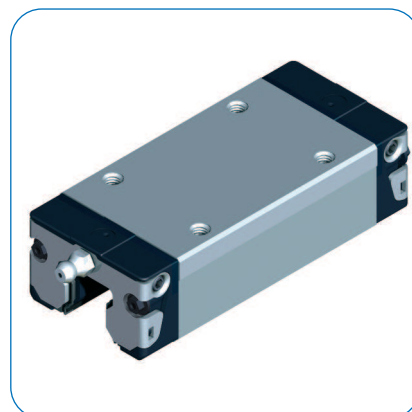
LLRHC xx LR
Slim line long. High.



LLRHC xx SU
Slim line short. Standard height.



LLRHC xx U
Slim line normal. Standard height.



LLRHC xx LU
Slim line long. Standard height.

Technical data

General information

The general technical data applies to all rail guides (all carriages and rails).

Special technical data is listed separately for the individual designs.

Preload classes

In view of the different user requirements, the ball rail guides can be supplied in four different preload classes.

So as not to reduce the service life, the preload should not amount to more than 1/3 of the bearing load F.

In general, the stiffness of the carriage increases according to the preload increase.

Guide systems with parallel rails

- In connection with the selected preload class the permissible deviation in parallelism of the rails must also be taken into account (see tables for the various designs).
- For the installation of rail guides in the accuracy class P5 we recommend the version with clearance T0 or the preload class T1 in order to avoid stresses owing to the tolerances.

Speed

v_{\max} : 5 m/s

Acceleration

a_{\max} : 500 m/s²

Only in the case of preloaded systems.

In the case of non-preloaded systems: $a_{\max} = 50 \text{ m/s}^2$

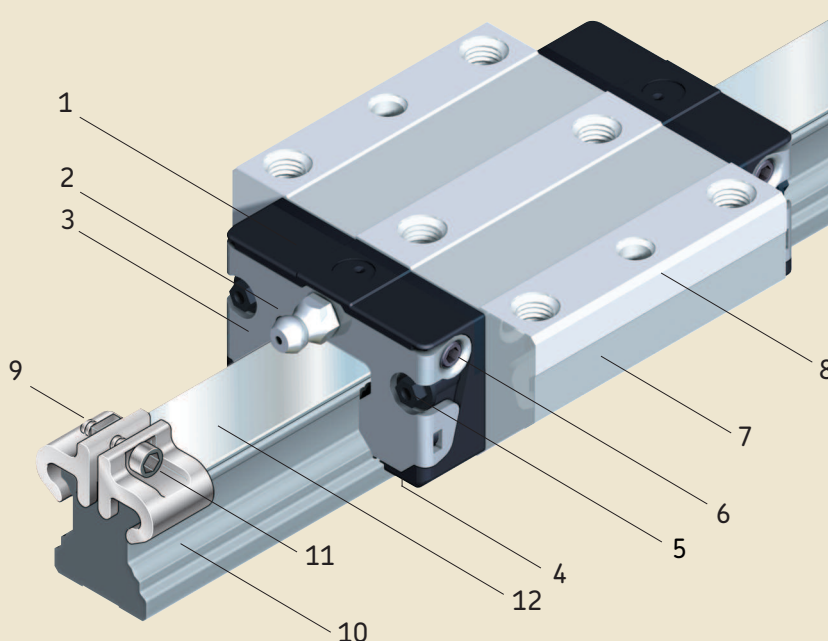
Temperature resistance

t_{\max} : 100 °C

This is a maximum value which is only permissible for a short time. In continuous operation a maximum temperature of 80 °C must not be exceeded.

Material specifications

- | | | | |
|---|-------------------------------------|----|--|
| 1 | Recirculation parts: POM (PA6.6) | 6 | Thread pins: 1.4301 |
| 2 | Lubrication nipple: carbon steel | 7 | Balls: bearing steel |
| 3 | Metal front plates: 1.4301 | 8 | Housing: tempered steel |
| 4 | Seals: TEE-E | 9 | Cover strip retaining clamps: aluminium |
| 5 | Flange screws: carbon steel | 10 | Clamping screw and nut: 1.4301 |
| | | 11 | Rail: tempered steel |
| | | 12 | Cover strip: 1.4301 |

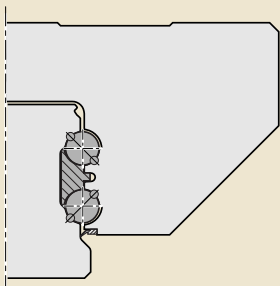


Friction

The friction coefficient μ of the ball rail guide is approx. 0,002 to 0,003 (not including the friction of the seal).

As a result of the design with 4 ball rows a 2-point contact exists for all load directions. This reduces friction to a minimum (Fig. 1).

Fig. 1



Seals

Seals should prevent the penetration of dirt and chips into the interior of the carriage in order to avoid premature failure.

Universal seal

Universal seals are installed as standard in SKF carriages.

They have a constant sealing effect on rails with and without cover strip.

In addition to efficient sealing, the design also provides for low friction.

For applications where low friction is required light-contact seals are available on request.

Front seal

Front seals can be ordered as accessories and are attached by the customer.

They are suitable for use in environments with fine dust or metal particles, as well as coolants or cutting fluids.

Note!

For extreme duty in environments with coarse dirt or metal particles, or where there is massive use of coolants or cutting fluids, Viton seals are available on request.

Viton seals have to be attached by the customer.

Scraper plates

Scraper plates can be ordered as accessories (have to be attached by the customer).

They are suitable for use in most environments where coarse dirt or chips are encountered.

Load rating

Definition of the basic dynamic load rating C

The radial load, constant in magnitude and direction, which a linear rolling bearing can in theory accommodate for a basic rating life represented by a travelled distance of 10^5 m (to DIN 636 Part 1).

The basic dynamic load ratings in the tables are generally 30 % higher than the values to DIN. They have been verified in tests.

Definition of the basic static load rating C₀

The static load in the direction of loading which corresponds to a calculated load in the centre of the most highly loaded contact point between the rolling element and both raceways (rail) at an osculation of $\leq 0,52, 4\ 200$ MPa.

Note:

At this load on the contact point a permanent total deformation of the rolling element and raceway occurs which corresponds to about 0,0001 times the rolling element diameter (to DIN 636 Part 2).

Definition and calculation of the basic rating life

The calculated life achievable with 90 % reliability for a single rolling bearing or a group of evidently identical rolling bearings running under identical conditions given the material generally used today of normal manufacturer's quality and usual operating conditions (to DIN 636 Part 1).

Basic rating life at constant speed

The basic rating life L or L_h can be calculated applying the formula (1), (2) or (3):

$$(1) L_{10} = \left(\frac{C}{P}\right)^3 10^5$$

$$(2) L_{10h} = \frac{L_{10}}{2 \times s \times n \times 60}$$

Basic rating life at changing speed

$$(3) L_{10h} = \frac{L_{10}}{60 \times v_m}$$

$$(4) v_m = \frac{t_1 \times v_1 + t_2 \times v_2 + \dots + t_n \times v_n}{100}$$

L_{10} = basic rating life (m)

L_{10h} = basic rating life (h)

C = basic dynamic load rating (N)

P = equivalent load (N)

s = stroke length (m)

n = stroke frequency (double strokes/min)

v_m = mean speed (m/min)

v_1, v_2, \dots, v_n = travel speeds (m/min)

t_1, t_2, \dots, t_n = time proportions for v_1, v_2, \dots, v_n (%)

The formulae for calculating the service life of profile rail guides apply to a stroke length of $S \geq 2$ times the carriage length. At lower values the load rating is reduced. Please consult SKF.

Dynamic equivalent bearing load for calculation of the service life

For a fluctuating bearing load the dynamic equivalent loading F is calculated according to formula (5):

$$(5) F_m = \sqrt[3]{\frac{F_1^3 \times s_1 + F_2^3 \times s_2 + \dots + F_n^3 \times s_n}{s}}$$

F_m = constant mean load (N)

F_1, F_2, \dots, F_n = constant loads during stroke lengths s_1, s_2, \dots, s_n (N)

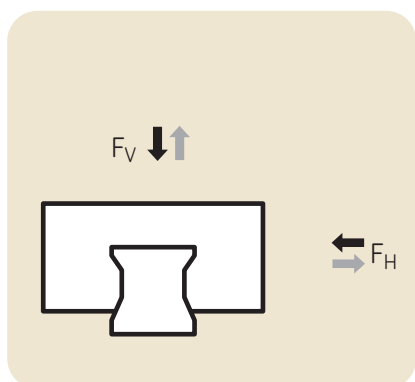
s = total stroke length ($s = s_1 + s_2 + \dots + s_n$), during which loads F_1, F_2, \dots, F_n have an effect (mm)

- given a combined bearing load

Note on dynamic load capacities and moments

Determination of dynamic load capacities and moments is based on a travel life of 100 000 m. However, frequently this is determined on the basis of only 50 000 m. In this case for comparison: multiply values C , M_c and M_A by 1.26 in accordance with SKF tables.

For carriages with ball chain the permissible moments are reduced in accordance with the load ratings.



Dynamic equivalent bearing load

For a combined external load – vertical and horizontal – the dynamic equivalent load F is calculated by means of formula (6):

$$(6) F = |F_V| + |F_H|$$

dynamic equivalent load (N)

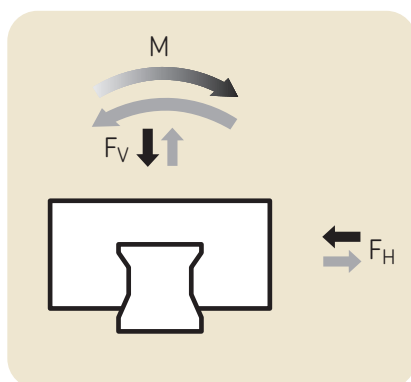
F_V = dynamic external load, vertical (N)

F_H = dynamic external load, horizontal (N)

Note: The design of the ball rail guide permits this simplified calculation.

Note:

If different load stages exist for F_V and F_H , F_V and F_H must be calculated individually using formula (5). An external load applied at any angle to the carriage must be divided into the proportions F_V and F_H . The amounts are then used in formula (6)



Dynamic equivalent bearing load

For a combined external load – vertical and horizontal – in combination with a torsional moment the dynamic equivalent load F can be calculated using formula (7):

$$(7) F = |F_V| + |F_H| + C \times \frac{|M|}{M_t}$$

F = dynamic equivalent load (N)

F_V, F_H = dynamic external loads (N)

M = dynamic torsional moment (Nm)

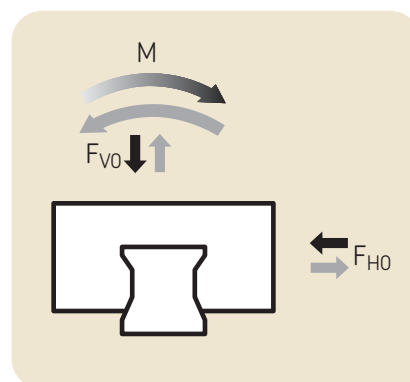
C = basic dynamic load rating (N)

M_t = dynamic permissible moment (Nm)

Formula (7) only applies if a single rail is used.

Note:

If different load stages exist for F_V and F_H , F_V and F_H must be calculated individually using formula (5). An external load applied at any angle to the carriage must be divided into the proportions F_V and F_H . The amounts are then used in formula (7).



Static equivalent bearing load

For a combined external static load – vertical and horizontal – in connection with a static torsional moment the static equivalent load F_0 can be calculated using formula (8).

The static equivalent load F_0 must not exceed the static load rating C_0 .

Formula (8) only applies if a single rail is used.

$$(8) F_0 = |F_{V0}| + |F_{H0}| + C_0 \times \frac{|M_0|}{M_{t0}}$$

F_0 = static equivalent load (N)

F_{V0}, F_{H0} = static external loads (N)

M_0 = static torsional moment (Nm)

C_0 = basic static load rating (N)

M_{t0} = static permissible moment (Nm)

Note:

An external load applied at any angle to the carriage must be divided into the proportions F_{V0} and F_{H0} . The amounts are then used in formula (8).

Accuracy

Accuracy classes

Accuracy classes and their tolerances

SKF profile rail guides are available in five accuracy classes. As shown in the adjacent illustration, the tolerances are defined for each accuracy class. The stated accuracy classes are available for almost all types of profile rail guides. For the designs which can be supplied please refer to the respective table on page 11.

Dimensional tolerance in height "H"

The dimensional tolerance in height "H" is the maximum deviation of the height "H" for the carriages on a profile rail (Fig. 2).

Dimensional tolerance in width "N"

The dimensional tolerance in width "N" is the maximum deviation of the "N" dimension for the carriages on a profile rail (Fig. 2).

- The "N" dimension designates the distance of the mounting surface of the profile rail from the ground side surface of the carriage.
- The accuracies stated are mean values and relate to the centre of the carriage.
- The tolerances should be checked again after the profile rail guide has been mounted on the machine bed.

Problem-free interchangeability through precision manufacture

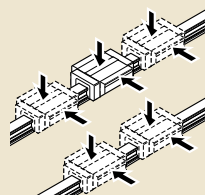
The rail and carriage are produced so precisely by SKF, especially in the ball raceway area, that each individual element can be exchanged at any time.

For example, a carriage can be used without any problems on different rails of the same size.

Conversely, various carriages can be used on one rail.

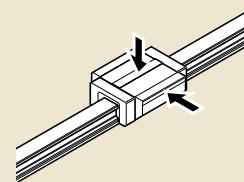
Fig. 1

| Accuracy class | Tolerance | | Max. differences in dimension H and N on one rail | |
|----------------|-----------|--------|---|----------|
| | H (µm) | N (µm) | Δ H (µm) | Δ N (µm) |
| P5 | ± 100 | ± 40 | 30 | 30 |
| P3 | ±40 | ±20 | 15 | 15 |
| P1 | ±20 | ±10 | 7 | 7 |
| P01 | ±10 | ±7 | 5 | 5 |
| P001 | ±5 | ±5 | 3 | 3 |



Measured in the centre of the carriage:

For any combination of carriages and rails over the entire rail length



For different carriages at the same rail position

* Tolerances for the combination of different accuracy classes in respect of carriage and rail can be referred to on page 11.

Fig. 2

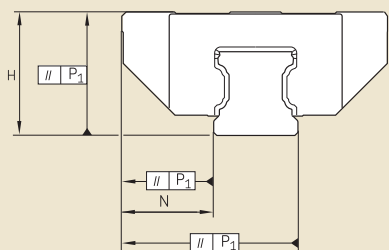
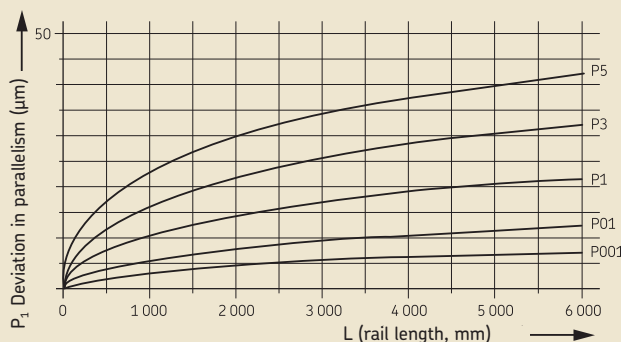


Fig. 3



Selection criteria for combination of accuracy classes

| Carriages | Rails | P5 μm | P3 μm | P1 μm | P01 μm | P001 μm |
|-----------|--|----------|----------|----------|-----------|------------|
| P5 | Tolerance dimension H (μm) | ± 100 | ± 48 | ± 32 | ± 23 | ± 19 |
| | Tolerance dimension N (μm) | ± 40 | ± 28 | ± 22 | ± 20 | ± 19 |
| | Max. difference of dimensions H and N on a rail (μm) | 30 | 30 | 30 | 30 | 30 |
| P3 | Tolerance dimension H (μm) | ± 88 | ± 40 | ± 23 | ± 23 | ± 19 |
| | Tolerance dimension N (μm) | ± 33 | ± 20 | ± 14 | ± 20 | ± 19 |
| | Max. difference of dimensions H and N on a rail (μm) | 15 | 15 | 15 | 15 | 15 |
| P1 | Tolerance dimension H (μm) | ± 84 | ± 34 | ± 21 | ± 11 | ± 7 |
| | Tolerance dimension N (μm) | ± 28 | ± 16 | ± 10 | ± 8 | ± 7 |
| | Max. difference of dimensions H and N on a rail (μm) | 7 | 7 | 7 | 7 | 7 |
| P01 | Tolerance dimension H (μm) | ± 83 | ± 33 | ± 19 | ± 10 | ± 6 |
| | Tolerance dimension N (μm) | ± 27 | ± 15 | ± 9 | ± 7 | ± 6 |
| | Max. difference of dimensions H and N on a rail (μm) | 5 | 5 | 5 | 5 | 5 |
| P001 | Tolerance dimension H (μm) | ± 82 | ± 32 | ± 18 | ± 9 | ± 5 |
| | Tolerance dimension N (μm) | ± 26 | ± 14 | ± 8 | ± 6 | ± 5 |
| | Max. difference of dimensions H and N on a rail (μm) | 3 | 3 | 3 | 3 | 3 |

Recommendations for the combination of accuracy classes

Recommended for short strokes and small distances between the carriages:

Carriage in higher accuracy class than guide rail.

Recommended for long strokes and larger distances between the carriages:

Guide rail in higher accuracy class than carriage.

Running accuracy as selection criterion

By means of perfected ball entry and exit zones in the carriages of accuracy classes P1 and P001, a hitherto unattained running accuracy accompanied by extremely low pulsation is achieved.

This is particularly suitable for ultra-fine metal cutting operations, metrology, high-precision scanners, erosion techniques etc.

Preloading and stiffness

For perfect operating behaviour under various operating conditions in an extremely wide range of applications it is necessary to establish the suitable preload. In general, a slight to medium preload is enough for the majority of applications. For special applications in which high shock loads and vibration can occur it is advisable to use a higher preloading. The preload classes offered by SKF are categorised in Table 4.

Selection of the preload class

In the designs with clearance no preloading is achieved. Instead, there is clearance of between 1 and 10 µm between the carriage and rail. If two rails and more than one carriage per rail are used this clearance is in most cases equalised by parallelism tolerances.

Preload force referred to the basic dynamic load rating C_{dyn} of the respective carriage.

Example:

Carriage LLRHC 35 A

$C = 41\,900\text{ N}$

Preload $0,02 \times C = 838\text{ N}$

This carriage is preloaded with a basic load of approx. 838N.

Table 4

Versions and area of applications

T0 – Clearance

For particularly smooth-running guide systems with low friction and low external influences. Designs with clearance are only available in the accuracy classes P5 and P3.

T1 - Preload 0,02 C

For precise guide systems with low external load and high requirements in respect of overall stiffness.

T2 - Preload 0,08 C

For precise guide systems with high external load and high requirements in respect of overall stiffness; also recommended for single-rail systems. Above-average moment loads are absorbed without any significant elastic deformation. At only medium moment loads the overall stiffness is further improved.

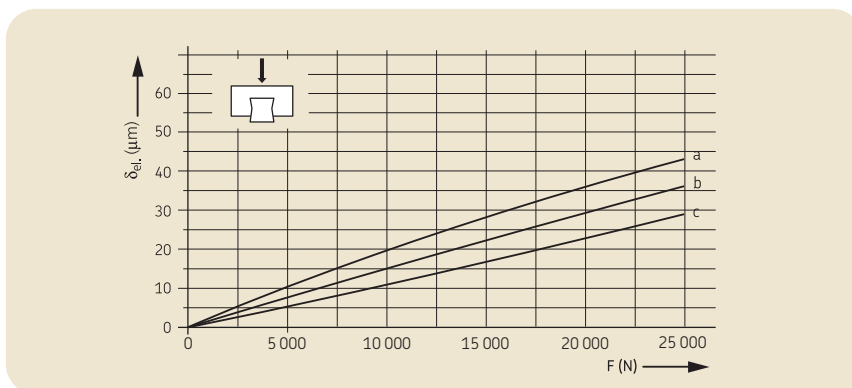
T3 - Preload 0,13 C

For highly rigid guide systems such as precision machine tools or injection mould clamping units. Above-average loads and moments are absorbed with lowest-possible elastic deformation. Version with preload T3 only available in accuracy classes P1, P01 and P001.

Deflection as a function of preload class and carriage

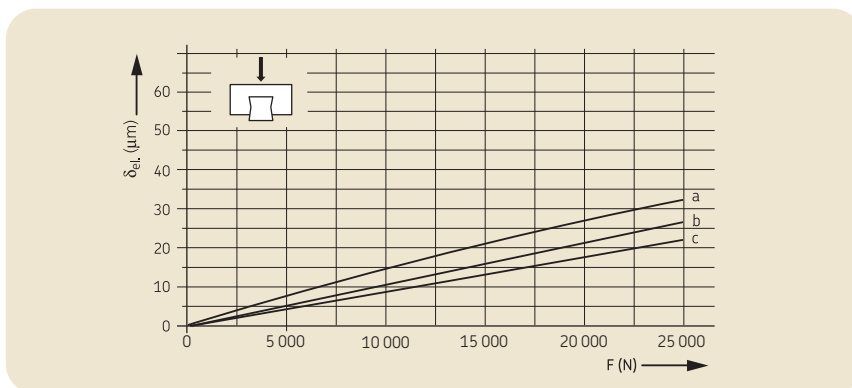
Example:

Carriage LLRHC 35 A,
 a) Preload 0,02 C (T1)
 b) Preload 0,08 C (T2)
 c) Preload 0,13 C (T3)



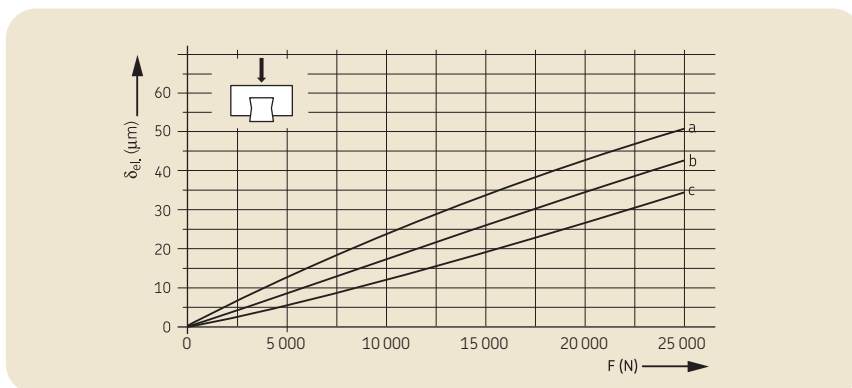
Example:

Carriage LLRHC 35 LA,
 a) Preload 0,02 C (T1)
 b) Preload 0,08 C (T2)
 c) Preload 0,13 C (T3)



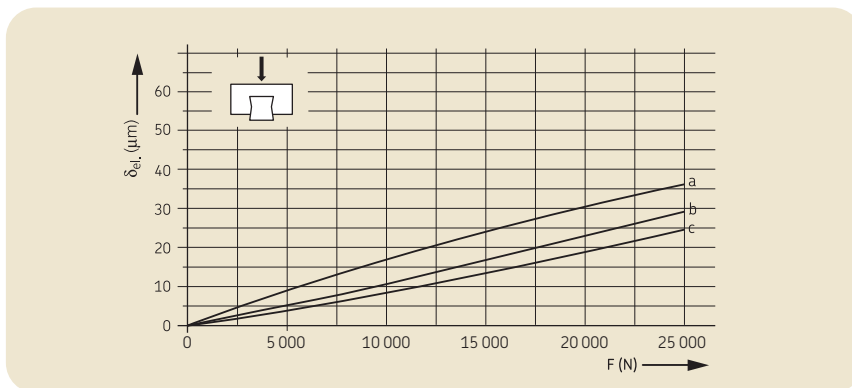
Example:

Carriage LLRHC 35 U,
 a) Preload 0,02 C (T1)
 b) Preload 0,08 C (T2)
 c) Preload 0,13 C (T3)



Example:

Carriage LLRHC 35 LU,
 a) Preload 0,02 C (T1)
 b) Preload 0,08 C (T2)
 c) Preload 0,13 C (T3)

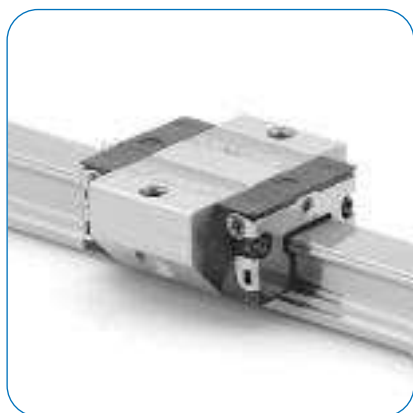


Legend

δ_{el} = elastic deformation
 F = load

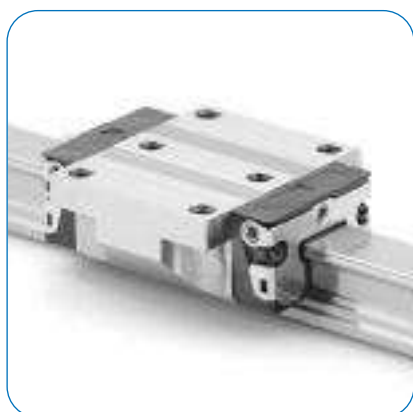
Carriages

Load ratings



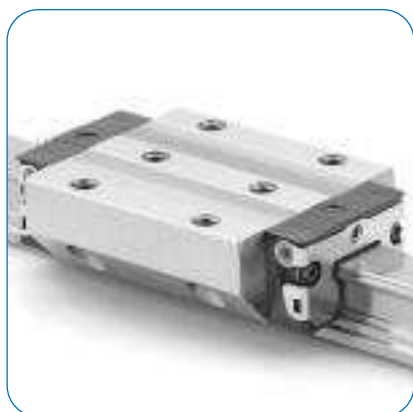
LLRHC xx SA (Flange short. Standard height.)

| Size | | 15 | 20 | 25 | 30 | 35 | 45 |
|---------------|--------------------|-------|--------|--------|--------|--------|----|
| Design | | | | | | | |
| ball chain | C (N) | 5 900 | 12 400 | 14 000 | 22 100 | 29 300 | – |
| no ball chain | C (N) | 6 800 | 12 400 | 15 800 | 22 100 | 29 300 | – |
| ball chain | C ₀ (N) | 6 700 | 13 600 | 15 200 | 24 800 | 32 400 | – |
| no ball chain | C ₀ (N) | 8 100 | 13 600 | 18 200 | 24 800 | 32 400 | – |



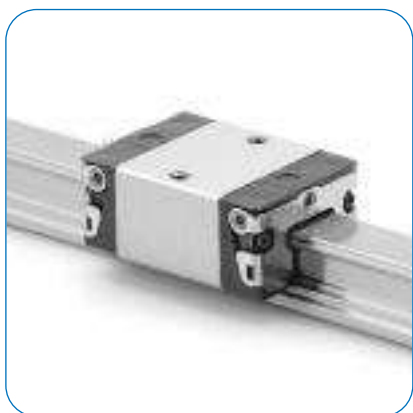
LLRHC xx A (Flange normal. Standard height.)

| Size | | 15 | 20 | 25 | 30 | 35 | 45 |
|---------------|--------------------|--------|--------|--------|--------|--------|--------|
| Design | | | | | | | |
| ball chain | C (N) | 7 280 | 17 400 | 21 300 | 29 300 | 41 900 | 63 300 |
| no ball chain | C (N) | 7 800 | 18 800 | 22 800 | 31 700 | 41 900 | 68 100 |
| ball chain | C ₀ (N) | 12 100 | 21 700 | 27 300 | 37 200 | 54 000 | 77 100 |
| no ball chain | C ₀ (N) | 13 500 | 24 400 | 30 400 | 41 300 | 54 000 | 85 700 |



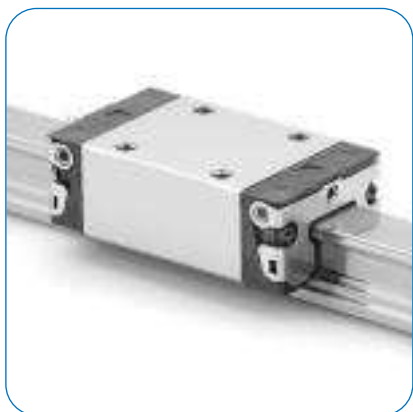
LLRHC xx LA (Flange long. Standard height.)

| Size | | 15 | 20 | 25 | 30 | 35 | 45 |
|---------------|--------------------|--------|--------|--------|--------|--------|---------|
| Design | | | | | | | |
| ball chain | C (N) | 9 000 | 23 100 | 27 500 | 38 000 | 53 000 | 81 900 |
| no ball chain | C (N) | 10 000 | 24 400 | 30 400 | 40 000 | 55 600 | 90 400 |
| ball chain | C ₀ (N) | 17 500 | 32 500 | 39 500 | 53 700 | 75 600 | 111 400 |
| no ball chain | C ₀ (N) | 20 200 | 35 200 | 45 500 | 57 800 | 81 000 | 128 500 |



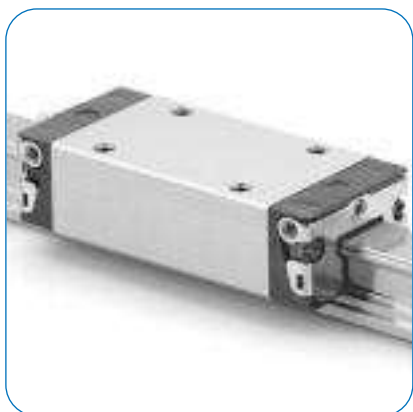
LLRHC xx SU (Slim line short. Standard height.)

| Size | | 15 | 20 | 25 | 30 | 35 | 45 |
|---------------|--------------------|-------|--------|--------|--------|--------|----|
| Design | | | | | | | |
| ball chain | C (N) | 5 900 | 12 400 | 14 000 | 22 100 | 29 300 | – |
| no ball chain | C (N) | 6 800 | 12 400 | 15 800 | 22 100 | 29 300 | – |
| ball chain | C ₀ (N) | 6 700 | 13 600 | 15 200 | 24 800 | 32 400 | – |
| no ball chain | C ₀ (N) | 8 100 | 13 600 | 18 200 | 24 800 | 32 400 | – |



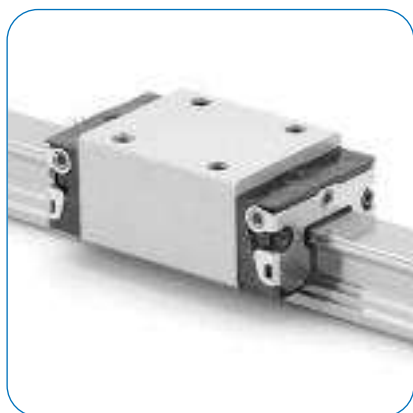
LLRHC xx U (Slim line normal. Standard height.)

| Size | | 15 | 20 | 25 | 30 | 35 | 45 |
|---------------|--------------------|--------|--------|--------|--------|--------|--------|
| Design | | | | | | | |
| ball chain | C (N) | 7 280 | 17 400 | 21 300 | 29 300 | 41 900 | 63 300 |
| no ball chain | C (N) | 7 800 | 18 800 | 22 800 | 31 700 | 41 900 | 68 100 |
| ball chain | C ₀ (N) | 12 100 | 21 700 | 27 300 | 37 200 | 54 000 | 77 100 |
| no ball chain | C ₀ (N) | 13 500 | 24 400 | 30 400 | 41 300 | 54 000 | 85 700 |



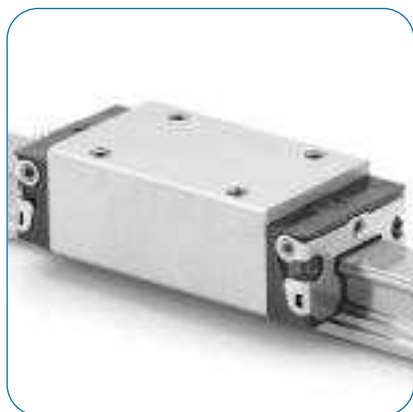
LLRHC xx LU (Slim line long. Standard height.)

| Size | | 15 | 20 | 25 | 30 | 35 | 45 |
|---------------|--------------------|--------|--------|--------|--------|--------|---------|
| Design | | | | | | | |
| ball chain | C (N) | 9 000 | 23 100 | 27 500 | 38 000 | 53 000 | 81 900 |
| no ball chain | C (N) | 10 000 | 24 400 | 30 400 | 40 000 | 55 600 | 90 400 |
| ball chain | C ₀ (N) | 17 500 | 32 500 | 39 500 | 53 700 | 75 600 | 111 400 |
| no ball chain | C ₀ (N) | 20 200 | 35 200 | 45 500 | 57 800 | 81 000 | 128 500 |



LLRHC xx R (Slim line normal. High.)

| Size | | 15 | 25 | 30 | 35 | 45 |
|---------------|--------------------|--------|--------|--------|--------|--------|
| Design | | | | | | |
| ball chain | C (N) | 7 280 | 21 300 | 29 300 | 41 900 | 63 300 |
| no ball chain | C (N) | 7 800 | 22 800 | 31 700 | 41 900 | 68 100 |
| ball chain | C ₀ (N) | 12 100 | 27 300 | 37 200 | 54 000 | 77 100 |
| no ball chain | C ₀ (N) | 13 500 | 30 400 | 41 300 | 54 000 | 85 700 |



LLRHC xx LR (Slim line long. High.)

