ALMOTION

EWELLIX

A Schaeffler Company

Profile rail guides - LLT catalogue

Contents

The heritage of innovation

Ewellix is a global innovator and manufacturer of linear motion and actuation solutions. Our state-of-the-art linear solutions are designed to increase machine performance, maximise uptime, reduce maintenance, improve safety and save energy. We engineer solutions for assembly automation, medical equipment, mobile machinery, distribution and a wide range of other industrial applications.

Technology leadership

We earned our reputation through decades of engineering excellence. Our journey began over 50 years ago as part of the SKF Group, a leading global technology provider. Our history provided us with the expertise to continuously develop new technologies and use them to create cutting edge products that offer our customers a competitive advantage.

In 2019, we became independent and changed our name to Ewellix. We are proud of our heritage. This gives us a unique foundation on which to build an agile business with engineering excellence and innovation as our core strengths.

Global presence and local support

With our global presence, we are uniquely positioned to deliver standard components and custom-engineered solutions, with full technical and applications support around the world. Our skilled engineers provide total life-cycle support, helping to optimise the design, operation and maintenance of equipment thus improving productivity and reliability while reducing costs. At Ewellix, we don't just provide products; we engineer integrated solutions that help customers realise their ambitions.

Schaeffler Group – We pioneer motion

Ewellix is since 2023 owned by the Schaeffler Group.

As a leading global supplier to the automotive and industrial sectors, the Schaeffler Group has been driving forward groundbreaking inventions and developments in the fields of motion and mobility for over 75 years.

With innovative technologies, products, and services for electric mobility, CO_2-efficient drives, Industry 4.0, digitalization, and renewable energies, the company is a reliable partner for making motion and mobility more efficient, intelligent, and sustainable.

Schaeffler manufactures high-precision components and systems for powertrain and chassis applications as well as rolling and plain bearing solutions for a large number of industrial applications.

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Trusted engineering expertise

Our industry is in motion; pushing towards solutions that reduce environmental impact and leverage new technology. We provide technical and manufacturing expertise to overcome our customers' challenges.

Engineering for the future

We work in a **wide range of industries**, where our solutions provide key functionality for business critical applications.

For the **medical industry**, we provide precision components for use in core medical equipment.

Our unparalleled understanding of **assembly automation** systems is based on decades of research into advanced automation components and techniques.

Our deep knowledge of **mobile machinery** provides powerful and reliable electromechanical solutions for the harshest conditions. In an **industrial distribution** setting, we supply linear expertise to our partners, empowering them to serve customers with greater efficiency.

We offer excellence

We have a **unique understanding of linear equipment** and how it's integrated in customers' applications to provide the best performance and machine efficiency.

We assist our customers by creating equipment that runs faster, longer and that is safe and sustainable.

We provide a wide variety of **linear motion components** and **electromechanical actuators** for equipping any automation application, thus helping our customers **increase productivity, reduce their footprint, energy use and maintenance**.

Actuation systems

Ball and roller screws

Linear guides and systems

1

Introduction

1.1 Product description

The productivity and economic success of a given application depends, to a large extent, on the quality of the selected linear components. Often these components determine market acceptance and thus help to obtain a competitive edge for the manufacturer. To do this, the linear components have to be as adaptable as possible to precisely meet the application's requirements, ideally with standard components.

The Ewellix profile rail guide series LLT satisfies these market demands: available in a wide range of sizes, carriages and accessories as well as in various preload and precision classes, LLT profile rail guides facilitate adaptation to individual application demands. In combination with their ability to operate at virtually unlimited stroke, this opens up almost any design option.

The range of possible applications include material handling, plastic injection moulding, woodworking, printing, packaging and medical devices, to name only a few. In these types of applications, the design of the LLT reveals its full capabilities.

Ewellix manufactures LLT profile rail guides in an X-arrangement with a 45° contact angle between the rolling elements and raceways. This design promotes equal load sharing in all four main load directions to provide greater design flexibility. Moreover, deviations in parallelism and height, which usually occur in multi-axis systems, can be compensated for more efficiently, resulting in reliable and smooth operation under a variety of operating conditions.

In addition, Ewellix offers a miniature profile rail guide series and a series of ready assembled and driven profile rail guide slides. Contact your Ewellix representative for additional information.

1.2 Design

Just as with rotary bearings, the raceways of profile rail guides can be arranged in an X- or O-configuration. The technical characteristics of these two arrangements are essentially the same. Therefore, there are no basic differences in behaviour in the vast majority of load situations, except when they are subjected to moment loads around the x-axis.

The Profile rail guides from Ewellix feature an X-arrangement, based on the contact angle of the rolling elements (↳ **fig. 1**).

The advantage of this arrangement is that deviations in parallelism and height, which usually appear in multi-axes systems, can be accommodated more effectively (↳ **fig. 2**).

Due to the design-related smaller lever arm, the X-arrangement provides better self-aligning capability.

In combination with a two-point contact of the rolling elements, running friction is kept to a minimum.

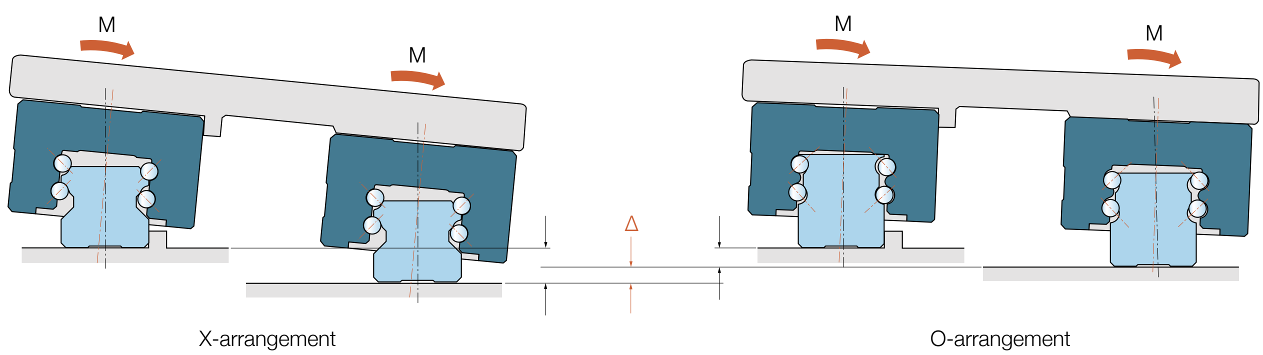
This results in a smooth and stick-slip-free operation of the guidance system.