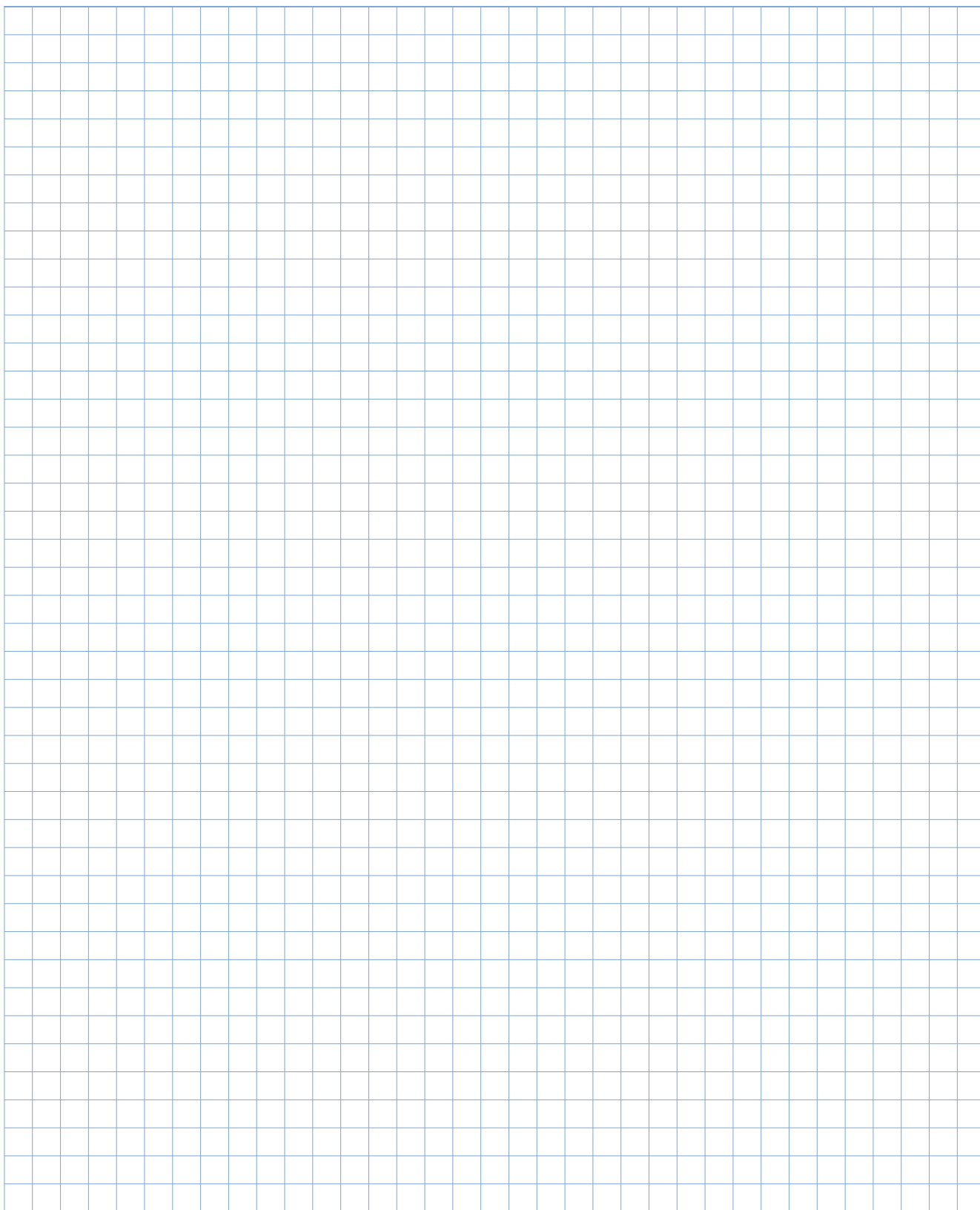
| Size | | 25 | 30 | 35 | 45 |
|---------------|--------------------|--------|--------|--------|---------|
| Design | | | | | |
| ball chain | C (N) | 27 500 | 38 000 | 53 000 | 81 900 |
| no ball chain | C (N) | 30 400 | 40 000 | 55 600 | 90 400 |
| ball chain | C ₀ (N) | 39 500 | 53 700 | 75 600 | 111 400 |
| no ball chain | C ₀ (N) | 45 500 | 57 800 | 81 000 | 128 500 |

Note on dynamic load capacities and moments

Determination of dynamic load capacities and moments is based on a travel life of 100 000 m. However, frequently this is determined on the basis of only 50 000 m. In this case for comparison: multiply values C, M_C and M_A by 1.26 in accordance with SKF tables.

For carriages with ball chain the permissible moments are reduced in accordance with the load ratings.

Notes



Accuracy classes, dimensions and designations

Carriage LLRHC xx SA

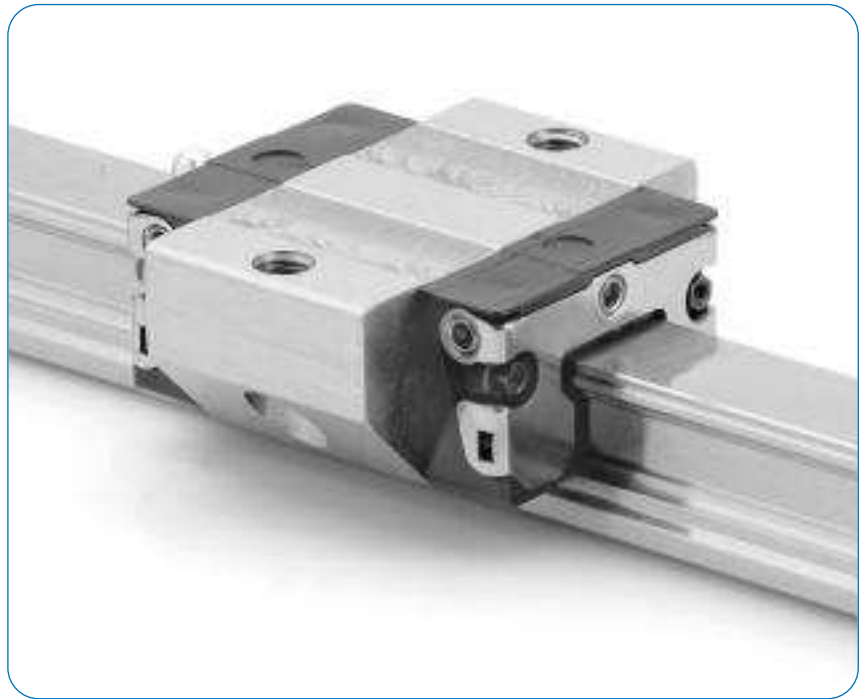
Flange short. Standard height.

For type designation see
designation system

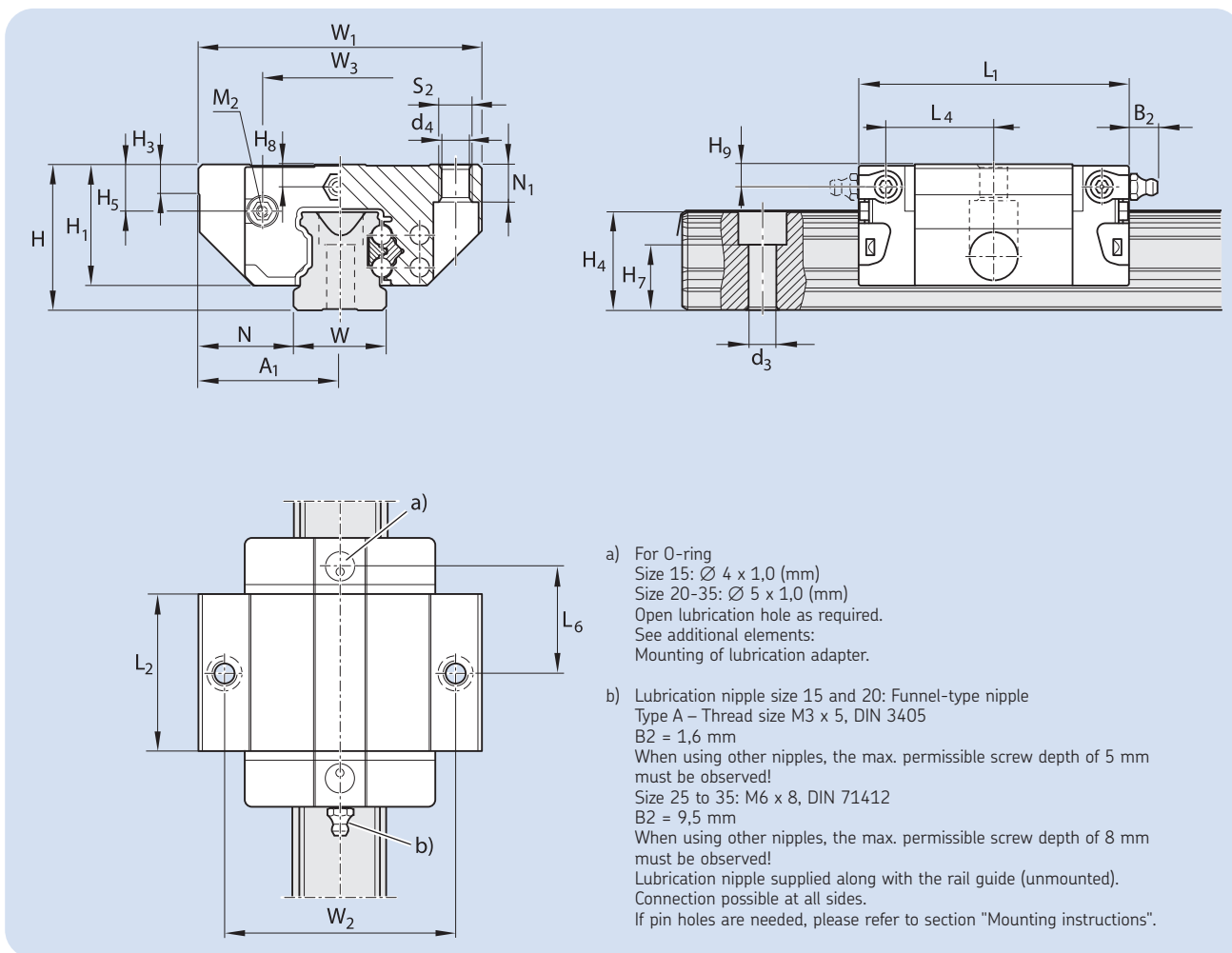
Dynamic values

Speed $v_{\max} = 5 \text{ m/s}$

Acceleration $a_{\max} = 500 \text{ m/s}^2$



| Size | Accuracy class | Type designation incl. preload class | |
|------|----------------|--------------------------------------|-------------------|
| | | T0 | T1 |
| 15 | P5 | LLRHC 15 SA T0 P5 | LLRHC 15 SA T1 P5 |
| | P3 | LLRHC 15 SA T0 P3 | LLRHC 15 SA T1 P3 |
| 20 | P5 | LLRHC 20 SA T0 P5 | LLRHC 20 SA T1 P5 |
| | P3 | LLRHC 20 SA T0 P3 | LLRHC 20 SA T1 P3 |
| 25 | P5 | LLRHC 25 SA T0 P5 | LLRHC 25 SA T1 P5 |
| | P3 | LLRHC 25 SA T0 P3 | LLRHC 25 SA T1 P3 |
| 30 | P5 | LLRHC 30 SA T0 P5 | LLRHC 30 SA T1 P5 |
| | P3 | LLRHC 30 SA T0 P3 | LLRHC 30 SA T1 P3 |
| 35 | P5 | LLRHC 35 SA T0 P5 | LLRHC 35 SA T1 P5 |
| | P3 | LLRHC 35 SA T0 P3 | LLRHC 35 SA T1 P3 |



- a) For O-ring
 Size 15: $\varnothing 4 \times 1,0$ (mm)
 Size 20-35: $\varnothing 5 \times 1,0$ (mm)
 Open lubrication hole as required.
 See additional elements:
 Mounting of lubrication adapter.
- b) Lubrication nipple size 15 and 20: Funnel-type nipple
 Type A – Thread size M3 x 5, DIN 3405
 B2 = 1,6 mm
 When using other nipples, the max. permissible screw depth of 5 mm must be observed!
 Size 25 to 35: M6 x 8, DIN 71412
 B2 = 9,5 mm
 When using other nipples, the max. permissible screw depth of 8 mm must be observed!
 Lubrication nipple supplied along with the rail guide (unmounted).
 Connection possible at all sides.
 If pin holes are needed, please refer to section "Mounting instructions".

| Size | Dimensions (mm) | | | | | | | | | | | | | | | | | | |
|------|-----------------|----------------|----|------|----------------|----------------|----|----------------|------------------------------|------------------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------------|--|
| | W ₁ | A ₁ | W | N | L ₁ | L ₂ | H | H ₁ | H ₄ ¹⁾ | H ₄ ²⁾ | H ₃ | W ₂ | W ₃ | H ₅ | L ₆ | L ₄ | H ₈ | H ₉ | |
| 15 | 47 | 23,5 | 15 | 16,0 | 44,7 | 25,7 | 24 | 19,90 | 16,30 | 16,20 | 5,0 | 38 | 24,55 | 6,70 | 16,25 | 17,85 | 3,20 | 3,20 | |
| 20 | 63 | 31,5 | 20 | 21,5 | 57,3 | 31,9 | 30 | 25,35 | 20,75 | 20,55 | 6,0 | 53 | 32,50 | 7,30 | 22,95 | 22,95 | 3,35 | 3,35 | |
| 25 | 70 | 35,0 | 23 | 23,5 | 67,0 | 38,6 | 36 | 29,90 | 24,45 | 24,25 | 7,5 | 57 | 38,30 | 11,50 | 25,35 | 26,50 | 5,50 | 5,50 | |
| 30 | 90 | 45,0 | 28 | 31,0 | 75,3 | 45,0 | 42 | 35,35 | 28,55 | 28,35 | 7,0 | 72 | 48,40 | 14,60 | 28,80 | 30,50 | 6,05 | 6,05 | |
| 35 | 100 | 50,0 | 34 | 33,0 | 84,9 | 51,4 | 48 | 40,40 | 32,15 | 31,85 | 8,0 | 82 | 58,00 | 17,35 | 32,70 | 34,20 | 6,90 | 6,90 ¹⁾ | |

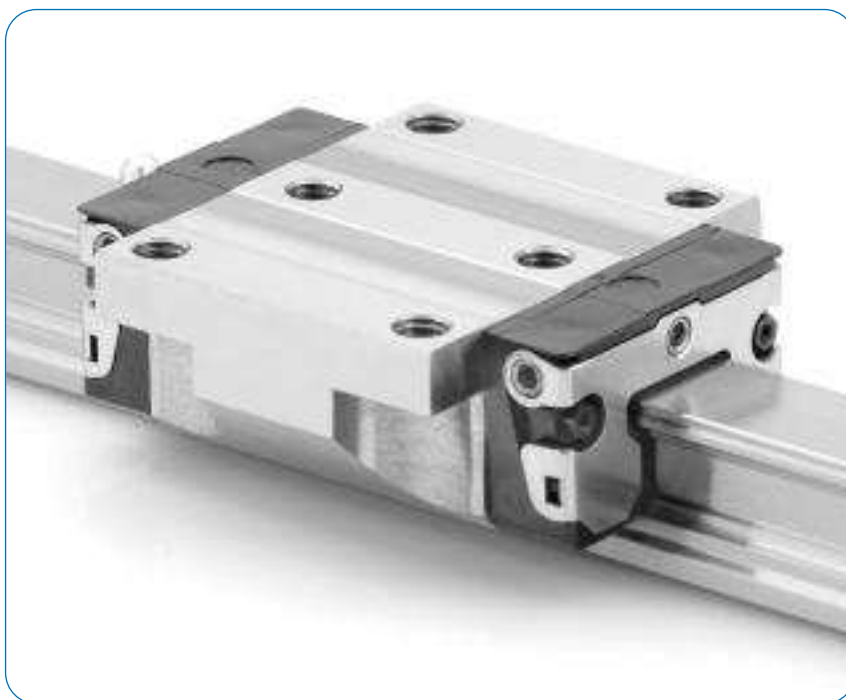
¹⁾ Dimension H₄ with cover strip.

²⁾ Dimension H₄ without cover strip

| Size | Dimensions (mm) | | | | | | Weight (kg) | Load ratings (N) | | Moments (N _m) | | | |
|------|-----------------|--------------------------------|----------------|----------------|----------------|----------------|-------------|------------------|----------------------|---------------------------|-----------------------|---------------------|----------------------|
| | N ₁ | H ₇ ^{±0,5} | d ₄ | S ₂ | d ₃ | M ₂ | | C dyn. | C ₀ stat. | M _C dyn. | M _{C0} stat. | M _A dyn. | M _B stat. |
| 15 | 5,2 | 10,3 | 4,3 | M5 | 4,4 | M2,5-3,5 depth | 0,15 | 5 400 | 8 100 | 52 | 80 | 19 | 28 |
| 20 | 7,7 | 13,2 | 5,3 | M6 | 6,0 | M3-5 depth | 0,30 | 12 400 | 13 600 | 150 | 170 | 52 | 58 |
| 25 | 9,3 | 15,2 | 6,7 | M8 | 7,0 | M3-5 depth | 0,50 | 15 900 | 18 200 | 230 | 260 | 82 | 94 |
| 30 | 11,0 | 17,0 | 8,5 | M10 | 9,0 | M3-5 depth | 0,80 | 22 100 | 24 800 | 380 | 430 | 133 | 150 |
| 35 | 12,0 | 20,5 | 8,5 | M10 | 9,0 | M3-5 depth | 1,20 | 29 300 | 32 400 | 640 | 700 | 200 | 220 |

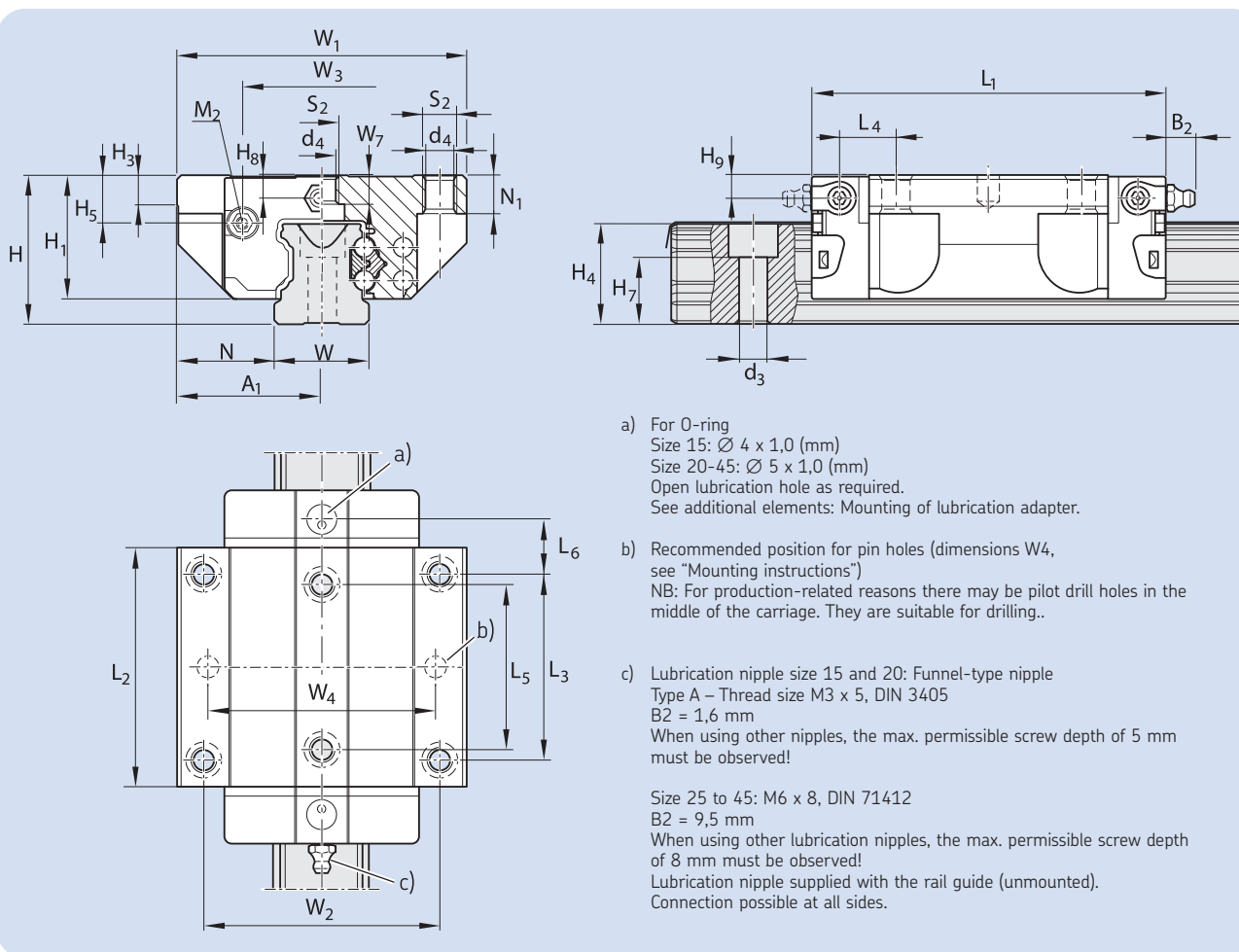
Carriage LLRHC xx A

Flange normal. Standard height.

For type designation see
designation system**Dynamic values**Speed $v_{max} = 5 \text{ m/s}$ Acceleration $a_{max} = 500 \text{ m/s}^2$ 

| Size | Accuracy class | Type designation incl. preload class | | | |
|------|----------------|--------------------------------------|-------------------------|-------------------------|--------------------|
| | | T0 | T1 | T2 | T3 |
| 15 | P5 | LLRHC 15 A T0 P5 | LLRHC 15 A T1 P5 | LLRHC 15 A T2 P5 | |
| | P3 | LLRHC 15 A T0 P3 | LLRHC 15 A T1 P3 | LLRHC 15 A T2 P3 | |
| | P1 | | LLRHC 15 A T1 P1 | LLRHC 15 A T2 P1 | LLRHC 15 A T3 P1 |
| | P01 | | LLRHC 15 A T1 P01 | LLRHC 15 A T2 P01 | LLRHC 15 A T3 P01 |
| | P001 | | LLRHC 15 A T1 P001 | LLRHC 15 A T2 P001 | LLRHC 15 A T3 P001 |
| 20 | P5 | LLRHC 20 A T0 P5 | LLRHC 20 A T1 P5 | LLRHC 20 A T2 P5 | |
| | P3 | LLRHC 20 A T0 P3 | LLRHC 20 A T1 P3 | LLRHC 20 A T2 P3 | |
| | P1 | | LLRHC 20 A T1 P1 | LLRHC 20 A T2 P1 | LLRHC 20 A T3 P1 |
| | P01 | | LLRHC 20 A T1 P01 | LLRHC 20 A T2 P01 | LLRHC 20 A T3 P01 |
| | P001 | | LLRHC 20 A T1 P001 | LLRHC 20 A T2 P001 | LLRHC 20 A T3 P001 |
| 25 | P5 | LLRHC 25 A T0 P5 | LLRHC 25 A T1 P5 | LLRHC 25 A T2 P5 | |
| | P3 | LLRHC 25 A T0 P3 | LLRHC 25 A T1 P3 | LLRHC 25 A T2 P3 | |
| | P1 | | LLRHC 25 A T1 P1 | LLRHC 25 A T2 P1 | LLRHC 25 A T3 P1 |
| | P01 | | LLRHC 25 A T1 P01 | LLRHC 25 A T2 P01 | LLRHC 25 A T3 P01 |
| | P001 | | LLRHC 25 A T1 P001 | LLRHC 25 A T2 P001 | LLRHC 25 A T3 P001 |
| 30 | P5 | LLRHC 30 A T0 P5 | LLRHC 30 A T1 P5 | LLRHC 30 A T2 P5 | |
| | P3 | LLRHC 30 A T0 P3 | LLRHC 30 A T1 P3 | LLRHC 30 A T2 P3 | |
| | P1 | | LLRHC 30 A T1 P1 | LLRHC 30 A T2 P1 | LLRHC 30 A T3 P1 |
| | P01 | | LLRHC 30 A T1 P01 | LLRHC 30 A T2 P01 | LLRHC 30 A T3 P01 |
| | P001 | | LLRHC 30 A T1 P001 | LLRHC 30 A T2 P001 | LLRHC 30 A T3 P001 |
| 35 | P5 | LLRHC 35 A T0 P5 | LLRHC 35 A T1 P5 | LLRHC 35 A T2 P5 | |
| | P3 | LLRHC 35 A T0 P3 | LLRHC 35 A T1 P3 | LLRHC 35 A T2 P3 | |
| | P1 | | LLRHC 35 A T1 P1 | LLRHC 35 A T2 P1 | LLRHC 35 A T3 P1 |
| | P01 | | LLRHC 35 A T1 P01 | LLRHC 35 A T2 P01 | LLRHC 35 A T3 P01 |
| | P001 | | LLRHC 35 A T1 P001 | LLRHC 35 A T2 P001 | LLRHC 35 A T3 P001 |
| 45 | P5 | LLRHC 45 A T0 P5 | LLRHC 45 A T1 P5 | LLRHC 45 A T2 P5 | |
| | P3 | LLRHC 45 A T0 P3 | LLRHC 45 A T1 P3 | LLRHC 45 A T2 P3 | |
| | P1 | | LLRHC 45 A T1 P1 | LLRHC 45 A T2 P1 | LLRHC 45 A T3 P1 |
| | P01 | | LLRHC 45 A T1 P01 | LLRHC 45 A T2 P01 | LLRHC 45 A T3 P01 |
| | P001 | | LLRHC 45 A T1 P001 | LLRHC 45 A T2 P001 | LLRHC 45 A T3 P001 |

bold text = standard range



- a) For O-ring
Size 15: $\varnothing 4 \times 1,0$ (mm)
Size 20-45: $\varnothing 5 \times 1,0$ (mm)
Open lubrication hole as required.
See additional elements: Mounting of lubrication adapter.
- b) Recommended position for pin holes (dimensions W_4 , see "Mounting instructions")
NB: For production-related reasons there may be pilot drill holes in the middle of the carriage. They are suitable for drilling..
- c) Lubrication nipple size 15 and 20: Funnel-type nipple
Type A – Thread size M3 x 5, DIN 3405
B2 = 1,6 mm
When using other nipples, the max. permissible screw depth of 5 mm must be observed!

Size 25 to 45: M6 x 8, DIN 71412
B2 = 9,5 mm
When using other lubrication nipples, the max. permissible screw depth of 8 mm must be observed!
Lubrication nipple supplied with the rail guide (unmounted).
Connection possible at all sides.

| Size | Dimensions (mm) | | | | | | | | | | | | | | | | | | | |
|------|-----------------|-------|----|------|-------|-------|----|-------|-------------|-------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| | W_1 | A_1 | W | N | L_1 | L_2 | H | H_1 | $H_4^{(1)}$ | $H_4^{(2)}$ | H_3 | W_2 | L_3 | L_5 | W_3 | H_5 | L_6 | L_4 | H_8 | H_9 |
| 15 | 47 | 23,5 | 15 | 16,0 | 58,2 | 39,2 | 24 | 19,90 | 16,30 | 16,20 | 5,0 | 38 | 30 | 26 | 24,55 | 6,70 | 8,00 | 9,6 | 3,20 | 3,20 |
| 20 | 63 | 31,5 | 20 | 21,5 | 75,0 | 49,6 | 30 | 25,35 | 20,75 | 20,55 | 6,0 | 53 | 40 | 35 | 32,50 | 7,30 | 11,80 | 11,8 | 3,35 | 3,35 |
| 25 | 70 | 35,0 | 23 | 23,5 | 86,2 | 57,8 | 36 | 29,90 | 24,45 | 24,25 | 7,5 | 57 | 45 | 40 | 38,30 | 11,50 | 12,45 | 13,6 | 5,50 | 5,50 |
| 30 | 90 | 45,0 | 28 | 31,0 | 97,7 | 67,4 | 42 | 35,35 | 28,55 | 28,35 | 7,0 | 72 | 52 | 44 | 48,40 | 14,60 | 14,00 | 15,7 | 6,05 | 6,05 |
| 35 | 100 | 50,0 | 34 | 33,0 | 110,5 | 77,0 | 48 | 40,40 | 32,15 | 31,85 | 8,0 | 82 | 62 | 52 | 58,00 | 17,35 | 14,50 | 16,0 | 6,90 | 6,90 |
| 45 | 120 | 60 | 45 | 37,5 | 137,6 | 97,0 | 60 | 50,30 | 40,15 | 39,85 | 10,0 | 100 | 80 | 60 | 69,80 | 20,90 | 17,30 | 19,3 | 8,20 | 8,20 |

¹⁾ Dimension H_4 with cover strip.

²⁾ Dimension H_4 without cover strip

| Size | Dimensions (mm) | | | | | | | Weight (kg) | Load ratings (N) | | Moments (N_m) | | Moments (N_m) | |
|------|-----------------|--------------|--------------|-------|-------|-------|----------------|-------------|------------------|-------------|-------------------|----------------|-------------------|---------------------|
| | N_1 | $W_7^{+0,5}$ | $H_7^{+0,5}$ | d_4 | S_2 | d_3 | M_2 | | C dyn. | C_0 stat. | M_C dyn. | M_{C0} stat. | M_A dyn. | M_B stat. |
| 15 | 5,2 | 4,4 | 10,3 | 4,3 | M5 | 4,4 | M2,5-3,5 depth | 0,20 | 7 800 | 13 500 | 74 | 130 | 40 | 71 |
| 20 | 7,7 | 5,2 | 13,2 | 5,3 | M6 | 6,0 | M3-5 depth | 0,45 | 18 800 | 24 400 | 240 | 310 | 130 | 165 |
| 25 | 9,3 | 7,0 | 15,2 | 6,7 | M8 | 7,0 | M3-5 depth | 0,65 | 22 800 | 30 400 | 320 | 430 | 180 | 240 |
| 30 | 11,0 | 7,9 | 17,0 | 8,5 | M10 | 9,0 | M3-5 depth | 1,10 | 31 700 | 41 300 | 540 | 720 | 290 | 380 |
| 35 | 12,0 | 10,2 | 20,5 | 8,5 | M10 | 9,0 | M3-5 depth | 1,60 | 41 900 | 54 000 | 890 | 1 160 | 440 | 565 |
| 45 | 15,0 | 14,4 | 23,5 | 10,4 | M12 | 14,0 | M4-7 depth | 3,00 | 68 100 | 85 700 | 1 830 | 2 310 | 890 | 1 130 ³⁾ |

Carriage LLRHC xx LA

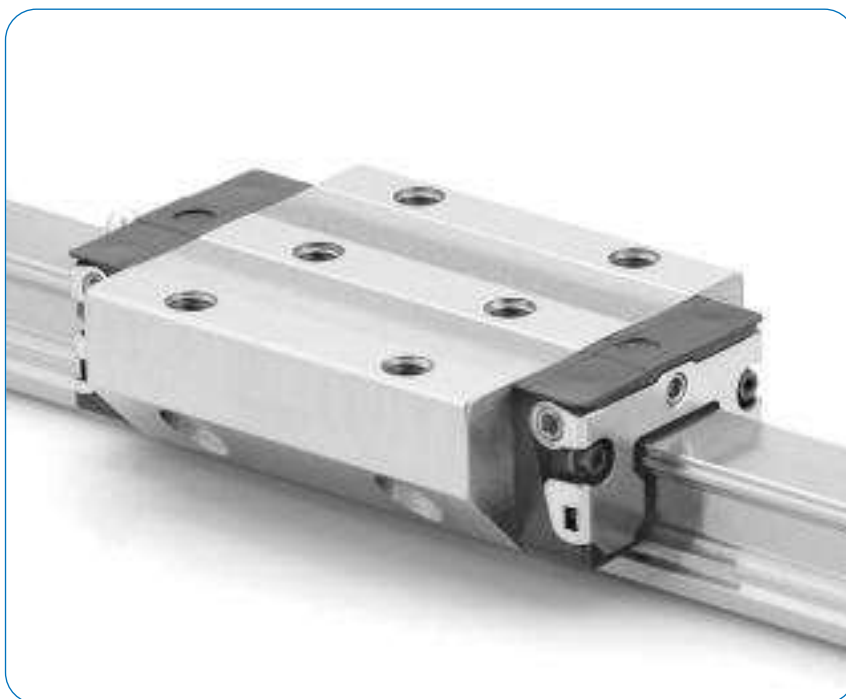
Flange long. Standard height.

For type designation see designation system

Dynamic values

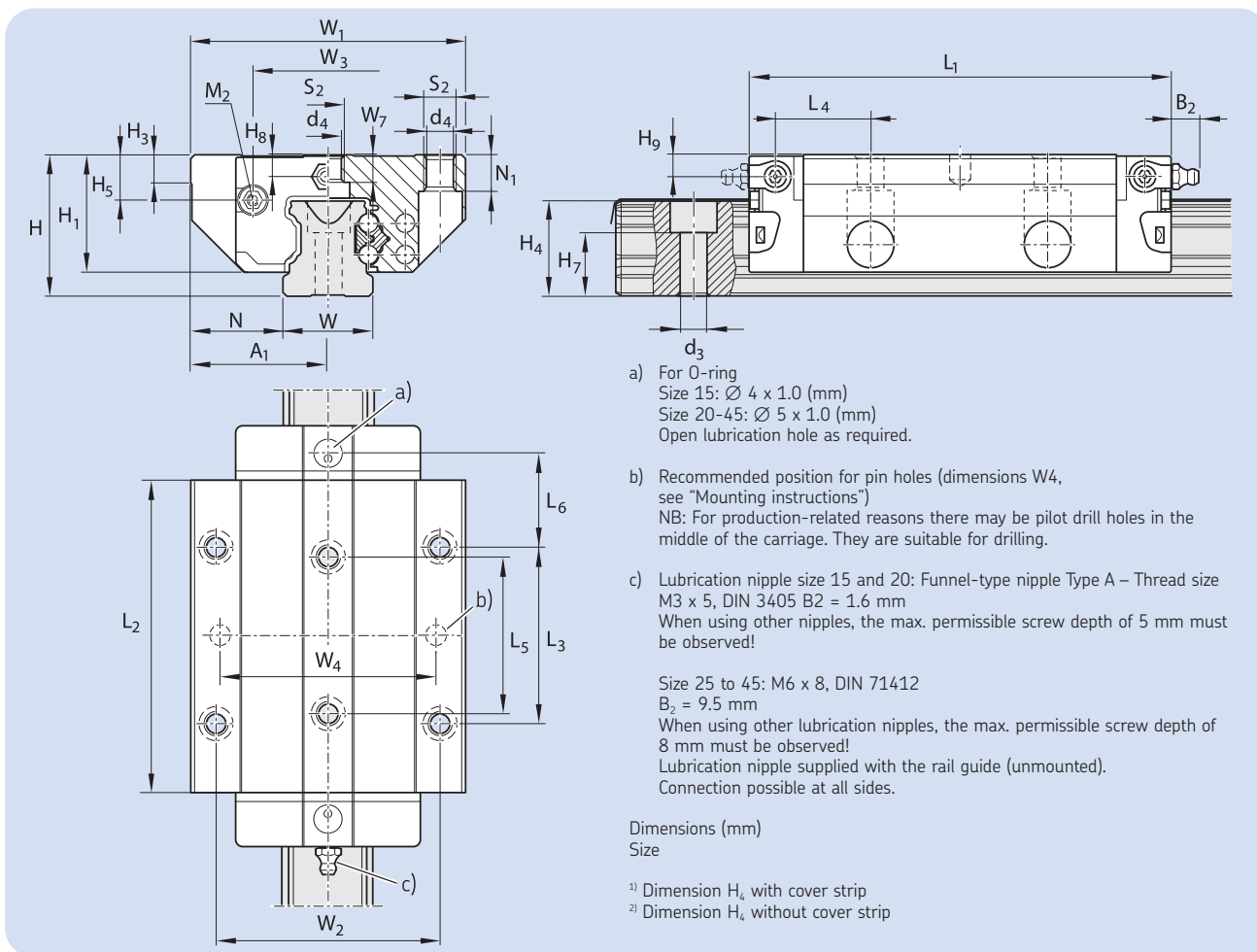
Speed $v_{max} = 5 \text{ m/s}$

Acceleration $a_{max} = 500 \text{ m/s}^2$



| Size | Accuracy class | Type designation incl. preload class | | | |
|------|----------------|--------------------------------------|--------------------------|--------------------------|---------------------|
| | | T0 | T1 | T2 | T3 |
| 15 | P5 | LLRHC 15 LA T0 P5 | LLRHC 15 LA T1 P5 | LLRHC 15 LA T2 P5 | |
| | P3 | LLRHC 15 LA T0 P3 | LLRHC 15 LA T1 P3 | LLRHC 15 LA T2 P3 | |
| | P1 | | LLRHC 15 LA T1 P1 | LLRHC 15 LA T2 P1 | LLRHC 15 LA T3 P1 |
| | P01 | | LLRHC 15 LA T1 P01 | LLRHC 15 LA T2 P01 | LLRHC 15 LA T3 P01 |
| | P001 | | LLRHC 15 LA T1 P001 | LLRHC 15 LA T2 P001 | LLRHC 15 LA T3 P001 |
| 20 | P5 | LLRHC 20 LA T0 P5 | LLRHC 20 LA T1 P5 | LLRHC 20 LA T2 P5 | |
| | P3 | LLRHC 20 LA T0 P3 | LLRHC 20 LA T1 P3 | LLRHC 20 LA T2 P3 | |
| | P1 | | LLRHC 20 LA T1 P1 | LLRHC 20 LA T2 P1 | LLRHC 20 LA T3 P1 |
| | P01 | | LLRHC 20 LA T1 P01 | LLRHC 20 LA T2 P01 | LLRHC 20 LA T3 P01 |
| | P001 | | LLRHC 20 LA T1 P001 | LLRHC 20 LA T2 P001 | LLRHC 20 LA T3 P001 |
| 25 | P5 | LLRHC 25 LA T0 P5 | LLRHC 25 LA T1 P5 | LLRHC 25 LA T2 P5 | |
| | P3 | LLRHC 25 LA T0 P3 | LLRHC 25 LA T1 P3 | LLRHC 25 LA T2 P3 | |
| | P1 | | LLRHC 25 LA T1 P1 | LLRHC 25 LA T2 P1 | LLRHC 25 LA T3 P1 |
| | P01 | | LLRHC 25 LA T1 P01 | LLRHC 25 LA T2 P01 | LLRHC 25 LA T3 P01 |
| | P001 | | LLRHC 25 LA T1 P001 | LLRHC 25 LA T2 P001 | LLRHC 25 LA T3 P001 |
| 30 | P5 | LLRHC 30 LA T0 P5 | LLRHC 30 LA T1 P5 | LLRHC 30 LA T2 P5 | |
| | P3 | LLRHC 30 LA T0 P3 | LLRHC 30 LA T1 P3 | LLRHC 30 LA T2 P3 | |
| | P1 | | LLRHC 30 LA T1 P1 | LLRHC 30 LA T2 P1 | LLRHC 30 LA T3 P1 |
| | P01 | | LLRHC 30 LA T1 P01 | LLRHC 30 LA T2 P01 | LLRHC 30 LA T3 P01 |
| | P001 | | LLRHC 30 LA T1 P001 | LLRHC 30 LA T2 P001 | LLRHC 30 LA T3 P001 |
| 35 | P5 | LLRHC 35 LA T0 P5 | LLRHC 35 LA T1 P5 | LLRHC 35 LA T2 P5 | |
| | P3 | LLRHC 35 LA T0 P3 | LLRHC 35 LA T1 P3 | LLRHC 35 LA T2 P3 | |
| | P1 | | LLRHC 35 LA T1 P1 | LLRHC 35 LA T2 P1 | LLRHC 35 LA T3 P1 |
| | P01 | | LLRHC 35 LA T1 P01 | LLRHC 35 LA T2 P01 | LLRHC 35 LA T3 P01 |
| | P001 | | LLRHC 35 LA T1 P001 | LLRHC 35 LA T2 P001 | LLRHC 35 LA T3 P001 |
| 45 | P5 | LLRHC 45 LA T0 P5 | LLRHC 45 LA T1 P5 | LLRHC 45 LA T2 P5 | |
| | P3 | LLRHC 45 LA T0 P3 | LLRHC 45 LA T1 P3 | LLRHC 45 LA T2 P3 | |
| | P1 | | LLRHC 45 LA T1 P1 | LLRHC 45 LA T2 P1 | LLRHC 45 LA T3 P1 |
| | P01 | | LLRHC 45 LA T1 P01 | LLRHC 45 LA T2 P01 | LLRHC 45 LA T3 P01 |
| | P001 | | LLRHC 45 LA T1 P001 | LLRHC 45 LA T2 P001 | LLRHC 45 LA T3 P001 |

bold text = standard range



| Size | Dimensions (mm) | | | | | | | | | | | | | | | | | | | |
|------|-----------------|-------|----|------|-------|-------|----|-------|------------|------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| | W_1 | A_1 | W | N | L_1 | L_2 | H | H_1 | $H_4^{1)}$ | $H_4^{2)}$ | H_3 | W_2 | L_3 | L_5 | W_3 | H_5 | L_6 | L_4 | H_8 | H_9 |
| 15 | 47 | 23,5 | 15 | 16,0 | 72,6 | 53,6 | 24 | 19,90 | 16,30 | 16,20 | 5,0 | 38 | 30 | 26 | 24,55 | 6,70 | 15,20 | 16,80 | 3,20 | 3,20 |
| 20 | 63 | 31,5 | 20 | 21,5 | 91,0 | 65,6 | 30 | 25,35 | 20,75 | 20,55 | 6,0 | 53 | 40 | 35 | 32,50 | 7,30 | 19,80 | 19,80 | 3,35 | 3,35 |
| 25 | 70 | 35,0 | 23 | 23,5 | 107,9 | 79,5 | 36 | 29,90 | 24,45 | 24,25 | 7,5 | 57 | 45 | 40 | 38,30 | 11,50 | 23,30 | 24,45 | 5,50 | 5,50 |
| 30 | 90 | 45,0 | 28 | 31,0 | 119,7 | 89,4 | 42 | 35,35 | 28,55 | 28,35 | 7,0 | 72 | 52 | 44 | 48,40 | 14,60 | 25,00 | 26,70 | 6,05 | 6,05 |
| 35 | 100 | 50,0 | 34 | 33,0 | 139,0 | 105,5 | 48 | 40,40 | 32,15 | 31,85 | 8,0 | 82 | 62 | 52 | 58,00 | 17,35 | 28,75 | 30,25 | 6,90 | 6,90 |
| 45 | 120 | 60,0 | 45 | 37,5 | 174,1 | 133,5 | 60 | 50,30 | 40,15 | 39,85 | 10,0 | 100 | 80 | 60 | 69,80 | 20,90 | 35,50 | 37,50 | 8,20 | 8,20 |

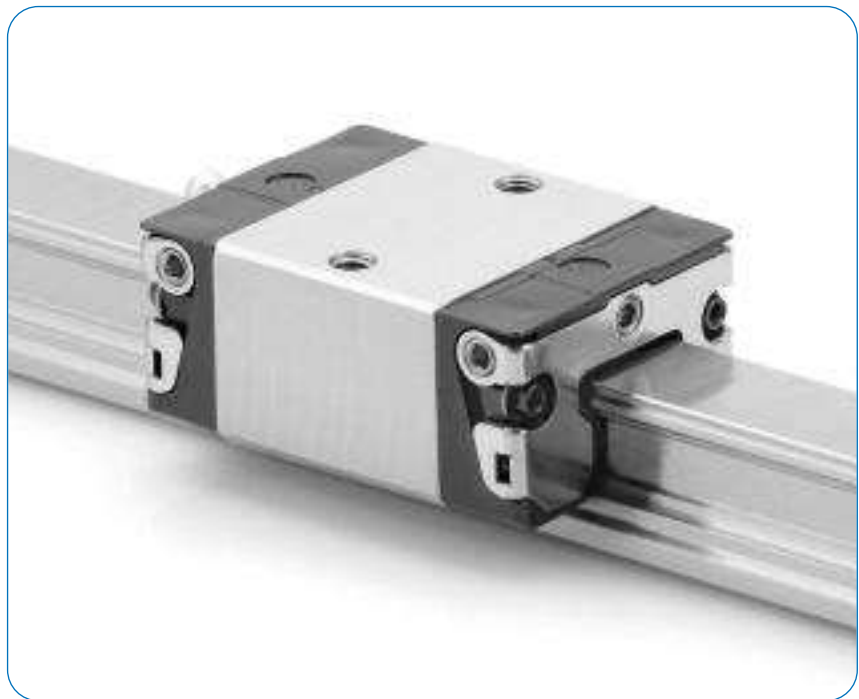
¹⁾ Dimension H_4 with cover strip.

²⁾ Dimension H_4 without cover strip

| Size | Dimensions (mm) | | | | | Weight (kg) | Load ratings (N) | | Moments (N_m) | | | | | |
|------|-----------------|--------------|--------------|-------|-------|-------------|------------------|-------------|-------------------|----------------|------------|-------------|-------|-------|
| | N_1 | $W_7^{+0,5}$ | $H_7^{+0,5}$ | d_4 | S_2 | | C dyn. | C_0 stat. | M_C dyn. | M_{C0} stat. | M_A dyn. | M_B stat. | | |
| 15 | 5,2 | 4,4 | 10,3 | 4,3 | M5 | 4,4 | M2,5-3,5 depth | 0,30 | 10 000 | 20 200 | 130 | 190 | 98 | 150 |
| 20 | 7,7 | 5,2 | 13,2 | 5,3 | M6 | 6,0 | M3-5 depth | 0,55 | 24 400 | 35 200 | 310 | 450 | 225 | 330 |
| 25 | 9,3 | 7,0 | 15,2 | 6,7 | M8 | 7,0 | M3-5 depth | 0,90 | 30 400 | 45 500 | 430 | 650 | 345 | 510 |
| 30 | 11,0 | 7,9 | 17,0 | 8,5 | M10 | 9,0 | M3-5 depth | 1,50 | 40 000 | 57 800 | 690 | 1 000 | 495 | 715 |
| 35 | 12,0 | 10,2 | 20,5 | 8,5 | M10 | 9,0 | M3-5 depth | 2,25 | 55 600 | 81 000 | 1 200 | 1 740 | 830 | 1 215 |
| 45 | 15,0 | 12,4 | 23,5 | 10,4 | M12 | 14,0 | M4-7 depth | 4,30 | 90 400 | 128 500 | 2 440 | 3 470 | 1 700 | 2 425 |

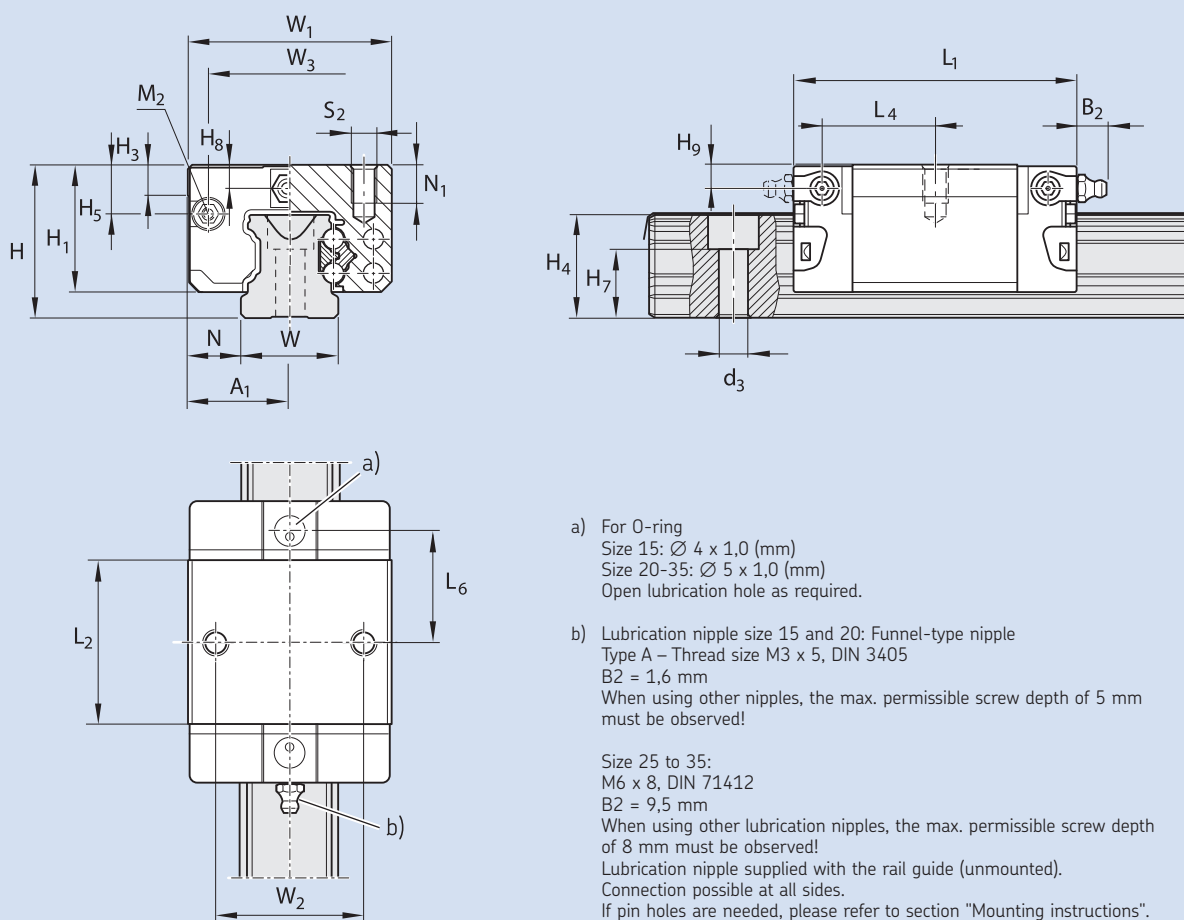
Carriage LLRHC xx SU

Slim line short. Standard height.

For type designation see
designation system**Dynamic values**Speed $v_{\max} = 5 \text{ m/s}$ Acceleration $a_{\max} = 500 \text{ m/s}^2$ 

| Size | Accuracy class | Type designation incl. preload class | |
|------|----------------|--------------------------------------|-------------------|
| | | T0 | T1 |
| 15 | P5 | LLRHC 15 SU T0 P5 | LLRHC 15 SU T1 P5 |
| | P3 | LLRHC 15 SU T0 P3 | LLRHC 15 SU T1 P3 |
| | P1 | LLRHC 15 SU T0 P1 | LLRHC 15 SU T1 P1 |
| 20 | P5 | LLRHC 20 SU T0 P5 | LLRHC 20 SU T1 P5 |
| | P3 | LLRHC 20 SU T0 P3 | LLRHC 20 SU T1 P3 |
| | P1 | LLRHC 20 SU T0 P1 | LLRHC 20 SU T1 P1 |
| 25 | P5 | LLRHC 25 SU T0 P5 | LLRHC 25 SU T1 P5 |
| | P3 | LLRHC 25 SU T0 P3 | LLRHC 25 SU T1 P3 |
| | P1 | LLRHC 25 SU T0 P1 | LLRHC 25 SU T1 P1 |
| 30 | P5 | LLRHC 30 SU T0 P5 | LLRHC 30 SU T1 P5 |
| | P3 | LLRHC 30 SU T0 P3 | LLRHC 30 SU T1 P3 |
| | P1 | LLRHC 30 SU T0 P1 | LLRHC 30 SU T1 P1 |
| 35 | P5 | LLRHC 35 SU T0 P5 | LLRHC 35 SU T1 P5 |
| | P3 | LLRHC 35 SU T0 P3 | LLRHC 35 SU T1 P3 |
| | P1 | LLRHC 35 SU T0 P1 | LLRHC 35 SU T1 P1 |

bold text = standard range



| Size | Dimensions (mm) | | | | | | | | | | | | | | | | | | |
|------|-----------------|----------------|----|------|----------------|----------------|----|----------------|------------------------------|------------------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------------|--|
| | W ₁ | A ₁ | W | N | L ₁ | L ₂ | H | H ₁ | H ₄ ¹⁾ | H ₄ ²⁾ | H ₃ | W ₂ | W ₃ | H ₅ | L ₆ | L ₄ | H ₈ | H ₉ | |
| 15 | 34 | 17 | 15 | 9,5 | 44,7 | 25,7 | 24 | 19,90 | 16,30 | 16,20 | 5,0 | 26 | 24,55 | 6,70 | 16,25 | 17,85 | 3,20 | 3,20 | |
| 20 | 44 | 22 | 20 | 12,0 | 57,3 | 31,9 | 30 | 25,35 | 20,75 | 20,55 | 6,0 | 32 | 32,50 | 7,30 | 22,95 | 22,95 | 3,35 | 3,35 | |
| 25 | 48 | 24 | 23 | 12,5 | 67,0 | 38,6 | 36 | 29,90 | 24,45 | 24,25 | 7,5 | 35 | 38,30 | 11,50 | 25,35 | 26,50 | 5,50 | 5,50 | |
| 30 | 60 | 30 | 28 | 16,0 | 75,3 | 45,0 | 42 | 35,35 | 28,55 | 28,35 | 7,0 | 40 | 48,40 | 14,60 | 28,80 | 30,50 | 6,05 | 6,05 | |
| 35 | 70 | 35 | 34 | 18,0 | 84,9 | 51,4 | 48 | 40,40 | 32,15 | 31,85 | 8,0 | 50 | 58,00 | 17,35 | 32,70 | 34,20 | 6,90 | 6,90 ¹⁾ | |

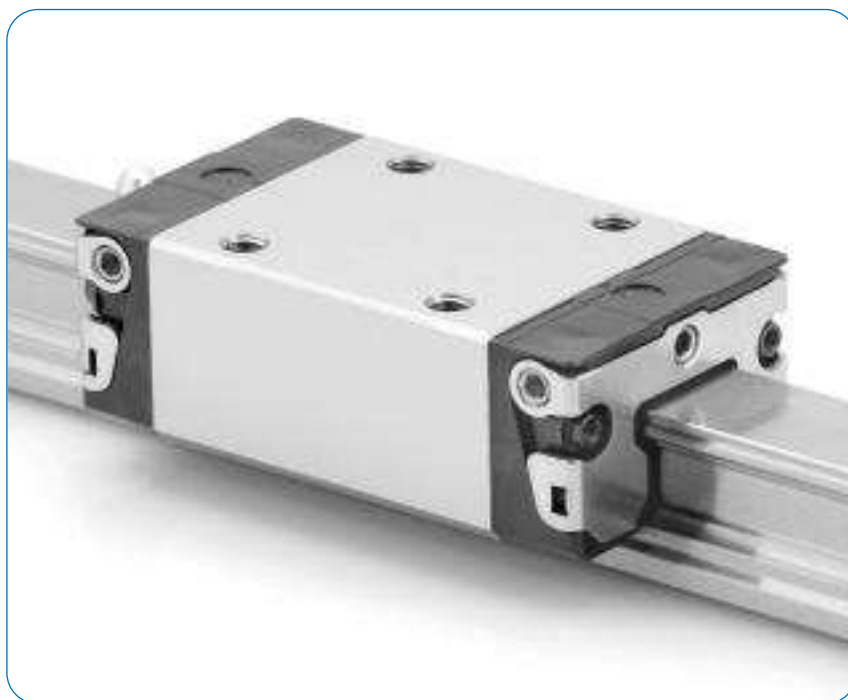
¹⁾ Dimension H₄ with cover strip.

²⁾ Dimension H₄ without cover strip

| Size | Dimensions (mm) | | | | | Weight (kg) | Load ratings (N) | | Moments (N _m) | | Moments (N _m) | |
|------|-----------------|--------------------------------|----------------|----------------|----------------|-------------|------------------|----------------------|---------------------------|-----------------------|---------------------------|----------------------|
| | N ₁ | H ₇ ^{±0,5} | S ₂ | d ₃ | M ₂ | | C dyn. | C ₀ stat. | M _C dyn. | M _{C0} stat. | M _A dyn. | M _B stat. |
| 15 | 6,0 | 10,3 | M4 | 4,4 | M2,5-3,5 depth | 0,10 | 5 400 | 8 100 | 52 | 80 | 19 | 28 |
| 20 | 7,5 | 13,2 | M5 | 6,0 | M3-5 depth | 0,25 | 12 400 | 13 600 | 150 | 170 | 52 | 58 |
| 25 | 9,0 | 15,2 | M6 | 7,0 | M3-5 depth | 0,35 | 15 900 | 18 200 | 230 | 260 | 82 | 94 |
| 30 | 12,0 | 17,0 | M8 | 9,0 | M3-5 depth | 0,60 | 22 100 | 24 800 | 380 | 430 | 133 | 150 |
| 35 | 13,0 | 20,5 | M8 | 9,0 | M3-5 depth | 0,90 | 29 300 | 32 400 | 640 | 700 | 200 | 220 |

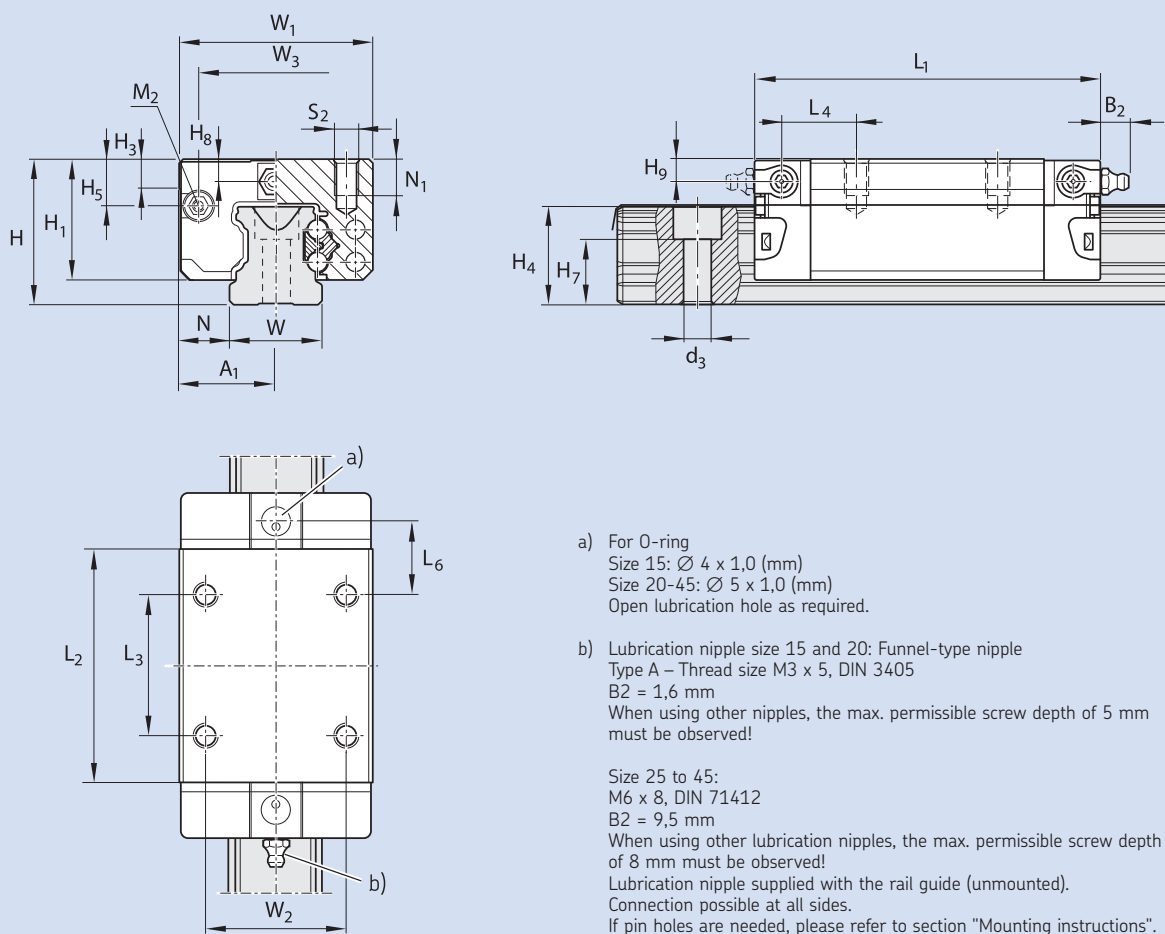
Carriage LLRHC xx U

Slim line normal. Standard height.