Fig. 1

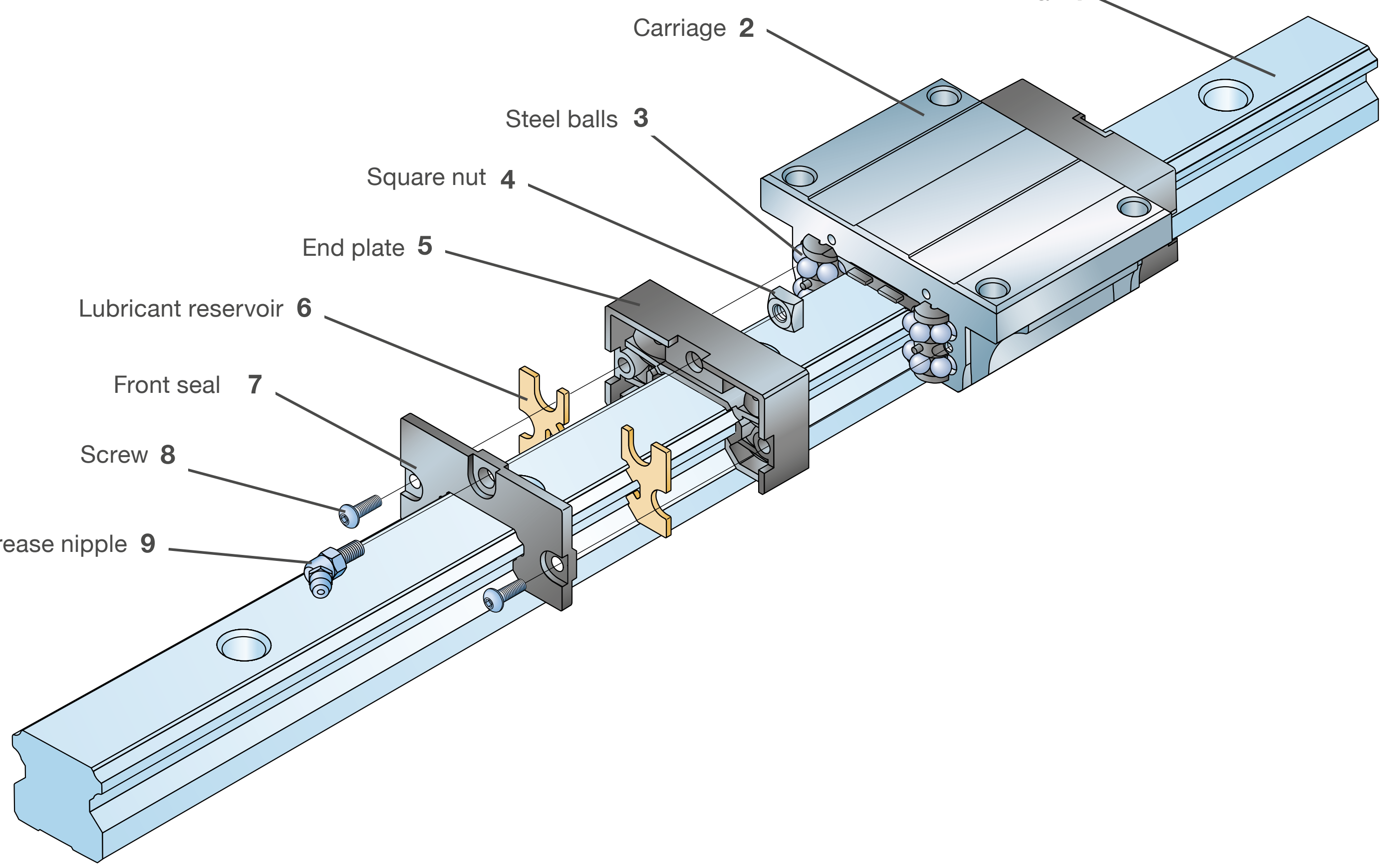
Schematic illustration of the different ball-arrangements

Fig. 2

Self-aligning capability in comparison



1.2.1 Components and material specifications



Material specifications

1. Steel, inductive hardened
2. Steel, case hardened
3. Bearing steel
4. Steel, zinc coated
5. POM, reinforced
6. EPU foam
7. PA 6.6 and Elastomer; alternative low friction S0 shield made from PA 6.6
8. Steel
9. Steel, nickel coated

1.2.2 Standard carriage components

Seals

The ingress of dirt, swarf and liquids, as well as lubricant leakage can significantly reduce the service life of a profile rail guide system. Ewellix LLT profile rail guide carriages are therefore supplied with front, side and inner seals as standard, which can significantly extend service life.

Front seal

Front seals are especially important since they provide protection for the carriage in the direction of movement.
They are designed as double-lip seals in order to provide improved wiping properties (↳ **fig. 3**).

Side seal

Side seals effectively prevent contaminants from working environment into the system from below. Seal design can deviate based on size (↳ **fig. 4**).

Inner seal

Inner seals are an additional means of protection against lubricant leakage. Seal design can deviate based on size (↳ **fig. 5**).

Grease nipple

Two lube ports with metal thread are located on both front sides of each carriage. As standard, one grease nipple for manual relubrication is supplied along with the carriage, while the opposite side is secured by a set screw. The metal thread also enables the easy and reliable mounting of automatic lubricators.

Grease nipples are according to standard JIS 1575:2000 (↳ **page 70**).

If some accessories require longer grease nipples, they will be provided.