For type designation see
designation system**Dynamic values**Speed $v_{\max} = 5 \text{ m/s}$ Acceleration $a_{\max} = 500 \text{ m/s}^2$ 

| Size | Accuracy class | Type designation incl. preload class | | |
|------|----------------|--------------------------------------|------------------|------------------|
| | | T0 | T1 | T2 |
| 15 | P5 | LLRHC 15 U T0 P5 | LLRHC 15 U T1 P5 | LLRHC 15 U T2 P5 |
| | P3 | LLRHC 15 U T0 P3 | LLRHC 15 U T1 P3 | LLRHC 15 U T2 P3 |
| | P1 | LLRHC 15 U T0 P1 | LLRHC 15 U T1 P1 | LLRHC 15 U T2 P1 |
| 20 | P5 | LLRHC 20 U T0 P5 | LLRHC 20 U T1 P5 | LLRHC 20 U T2 P5 |
| | P3 | LLRHC 20 U T0 P3 | LLRHC 20 U T1 P3 | LLRHC 20 U T2 P3 |
| | P1 | LLRHC 20 U T0 P1 | LLRHC 20 U T1 P1 | LLRHC 20 U T2 P1 |
| 25 | P5 | LLRHC 25 U T0 P5 | LLRHC 25 U T1 P5 | LLRHC 25 U T2 P5 |
| | P3 | LLRHC 25 U T0 P3 | LLRHC 25 U T1 P3 | LLRHC 25 U T2 P3 |
| | P1 | LLRHC 25 U T0 P1 | LLRHC 25 U T1 P1 | LLRHC 25 U T2 P1 |
| 30 | P5 | LLRHC 30 U T0 P5 | LLRHC 30 U T1 P5 | LLRHC 30 U T2 P5 |
| | P3 | LLRHC 30 U T0 P3 | LLRHC 30 U T1 P3 | LLRHC 30 U T2 P3 |
| | P1 | LLRHC 30 U T0 P1 | LLRHC 30 U T1 P1 | LLRHC 30 U T2 P1 |
| 35 | P5 | LLRHC 35 U T0 P5 | LLRHC 35 U T1 P5 | LLRHC 35 U T2 P5 |
| | P3 | LLRHC 35 U T0 P3 | LLRHC 35 U T1 P3 | LLRHC 35 U T2 P3 |
| | P1 | LLRHC 35 U T0 P1 | LLRHC 35 U T1 P1 | LLRHC 35 U T2 P1 |
| 45 | P5 | LLRHC 45 U T0 P5 | LLRHC 45 U T1 P5 | LLRHC 45 U T2 P5 |
| | P3 | LLRHC 45 U T0 P3 | LLRHC 45 U T1 P3 | LLRHC 45 U T2 P3 |
| | P1 | LLRHC 45 U T0 P1 | LLRHC 45 U T1 P1 | LLRHC 45 U T2 P1 |

bold text = standard range



- a) For O-ring
 Size 15: $\varnothing 4 \times 1,0$ (mm)
 Size 20-45: $\varnothing 5 \times 1,0$ (mm)
 Open lubrication hole as required.
 - b) Lubrication nipple size 15 and 20: Funnel-type nipple
 Type A – Thread size M3 x 5, DIN 3405
 B2 = 1,6 mm
 When using other nipples, the max. permissible screw depth of 5 mm must be observed!
- Size 25 to 45:
 M6 x 8, DIN 71412
 B2 = 9,5 mm
 When using other lubrication nipples, the max. permissible screw depth of 8 mm must be observed!
 Lubrication nipple supplied with the rail guide (unmounted).
 Connection possible at all sides.
 If pin holes are needed, please refer to section "Mounting instructions".

| Size | Dimensions (mm) | | | | | | | | | | | | | | | | | | |
|------|-----------------|----------------|----|------|----------------|----------------|----|----------------|------------------------------|------------------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| | W ₁ | A ₁ | W | N | L ₁ | L ₂ | H | H ₁ | H ₄ ¹⁾ | H ₄ ²⁾ | H ₃ | W ₂ | L ₃ | W ₃ | H ₅ | L ₆ | L ₄ | H ₈ | H ₉ |
| 15 | 34 | 17 | 15 | 9,5 | 58,2 | 39,2 | 24 | 19,90 | 16,30 | 16,20 | 5,0 | 26 | 26 | 24,55 | 6,70 | 10,00 | 11,60 | 3,20 | 3,20 |
| 20 | 44 | 22 | 20 | 12,0 | 75,0 | 49,6 | 30 | 25,35 | 20,75 | 20,55 | 6,0 | 32 | 36 | 32,50 | 7,30 | 13,80 | 13,80 | 3,35 | 3,35 |
| 25 | 48 | 24 | 23 | 12,5 | 86,2 | 57,8 | 36 | 29,90 | 24,45 | 24,25 | 7,5 | 35 | 35 | 38,30 | 11,50 | 17,45 | 18,60 | 5,50 | 5,50 |
| 30 | 60 | 30 | 28 | 16,0 | 97,7 | 67,4 | 42 | 35,35 | 28,55 | 28,35 | 7,0 | 40 | 40 | 48,40 | 14,60 | 20,00 | 21,70 | 6,05 | 6,05 |
| 35 | 70 | 35 | 34 | 18,0 | 110,5 | 77,0 | 48 | 40,40 | 32,15 | 31,85 | 8,0 | 50 | 50 | 58,00 | 17,35 | 20,50 | 22,00 | 6,90 | 6,90 |
| 45 | 86 | 43 | 45 | 20,5 | 137,6 | 97,0 | 60 | 50,30 | 40,15 | 39,85 | 10,0 | 60 | 60 | 69,80 | 20,90 | 27,30 | 29,30 | 8,20 | 8,20 |

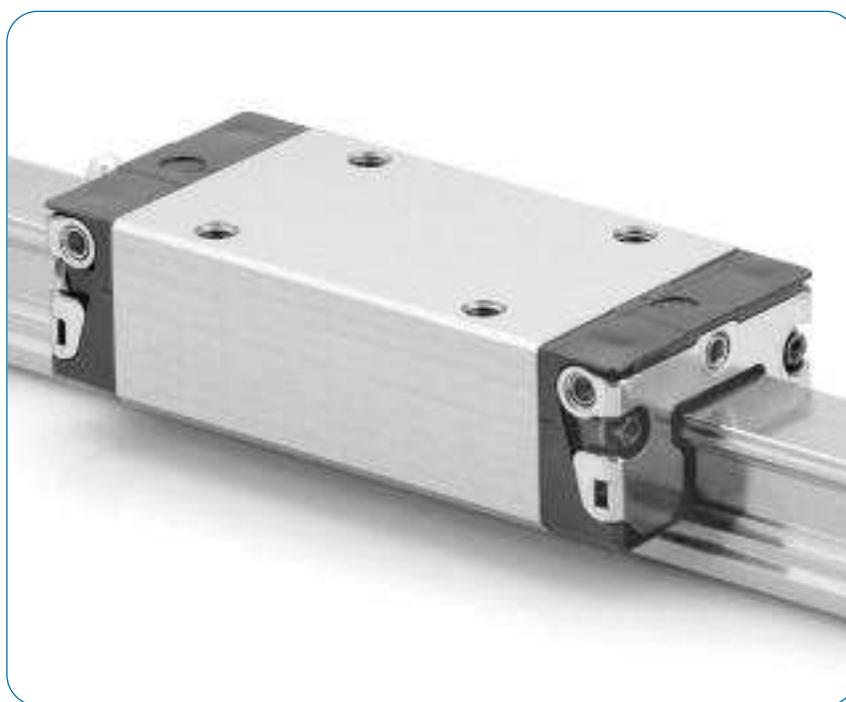
¹⁾ Dimension H₄ with cover strip.

²⁾ Dimension H₄ without cover strip

| Size | Dimensions (mm) | | | | | Weight (kg) | Load ratings (N) | | Moments (N _m) | | | |
|------|-----------------|--------------------------------|----------------|----------------|----------------|-------------|------------------|----------------------|---------------------------|-----------------------|---------------------|----------------------|
| | N ₁ | H ₇ ^{+0,5} | S ₂ | d ₃ | M ₂ | | C dyn. | C ₀ stat. | M _C dyn. | M _{C0} stat. | M _A dyn. | M _B stat. |
| 15 | 6,0 | 10,3 | M4 | 4,4 | M2,5-3,5 depth | 0,15 | 7 800 | 13 500 | 74 | 130 | 40 | 71 |
| 20 | 7,5 | 13,2 | M5 | 6,0 | M3-5 depth | 0,35 | 18 800 | 24 400 | 240 | 310 | 130 | 165 |
| 25 | 9,0 | 15,2 | M6 | 7,0 | M3-5 depth | 0,50 | 22 800 | 30 400 | 320 | 430 | 180 | 240 |
| 30 | 12,0 | 17,0 | M8 | 9,0 | M3-5 depth | 0,85 | 31 700 | 41 300 | 540 | 720 | 290 | 380 |
| 35 | 13,0 | 20,5 | M8 | 9,0 | M3-5 depth | 1,25 | 41 900 | 54 000 | 890 | 1 160 | 440 | 565 |
| 45 | 18,0 | 23,5 | M10 | 14,0 | M4-7 depth | 2,40 | 68 100 | 85 700 | 1 830 | 2 310 | 890 | 1 130 |

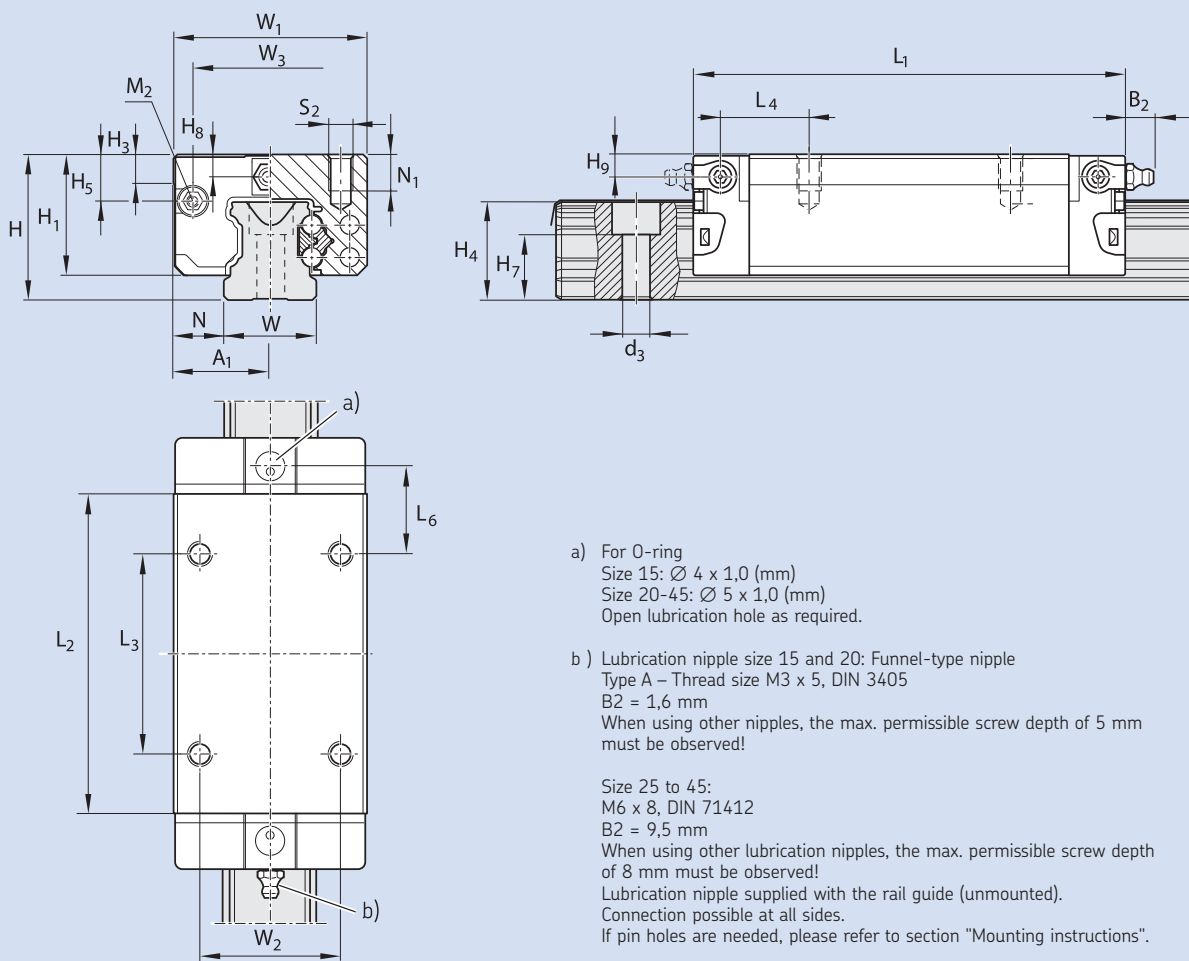
Carriage LLRHC xx LU

Slim line normal. Standard height.

For type designation see
designation system**Dynamic values**Speed $v_{\max} = 5 \text{ m/s}$ Acceleration $a_{\max} = 500 \text{ m/s}^2$ 

| Size | Accuracy class | Type designation incl. preload class | | |
|------|----------------|--------------------------------------|-------------------|-------------------|
| | | T0 | T1 | T2 |
| 15 | P5 | LLRHC 15 LU T0 P5 | LLRHC 15 LU T1 P5 | LLRHC 15 LU T2 P5 |
| | P3 | LLRHC 15 LU T0 P3 | LLRHC 15 LU T1 P3 | LLRHC 15 LU T2 P3 |
| | P1 | | LLRHC 15 LU T1 P1 | LLRHC 15 LU T2 P1 |
| 20 | P5 | LLRHC 20 LU T0 P5 | LLRHC 20 LU T1 P5 | LLRHC 20 LU T2 P5 |
| | P3 | LLRHC 20 LU T0 P3 | LLRHC 20 LU T1 P3 | LLRHC 20 LU T2 P3 |
| | P1 | | LLRHC 20 LU T1 P1 | LLRHC 20 LU T2 P1 |
| 25 | P5 | LLRHC 25 LU T0 P5 | LLRHC 25 LU T1 P5 | LLRHC 25 LU T2 P5 |
| | P3 | LLRHC 25 LU T0 P3 | LLRHC 25 LU T1 P3 | LLRHC 25 LU T2 P3 |
| | P1 | | LLRHC 25 LU T1 P1 | LLRHC 25 LU T2 P1 |
| 30 | P5 | LLRHC 30 LU T0 P5 | LLRHC 30 LU T1 P5 | LLRHC 30 LU T2 P5 |
| | P3 | LLRHC 30 LU T0 P3 | LLRHC 30 LU T1 P3 | LLRHC 30 LU T2 P3 |
| | P1 | | LLRHC 30 LU T1 P1 | LLRHC 30 LU T2 P1 |
| 35 | P5 | LLRHC 35 LU T0 P5 | LLRHC 35 LU T1 P5 | LLRHC 35 LU T2 P5 |
| | P3 | LLRHC 35 LU T0 P3 | LLRHC 35 LU T1 P3 | LLRHC 35 LU T2 P3 |
| | P1 | | LLRHC 35 LU T1 P1 | LLRHC 35 LU T2 P1 |
| 45 | P5 | LLRHC 45 LU T0 P5 | LLRHC 45 LU T1 P5 | LLRHC 45 LU T2 P5 |
| | P3 | LLRHC 45 LU T0 P3 | LLRHC 45 LU T1 P3 | LLRHC 45 LU T2 P3 |
| | P1 | | LLRHC 45 LU T1 P1 | LLRHC 45 LU T2 P1 |

bold text = Standard range



| Size | Dimensions (mm) | | | | | | | | | | | | | | | | | | |
|------|-----------------|----------------|----|------|----------------|----------------|----|----------------|------------------------------|------------------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| | W ₁ | A ₁ | W | N | L ₁ | L ₂ | H | H ₁ | H ₁ ¹⁾ | H ₂ ²⁾ | H ₃ | W ₂ | L ₃ | W ₃ | H ₅ | L ₆ | L ₄ | H ₈ | H ₉ |
| 15 | 34 | 17 | 15 | 9,5 | 72,6 | 53,6 | 24 | 19,90 | 16,30 | 16,20 | 5,0 | 26 | 26 | 24,55 | 6,70 | 17,20 | 18,80 | 3,20 | 3,20 |
| 20 | 44 | 22 | 20 | 12,0 | 91,0 | 65,6 | 30 | 25,35 | 20,75 | 20,55 | 6,0 | 32 | 50 | 32,50 | 7,30 | 14,80 | 14,80 | 3,35 | 3,35 |
| 25 | 48 | 24 | 23 | 12,5 | 107,9 | 79,5 | 36 | 29,90 | 24,45 | 24,25 | 7,5 | 35 | 50 | 38,30 | 11,50 | 20,80 | 21,95 | 5,50 | 5,50 |
| 30 | 60 | 30 | 28 | 16,0 | 119,7 | 89,4 | 42 | 35,35 | 28,55 | 28,35 | 7,0 | 40 | 60 | 48,40 | 14,60 | 21,00 | 22,70 | 6,05 | 6,05 |
| 35 | 70 | 35 | 34 | 18,0 | 139,0 | 105,5 | 48 | 40,40 | 32,15 | 31,85 | 8,0 | 50 | 72 | 58,00 | 17,35 | 23,75 | 25,25 | 6,90 | 6,90 |
| 45 | 86 | 43 | 45 | 20,5 | 174,1 | 133,5 | 60 | 50,30 | 40,15 | 39,85 | 10,0 | 60 | 80 | 69,80 | 20,90 | 35,50 | 37,50 | 8,20 | 8,20 |

¹⁾ Dimension H₄ with cover strip.

²⁾ Dimension H₄ without cover strip

| Size | Dimensions (mm) | | | | Weight (kg) | Load ratings (N) | Moments (N _m) | | | | |
|------|-----------------|--------------------------------|----------------|----------------|-------------|------------------|---------------------------|----------------------|---------------------|-----------------------|---------------------|
| | N ₁ | H ₇ ^{+0,5} | S ₂ | d ₃ | | | C dyn. | C ₀ stat. | M _C dyn. | M _{C0} stat. | M _A dyn. |
| 15 | 6,0 | 10,3 | M4 | 4,4 | 0,20 | 10 000 | 20 200 | 130 | 190 | 98 | 150 |
| 20 | 7,5 | 13,2 | M5 | 6,0 | 0,45 | 24 400 | 35 200 | 310 | 450 | 225 | 330 |
| 25 | 9,0 | 15,2 | M6 | 7,0 | 0,65 | 30 400 | 45 500 | 430 | 650 | 345 | 510 |
| 30 | 12,0 | 17,0 | M8 | 9,0 | 1,10 | 40 000 | 57 800 | 690 | 1 000 | 495 | 715 |
| 35 | 13,0 | 20,5 | M8 | 9,0 | 1,70 | 55 600 | 81 000 | 1 200 | 1 740 | 830 | 1 215 |
| 45 | 18,0 | 23,5 | M10 | 14,0 | 3,20 | 90 400 | 128 500 | 2 440 | 3 470 | 1 700 | 2 425 |

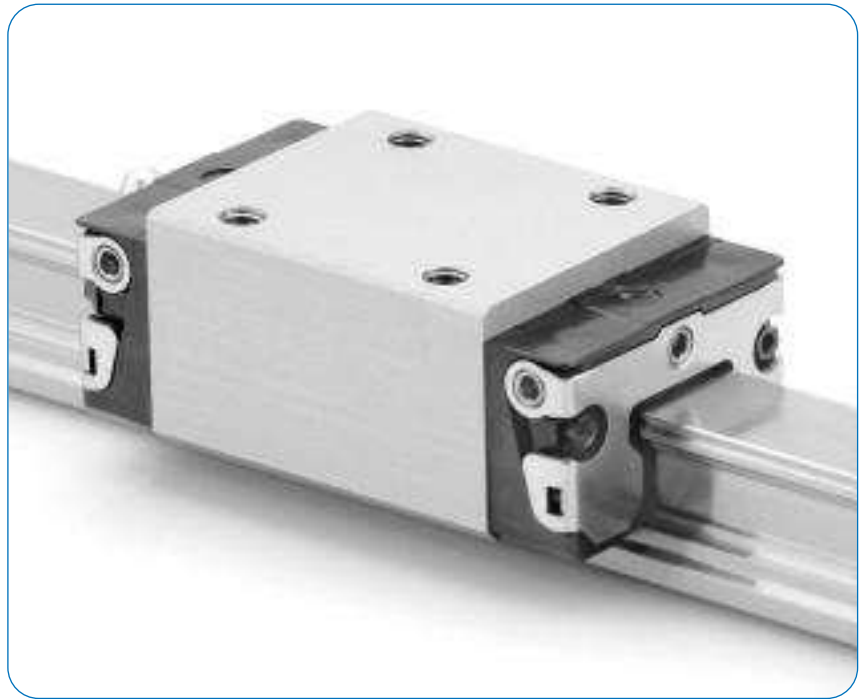
Carriage LLRHC xx R
Slim line normal. High.

For type designation see
designation system

Dynamic values

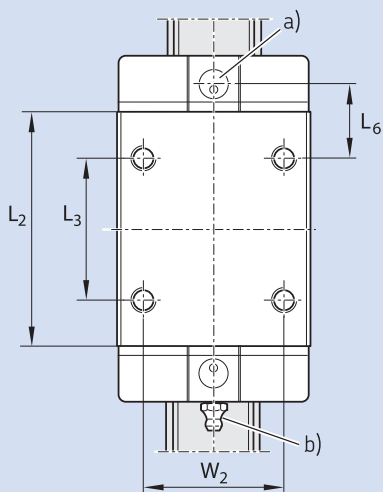
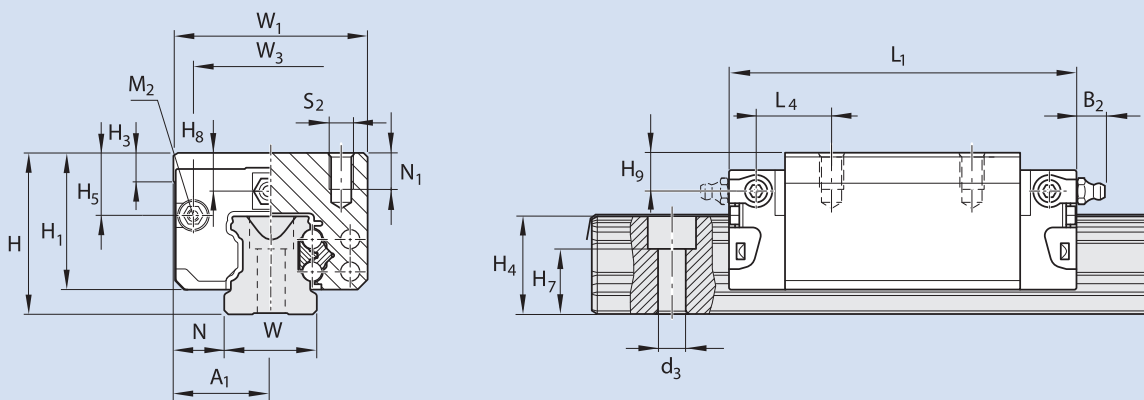
Speed $v_{\max} = 5 \text{ m/s}$

Acceleration $a_{\max} = 500 \text{ m/s}^2$



| Size | Accuracy class | Type designation incl. preload class | | |
|------|----------------|--------------------------------------|-------------------------|-------------------------|
| | | T0 | T1 | T2 |
| 15 | P5 | LLRHC 15 R T0 P5 | LLRHC 15 R T1 P5 | LLRHC 15 R T2 P5 |
| | P3 | LLRHC 15 R T0 P3 | LLRHC 15 R T1 P3 | LLRHC 15 R T2 P3 |
| | P1 | | LLRHC 15 R T1 P1 | LLRHC 15 R T2 P1 |
| 25 | P5 | LLRHC 25 R T0 P5 | LLRHC 25 R T1 P5 | LLRHC 25 R T2 P5 |
| | P3 | LLRHC 25 R T0 P3 | LLRHC 25 R T1 P3 | LLRHC 25 R T2 P3 |
| | P1 | | LLRHC 25 R T1 P1 | LLRHC 25 R T2 P1 |
| 30 | P5 | LLRHC 30 R T0 P5 | LLRHC 30 R T1 P5 | LLRHC 30 R T2 P5 |
| | P3 | LLRHC 30 R T0 P3 | LLRHC 30 R T1 P3 | LLRHC 30 R T2 P3 |
| | P1 | | LLRHC 30 R T1 P1 | LLRHC 30 R T2 P1 |
| 35 | P5 | LLRHC 35 R T0 P5 | LLRHC 35 R T1 P5 | LLRHC 35 R T2 P5 |
| | P3 | LLRHC 35 R T0 P3 | LLRHC 35 R T1 P3 | LLRHC 35 R T2 P3 |
| | P1 | | LLRHC 35 R T1 P1 | LLRHC 35 R T2 P1 |
| 45 | P5 | LLRHC 45 R T0 P5 | LLRHC 45 R T1 P5 | LLRHC 45 R T2 P5 |
| | P3 | LLRHC 45 R T0 P3 | LLRHC 45 R T1 P3 | LLRHC 45 R T2 P3 |
| | P1 | | LLRHC 45 R T1 P1 | LLRHC 45 R T2 P1 |

bold text = Standard range



- a) For O-ring
 Size 15: $\varnothing 4 \times 1,0$ (mm)
 Size 20-45: $\varnothing 5 \times 1,0$ (mm)
 Open lubrication hole as required.
 - b) Lubrication nipple size 15 and 20: Funnel-type nipple
 Type A – Thread size M3 x 5, DIN 3405
 B2 = 1,6 mm
 When using other nipples, the max. permissible screw depth of 5 mm must be observed!
- Size 25 to 45:
 M6 x 8, DIN 71412
 B2 = 9,5 mm
 When using other lubrication nipples, the max. permissible screw depth of 8 mm must be observed!
 Lubrication nipple supplied with the rail guide (unmounted).
 Connection possible at all sides.
 If pin holes are needed, please refer to section "Mounting instructions".

| Size | Dimensions (mm) | | | | | | | | | | | | | | | | | | |
|------|-----------------|----------------|----|------|----------------|----------------|----|----------------|------------------------------|------------------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| | W ₁ | A ₁ | W | N | L ₁ | L ₂ | H | H ₁ | H ₄ ¹⁾ | H ₄ ²⁾ | H ₃ | W ₂ | L ₃ | W ₃ | H ₅ | L ₆ | L ₄ | H ₈ | H ₉ |
| 15 | 34 | 17 | 15 | 9,5 | 58,2 | 39,2 | 28 | 23,90 | 16,30 | 16,20 | 5,0 | 26 | 26 | 24,55 | 10,70 | 10,00 | 11,60 | 7,20 | 7,20 |
| 25 | 48 | 24 | 23 | 12,5 | 86,2 | 57,8 | 40 | 33,90 | 24,45 | 24,25 | 7,5 | 35 | 35 | 38,30 | 15,50 | 17,45 | 18,60 | 9,50 | 9,50 |
| 30 | 60 | 30 | 28 | 16,0 | 97,7 | 67,4 | 45 | 38,35 | 28,55 | 28,35 | 7,0 | 40 | 40 | 48,40 | 17,60 | 20,00 | 21,70 | 9,05 | 9,05 |
| 35 | 70 | 35 | 34 | 18,0 | 110,5 | 77,0 | 55 | 47,40 | 32,15 | 31,85 | 8,0 | 50 | 50 | 58,00 | 24,35 | 20,50 | 22,00 | 13,90 | 13,90 |
| 45 | 86 | 43 | 45 | 20,5 | 137,6 | 97,0 | 70 | 60,30 | 40,15 | 39,85 | 10,0 | 60 | 60 | 69,80 | 30,90 | 27,30 | 29,30 | 18,20 | 18,20 |

¹⁾ Dimension H₄ with cover strip.

²⁾ Dimension H₄ without cover strip

| Size | Dimensions (mm) | | | | Weight (kg) | Load ratings (N) | | Moments (N _m) | | Moments (N _m) | | |
|------|-----------------|--------------------------------|----------------|----------------|----------------|------------------|--------|---------------------------|---------------------|---------------------------|---------------------|----------------------|
| | N ₁ | H ₇ ^{+0,5} | S ₂ | d ₃ | | M ₂ | C dyn. | C ₀ stat. | M _C dyn. | M _{C0} stat. | M _A dyn. | M _B stat. |
| 15 | 6,0 | 10,3 | M4 | 4,4 | M2,5-3,5 depth | 0,20 | 7 800 | 13 500 | 74 | 130 | 40 | 71 |
| 25 | 9,0 | 15,2 | M6 | 7,0 | M3-5 depth | 0,60 | 22 800 | 30 400 | 320 | 430 | 180 | 240 |
| 30 | 12,0 | 17,0 | M8 | 9,0 | M3-5 depth | 0,95 | 31 700 | 41 300 | 540 | 720 | 290 | 380 |
| 35 | 13,0 | 20,5 | M8 | 9,0 | M3-5 depth | 1,55 | 41 900 | 54 000 | 890 | 1 160 | 440 | 565 |
| 45 | 18,0 | 23,5 | M10 | 14,0 | M4-7 depth | 3,00 | 68 100 | 85 700 | 1 830 | 2 310 | 890 | 1130 |

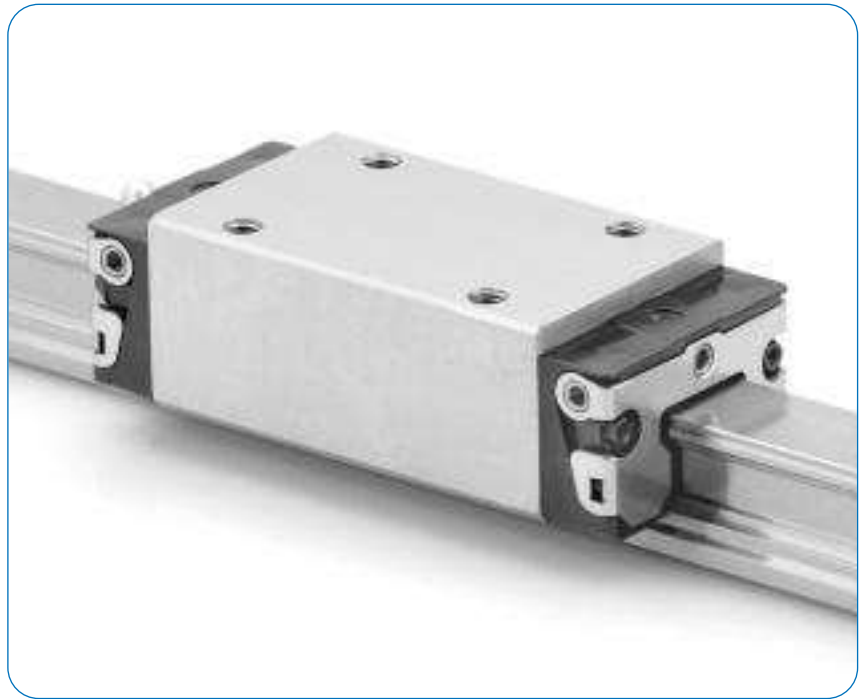
Carriage LLRHC xx LR
Slim line long. High.

For type designation see
designation system

Dynamic values

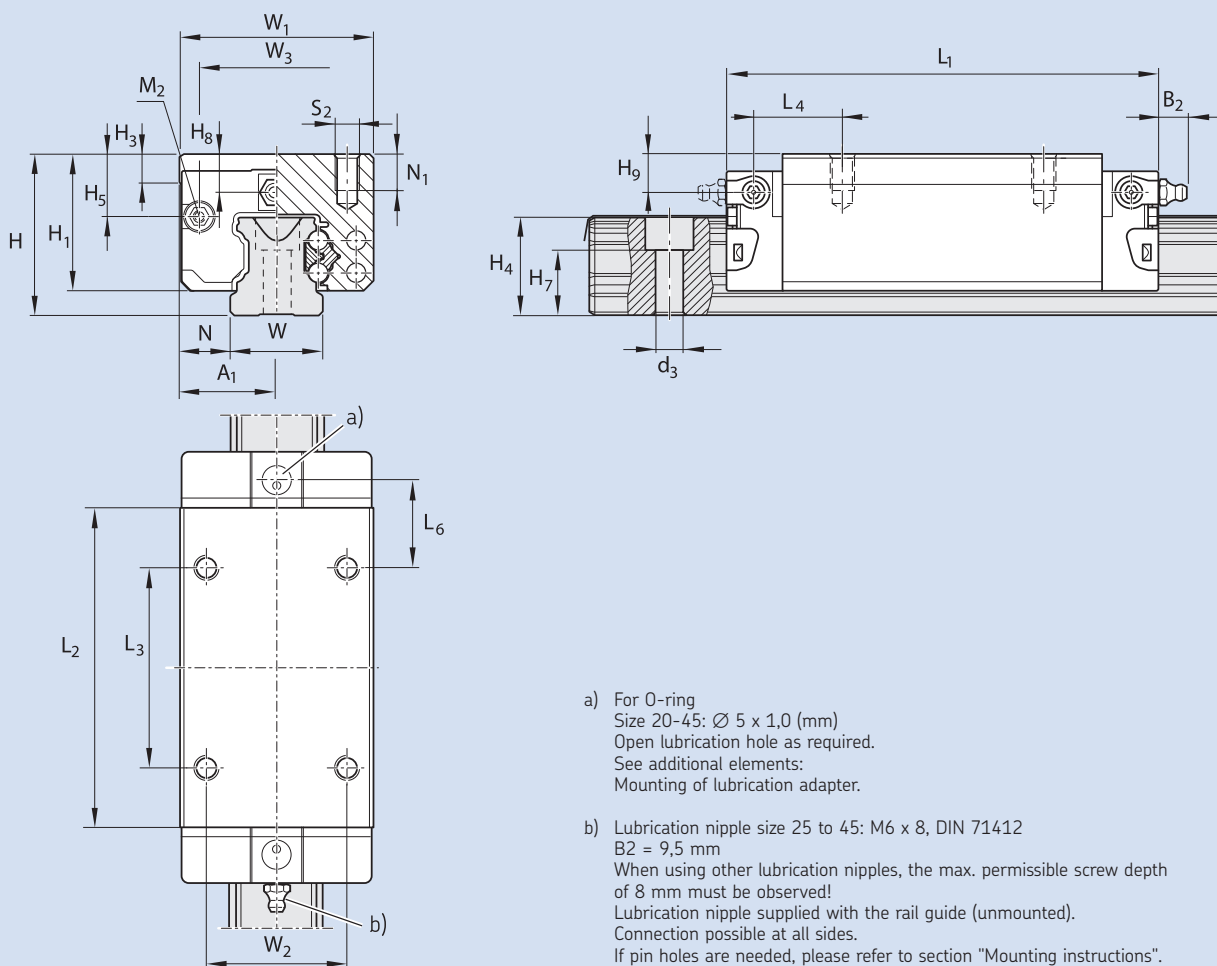
Speed $v_{\max} = 5 \text{ m/s}$

Acceleration $a_{\max} = 500 \text{ m/s}^2$



| Size | Accuracy class | Type designation incl. preload class | | |
|------|----------------|--------------------------------------|--------------------------|--------------------------|
| | | T0 | T1 | T2 |
| 25 | P5 | LLRHC 25 LR T0 P5 | LLRHC 25 LR T1 P5 | LLRHC 25 LR T2 P5 |
| | P3 | LLRHC 25 LR T0 P3 | LLRHC 25 LR T1 P3 | LLRHC 25 LR T2 P3 |
| | P1 | | LLRHC 25 LR T1 P1 | LLRHC 25 LR T2 P1 |
| 30 | P5 | LLRHC 30 LR T0 P5 | LLRHC 30 LR T1 P5 | LLRHC 30 LR T2 P5 |
| | P3 | LLRHC 30 LR T0 P3 | LLRHC 30 LR T1 P3 | LLRHC 30 LR T2 P3 |
| | P1 | | LLRHC 30 LR T1 P1 | LLRHC 30 LR T2 P1 |
| 35 | P5 | LLRHC 35 LR T0 P5 | LLRHC 35 LR T1 P5 | LLRHC 35 LR T2 P5 |
| | P3 | LLRHC 35 LR T0 P3 | LLRHC 35 LR T1 P3 | LLRHC 35 LR T2 P3 |
| | P1 | | LLRHC 35 LR T1 P1 | LLRHC 35 LR T2 P1 |
| 45 | P5 | LLRHC 45 LR T0 P5 | LLRHC 45 LR T1 P5 | LLRHC 45 LR T2 P5 |
| | P3 | LLRHC 45 LR T0 P3 | LLRHC 45 LR T1 P3 | LLRHC 45 LR T2 P3 |
| | P1 | | LLRHC 45 LR T1 P1 | LLRHC 45 LR T2 P1 |

bold text = Standard range

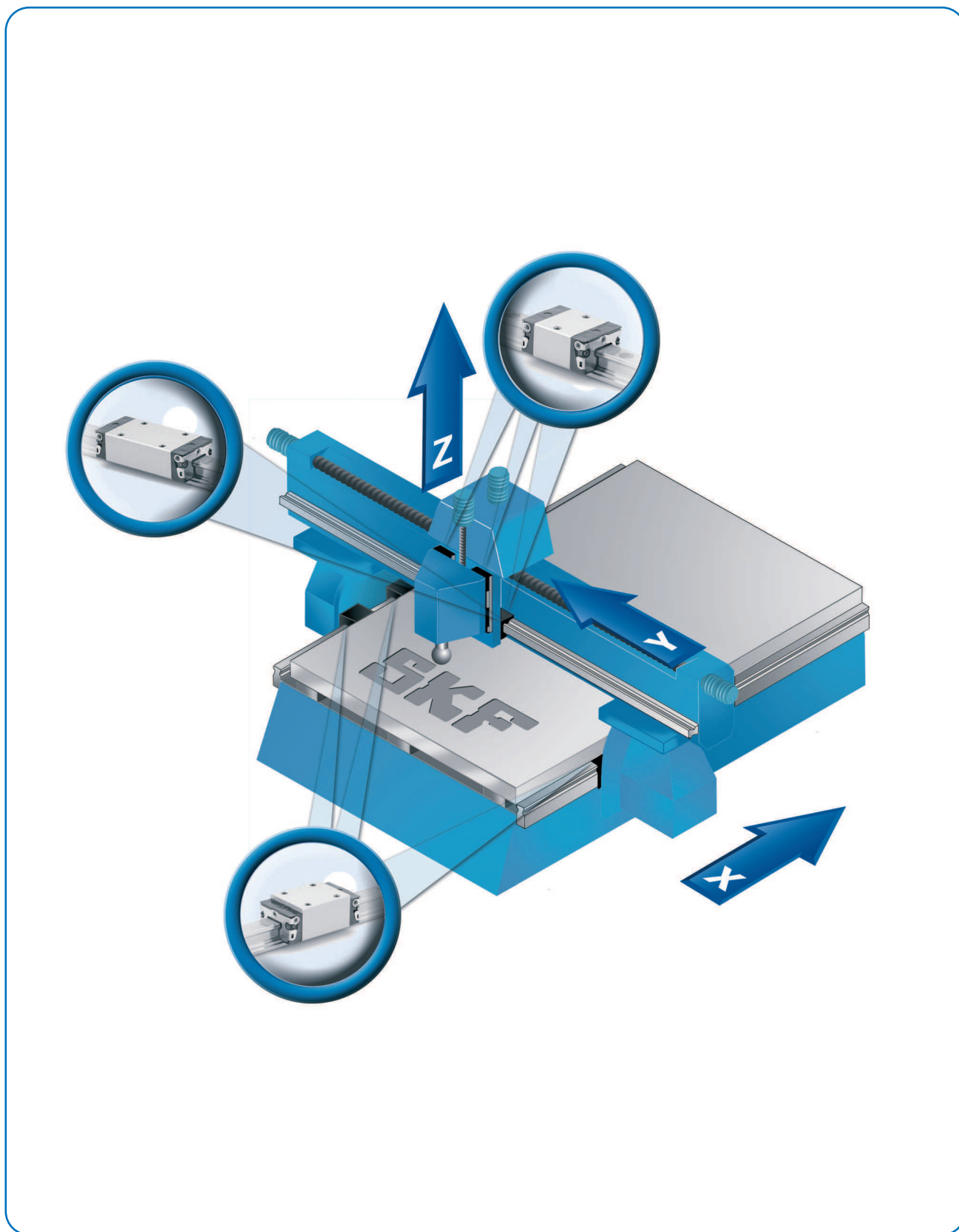


| Size | Dimensions (mm) | | | | | | | | | | | | | | | | | | |
|------|-----------------|----------------|----|------|----------------|----------------|----|----------------|------------------------------|------------------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| | W ₁ | A ₁ | W | N | L ₁ | L ₂ | H | H ₁ | H ₄ ¹⁾ | H ₄ ²⁾ | H ₃ | W ₂ | L ₃ | W ₃ | H ₅ | L ₆ | L ₄ | H ₈ | H ₉ |
| 25 | 48 | 24 | 23 | 12,5 | 107,9 | 79,5 | 40 | 33,90 | 24,45 | 24,25 | 7,5 | 35 | 50 | 38,30 | 15,50 | 20,80 | 21,95 | 9,50 | 9,50 |
| 30 | 60 | 30 | 28 | 16,0 | 119,7 | 89,4 | 45 | 38,35 | 28,55 | 28,35 | 7,0 | 40 | 60 | 48,40 | 17,60 | 21,00 | 22,70 | 9,05 | 9,05 |
| 35 | 70 | 35 | 34 | 18,0 | 139,0 | 105,5 | 55 | 47,40 | 32,15 | 31,85 | 8,0 | 50 | 72 | 58,00 | 24,35 | 23,75 | 25,25 | 13,90 | 13,90 |
| 45 | 86 | 43 | 45 | 20,5 | 174,1 | 133,5 | 70 | 60,30 | 40,15 | 39,85 | 10,0 | 60 | 80 | 69,80 | 30,90 | 35,50 | 37,50 | 18,20 | 18,20 |

¹⁾ Dimension H₄ with cover strip.

²⁾ Dimension H₄ without cover strip

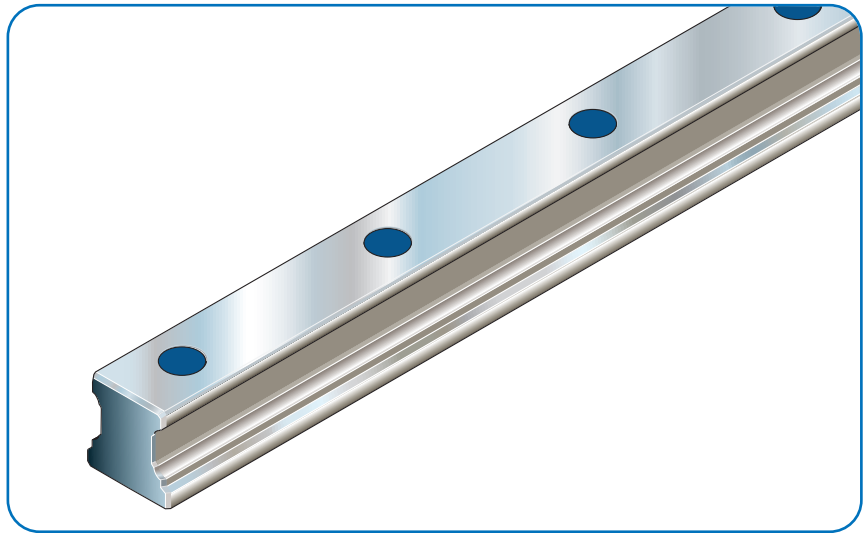
| Size | Dimensions (mm) | | | | Weight (kg) | Load ratings (N) | | Moments (N _m) | | | | |
|------|-----------------|--------------------------------|----------------|----------------|-------------|------------------|----------------------|---------------------------|-----------------------|---------------------|----------------------|---------------------|
| | N ₁ | H ₇ ^{+0,5} | S ₂ | d ₃ | | C dyn. | C ₀ stat. | M _C dyn. | M _{C0} stat. | M _A dyn. | M _B stat. | |
| 25 | 9,0 | 15,2 | M6 | 7,0 | M3-5 depth | 0,80 | 30 400 | 45 500 | 430 | 650 | 345 | 510 |
| 30 | 12,0 | 17,0 | M8 | 9,0 | M3-5 depth | 1,20 | 40 000 | 57 800 | 690 | 1 000 | 495 | 715 |
| 35 | 13,0 | 20,5 | M8 | 9,0 | M3-5 depth | 2,10 | 55 600 | 81 000 | 1 200 | 1 740 | 830 | 1 215 |
| 45 | 18,0 | 23,5 | M10 | 14,0 | M4-7 depth | 4,10 | 90 400 | 128 500 | 2 440 | 3 470 | 1 700 | 2 425 ³⁾ |



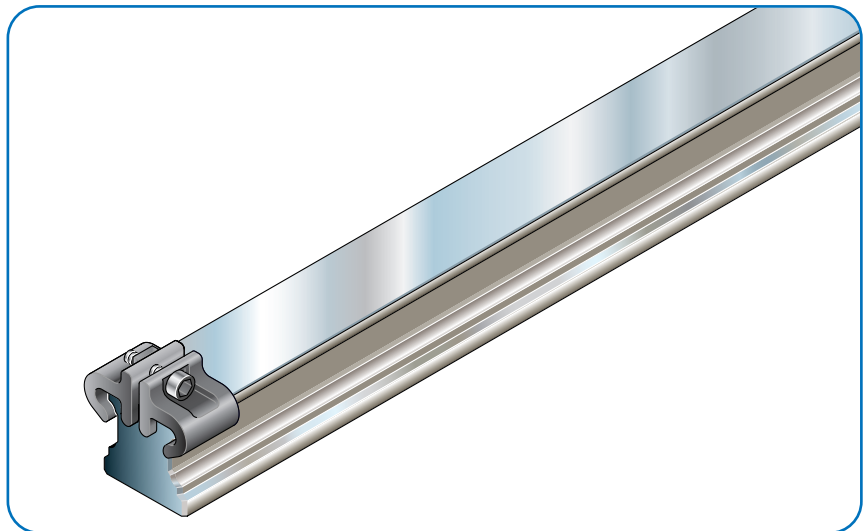
Standard rails

Product overview

Rails with protective caps made of plastics



Rails with cover strip and cover strip retaining clamps made of aluminium
- without end face threaded holes
(not required)



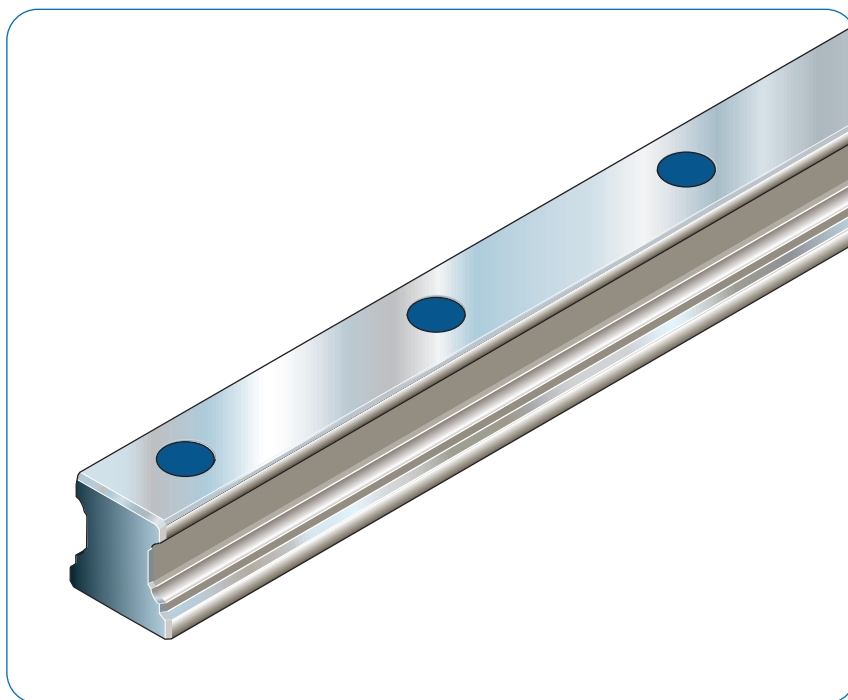
Accuracy classes, dimensions and designations

LLRHR rails

For mounting from above with plastic mounting caps (supplied).

Note

The rails can also be supplied in several parts.

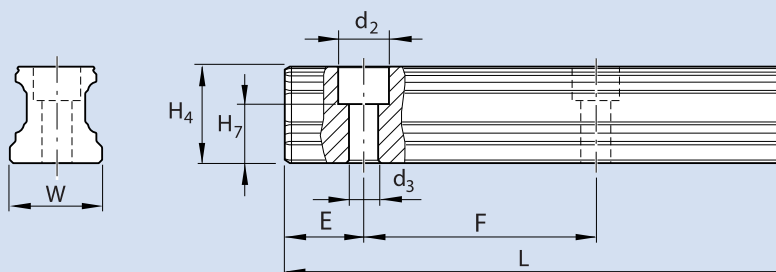


Type designation and rail lengths

| Standard rail | | Rail one-piece | Rail multi-piece | Pitch |
|---------------|----------|----------------------|------------------------|--------|
| Size | Accuracy | Designation | Designation | T [mm] |
| 15 | P5 | LLRHR 15 - xxxx P5 | LLRHR 15 - xxxx P5 A | 60 |
| | P3 | LLRHR 15 - xxxx P3 | LLRHR 15 - xxxx P3 A | |
| | P1 | LLRHR 15 - xxxx P1 | LLRHR 15 - xxxx P1 A | |
| | P01 | LLRHR 15 - xxxx P01 | LLRHR 15 - xxxx P01 A | |
| | P001 | LLRHR 15 - xxxx P001 | LLRHR 15 - xxxx P001 A | |
| | | | | |
| 20 | P5 | LLRHR 20 - xxxx P5 | LLRHR 20 - xxxx P5 A | 60 |
| | P3 | LLRHR 20 - xxxx P3 | LLRHR 20 - xxxx P3 A | |
| | P1 | LLRHR 20 - xxxx P1 | LLRHR 20 - xxxx P1 A | |
| | P01 | LLRHR 20 - xxxx P01 | LLRHR 20 - xxxx P01 A | |
| | P001 | LLRHR 20 - xxxx P001 | LLRHR 20 - xxxx P001 A | |
| | | | | |
| 25 | P5 | LLRHR 25 - xxxx P5 | LLRHR 25 - xxxx P5 A | 60 |
| | P3 | LLRHR 25 - xxxx P3 | LLRHR 25 - xxxx P3 A | |
| | P1 | LLRHR 25 - xxxx P1 | LLRHR 25 - xxxx P1 A | |
| | P01 | LLRHR 25 - xxxx P01 | LLRHR 25 - xxxx P01 A | |
| | P001 | LLRHR 25 - xxxx P001 | LLRHR 25 - xxxx P001 A | |
| | | | | |
| 30 | P5 | LLRHR 30 - xxxx P5 | LLRHR 30 - xxxx P5 A | 80 |
| | P3 | LLRHR 30 - xxxx P3 | LLRHR 30 - xxxx P3 A | |
| | P1 | LLRHR 30 - xxxx P1 | LLRHR 30 - xxxx P1 A | |
| | P01 | LLRHR 30 - xxxx P01 | LLRHR 30 - xxxx P01 A | |
| | P001 | LLRHR 30 - xxxx P001 | LLRHR 30 - xxxx P001 A | |
| | | | | |
| 35 | P5 | LLRHR 35 - xxxx P5 | LLRHR 35 - xxxx P5 A | 80 |
| | P3 | LLRHR 35 - xxxx P3 | LLRHR 35 - xxxx P3 A | |
| | P1 | LLRHR 35 - xxxx P1 | LLRHR 35 - xxxx P1 A | |
| | P01 | LLRHR 35 - xxxx P01 | LLRHR 35 - xxxx P01 A | |
| | P001 | LLRHR 35 - xxxx P001 | LLRHR 35 - xxxx P001 A | |
| | | | | |
| 45 | P5 | LLRHR 45 - xxxx P5 | LLRHR 45 - xxxx P5 A | 105 |
| | P3 | LLRHR 45 - xxxx P3 | LLRHR 45 - xxxx P3 A | |
| | P1 | LLRHR 45 - xxxx P1 | LLRHR 45 - xxxx P1 A | |
| | P01 | LLRHR 45 - xxxx P01 | LLRHR 45 - xxxx P01 A | |
| | P001 | LLRHR 45 - xxxx P001 | LLRHR 45 - xxxx P001 A | |
| | | | | |

bold text = standard range

xxxx = rail length



| Size | Dimensions (mm) | | | H ₇ ^{+0.5} | d ₂ | d ₃ | E _{1 min} | F | L _{max} | Weight kg/m |
|------|-----------------|----------------|----------------|--------------------------------|----------------|----------------|--------------------|-------|------------------|----------------|
| | W | H ₄ | H ₇ | | | | | | | |
| 15 | 15 | 16,20 | 10,3 | 7,4 | 4,4 | 10 | 60 | 4 000 | 1,4 | |
| 20 | 20 | 20,55 | 13,2 | 9,4 | 6,0 | 10 | 60 | 4 000 | 2,4 | |
| 25 | 23 | 24,25 | 15,2 | 11,0 | 7,0 | 10 | 60 | 4 000 | 3,2 | |
| 30 | 28 | 28,35 | 17,0 | 15,0 | 9,0 | 12 | 80 | 4 000 | 5,0 | |
| 35 | 34 | 31,85 | 20,5 | 15,0 | 9,0 | 12 | 80 | 4 000 | 6,8 | |
| 45 | 45 | 39,85 | 23,5 | 20,0 | 14,0 | 16 | 105 | 4 000 | 10,5 | |

The “E” dimension designates the distance from the rail end to the centre of the first attachment hole. If no customer-specific “E” dimension is provided with the order, the rails are produced according to the following formula:

$$E = \frac{L - (z - 1) \times F}{2}$$

- E = Rail end dimension
- F = Distance of attachment holes
- L = Rail length
- z = Number of attachment holes

The distance of the first and last attachment holes is mediated.

If several possibilities arise, the shorter “E” dimension will be produced!

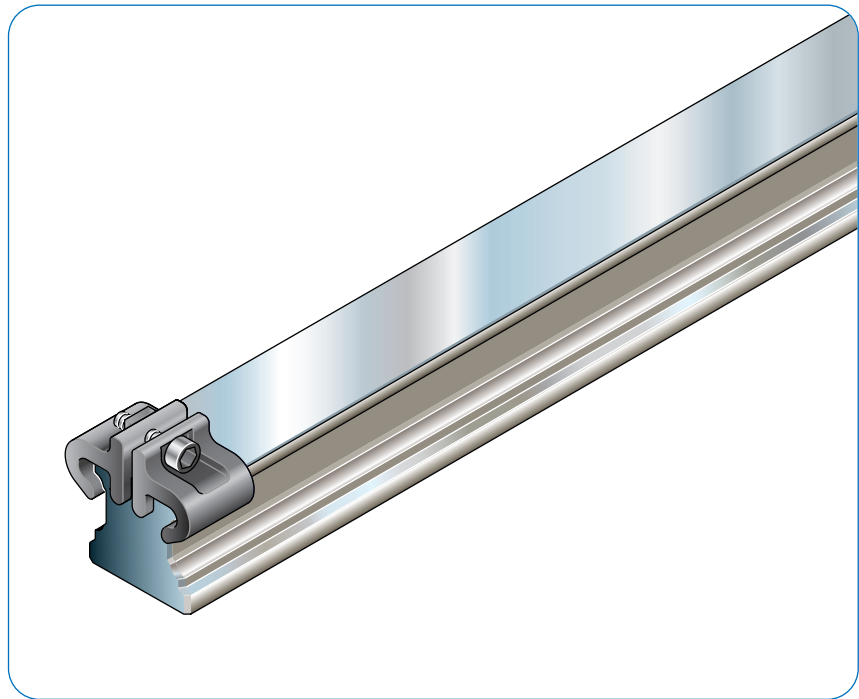
LLRHR D2 rails

For mounting from above with cover strip and strip retaining clamps.

- Robust cover strip retaining clamps made of aluminium
- Rail without end face threaded holes (not required for cover strip retaining clamps)

Note

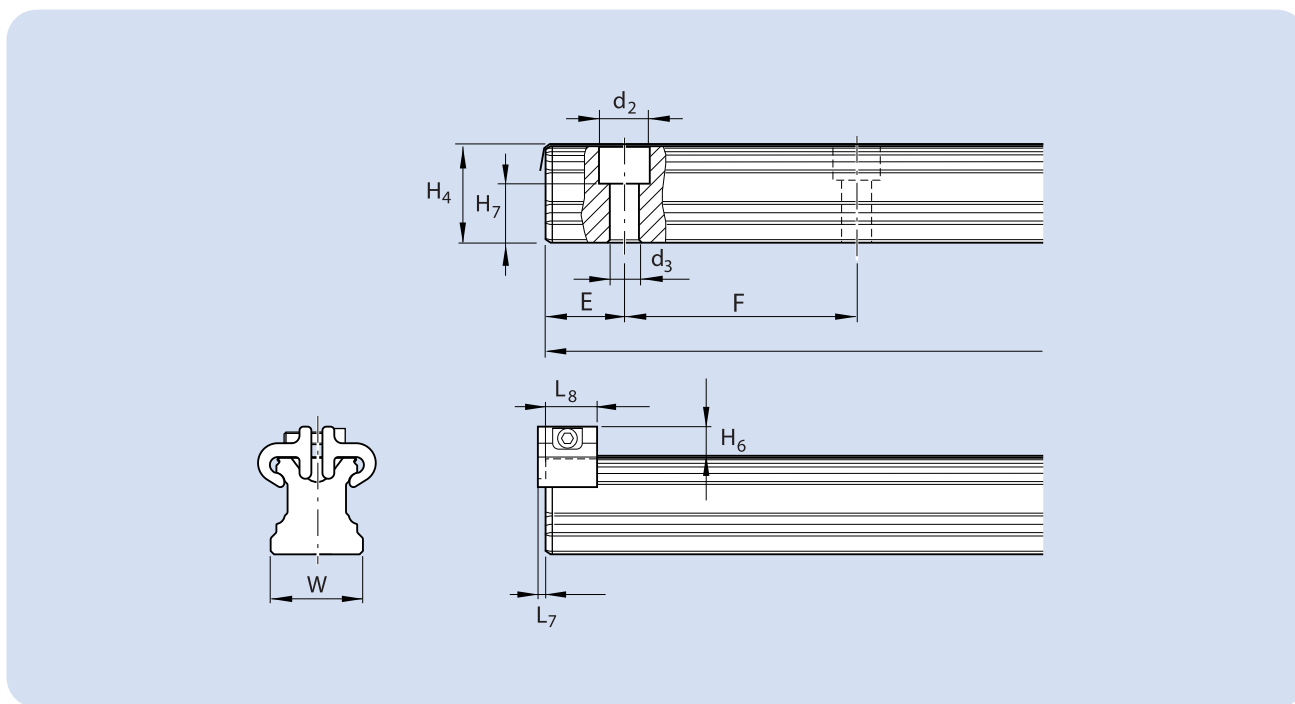
The rails can also be supplied in several parts.