Fig. 3

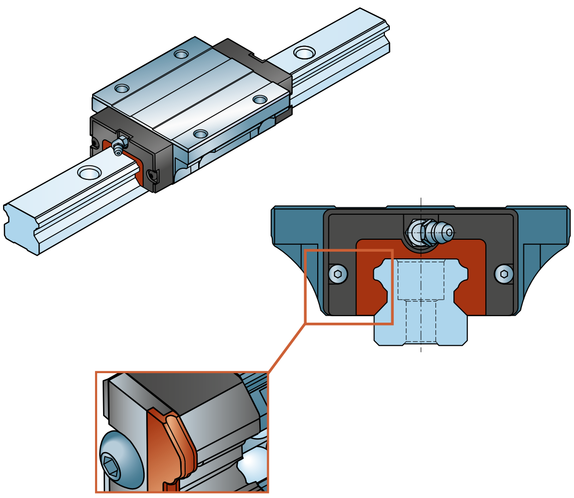


Fig.4

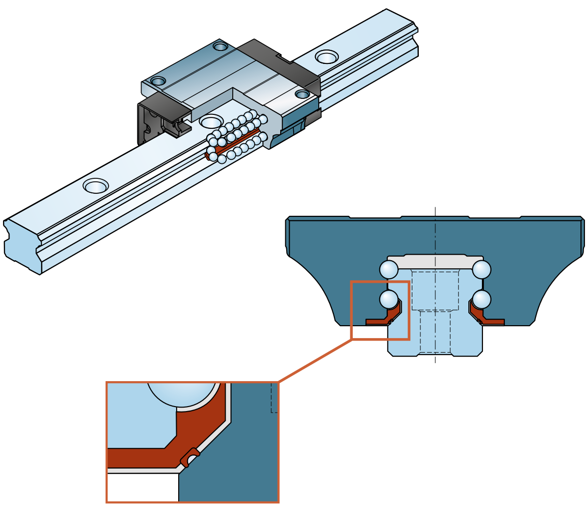
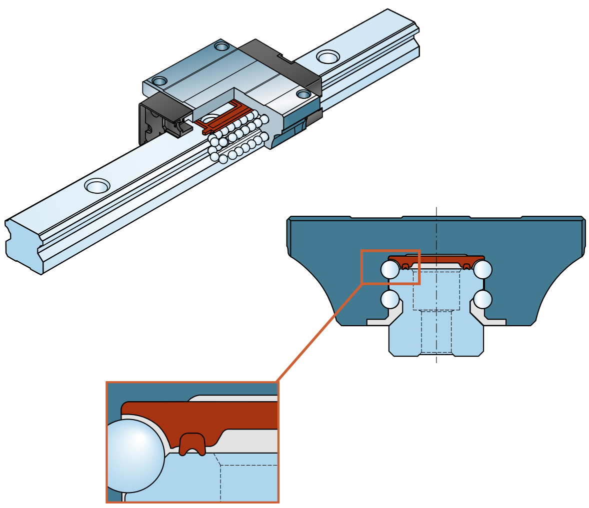
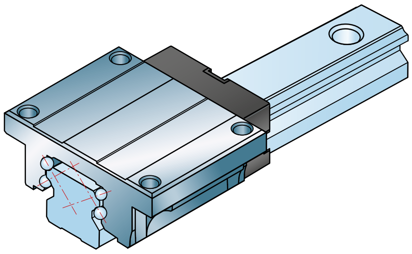


Fig. 5

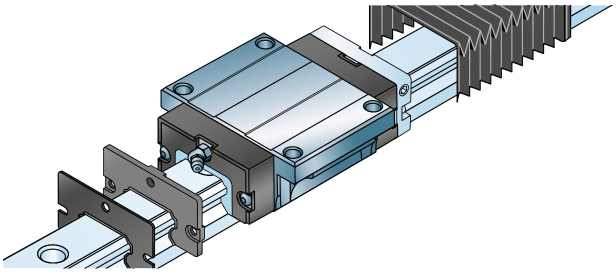


1.3 Features and benefits



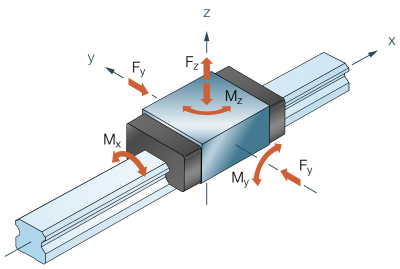
Improved running performance

The LLT profile rail guide has four rows of balls with a 45° contact angle between the rolling elements and raceways. This X-arrangement improves the system's self-aligning capability. Mounting deviations can be accommodated even under preload, resulting in smooth running performance. Friction is kept to a minimum due to two-point ball contact. This enables reliable, stick-slip-free operation for the life of the rail guide.



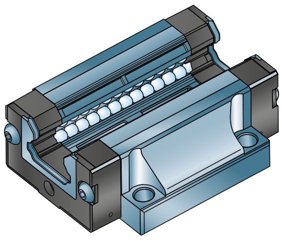
Modular concept for customized solutions

Applications have different speed, precision and environmental requirements. As a result, Ewellix LLT rail guides use modular components so that cost-effective solutions can be built based on the needs of the application. Various precision and preload classes are available to meet different precision and rigidity requirements. Furthermore, a wide range of accessories supports its adaptation to specific environmental needs.



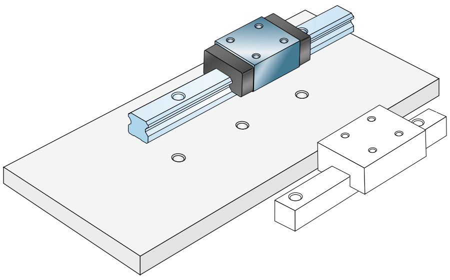
Rigidity, strength and precision for improved production processes

The four-row arrangement of balls at a 45° angle optimizes load sharing in all four main load directions and is in accordance with ISO 14728. This feature provides a high degree of design flexibility. The ability to accommodate high loads and moment loads makes these rail guides ideal even for single carriage systems.



Longer service life and reduced maintenance

Ewellix profile rail guide carriages are pre-lubricated at the factory. The integrated lubricant reservoirs, located in the end plates, constantly relubricate the circulating balls. Both ends of the carriage have threaded metal lubrication ports to accommodate an automatic re-lubrication system. One grease nipple is provided as standard with each carriage. These fully sealed carriages have double lip seals on both ends as well as side and inner seals. The low-friction seals are highly effective against the ingress of contaminants.



Interchangeability and global availability

The main dimensions of Ewellix profile rail guides are in accordance with ISO 12090-1. This enables dimensional interchangeability with all ISO-compliant brands. Ewellix's global sales and distribution network results in availability of replacement parts and serviceability for all systems worldwide.