Type designation and rail lengths

| Standard rail | | Rail one-piece Designation | Rail multi-piece Designation | Pitch T [mm] |
|---------------|---------|----------------------------|------------------------------|-------------------------|
| 15 | P5 D2 | LLRHR 15 - xxxx P5 D2 | LLRHR 15 - xxxx P5 A D2 | 60 |
| | P3 D2 | LLRHR 15 - xxxx P3 D2 | LLRHR 15 - xxxx P3 A D2 | |
| | P1 D2 | LLRHR 15 - xxxx P1 D2 | LLRHR 15 - xxxx P1 A D2 | |
| | P01 D2 | LLRHR 15 - xxxx P01 D2 | LLRHR 15 - xxxx P01 A D2 | |
| | P001 D2 | LLRHR 15 - xxxx P001 D2 | LLRHR 15 - xxxx P001 A D2 | |
| | 20 | P5 D2 | LLRHR 20 - xxxx P5 D2 | |
| P3 D2 | | LLRHR 20 - xxxx P3 D2 | LLRHR 20 - xxxx P3 A D2 | |
| P1 D2 | | LLRHR 20 - xxxx P1 D2 | LLRHR 20 - xxxx P1 A D2 | |
| P01 D2 | | LLRHR 20 - xxxx P01 D2 | LLRHR 20 - xxxx P01 A D2 | |
| P001 D2 | | LLRHR 20 - xxxx P001 D2 | LLRHR 20 - xxxx P001 A D2 | |
| 25 | | P5 D2 | LLRHR 25 - xxxx P5 D2 | LLRHR 25 - xxxx P5 A D2 |
| | P3 D2 | LLRHR 25 - xxxx P3 D2 | LLRHR 25 - xxxx P3 A D2 | |
| | P1 D2 | LLRHR 25 - xxxx P1 D2 | LLRHR 25 - xxxx P1 A D2 | |
| | P01 D2 | LLRHR 25 - xxxx P01 D2 | LLRHR 25 - xxxx P01 A D2 | |
| | P001 | LLRHR 25 - xxxx P001 D2 | LLRHR 25 - xxxx P001 A D2 | |
| | 30 | P5 D2 | LLRHR 30 - xxxx P5 D2 | LLRHR 30 - xxxx P5 A D2 |
| P3 D2 | | LLRHR 30 - xxxx P3 D2 | LLRHR 30 - xxxx P3 A D2 | |
| P1 D2 | | LLRHR 30 - xxxx P1 D2 | LLRHR 30 - xxxx P1 A D2 | |
| P01 D2 | | LLRHR 30 - xxxx P01 D2 | LLRHR 30 - xxxx P01 A D2 | |
| P001 D2 | | LLRHR 30 - xxxx P001 D2 | LLRHR 30 - xxxx P001 A D2 | |
| 35 | | P5 D2 | LLRHR 35 - xxxx P5 D2 | LLRHR 35 - xxxx P5 A D2 |
| | P3 D2 | LLRHR 35 - xxxx P3 D2 | LLRHR 35 - xxxx P3 A D2 | |
| | P1 D2 | LLRHR 35 - xxxx P1 D2 | LLRHR 35 - xxxx P1 A D2 | |
| | P01 D2 | LLRHR 35 - xxxx P01 D2 | LLRHR 35 - xxxx P01 A D2 | |
| | P001 D2 | LLRHR 35 - xxxx P001 D2 | LLRHR 35 - xxxx P001 A D2 | |
| | 45 | P5 D2 | LLRHR 45 - xxxx P5 D2 | LLRHR 45 - xxxx P5 A D2 |
| P3 D2 | | LLRHR 45 - xxxx P3 D2 | LLRHR 45 - xxxx P3 A D2 | |
| P1 D2 | | LLRHR 45 - xxxx P1 D2 | LLRHR 45 - xxxx P1 A D2 | |
| P01 D2 | | LLRHR 45 - xxxx P01 D2 | LLRHR 45 - xxxx P01 A D2 | |
| P001 D2 | | LLRHR 45 - xxxx P001 D2 | LLRHR 45 - xxxx P001 A D2 | |

bold text = standard range
xxxx = rail length



| Size | Dimensions (mm) | | | | | | | | | | Weight kg/m | |
|------|-----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------------|-----|----------------|------------------|
| | W | H ₄ | H ₇ | H ₆ | L ₈ | L ₇ | d ₂ | d ₃ | E _{1 min} | F | | L _{max} |
| 15 | 15 | 16,3 | 10,3 | 7,3 | 12,0 | 2,0 | 7,4 | 4,4 | 10 | 60 | 3 000 | 1,4 |
| 20 | 20 | 20,75 | 13,2 | 7,1 | 12,0 | 2,0 | 9,4 | 6,0 | 10 | 60 | 4 000 | 2,4 |
| 25 | 23 | 24,45 | 15,2 | 8,2 | 13,0 | 2,0 | 11,0 | 7,0 | 10 | 60 | 4 000 | 3,2 |
| 30 | 28 | 28,5 | 17,0 | 8,7 | 13,0 | 2,0 | 15,0 | 9,0 | 12 | 80 | 4 000 | 5,0 |
| 35 | 34 | 32,15 | 20,5 | 11,7 | 16,0 | 2,2 | 15,0 | 9,0 | 12 | 80 | 4 000 | 6,8 |
| 45 | 45 | 40,15 | 23,5 | 12,5 | 18,0 | 2,2 | 20,0 | 14,0 | 16 | 105 | 4 000 | 10,5 |

The “E” dimension designates the distance from the rail end to the centre of the first attachment hole. If no customer-specific “E” dimension is provided with the order, the rails are produced according to the following formula:

$$E = \frac{L - (z - 1) \times F}{2}$$

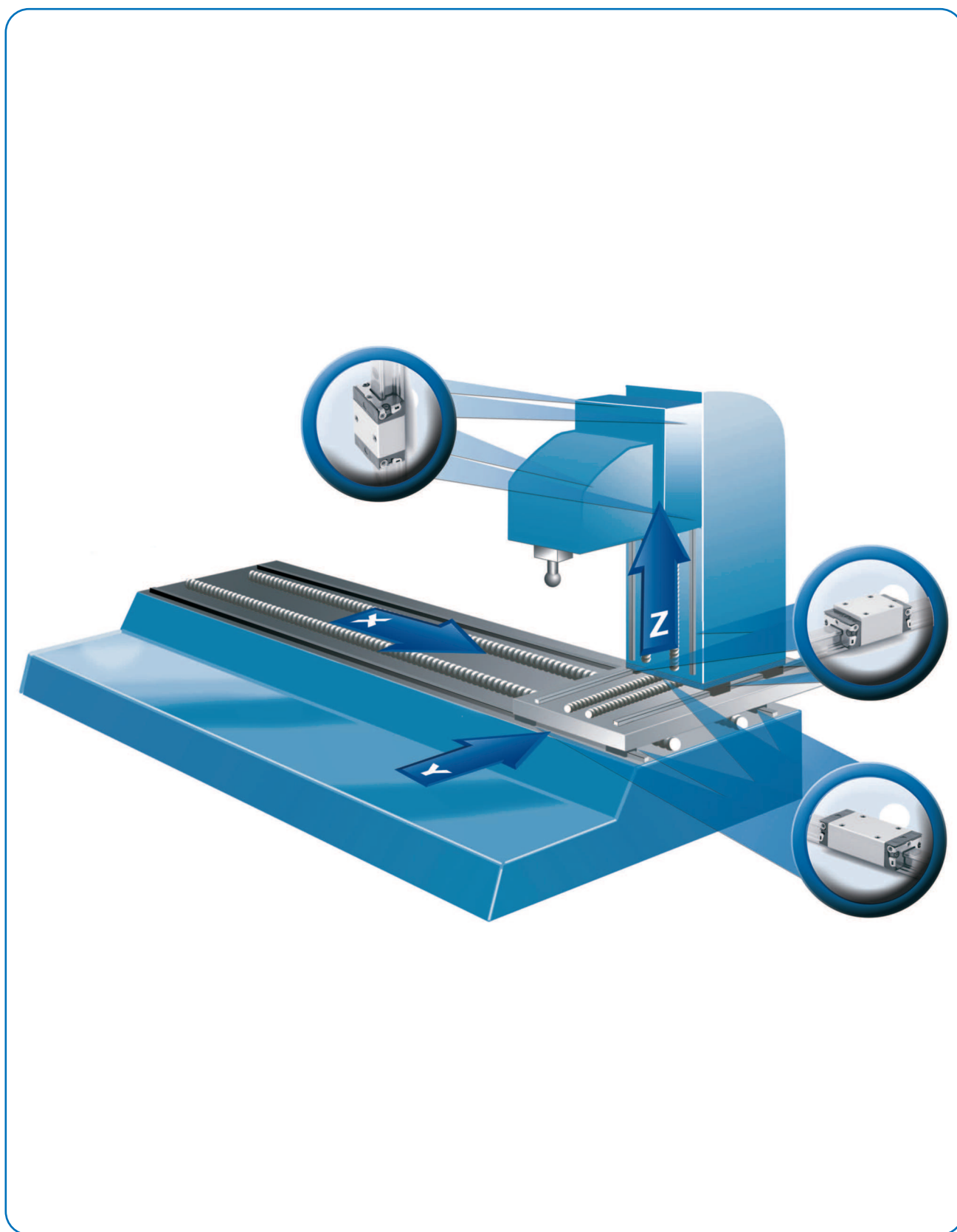
- E = Rail end dimension
- F = Distance of attachment holes
- L = Rail length
- z = Number of attachment holes

The distance of the first and last attachment holes is mediated.

If several possibilities arise, the shorter “E” dimension will be produced!

Notes

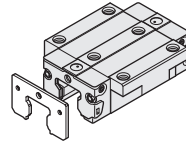




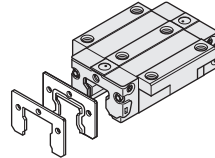
Accessories

Product overview

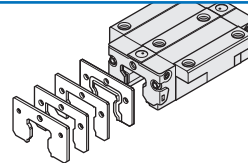
Scraper plate



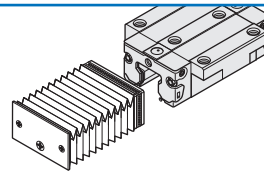
Two-piece front seal



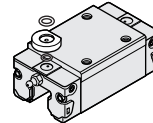
Sealing kit



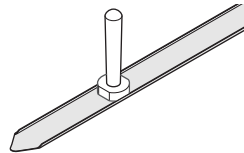
Bellows



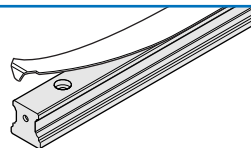
Lubrication adapter



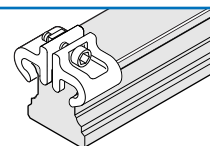
Expanding mandrel



Loose cover strip



Cover strip retaining clamps
made of aluminium



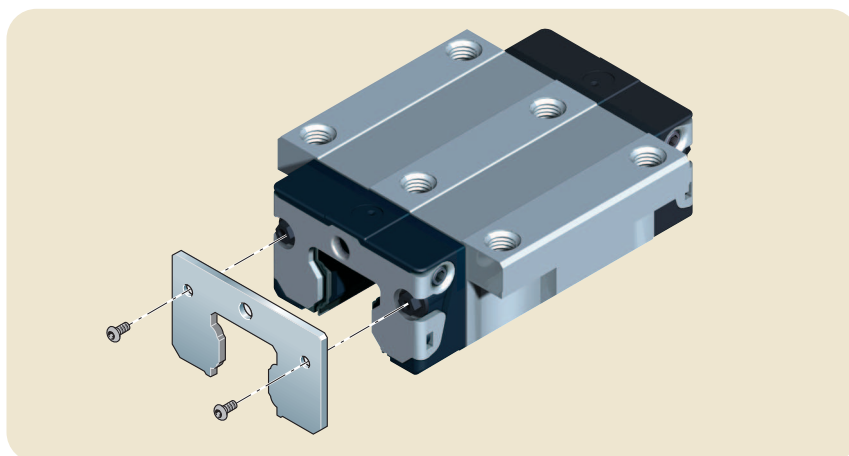
Standard carriages

Scraper plate

- Material: stainless spring steel to DIN EN 10088
- Condition: bright
- Precision design with 0,2 to 0,3 mm maximum gap measurement

Mounting:

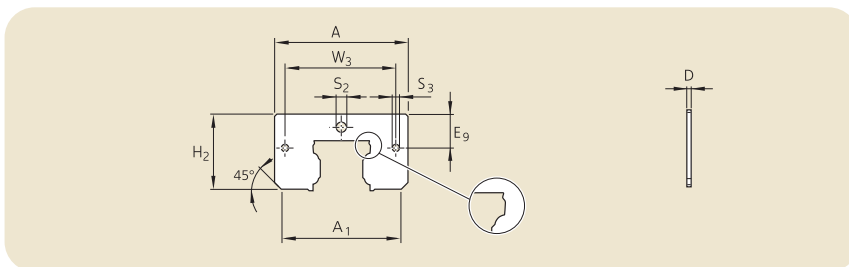
Fastening screws are supplied. During mounting please ensure an even gap between the rail and scraper plate.



Scraper plate for rails with and without cover strip

Note:

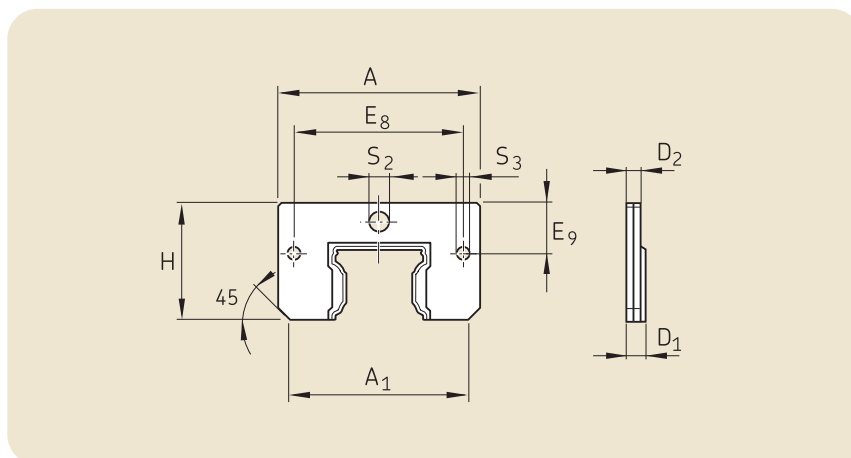
Use in combination with two-piece front seal kit LLRHZxxS3.



| Size | Part numbers | Dimensions (mm) | | | | | | | | Weight (g) |
|------|----------------|-----------------|----------------|----------------|----------------|----------------|----------------|----------------|-----|------------|
| | | A | A ₁ | H ₂ | W ₃ | E ₉ | S ₂ | S ₃ | D | |
| 15 | LLRHZ 15 S1 | 33 | 26,4 | 19,2 | 24,55 | 6,3 | 4,6 | 3,5 | 1,0 | 4 |
| 20 | LLRHZ 20 S1 | 42 | 40,0 | 24,8 | 32,4 | 6,8 | 5,1 | 4 | 1,0 | 6 |
| 25 | LLRHZ 25 S1 | 47 | 41,6 | 29,5 | 38,3 | 11,0 | 7 | 4 | 1,0 | 8 |
| 30 | LLRHZ 30 S1 | 59 | 52,8 | 34,7 | 48,4 | 14,1 | 7 | 4 | 1,0 | 12 |
| 35 | LLRHZ 35 S1 | 69 | 60,9 | 40,1 | 58,0 | 17,0 | 7 | 4 | 1,0 | 16 |
| 35* | LLRHZ 35 S1 CS | 69 | 60,9 | 40,1 | 58,0 | 17,0 | 7 | 4 | 1,0 | 16 |
| 45 | LLRHZ 45 S1 | 85 | 76,7 | 50,0 | 69,8 | 20,5 | 7 | 5 | 2,0 | 50 |
| 45* | LLRHZ 45 S1 CS | 85 | 76,7 | 50,0 | 69,8 | 20,5 | 7 | 5 | 2,0 | 50 |

* Scraper plates in combination with cover strip

Two-piece front seal

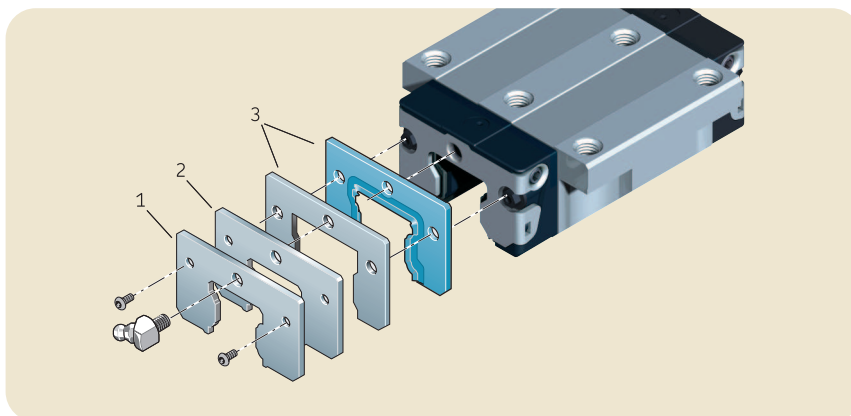


| Size | Part numbers | Dimensions (mm) | | | | | | | | | | Weight (g) |
|------|--------------|-----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----|------------|
| | | A | A ₁ | H ₂ | W ₃ | E ₉ | S ₂ | S ₃ | D ₁ | D ₂ | | |
| 15 | LLRHZ 15 S2 | 32 | 27 | 19,0 | 24,55 | 6,3 | 3,5 | 3,5 | 3,0 | 2,2 | 6 | |
| 20 | LLRHZ 20 S2 | 42 | 39 | 24,3 | 32,4 | 6,8 | 5,1 | 4 | 3,3 | 2,5 | 8 | |
| 25 | LLRHZ 25 S2 | 47 | 42 | 29,0 | 38,3 | 11,0 | 7 | 4 | 3,3 | 2,5 | 10 | |
| 30 | LLRHZ 30 S2 | 59 | 53 | 34,5 | 48,4 | 14,1 | 7 | 4 | 4,5 | 3,3 | 18 | |
| 35 | LLRHZ 35 S2 | 69 | 61 | 39,5 | 58,0 | 17,0 | 7 | 4 | 4,5 | 3,3 | 25 | |
| 45 | LLRHZ 45 S2 | 85 | 77 | 49,5 | 69,8 | 20,5 | 7 | 5 | 5,5 | 4,0 | 55 | |

Seal kit

The seal kit consists of the following components:

- 1 Scraper plate
- 2 Support plate
- 3 Two-piece front seal



| Size | Seal kit Designation |
|--------|----------------------|
| 15 | LLRHZ 15 S3 |
| 20 | LLRHZ 20 S3 |
| 25 | LLRHZ 25 S3 |
| 30 | LLRHZ 30 S3 |
| 35 | LLRHZ 35 S3 |
| 35 CS* | LLRHZ 35 S3 CS |
| 45 | LLRHZ 45 S3 |
| 45 CS* | LLRHZ 45 S3 CS |

*Seal kit in combination with cover strip

Lubrication adapter

For high carriages:

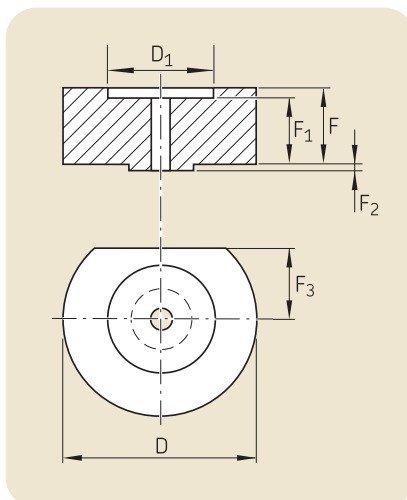
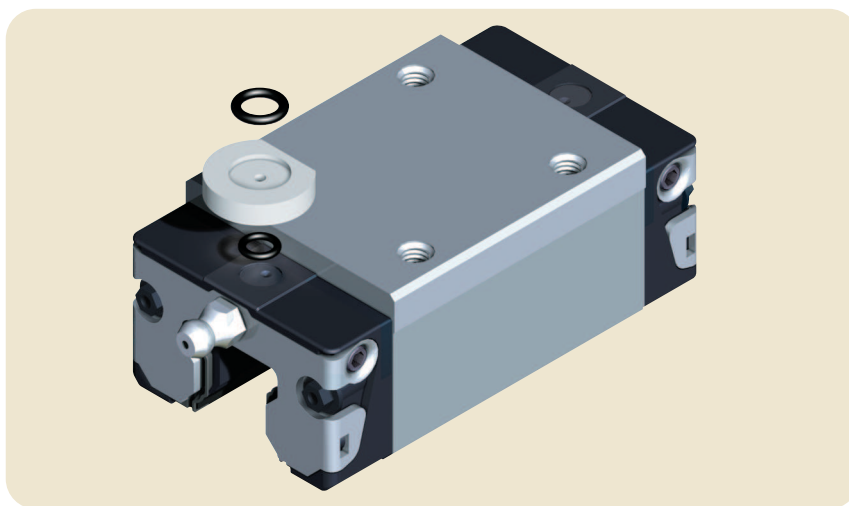
LLRHC_R

LLRHC_LR

- Material: plastic
- Contents: 1 piece

Mounting:

O-rings are supplied.



Type designations and dimensions

| Size | Part numbers | Dimensions (mm) | | | | | | |
|------|--------------|-----------------|----------------|----------------|------|----------------|----------------|----------------|
| | | D | D ₁ | D ₂ | F | F ₁ | F ₂ | F ₃ |
| 15 | LLRHZ 15 0 | 12 | 6,2 | 3,4 | 3,70 | 3,10 | 0,50 | 3,20 |
| 25 | LLRHZ 25 0 | 15 | 7,2 | 4,4 | 3,80 | 3,20 | 0,50 | 5,85 |
| 30 | LLRHZ 30 0 | 16 | 7,2 | 4,4 | 2,80 | 2,20 | 0,50 | 6,10 |
| 35 | LLRHZ 35 0 | 18 | 7,2 | 4,4 | 6,80 | 6,20 | 0,50 | 6,80 |
| 45 | LLRHZ 45 0 | 20 | 7,2 | 4,4 | 9,80 | 9,20 | 0,50 | 8,30 |

Mounting of lubrication adapter

A lubrication adapter is necessary on high carriages if lubrication is to take place from the table part.

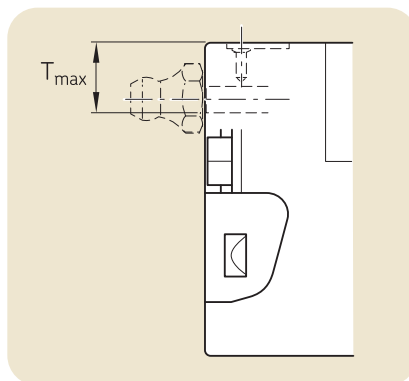
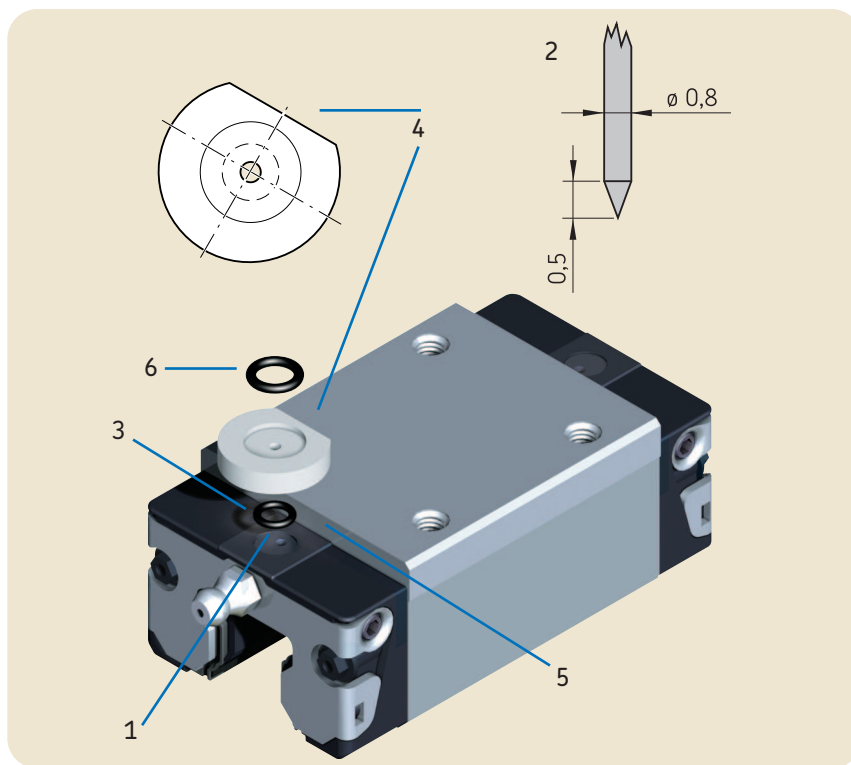
⚠ In the recess for the O-ring seal a further small recess (1) has been preformed. Do not drill this open. Risk of dirt incursion!

- Heat up metal tip (2) with a diameter of 0,8 mm.
- Carefully open the recess (1) with the metal tip and push through.
Observe maximum permissible depth T_{max} stated in the table!
- Insert O-ring seal (3) in the recess.
- Insert lubrication adapter at an angle in the recess and press the flattened side (4) onto the steel part (5). Use grease for fixing.
- Insert O-ring seal (6) in the lubrication adapter.

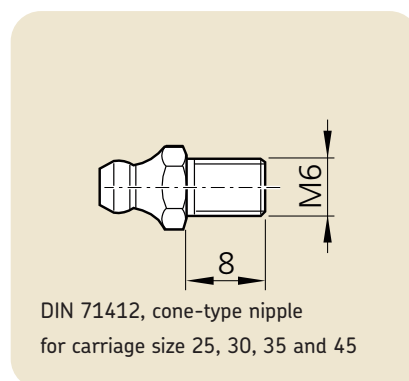
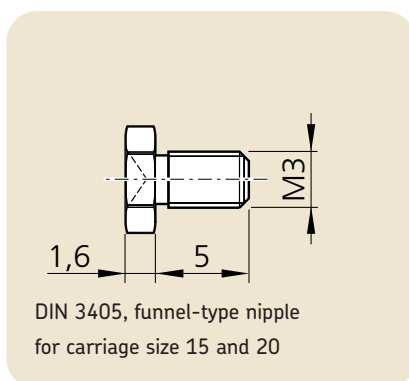
Size

Top lubrication opening: maximum permissible depth for penetration T_{max} (mm)

| Size | Top lubrication opening: maximum permissible depth for penetration T_{max} (mm) |
|------|---|
| 15 | 3,6 |
| 20 | 3,9 |
| 25 | 3,3 |
| 30 | 6,6 |
| 35 | 7,5 |
| 45 | 8,8 |



Lubrication nipple dimensions

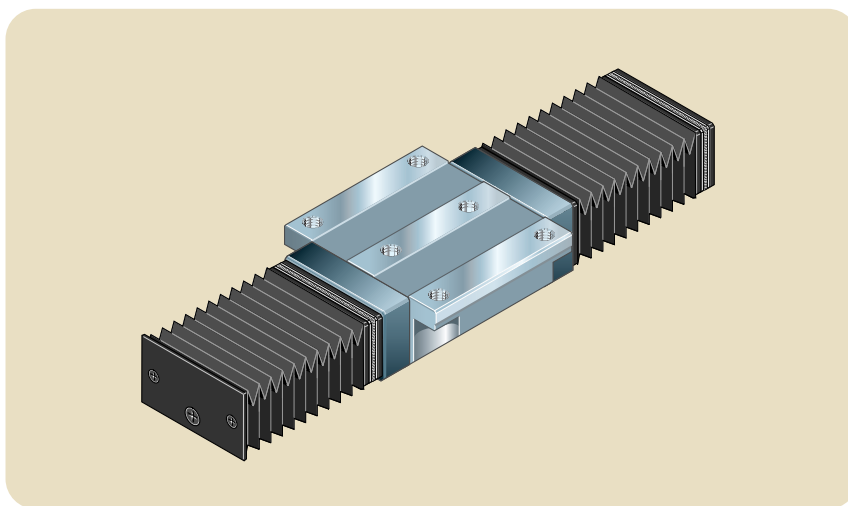





Bellows

Material:

Bellows are made out of polyester fabric with polyurethane coating
 Adapter plates are made out of aluminium.

The lubrication nipple on the carriage can be used.



| Size |  Type 2 with fastening plate for the carriage and end plate for the rail |  Type 4 with two fastening plates for the carriages |  Type 9 loose bellows (spare part) |
|------|---|--|---|
| 15 | LLRHB 15 B2 xx | LLRHB 15 B4 xx | LLRHB 15 xx |
| 20 | LLRHB 20 B2 xx | LLRHB 20 B4 xx | LLRHB 20 xx |
| 25 | LLRHB 25 B2 xx | LLRHB 25 B4 xx | LLRHB 25 xx |
| 30 | LLRHB 30 B2 xx | LLRHB 30 B4 xx | LLRHB 30 xx |
| 35 | LLRHB 35 B2 xx | LLRHB 35 B4 xx | LLRHB 35 xx |
| 45 | LLRHB 45 B2 xx | LLRHB 45 B4 xx | LLRHB 45 xx |

xx = Number of folds

Mounting

The bellows are pre-mounted.
The fixing screws are supplied.

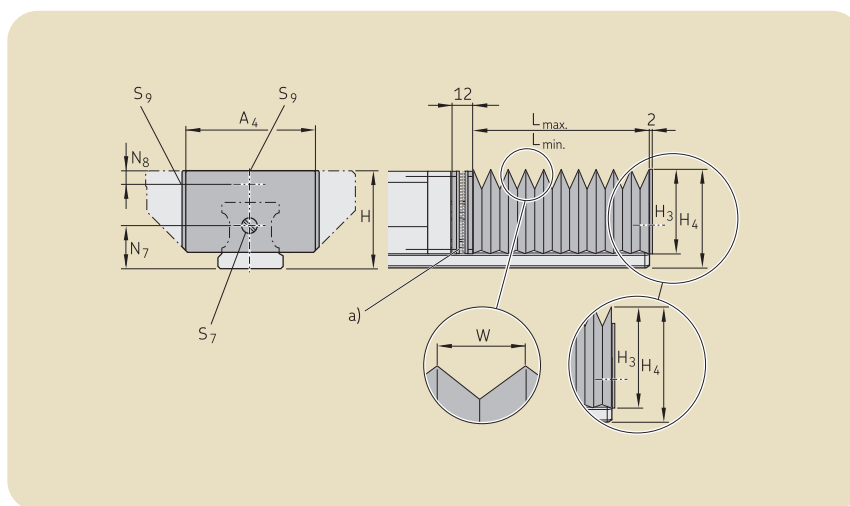
On type 2 in each case one thread M4-10 deep, 2 x 45° countersunk, must be inserted in the end face of the rail.

Size 25 - 45:

The lubrication nipple on the carriage can be used.

Size 15 and 20:

A drive-type lubrication nipple is supplied.



Calculation of the bellows

$$L_{min} = L_{max} - \text{Stroke}$$

$$L_{max} = (\text{Stroke} + 30) \cdot U$$

$$\text{Number of folds} = \frac{L_{max}}{W} + 2$$

L_A = Carriage length L_1 plus 2x12 mm for the fastening plates.

L_{max} = Bellows stretched

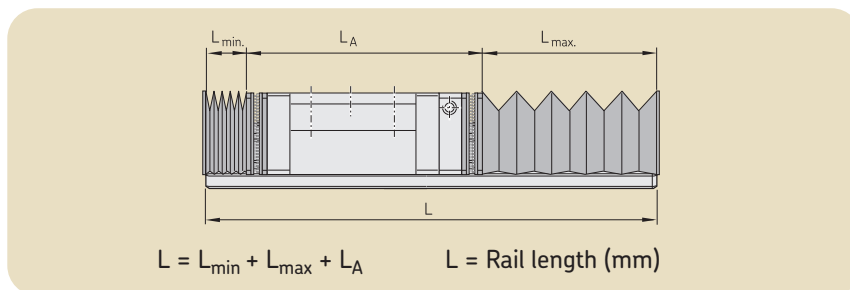
L_{min} = Bellows pushed together

Stroke = Stroke (mm)

U = Calculation factor

W = Maximum extension of folds

Calculation of the rail length



Dimensions of the bellows

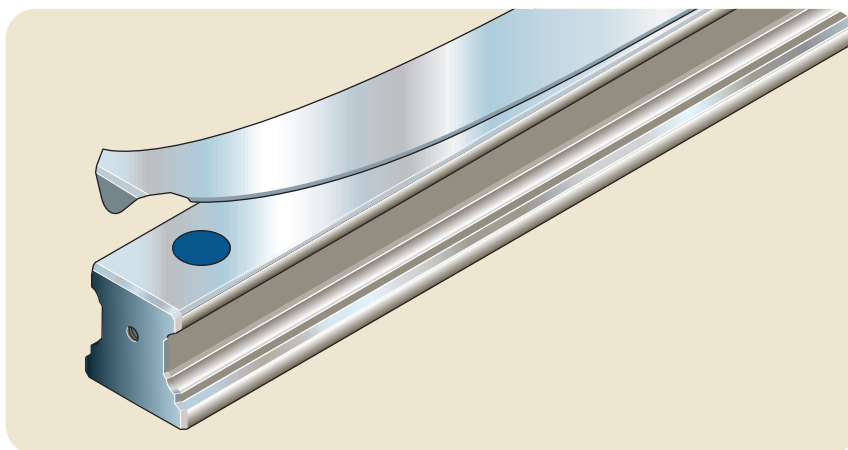
| Size | Dimensions (mm) | | | | | | | | | | | Factor U |
|------|-----------------|-------|----|-------|-------|-------|-------|-------|-------|-------|------|----------|
| | A_4 | B_3 | H | H_3 | H_4 | N_7 | N_8 | S_7 | S_8 | S_9 | W | |
| 15 | 45 | 11 | 24 | 26,5 | 31,5 | 11 | 3,4 | M4 | ø3 | M3 | 19,9 | 1,18 |
| 20 | 42 | 12 | 30 | 24,0 | 29,2 | 13 | 3,5 | M4 | ø3 | M3 | 10,3 | 1,33 |
| 25 | 45 | 12 | 36 | 28,5 | 35,0 | 15 | 6,0 | M4 | M6 | M3 | 12,9 | 1,32 |
| 30 | 55 | 12 | 42 | 34,0 | 41,0 | 18 | 8,0 | M4 | M6 | M6 | 15,4 | 1,25 |
| 35 | 64 | 12 | 48 | 39,0 | 47,0 | 22 | 8,0 | M4 | M6 | M6 | 19,9 | 1,18 |
| 45 | 83 | 12 | 60 | 49,0 | 59,0 | 30 | 8,0 | M4 | M6 | M6 | 26,9 | 1,13 |

Cover strip

Advantages of the cover strip

The cover strip can be simply clipped on and pulled off.

- This considerably simplifies and quickens mounting:
 - It is not necessary to close every single drill hole
 - It is not necessary to wait for the adhesive to set on adhesive strips.
- Multiple mounting and removal is possible (up to 4 times)



Designs/Functions

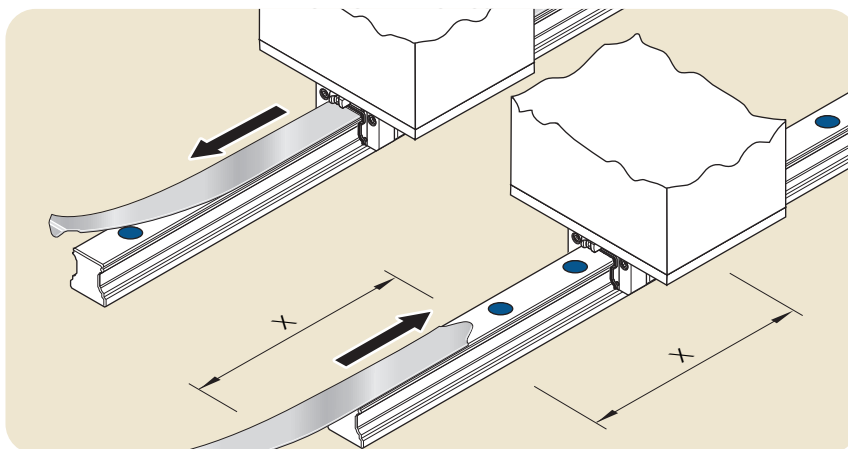
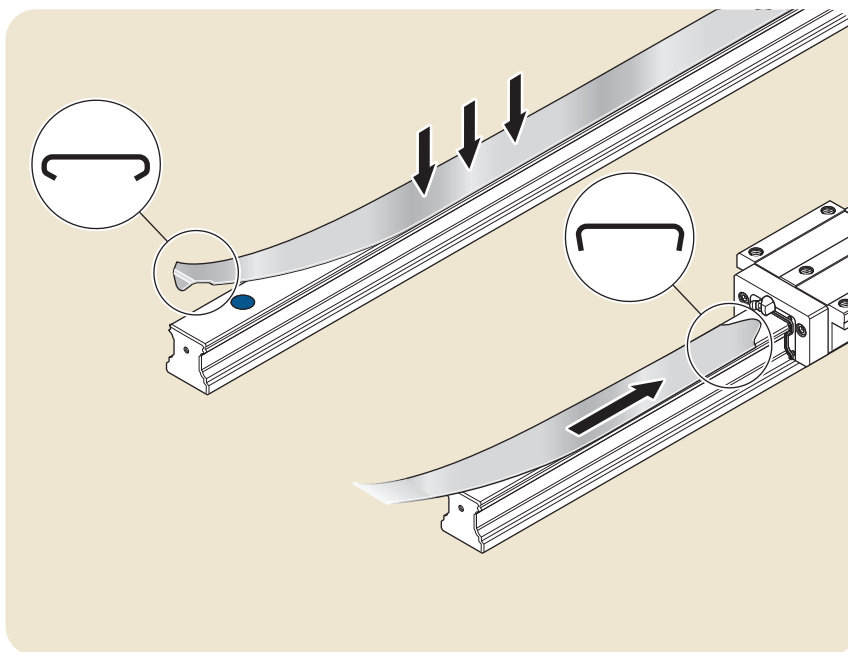
Cover strip with fixed seat (standard)

- The cover strip is clipped on before the carriages are mounted and stays firmly in place.

With an optionally available expanding mandrel for 0,15 mm cover strips or a special expanding tool for 0,3 mm cover strips a slide can also be retroactively created in order to remove a cover strip.

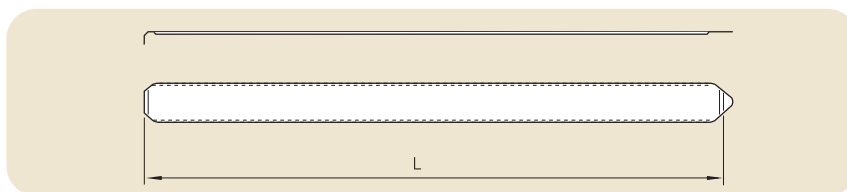
In particular, however, the slide length X can be optimally adapted to the specific application.

Please observe the precise mounting instructions!



**Cover strip for initial mounting/
stock/replacement**

For each guide rail length a matching cover strip with fixed seat can be supplied.



**Ordering a standard cover strip
with fixed seat**

Example:

Rail Size 35,

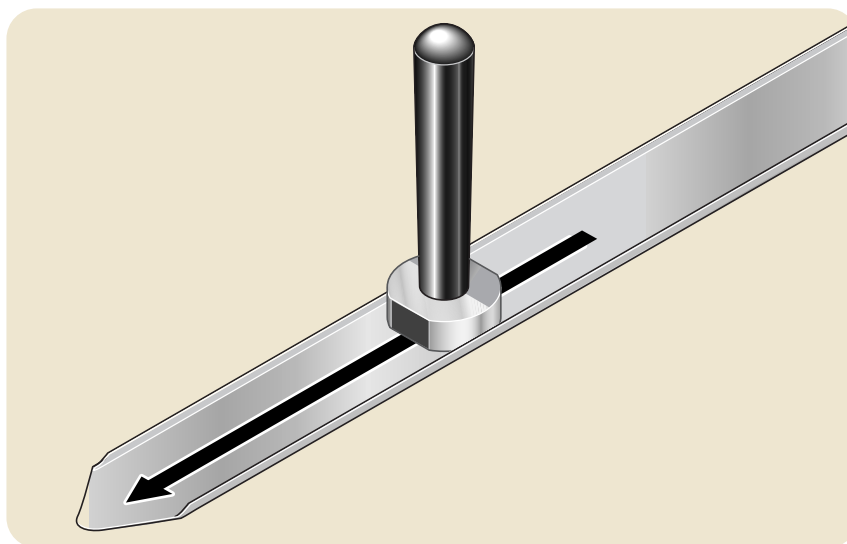
Rail length L = 2 696 mm

LLRHZ 15 – 2 969 CS

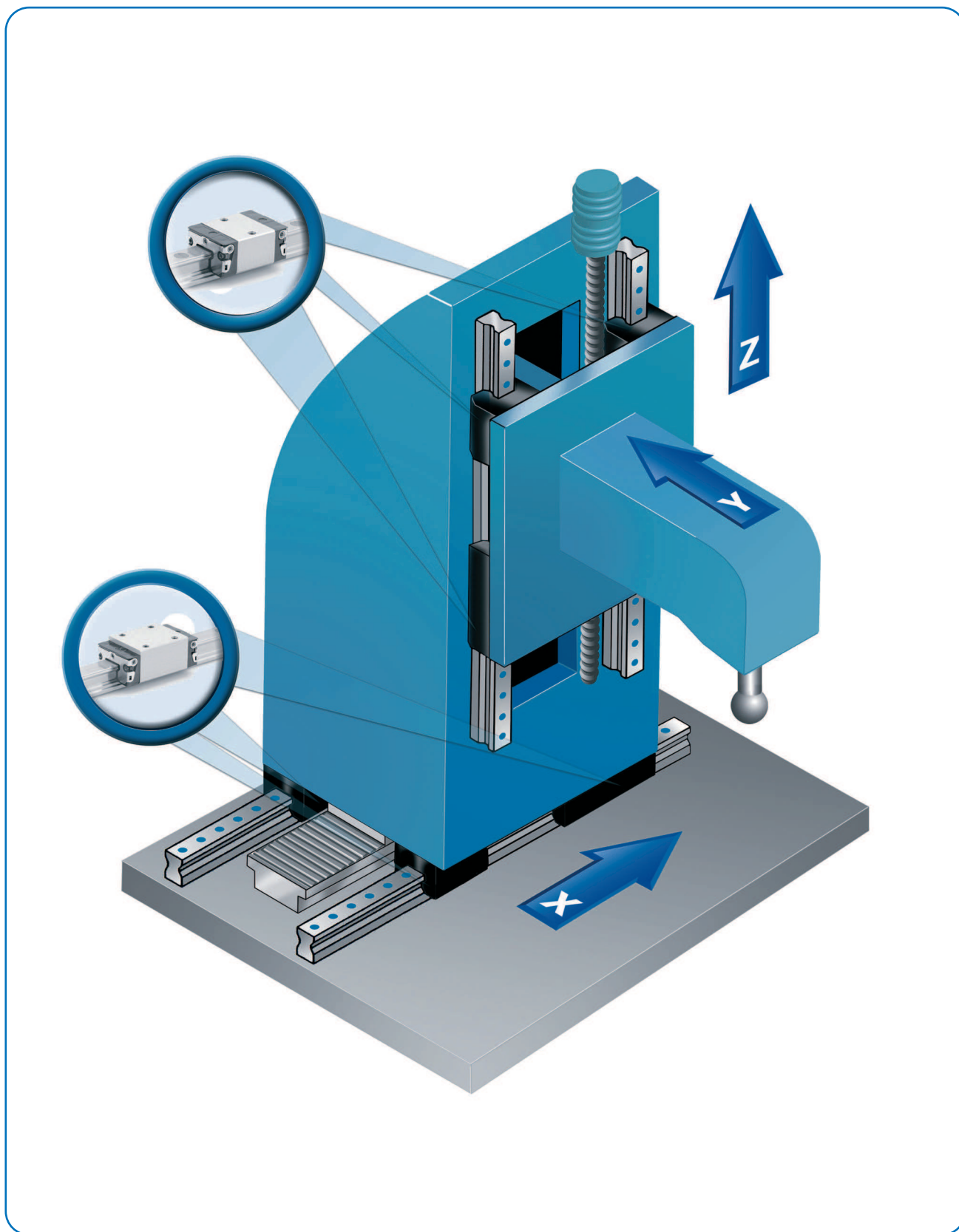
(For order designation see product table)

| Size | Standard cover strips Order designation, length (mm) |
|------|---|
| 15 | LLRHZ 15 - xxx CS |
| 20 | LLRHZ 20 - xxx CS |
| 25 | LLRHZ 25 - xxx CS |
| 30 | LLRHZ 30 - xxx CS |
| 35 | LLRHZ 35 - xxx CS |
| 45 | LLRHZ 45 - xxx CS |

**Expanding mandrel to create a slide
on the cover strip**



| Size | Expanding mandrel Order designation |
|------|--|
| 15 | LLRHZ 15 W |
| 20 | LLRHZ 20 W |
| 25 | LLRHZ 25 W |
| 30 | LLRHZ 30 W |
| 35 | LLRHZ 35 W |
| 45 | LLRHZ 45 W |



Cover strip retaining clamps

For guide rails without end-face threaded holes.

SKF recommends the use of cover strip retaining clamps.

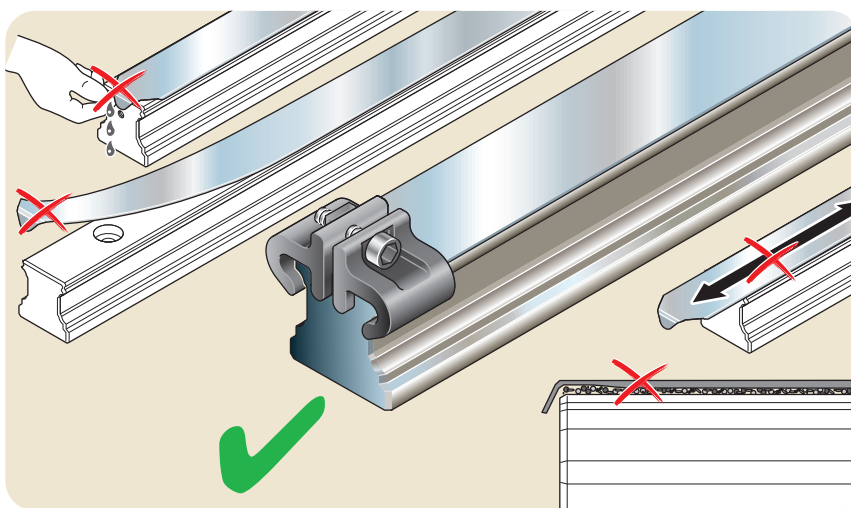
These can:

- prevent unintentional removal of the strip and incursion of dirt
- fix the cover strip in place

Materials:

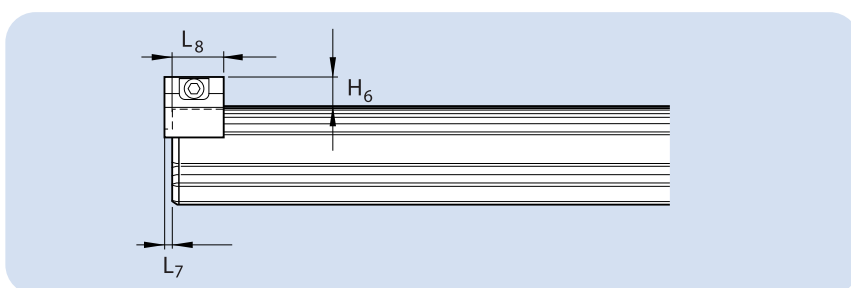
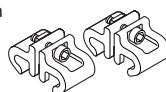
Retaining clamps made of aluminium, black anodised.

Clamping screw and nut made of corrosion-resistant steel.

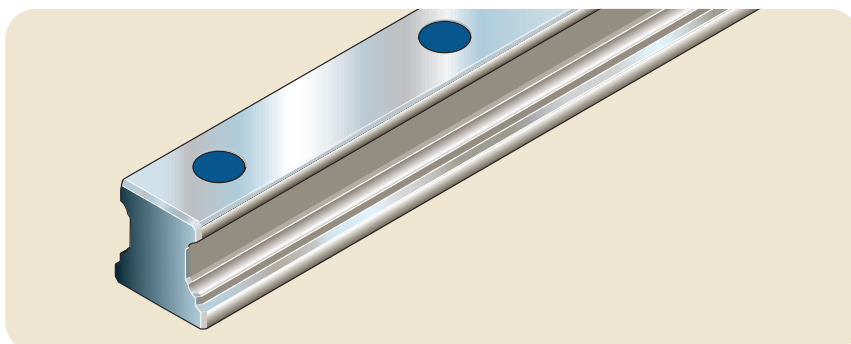


Order designations for cover strip retaining clamps

| Size | Retaining clamps (2 pieces per unit) Order designation | Dimensions (mm) | | |
|------|---|-----------------|----------------|----------------|
| | | H ₆ | L ₇ | L ₈ |
| 15 | LLR 15 CSG | 7,3 | 2,0 | 12 |
| 20 | LLR 20 CSG | 7,1 | 2,0 | 12 |
| 25 | LLR 25 CSG | 8,2 | 2,0 | 13 |
| 30 | LLR 30 CSG | 8,7 | 2,0 | 13 |
| 35 | LLR 35 CSG | 11,7 | 2,2 | 16 |
| 45 | LLR 45 CSG | 12,5 | 2,2 | 18 |



Plastic caps are supplied as standard if a cover strip has not been ordered.



Stop edges, corner radii, screw sizes and tightening torques

Carriages made of steel, type A, LA

- Standard width

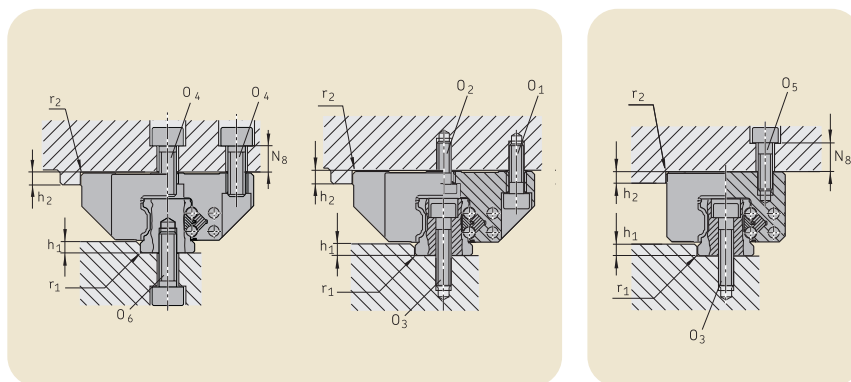
Rails

- Can be screwed from above

Carriages made of steel, type U, LU, R, LR

Rails

- Can be screwed from above



The combinations shown are examples. In principle all carriages can be combined with all rails.

| Size | h ₁ | | r ₁ | h ₂ | r ₂ | O ₁ | O ₂ ²⁾ | O ₄ ²⁾²⁾ | O ₅ | O ₃ | O ₆ | N ₈ |
|------|----------------|------|----------------|----------------|----------------|---------------------|------------------------------|--------------------------------|---------------------|----------------|----------------|----------------|
| | min. | max. | max. | | max. | DIN 912 4 Pieces | DIN 6912 2 Pieces | DIN 912 6 Pieces | DIN 912 4 Pieces | DIN 912 | DIN 912 | (mm) |
| 15 | 2,5 | 3,5 | 0,4 | 4 | 0,6 | M4x12 | M4x10 | M5x12 | M4x12 | M4x20 | M5x12 | 6 |
| 20 | 2,5 | 4,0 | 0,6 | 5 | 0,6 | M5x16 | M5x12 | M6x16 | M5x16 | M5x25 | M6x16 | 9 |
| 25 | 3,0 | 5,0 | 0,8 | 5 | 0,8 | M6x20 | M6x16 | M8x20 | M6x18 | M6x30 | M6x20 | 10 |
| 30 | 3,0 | 5,0 | 0,8 | 6 | 0,8 | M8x25 | M8x16 | M10x20 | M8x20 | M8x30 | M8x20 | 10 |
| 35 | 3,5 | 6,0 | 0,8 | 6 | 0,8 | M8x25 | M8x20 | M10x25 | M8x25 | M8x35 | M8x25 | 13 |
| 45 | 4,5 | 8,0 | 0,8 | 8 | 0,8 | M10x30 | M10x25 | M12x30 | M10x30 | M12x45 | M12x30 | 14 |

Dimensions and guide values for permissible lateral force without additional lateral fixing

| | Screw strength class | Carriages | | Rails | | | |
|----------------------|----------------------|-----------|----------------------|--------|--------|--------|--------|
| Carriages A, U, R | 8.8 | 0,11 C | 0,15 C ³⁾ | 0,23 C | 0,11 C | 0,06 C | 0,06 C |
| | 12.9 | 0,18 C | 0,22 C ³⁾ | 0,35 C | 0,18 C | 0,10 C | 0,10 C |
| Carriages LA, LU, LR | 8.8 | 0,08 C | 0,13 C ³⁾ | 0,18 C | 0,08 C | 0,04 C | 0,04 C |
| | 12.9 | 0,14 C | 0,18 C ³⁾ | 0,26 C | 0,14 C | 0,07 C | 0,07 C |

¹⁾ If the carriage is fastened from above with only four O₄ screws:



- permissible lateral force 1/3 lower
- lower stiffness

²⁾ If the carriage is fastened with 6 screws:

Tighten the middle screws with a tightening torque for strength class 8.8

³⁾ If fastened with two O₂ screws and four O₁ screws

Tightening torques of the fixing screws in Nm

| | M4 | M5 | M6 | M8 | M10 | M12 | M14 | M16 |
|---|------|-----|-----|-----|-----|-----|-----|-----|
|  | 8.8 | 2,7 | 5,5 | 9,5 | 23 | 46 | 80 | 125 |
|  | 12.9 | 4,6 | 9,5 | 16 | 39 | 77 | 135 | 215 |

Pinning

If the guide values for the permissible lateral force are exceeded (see table) the carriage must be additionally fixed by means of pinning or stop edges.

The recommended dimensions for the pin holes can be obtained from the drawings and table.

Usable pins:

- tapered pin (hardened) or
- straight pin DIN ISO 8734

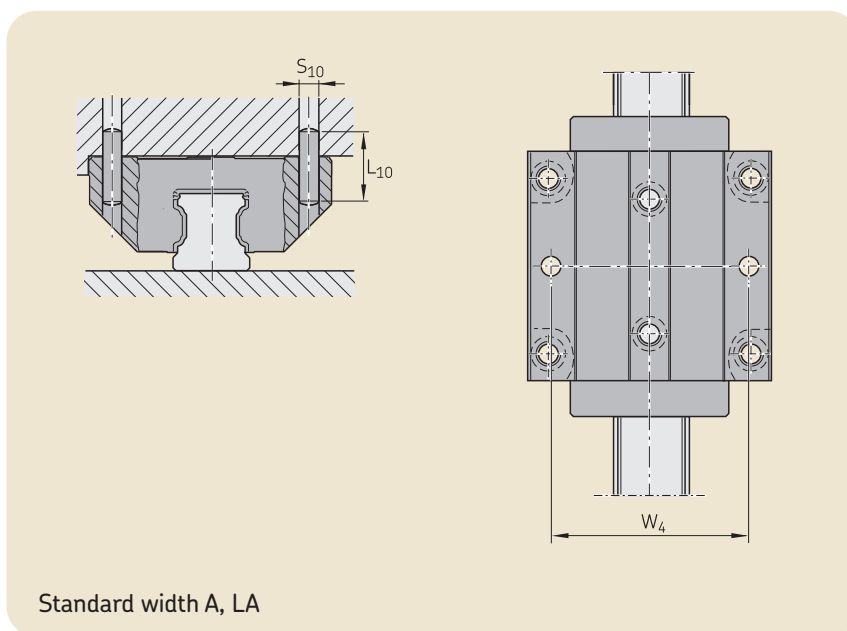
Instructions

For production-related reasons there may be pilot drill holes in the middle of the carriage at the recommended positions for pin holes ($\varnothing < S_{10}$). They are suitable for drilling.

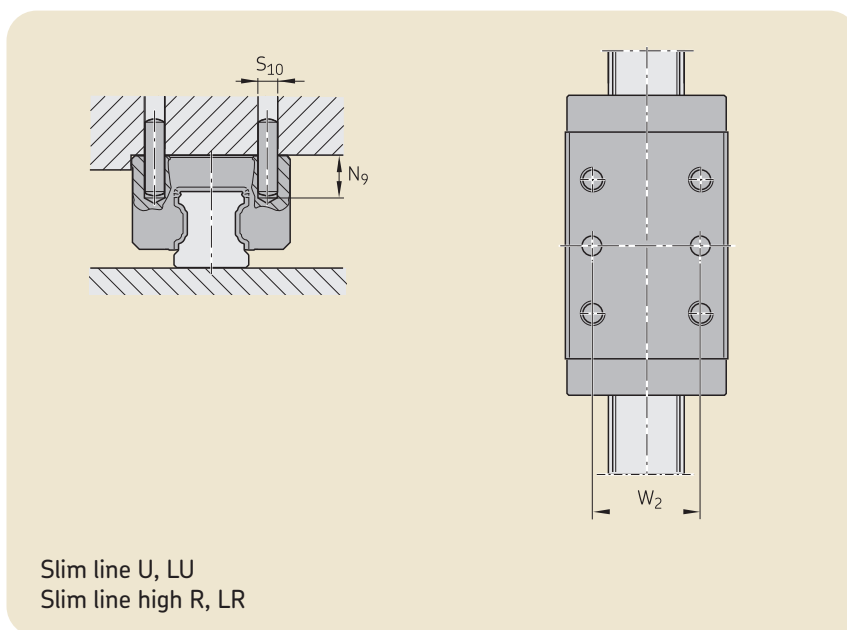
If necessary, the pinning must be carried out in a different position (e.g. middle lube port), but must not exceed the dimension L_3 in longitudinal direction (L_3 can be obtained from the dimension tables for the individual versions).

Keep to dimensions W_2 and W_4 !

Do not complete the pin holes until after mounting (see also general mounting instructions - available through your normal SKF contact).



Standard width A, LA



Slim line U, LU
Slim line high R, LR

| Size | Dimensions (mm) | | | | |
|------|-----------------|----------|-------|-------|-------------|
| | S_{10} | L_{10} | W_2 | W_4 | N_9 (max) |
| 15 | 4 | 18 | 26 | 38 | 6,0 |
| 20 | 5 | 24 | 32 | 53 | 7,5 |
| 25 | 6 | 32 | 35 | 55 | 9,0 |
| 30 | 8 | 36 | 40 | 70 | 12,0 |
| 35 | 8 | 40 | 50 | 80 | 13,0 |
| 45 | 10 | 50 | 60 | 98 | 18,0 |

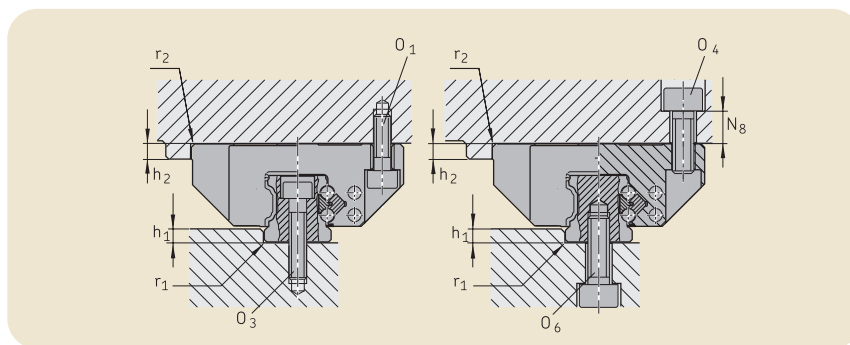
Stop edges, corner radii, screw sizes and tightening torques

Carriages SA

- Standard width, short

Rails

- Can be screwed from above

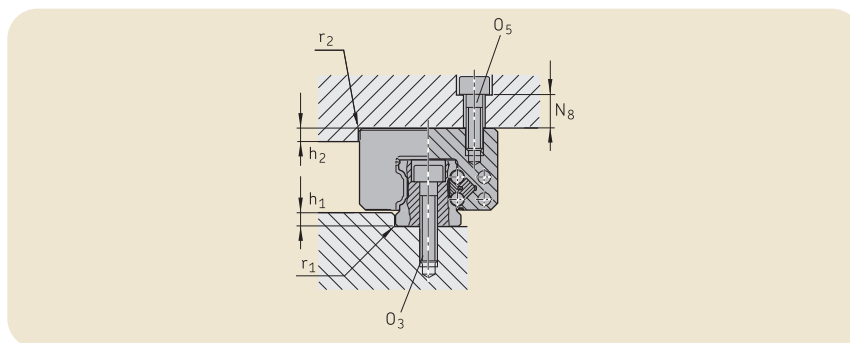


Carriages SU

- Slim line short

Rails

- Can be screwed from above



Note

The combinations shown are examples. In principle all carriages can be combined with all rails.

The screw connection for the carriages using 2 screws is completely adequate to withstand the maximum load. (See maximum load ability and moment loadability for the individual versions.)