1.4 Product range

1.4.1. Product overview

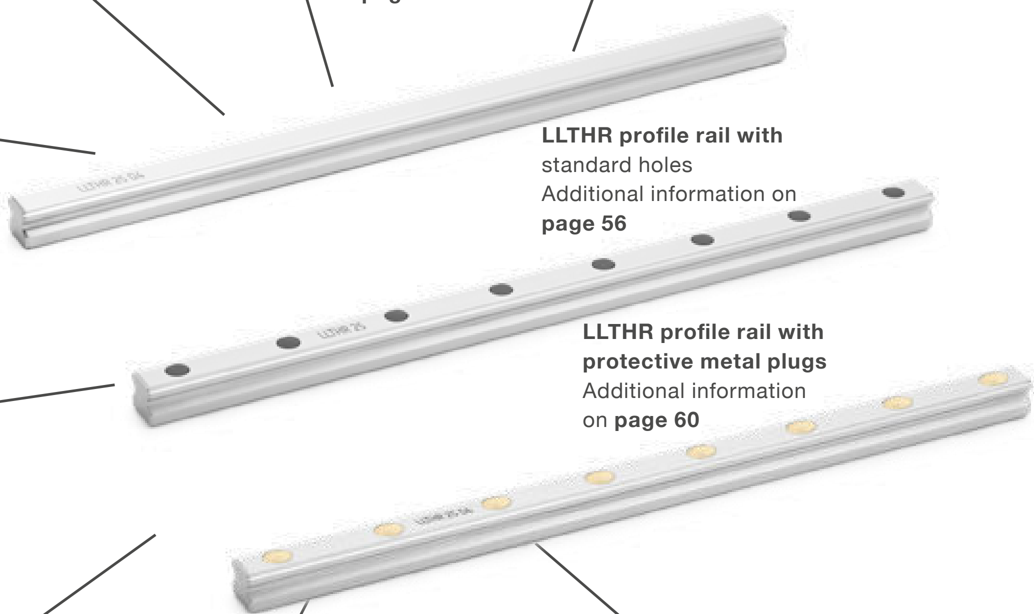
LLTHC ... SA
Flanged carriage, short length, standard height
Further information on **page 38**

LLTHC ... A
Flanged carriage, standard length, standard height.
Further information on **page 40**

LLTHC ... LA
Flanged carriage, extended length, standard height
Further information on **page 42**

LLTHC ... R
Slim-line carriage, standard length, extended height
Further information on **page 50**

LLTHR profile rail with blind holes
Additional information on **page 58**



LLTHR profile rail with standard holes
Additional information on **page 56**

LLTHR profile rail with protective metal plugs
Additional information on **page 60**

LLTHC ... LR
Slim-line carriage, extended length, extended height
Further information on **page 52**

LLTHC ... SU
Slim-line carriage, short length, standard height
Further information on **page 44**

LLTHC ... U
Slim-line carriage, standard length, standard height
Further information on **page 46**

LLTHC ... LU
Slim-line carriage, extended length, standard height
Further information on **page 48**

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1.4.2 Preferred range

Carriages

Table 1

Size	Precision class	Designation Preload class T0	T1	T2
15	P5	LLTHC 15 SA T0 P5	LLTHC 15 SA T1 P5	–
		LLTHC 15 A T0 P5	LLTHC 15 A T1 P5	LLTHC 15 A T2 P5
		LLTHC 15 SU T0 P5	LLTHC 15 SU T1 P5	–
		LLTHC 15 U T0 P5	LLTHC 15 U T1 P5	LLTHC 15 U T2 P5
		LLTHC 15 R T0 P5	LLTHC 15 R T1 P5	LLTHC 15 R T2 P5
	P3	LLTHC 15 SA T0 P3	LLTHC 15 SA T1 P3	–
		LLTHC 15 A T0 P3	LLTHC 15 A T1 P3	–
		LLTHC 15 SU T0 P3	LLTHC 15 SU T1 P3	–
		LLTHC 15 U T0 P3	LLTHC 15 U T1 P3	–
		LLTHC 15 R T0 P3	LLTHC 15 R T1 P3	–
20	P5	LLTHC 20 SA T0 P5	LLTHC 20 SA T1 P5	–
		LLTHC 20 A T0 P5	LLTHC 20 A T1 P5	LLTHC 20 A T2 P5
		LLTHC 20 LA T0 P5	LLTHC 20 LA T1 P5	LLTHC 20 LA T2 P5
		LLTHC 20 SU T0 P5	LLTHC 20 SU T1 P5	–
		LLTHC 20 U T0 P5	LLTHC 20 U T1 P5	LLTHC 20 U T2 P5
		LLTHC 20 LR T0 P5	LLTHC 20 LR T1 P5	LLTHC 20 LR T2 P5
	P3	LLTHC 20 SA T0 P3	LLTHC 20 SA T1 P3	–
		LLTHC 20 A T0 P3	LLTHC 20 A T1 P3	–
		LLTHC 20 LA T0 P3	LLTHC 20 LA T1 P3	–
		LLTHC 20 SU T0 P3	LLTHC 20 SU T1 P3	–
		LLTHC 20 U T0 P3	LLTHC 20 U T1 P3	–
		LLTHC 20 LR T0 P3	LLTHC 20 LR T1 P3	–
25	P5	LLTHC 25 SA T0 P5	LLTHC 25 SA T1 P5	–
		LLTHC 25 A T0 P5	LLTHC 25 A T1 P5	LLTHC 25 A T2 P5
		LLTHC 25 LA T0 P5	LLTHC 25 LA T1 P5	LLTHC 25 LA T2 P5
		LLTHC 25 SU T0 P5	LLTHC 25 SU T1 P5	–
		LLTHC 25 U T0 P5	LLTHC 25 U T1 P5	LLTHC 25 U T2 P5
		LLTHC 25 LU T0 P5	LLTHC 25 LU T1 P5	LLTHC 25 LU T2 P5
		LLTHC 25 R T0 P5	LLTHC 25 R T1 P5	LLTHC 25 R T2 P5
		LLTHC 25 LR T0 P5	LLTHC 25 LR T1 P5	LLTHC 25 LR T2 P5
	P3	LLTHC 25 SA T0 P3	LLTHC 25 SA T1 P3	–
		LLTHC 25 A T0 P3	LLTHC 25 A T1 P3	–
		LLTHC 25 LA T0 P3	LLTHC 25 LA T1 P3	–
		LLTHC 25 SU T0 P3	LLTHC 25 SU T1 P3	–
		LLTHC 25 U T0 P3	LLTHC 25 U T1 P3	–
		LLTHC 25 LU T0 P3	LLTHC 25 LU T1 P3	–
		LLTHC 25 R T0 P3	LLTHC 25 R T1 P3	–
		LLTHC 25 LR T0 P3	LLTHC 25 LR T1 P3	–