Dimensions and guide values for permissible lateral force without additional lateral fixing

| Size | h ₁ | | r ₁ | h ₂ | r ₂ | O ₁ | O ₄ | O ₅ | O ₃ | O ₆ | N ₈ |
|------|----------------|--------------|----------------|----------------|----------------|-------------------|-------------------|-------------------|-----------------|-----------------|----------------|
| | min. (mm) | max. (mm) | max. (mm) | | max. (mm) | DIN 912 | DIN 912 | DIN 912 | DIN 912 | DIN 912 | |
| 15 | 2,5 | 3,5 | 0,4 | 4 | 0,6 | 2 Pieces M4x12 | 2 Pieces M5x12 | 2 Pieces M4x12 | (Rail) M4x20 | (Rail) M5x12 | 6 |
| 20 | 2,5 | 4,0 | 0,6 | 5 | 0,6 | M5x16 | M6x16 | M5x16 | M5x25 | M6x16 | 9 |
| 25 | 3,0 | 5,0 | 0,8 | 5 | 0,8 | M6x20 | M8x20 | M6x18 | M6x30 | M6x20 | 10 |
| 30 | 3,0 | 5,0 | 0,8 | 6 | 0,8 | M8x25 | M10x20 | M8x20 | M8x30 | M8x20 | 10 |
| 35 | 3,5 | 6,0 | 0,8 | 6 | 0,8 | M8x25 | M10x25 | M8x25 | M8x35 | M8x25 | 13 |

| Screw strength class | Carriages | | | Rails | | |
|----------------------|-----------|--------|--------|--------|--------|--|
| 8.8 | 0,08 C | 0,12 C | 0,08 C | 0,09 C | 0,09 C | |
| 12.9 | 0,13 C | 0,21 C | 0,13 C | 0,15 C | 0,15 C | |

Tightening torques of the fixing screws in Nm

| Screw | M4 | M5 | M6 | M8 | M10 | M12 | M14 | M16 |
|-------|-----|-----|-----|-----|-----|-----|-----|-----|
| | 8.8 | 2,7 | 5,5 | 9,5 | 23 | 46 | 80 | 125 |
| 12.9 | 4,6 | 9,5 | 16 | 39 | 77 | 135 | 215 | 340 |

Pinning

If the guide values for the permissible lateral force are exceeded (see table) the carriage must be additionally fixed by means of pinning or stop edges.

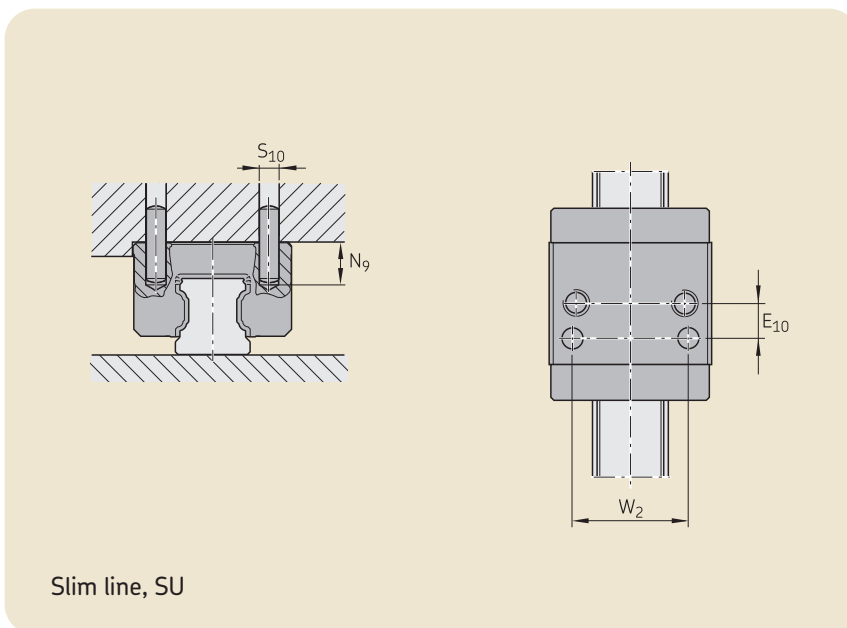
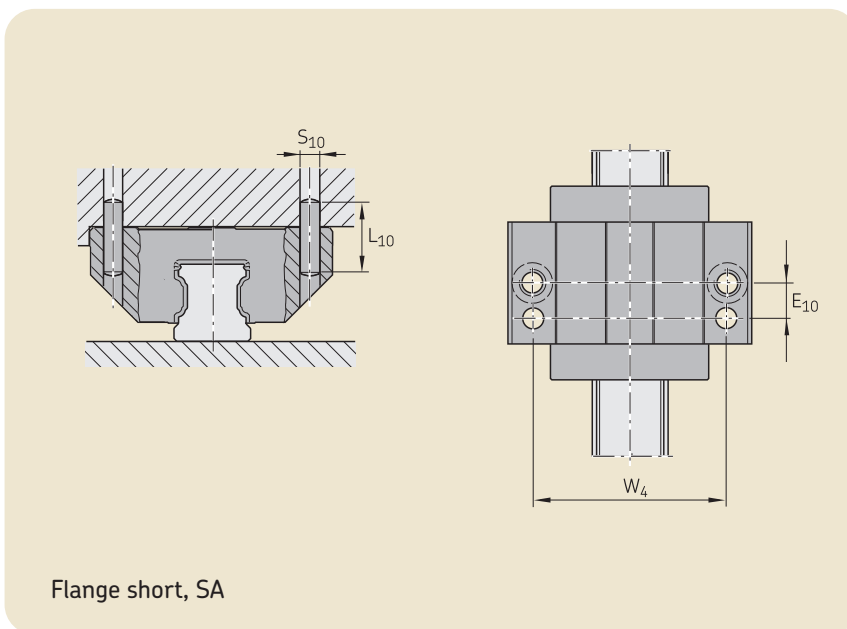
The recommended dimensions for the pin holes can be obtained from the drawings and table.

Usable pins:

- tapered pin (hardened) or
- straight pin DIN ISO 8734

Instructions

For production-related reasons there may be pilot drill holes in the middle of the carriage at the recommended positions for pin holes ($\varnothing < S_{10}$). They are suitable for drilling.



| Size | Dimensions (mm) | | W_4 | W_2 | E_{10} | N_9 (max) |
|------|-----------------|----------|-------|-------|----------|-------------|
| | S_{10} | L_{10} | | | | |
| 15 | 4 | 18 | 38 | 26 | 9 | 3,0 |
| 20 | 5 | 24 | 53 | 32 | 10 | 3,5 |
| 25 | 6 | 32 | 55 | 35 | 11 | 7,0 |
| 30 | 8 | 36 | 70 | 40 | 14 | 10,0 |
| 35 | 8 | 40 | 80 | 50 | 15 | 12,0 |

Tapered pin (hardened), straight pin (DIN 6325)

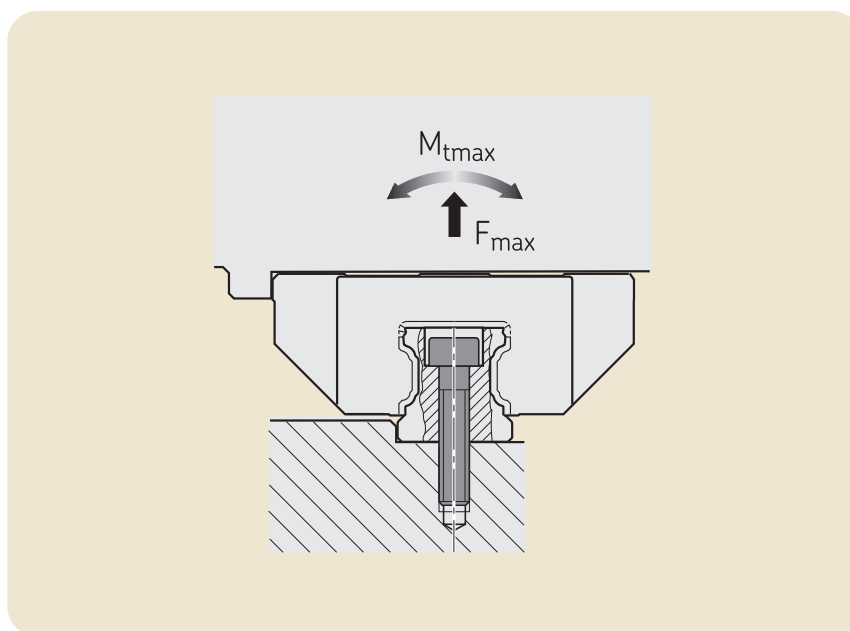
Loading of the screw connections between rail and substructure

The screw connections specified in the DIN 645-1 standard can become excessively loaded owing to the high performance capacity of the profile rail guides.

The screw connection between the guide rail and the substructure is critical. If the lift-off loads (F) or moments (M_t) are higher than the respective load values in the table, the screw connection must be recalculated separately.

The figures apply to the following conditions:

- Grade 12.9 fixings screws
- Screws tightened using a torque wrench
- Slightly oiled screws (for grade 8.8 screws approximately a reduction factor of 0,6 can be applied)



Lift-off loads and moment
Rail screwed from above

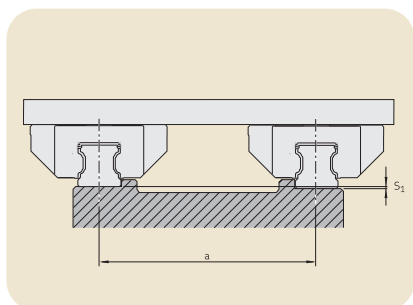
| Carriage | LLRH--SA, LLRH--SU | | LLRH--A, LLRH--U, LLRH--R | | LLRH--LA, LLRH--LU, LLRH--LR | |
|----------|-----------------------|---------------------|------------------------------|---------------------|---------------------------------|---------------------|
| | F_{max} (N) | $M_{t max}$ (Nm) | F_{max} (N) | $M_{t max}$ (Nm) | F_{max} (N) | $M_{t max}$ (Nm) |
| 15 | 6 040 | 41 | 7 050 | 47 | 8 060 | 54 |
| 20 | 10 000 | 90 | 11 700 | 106 | 13 400 | 121 |
| 25 | 14 600 | 154 | 17 100 | 180 | 19 500 | 205 |
| 30 | - | 360 | 32 400 | 420 | 37 100 | 480 |
| 35 | 27 500 | 440 | 32 100 | 510 | 36 700 | 580 |
| 45 | - | - | 78 100 | 1 680 | 89 300 | 1 920 |

Height deviation

The values for height deviation apply to all carriages.

Approximately 20 % higher values are permissible for the SA (standard width short) and SU (slim line short) carriages.

Given adherence to the permissible height deviation S_1 and S_2 , the influence on the service life is generally negligible.



Permissible height deviation in lateral direction

In the permissible height deviation S_1 , the tolerance for dimension H according to the table is already taken into account in "Technical Data".

$$S_1 = a \times Y$$

S_1 = Permissible height deviation (mm)

a = Distance between the rails (mm)

Y = Calculation factor

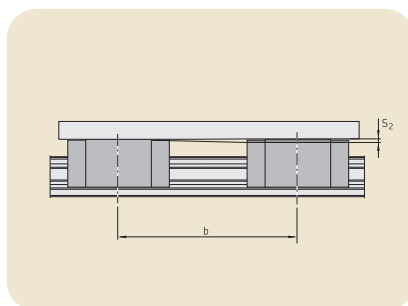
Permissible height deviation in longitudinal direction

For carriages

In the permissible height deviation S_2 the tolerance "maximum difference of dimension H on a rail" according to the table is already taken into account in "Technical Data".

Approximately 40 % higher values are permissible for SA and SU carriages.

On A-type carriages (standard width long), LU and LR approx. 30 % lower values are permissible.



Permissible height deviation S_2 on carriages

$$S_2 = b \times 4,3 \times 10^{-5}$$

S_2 = Permissible height deviation (mm)

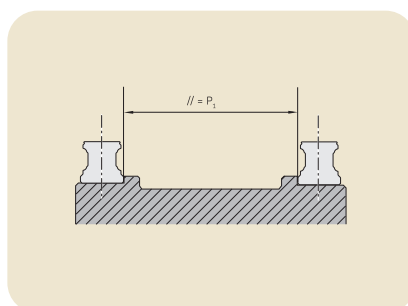
b = Distance between the carriages (mm)

Calculation factor Y for carriages

| Calculation factor | Preload class | | | |
|--------------------|--|-------------------------|-------------------------|-------------------------|
| | T0 up to approx. 10 μ m clearance | T1 Preload 0,02 C | T2 Preload 0,08 C | T3 Preload 0,13 C |
| Y | $4,3 \times 10^{-4}$ | $2,8 \times 10^{-4}$ | $1,7 \times 10^{-4}$ | $1,2 \times 10^{-4}$ |

Parallelism of mounted rails measured on the rails and the carriages
The values for the deviation in parallelism P_1 apply to all carriages.

Approximately 20 % higher values are permissible for the SA and SU carriages.



Deviation in parallelism P_1 for carriages

Through the deviation in parallelism P_1 the preload is increased somewhat on one side.

If the table values are adhered to, the influence on the service life is generally negligible.

The values shown in the following table apply to applications in which highest precision is required.

For all other uses and for general mechanical engineering doubled values can be applied.

| Size | Deviation in parallelism P_1 (mm) for high precision demands | | | |
|------|--|-------------------------|-------------------------|-------------------------|
| | T0 up to approx. 10 μm clearance | T1 Preload 0,02 C | T2 Preload 0,08 C | T3 Preload 0,13 C |
| 15 | 0,015 | 0,009 | 0,005 | 0,004 |
| 20 | 0,018 | 0,011 | 0,006 | 0,004 |
| 25 | 0,019 | 0,012 | 0,007 | 0,005 |
| 30 | 0,021 | 0,014 | 0,009 | 0,006 |
| 35 | 0,023 | 0,015 | 0,010 | 0,007 |
| 45 | 0,028 | 0,019 | 0,012 | 0,009 |

Maintenance and lubrication

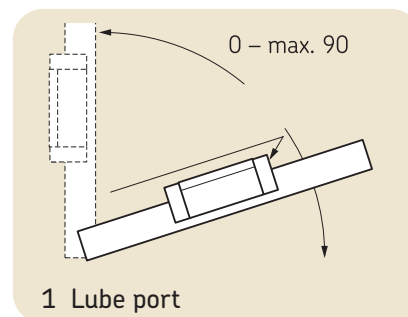
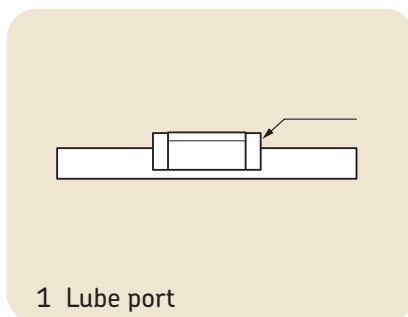
Maintenance and lubrication

As a function of the stroke length

Stroke > 2 × length of the carriage

- 1 lube port needs to be provided per carriage.
- Oil lubrication in accordance with ISO VG 220.

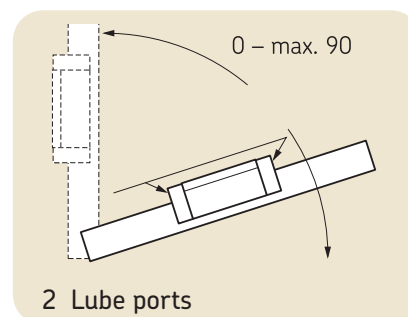
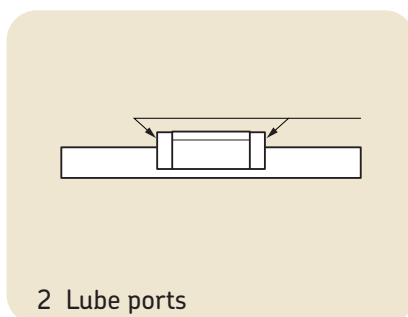
For lubrication quantities please refer to the next page.



Stroke < 2 × length of the carriage

- 2 lube ports need to be provided per carriage.
- Apply the prescribed lubricant quantity per lube port.
- Oil lubrication in accordance with ISO VG 220.

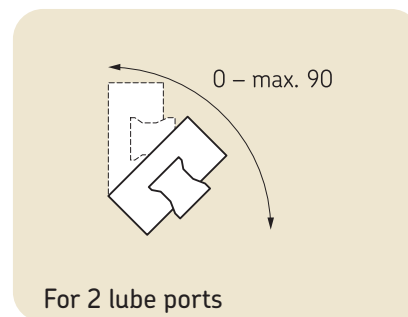
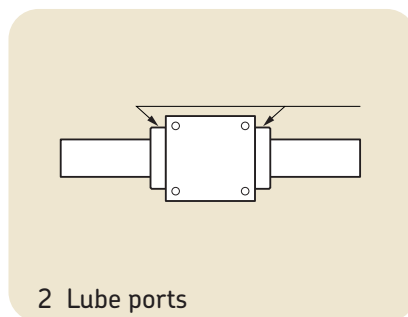
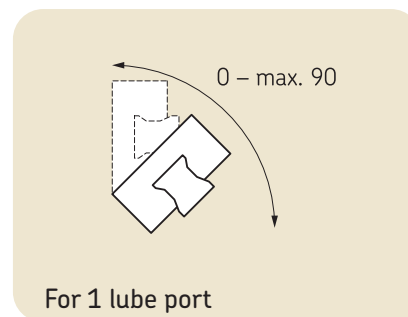
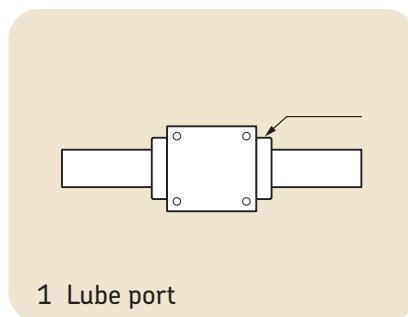
For lubrication quantities please refer to the next page.



Installation in inclined or side position (wall mounting)

Stroke > 2 × length of the carriage

- 1 lube port needs to be provided per carriage.
- Apply the lubricant quantity stated in the table with an impulse.
- If the lubricant quantity cannot be applied with an impulse, please consult SKF.



Maintenance

Dirt can drop and settle on exposed rails in particular. To maintain the function of seals and cover strips, such dirt must be regularly removed. For this purpose a “cleaning stroke” should be carried out over the entire length of travel at least twice a day, and at the latest after eight hours. Carry out a cleaning stroke each time before switching off the machine.

Lubrication

Grease lubrication

Initial lubrication of the carriage (basic lubrication)

No initial lubrication is required if the carriage has been greased at the factory.

The initial lubrication takes place with three times the part quantity stated in Table 1:

1. Grease the carriage with the first part quantity stated in table 1.
2. Move the carriage backwards and forwards with three double strokes along at least three times the carriage length.
3. Repeat step 1 and 2 twice.
4. Check whether a lubricating film is visible on the rail.

Ball rail guides are supplied in protected form. With basic greasing at the factory, both grease and oil lubrication is possible.

For lubrication we recommend lubricating grease to DIN 51825: – KP2K-20, consistency class NLGI 2 to DIN 51818. This can be obtained from SKF, see recommendation for lubricating greases.

Never start to use carriages without basic lubrication.

Observe the manufacturer’s instructions, in particular instructions concerning incompatibilities.

⚠ Greases with a proportion of solid lubricant (such as graphite) should not be used!

Re-lubricating the carriage

When the re-lubrication interval according to Table 2 has been reached, the carriage must be lubricated with the lubricant quantity as stated in Table 1. Where such environmental influences as dirt, the use of coolants, vibration, shock loads etc. are encountered, we recommend that the re-lubrication intervals be shortened accordingly.

Longer re-lubrication intervals apply in the case of smaller loads.

Short stroke

Stroke < 2 × carriage length

- 2 lube ports need to be provided per carriage and lubricated in each case!

Stroke < 0,5 × carriage length

- 2 lube ports need to be provided per carriage and lubricated in each case!
- For each lubrication cycle move the carriage 2 × the carriage length. If this is not possible, please consult SKF.

Lubricant quantities as stated in Table 1 (re-lubrication). Apply the stated quantity for each lube port.

* NLGI 00 greases reduce the re-lubrication intervals to 75 % of the values stated in Table 2.

Table 1

| Size | Grease lubrication | |
|------|---------------------------------|----------------|
| | Initial lubrication by customer | Re-lubrication |
| 15 | 0,4 (x 3) | 0,4 (x 2) |
| 20 | 0,7 (x 3) | 0,7 (x 2) |
| 25 | 1,4 (x 3) | 1,4 (x 2) |
| 30 | 2,2 (x 3) | 2,2 (x 2) |
| 35 | 2,2 (x 3) | 2,2 (x 2) |
| 45 | 4,7 (x 3) | 4,7 (x 2) |

Table 2

| Size | Grease lubrication | |
|------|--|---------|
| | Relubrication intervals under normal operating conditions, v ≤ 1 m/s | |
| | Travel (km) under load ≤ 0,15 C | ≤ 0,3 C |
| 15 | 5 000 | 1 200 |
| 20 | 5 000 | 1 200 |
| 25 | 10 000 | 2 400 |
| 30 | 10 000 | 2 400 |
| 35 | 10 000 | 2 400 |

Oil lubrication

Oil quantities for initial lubrication and re-lubrication

⚠ Apply the entire quantity of oil with a single lubrication impulse!

Carriages initially greased at the factory can also be re-lubricated with oil.

In the case of carriages which have not been initially greased at the factory, carry out the initial lubrication in accordance with Table 3.

If environmental influences such as dirt, use of coolants, vibration, shock loads etc. are encountered, we recommend that the re-lubrication intervals be shortened accordingly. Refer to Table 4.

Central oil lubrication

Oil quantities and lubrication impulses for central oil lubrication

Note:

Recommended waiting time between the impulses:
10 seconds.

For example size 45:
4 impulses with in each case 0,6 cm³ in 30 seconds.
Refer to Table 5.

Table 3

| Size | Oil lubrication Initial lubrication by customer Part quantity (cm ³) | Re-lubrication Part quantity (cm ³) |
|------|--|--|
| 15 | 0,4 (x 2) | 0,4 |
| 20 | 0,7 (x 2) | 0,7 |
| 25 | 1,0 (x 2) | 1,0 |
| 30 | 1,1 (x 2) | 1,1 |
| 35 | 1,2 (x 2) | 1,2 |
| 45 | 2,2 (x 2) | 2,2 |

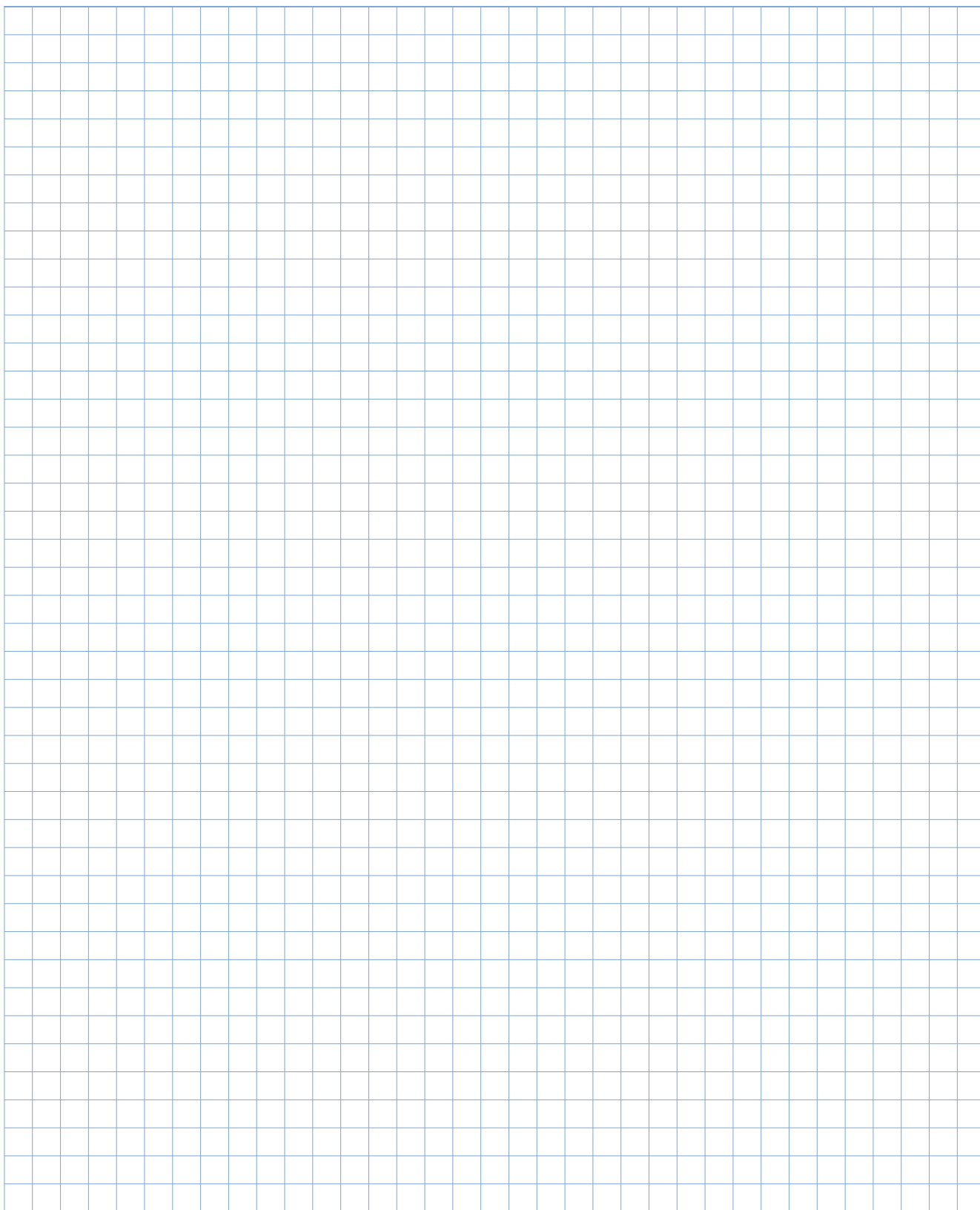
Table 4

| Size | Oil lubrication Re-lubrication intervals under normal operating conditions, $v \leq 1$ m/s | |
|------|---|--------------|
| | Travel (km) | |
| | under load $\leq 0,15$ C | $\leq 0,3$ C |
| 15 | 2 500 | 600 |
| 20 | 2 500 | 600 |
| 25 | 5 000 | 1 200 |
| 30 | 5 000 | 1 200 |
| 35 | 5 000 | 1 200 |

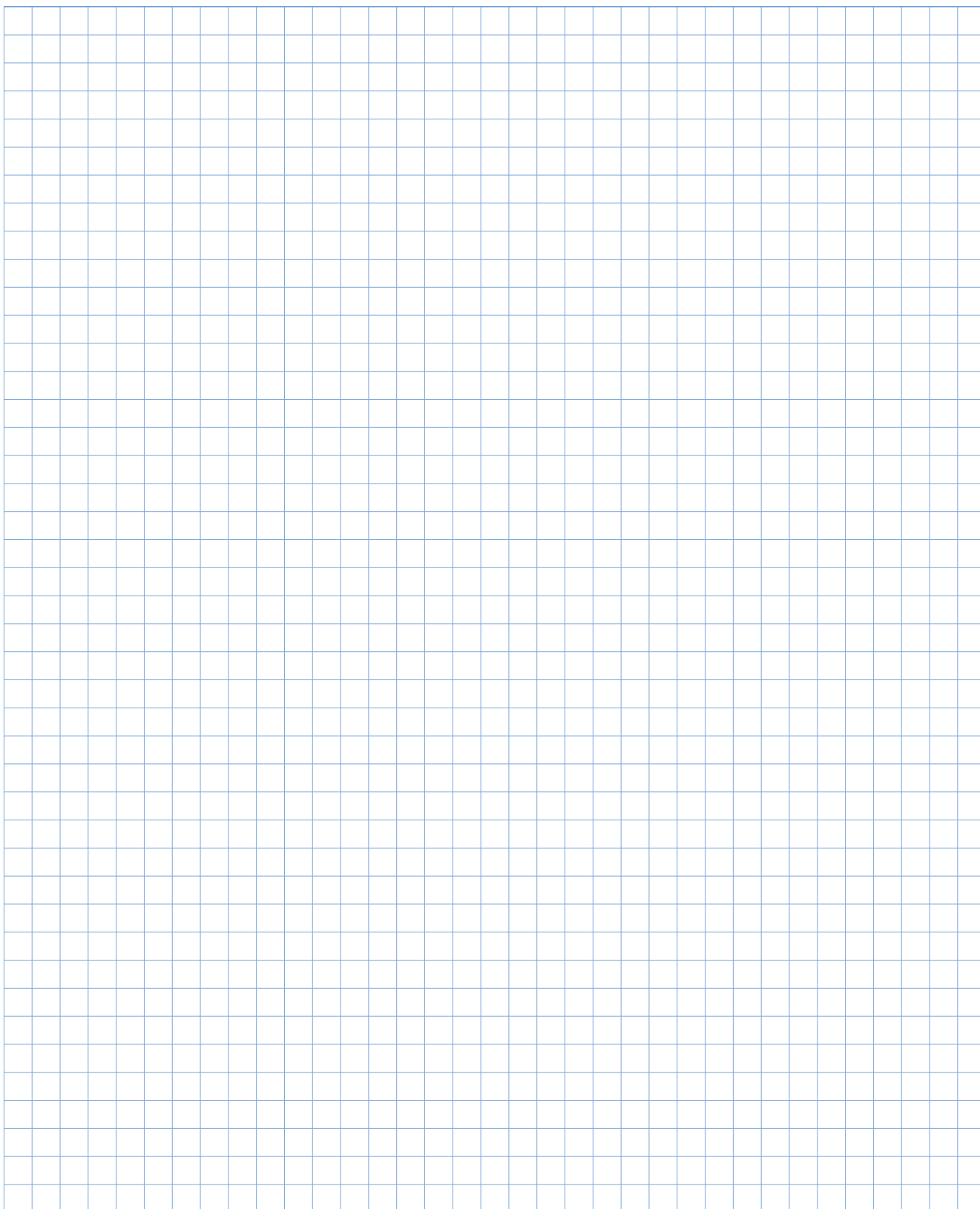
Table 5

| Size | Central oil lubrication Oil quantities Impulse (cm ³) | Impulses per lubrication cycle Number of impulses |
|------|---|--|
| | 15 | 0,6 |
| 20 | 0,6 | 1 |
| 25 | 0,6 | 2 |
| 30 | 0,6 | 2 |
| 35 | 0,6 | 2 |
| 45 | 0,6 | 4 |

Notes



Notes





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