Table 1

Size	**Precision class**	**Designation** Preload class T0	 T1	 T2
30	P5	LLTHC 30 SA T0 P5	LLTHC 30 SA T1 P5	–
		LLTHC 30 A T0 P5	LLTHC 30 A T1 P5	LLTHC 30 A T2 P5
		LLTHC 30 LA T0 P5	LLTHC 30 LA T1 P5	LLTHC 30 LA T2 P5
		LLTHC 30 SU T0 P5	LLTHC 30 SU T1 P5	–
		LLTHC 30 U T0 P5	LLTHC 30 U T1 P5	LLTHC 30 U T2 P5
		LLTHC 30 LU T0 P5	LLTHC 30 LU T1 P5	LLTHC 30 LU T2 P5
		LLTHC 30 R T0 P5	LLTHC 30 R T1 P5	LLTHC 30 R T2 P5
		LLTHC 30 LR T0 P5	LLTHC 30 LR T1 P5	LLTHC 30 LR T2 P5
	P3	LLTHC 30 SA T0 P3	LLTHC 30 SA T1 P3	–
		LLTHC 30 A T0 P3	LLTHC 30 A T1 P3	–
		LLTHC 30 LA T0 P3	LLTHC 30 LA T1 P3	–
		LLTHC 30 SU T0 P3	LLTHC 30 SU T1 P3	–
		LLTHC 30 U T0 P3	LLTHC 30 U T1 P3	–
		LLTHC 30 LU T0 P3	LLTHC 30 LU T1 P3	–
		LLTHC 30 R T0 P3	LLTHC 30 R T1 P3	–
		LLTHC 30 LR T0 P3	LLTHC 30 LR T1 P3	–
35	P5	LLTHC 35 SA T0 P5	LLTHC 35 SA T1 P5	–
		LLTHC 35 A T0 P5	LLTHC 35 A T1 P5	LLTHC 35 A T2 P5
		LLTHC 35 LA T0 P5	LLTHC 35 LA T1 P5	LLTHC 35 LA T2 P5
		LLTHC 35 SU T0 P5	LLTHC 35 SU T1 P5	–
		LLTHC 35 U T0 P5	LLTHC 35 U T1 P5	LLTHC 35 U T2 P5
		LLTHC 35 LU T0 P5	LLTHC 35 LU T1 P5	LLTHC 35 LU T2 P5
		LLTHC 35 R T0 P5	LLTHC 35 R T1 P5	LLTHC 35 R T2 P5
		LLTHC 35 LR T0 P5	LLTHC 35 LR T1 P5	LLTHC 35 LR T2 P5
	P3	LLTHC 35 SA T0 P3		–
		LLTHC 35 A T0 P3		–
		LLTHC 35 LA T0 P3		–
		LLTHC 35 SU T0 P3		–
		LLTHC 35 U T0 P3		–
		LLTHC 35 LU T0 P3		–
		LLTHC 35 R T0 P3		–
		LLTHC 35 LR T0 P3		–
45	P5	LLTHC 45 A T0 P5	LLTHC 45 A T1 P5	LLTHC 45 A T2 P5
		LLTHC 45 LA T0 P5	LLTHC 45 LA T1 P5	LLTHC 45 LA T2 P5
		LLTHC 45 U T0 P5	LLTHC 45 U T1 P5	LLTHC 45 U T2 P5
		LLTHC 45 LU T0 P5	LLTHC 45 LU T1 P5	LLTHC 45 LU T2 P5
		LLTHC 45 R T0 P5	LLTHC 45 R T1 P5	LLTHC 45 R T2 P5
		LLTHC 45 LR T0 P5	LLTHC 45 LR T1 P5	LLTHC 45 LR T2 P5
	P3	LLTHC 45 A T0 P3	LLTHC 45 A T1 P3	–
		LLTHC 45 LA T0 P3	LLTHC 45 LA T1 P3	–
		LLTHC 45 U T0 P3	LLTHC 45 U T1 P3	–
		LLTHC 45 LU T0 P3	LLTHC 45 LU T1 P3	–
		LLTHC 45 R T0 P3	LLTHC 45 R T1 P3	–
		LLTHC 45 LR T0 P3	LLTHC 45 LR T1 P3	–

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Rails

Table 2

Size	Precision class	Designation	
		One-piece-rail	Multi-piece-rail
15	P5	LLTHR 15-…P5	LLTHR 15-…P5 A
		LLTHR 15-…P5 D4	LLTHR 15-…P5 A D4
	P3	LLTHR 15-…P3	LLTHR 15-…P3 A
		LLTHR 15-…P3 D4	LLTHR 15-…P3 A D4
20	P5	LLTHR 20-…P5	LLTHR 20-…P5 A
		LLTHR 20-…P5 D4	LLTHR 20-…P5 A D4
	P3	LLTHR 20-…P3	LLTHR 20-…P3 A
		LLTHR 20-…P3 D4	LLTHR 20-…P3 A D4
25	P5	LLTHR 25-…P5	LLTHR 25-…P5 A
		LLTHR 25-…P5 D4	LLTHR 25-…P5 A D4
		LLTHR 25-…P5 D6	LLTHR 25-…P5 A D6
	P3	LLTHR 25-…P3	LLTHR 25-…P3 A
		LLTHR 25-…P3 D4	LLTHR 25-…P3 A D4
		LLTHR 25-…P3 D6	LLTHR 25-…P3 A D6
30	P5	LLTHR 30-…P5	LLTHR 30-…P5 A
		LLTHR 30-…P5 D4	LLTHR 30-…P5 A D4
		LLTHR 30-…P5 D6	LLTHR 30-…P5 A D6
	P3	LLTHR 30-…P3	LLTHR 30-…P3 A
		LLTHR 30-…P3 D4	LLTHR 30-…P3 A D4
		LLTHR 30-…P3 D6	LLTHR 30-…P3 A D6
35	P5	LLTHR 35-…P5	LLTHR 35-…P5 A
		LLTHR 35-…P5 D4	LLTHR 35-…P5 A D4
		LLTHR 35-…P5 D6	LLTHR 35-…P5 A D6
	P3	LLTHR 35-…P3	LLTHR 35-…P3 A
		LLTHR 35-…P3 D4	LLTHR 35-…P3 A D4
		LLTHR 35-…P3 D6	LLTHR 35-…P3 A D6
45	P5	LLTHR 45-…P5	LLTHR 45-…P5 A
		LLTHR 45-…P5 D4	LLTHR 45-…P5 A D4
		LLTHR 45-…P5 D6	LLTHR 45-…P5 A D6
	P3	LLTHR 45-…P3	LLTHR 45-…P3 A
		LLTHR 45-…P3 D4	LLTHR 45-…P3 A D4
		LLTHR 45-…P3 D6	LLTHR 45-…P3 A D6

2

Selection guide

2.1 Technical data

2.1.1 Load rating

Definition of the basic dynamic load rating C

The basic dynamic load rating C is the radial load, constant in magnitude and direction, which a linear rolling bearing can theoretically accommodate for a basic rating life represented by a travelled distance of 100 km (according to ISO 14728 Part 1).

NOTE: As per ISO 14728 Part 1, it is also permissible to state a reference distance of 50 km travelled. In this case, a conversion factor of 1,26 should be applied in order to enable proper comparison of the two load rating values (↳ **formula 1**).

(1) $$C_{100} = \frac{C_{50}}{1,26}$$

Definition of the basic static load rating C_0

The basic static load rating C_0 is the static load in the direction of loading which corresponds to a calculated stress at the centre of the most heavily loaded contact point between the rolling element and each of the raceways of carriage and rail.

NOTE: This stress produces a permanent total deformation of the rolling element and the raceway which corresponds to about 0,0001 times the rolling element diameter (according to ISO 14728 Part 2).

Verification and validation

The load ratings stated in this catalogue have been calculated for all product types based on the standards cited.

The calculation model prescribed in the standards has been complemented and verified by Ewellix through internal simulations.

Since it is not economically feasible to test the load ratings of all catalogue types in practice, Ewellix carries out standardized durability examinations at regular intervals by means of selected reference sizes. These tests provide statistical evidence and documentation that the theoretically ascertained load ratings are valid under standardized practical test conditions.

In many cases, this Ewellix internal validation process saves the customer intensive field tests and offers high reliability for LLT profile rail guide designs.

Only in cases where the operating conditions are not known, as well as in cases where these conditions are more exacting than usual, customers are advised to conduct further field tests.

In practice, it is a common approach to integrate results and experiences of existing and proven designs in new designs and apply them to new applications. When using LLT profile rail guides, it also makes sense for customers to build on previous application experience in the continuous development of their applications.

2.1.2 Preload classes

To adjust a profile rail guide to the specific requirements of a given application, it is advisable to choose an appropriate preload. Preload can enhance the performance of an entire linear guidance system and increase the rigidity of the carriage under load .

Preload is determined by oversizing between steel balls and raceways on carriage and rail track. This is ensured by state-of-the-art, high-precision grinding processes carefully matched with rolling elements.

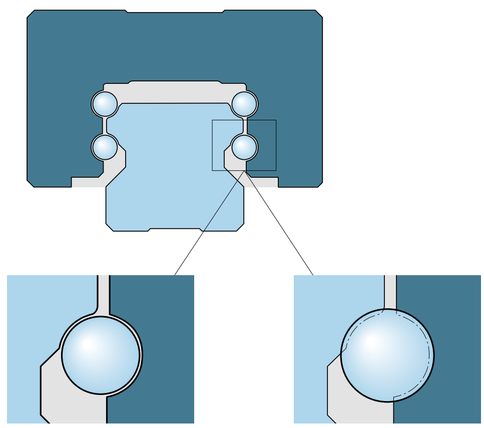
LLT ball profile rail guides are available in three different preload classes, as shown in **table 1**.

NOTE: The principle of the preload generation is shown in **fig. 1**.

For information about what preload classes are typically applied to different applications, see chapter **4.5 Typical application areas** (↳ **page 95**).

Fig. 1

Generation of preload



System without preload *Preloaded system with oversized balls*

Table 1

Determining preload values according to preload class

Preload class	Preload force F_{Pr}
T0	**Zero to light preload** For extremely smooth-running profile rail guide systems requiring low friction. This preload class is only available in P5 and P3 precision classes.
T1	**F_{Pr} = 2 % of C** For precise profile rail guide systems with low and medium external loads and a high degree of rigidity.
T2	**F_{Pr} = 8 % of C** For precise profile rail guide systems with high external load and high requirements for overall rigidity. Also recommended for single-rail systems. Additional common moment loads are absorbed without any significant elastic deformation.

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2.1.3 Accuracy

Precision classes

Ewellix manufactures its LLT ball profile rail guides in three precision classes. These precision classes define the maximum tolerance range of a profile rail system in terms of height, width and parallelism. This choice determines the running accuracy of the system within the application (↳ **table 2** and chapter ↳ **4.5 Typical application areas, page 95**, for further information).

Width and height precision

The tolerance of width N determines the maximum deviation of the distance from the carriage to the rail in lateral direction. Both sides of the rail and the ground side of the carriage can be used as the reference side.

The tolerance of height H is measured between the mounting surface of the carriage and the ground bottom face of the rail. H and N are arithmetic mean values.

The deviations ΔH and ΔN result, when different carriages are measured on the same rail position.

Running parallelism

This refers to the running parallelism tolerance between the two reference planes of the rail and carriage when the carriage is moved along the entire rail length, the rail being screwed to the reference plane. Please refer to **diagram 1** for detailed information.

Combination of rails and carriages

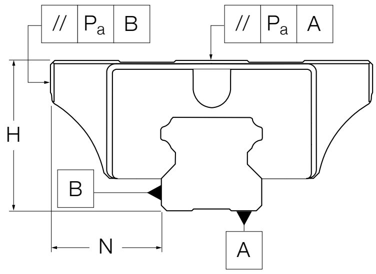
All carriages and rails of the same size and precision class (P5/P3) can be combined with each other while maintaining the initial precision class. They are fully interchangeable. Mixed precision classes are possible.

NOTE: The lower accuracy can be guaranteed when system item assembled by rail and carriage with different accuracy.

NOTE: Precision class P1 can only be delivered as a complete system.

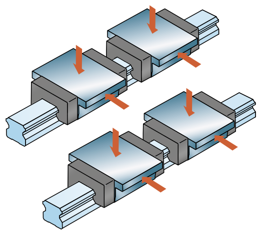
NOTE: Preload/Precision class T2 P3 can only be delivered as a complete system.

Table 2

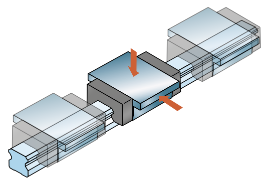


Precision class	Tolerances		Differences in dimension H and N on one rail	
	H [1)]	N	ΔH [1)] max.	ΔN max.
–	µm		µm	
P5	±100	±40	30	30
P3	±40	±20	15	15
P1	±20	±10	7	7

[1)] Measured at the centre of the carriage



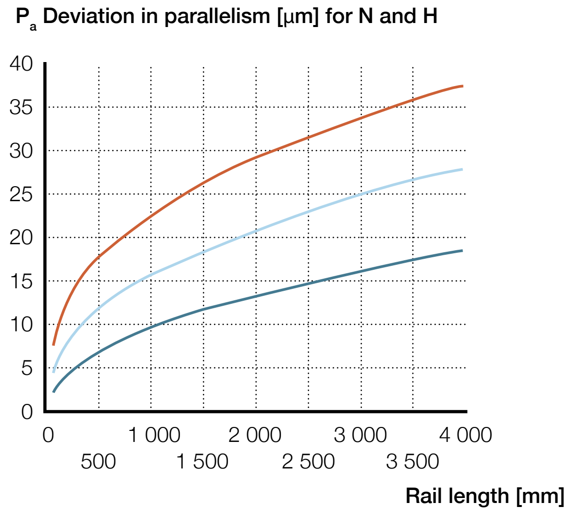
For any combination of carriages and rails



For different carriages on the same rail position

Diagram 1

Running parallelism



P5 = Standard
P1 = High
P3 = Medium

2.1.4 Rigidity

The rigidity of LLT profile rail guides, in addition to their load carrying capacity, is one of the most important criteria in product selection.

Rigidity can be defined as the deformation characteristics of a guidance system under external load. The rigidity of a system depends on the magnitude and direction of the external load, the type of guidance system (size, carriage type, preload) and the mechanical properties of the adjacent support structure. Usually, this load is indicated, including magnitude and direction, on the point of load application of the mounted guidance system.

Rigidity values, which only take deflection of the rolling elements into consideration, can deviate considerably under realistic conditions due to the elasticity of the support structure, the screw connections and the joints between components. Therefore, the overall rigidity at the bearing point is, as a rule, lower than that of the actual guidance system.

The different sizes and types of LLT profile rail guides feature significant differences in their deformation behaviour.

The diagrams represent only the deformation values for a single reference size. These values are measured on properly mounted LLTHS 25 rail guides bolted to well-prepared support surfaces. The loads were applied symmetrically between the load carrying raceways.

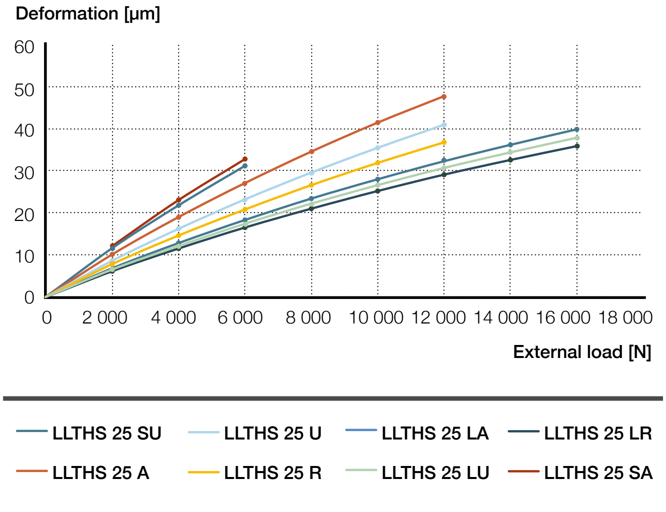
Rigidity values for other types of LLT profile rail guides are available on request.

Furthermore, the type and size of the carriage has an impact on rigidity due to the geometrical differences.

Diagram 2 shows the deformation behaviour of an LLT profile rail guide based on the selected carriage type in one load direction. It represents the behaviour of eight different size 25 carriage types under vertical pushing load in an identical mounting situation.

Diagram 2

Deformation behaviour of size 25 under vertical pushing load, with 8 type different carriages



2.1.5 Permissible operating conditions

The function of LLT profile rail guides can be realized only if there are no deviations from the specified operating conditions. The formulae and life values stated in the chapter **2.2 Calculation of bearing loads** (↳ **page 24**) are valid only if the operating conditions described in the following are met.

1.1.1 Permissible speed and acceleration

LLT profile rail guides can reach a maximum speed of
v_{max} = 5 m/s.
The maximum acceleration is
a_{max} = 75 m/s^2 (for preloaded systems).

Permissible maximum load

When selecting an LLT profile rail guide, the dynamic and static load ratings are key factors in this process.

For example, the equivalent dynamic mean load during operation must not exceed 50 % of the dynamic load rating. To calculate the dynamic bearing load, see **page 26**.

Exceeding the dynamic load ratings in operation results in a deviation of the usual load distribution, and can significantly reduce bearing service life. A statistical evaluation according to Weibull is not reliable in these cases.

As stated in ISO 14728 Part 2, the maximum load should not exceed 50 % of the static load rating.

Required minimum load

To prevent the balls from sliding in the load zone during operation at higher speed, the carriage must be under a minimum load at all times. A value of about 2 % of the dynamic load rating can be used as a guideline. This is particularly important for applications that are characterized by highly dynamic cycles. LLT profile rail guides in the T1 preload class are typically able to satisfy minimum load requirements.

Permissible operating temperatures

The permissible temperature range for LLT profile rail guides is:

Continuous operation: –20 to +80 °C
Short-term: max. 100 °C

This temperature range is determined by the synthetic materials used for the ball retainers, recirculation devices and seals.

The time limit for the permissible maximum temperature is dependent on the actual operating conditions.
Low speed (< 0,2 m/s), slightly loaded (P < 15 % C) or stationary applications can be exposed to an ambient temperature < 100 °C for up to one hour.
Design measures like heat shielding can extend this period.

Be sure to check that the temperature limits of the lubricant can withstand elevated temperatures prior to use.

Standstill operation

When external forces create vibrations in a stationary LLT profile rail guide, surface damage due to micro-movements between the balls and raceways may occur. This can increase noise levels during dynamic operation and reduce system service life.

To avoid this type of damage, the guides should be isolated from external vibration and mechanically unloaded for transport purposes.

2.1.6 Friction

In addition to the external operating load, the friction in a guidance system is determined by a number of other factors. For example, the preload class, external loads, speed of travel and viscosity of the lubricant should be taken into consideration.

The displacement resistance is determined by the proportions of rolling and sliding friction generated by the rolling elements in the contact zone. Also, the recirculation geometry as well as the lubricant have an influence.

The effect of the lubricant depends on its characteristics, quantity and condition.

A running-in phase provides a better distribution of the lubricant in the carriage, and therefore reduces friction.

The operating temperature of the guidance system also influences friction. Higher temperatures reduce the viscosity of the lubricant.

Another factor is the sliding friction of the front and longitudinal seals in contact with the profile rail guide. The friction generated by the seals will, however, decrease after the running-in phase.

The friction can be reduced to a minimum when carriages with low friction shields S0 from size 15 to 30 are used. Due to the reduced sealing ability of these shields, these carriages should only be considered for applications in clean environments.

Moreover, the mounting precision of the rails relative to each other plays an important part, just like the flatness of the saddle plates as well as attachment structure for rail tracks connected to the guides.

The coefficient of friction for lubricated profile rail guides is typically between μ = 0,003 and 0,005. Lower values should be selected for higher loads, and higher values for lower loads. The friction values of the seals must be added to these values.

Table 3

Standard seal					
Test condition			Greased (Grease type LGEP2) Standard seal + side seal + inner seal		
Designation			LLTHS XX TX PX		
–	Size	Carriage length	Running friction force standard (N) Max.		
			T0	T1	T2
Friction Force	15	Short	≤ 4,5	≤ 5,5	–
		Normal	≤ 5,5	≤ 6,5	≤ 8,5
	20	Short	≤ 9,5	≤ 10,5	–
		Normal	≤ 10,5	≤ 11,5	≤ 14,0
		Long	≤ 11,5	≤ 12,5	≤ 15,0
	25	Short	≤ 12,5	≤ 13,5	–
		Normal	≤ 13,5	≤ 14,5	≤ 17,0
		Long	≤ 14,5	≤ 15,5	≤ 18,0
	30	Short	≤ 14,5	≤ 15,5	–
		Normal	≤ 16,0	≤ 17,5	≤ 22,5
		Long	≤ 16,5	≤ 18,0	≤ 23,0
	35	Short	≤ 17,5	≤ 19,0	–
		Normal	≤ 19,0	≤ 20,5	≤ 26,5
		Long	≤ 20,0	≤ 21,5	≤ 27,5
	45	Normal	≤ 22,0	≤ 23,5	≤ 30,5
		Long	≤ 26,0	≤ 28,0	≤ 35,5

Table 4

Low friction shields S0					
Test condition			**Without greasing**		
			Low friction shields S0 + Side seal + inner seal		
Designation			LLTHS XX TX PX		
–	Size	Carriage length	Running friction force standard (N) Max.		
			T0	T1	T2
Friction Force	15	Short	≤ 1,2	≤ 1,5	–
		Normal	≤ 1,5	≤ 1,8	≤ 2,3
	20	Short	≤ 1,7	≤ 2,0	–
		Normal	≤ 2,0	≤ 2,3	≤ 3,1
		Long	≤ 2,5	≤ 2,8	≤ 3,6
	25	Short	≤ 2,0	≤ 2,4	–
		Normal	≤ 2,4	≤ 2,8	≤ 3,8
		Long	≤ 3,0	≤ 3,4	≤ 4,4
	30	Short	≤ 2,5	≤ 3,0	–
		Normal	≤ 3,0	≤ 3,5	≤ 4,8
		Long	≤ 3,5	≤ 4,0	≤ 5,3

Table 5

Additional friction force				
Test condition			**Without greasing**	
			Side seal + inner seal	
Size	Additional friction force base on standard seal (N)			
	S1	S7	S6	S3
	S1 kit on one side	S7 kit on one side	S6 kit on one side	S3 kit on one side
15	0	1	1,02	4
20	0	1,25	1,02	4
25	0	1,5	2,04	4
30	0	1,75	3,06	4
35	0	2	4,08	4
45	0	2,25	-	4

NOTE:

1. Calculation example: LLTH 15 U T0 carriage standard push and pull force specification is less than or equal to 5.5N, S7 single-plate friction force will increased 1N, so after the S7 single-plate is installed on one side, the push and pull force specification will be less than or equal to 6.5N (5.5N + 1N); after the S7 single-plate is installed on both sides, the push and pull force specification is less than or equal to 7.5N (5.5N+1N*2)

2.1.7 Applications in corrosive environments

To ensure that LLT profile rail guides operate reliably in corrosive environments, the carriages and rails must be protected with special coatings. These coatings bring about substantial improvements in corrosion resistance and thus increase the wear resistance under critical operating conditions.

Ewellix protects components with the following coatings:

LLTHR rails:	TDC (Thin Dense Chrome) coating
	Trivalent Chrome coating
LLTHC carriages:	Nickel layer

Rail: The rail features a very thin TDC and Trivalent Chrome layer that provides effective corrosion protection, but does not affect the load rating of the system. The TDC has an excellent corrosion protection and withstands 72 hours salt spray test. The cost competitive Trivalent Chrome coating has a proven 24 hours salt spray test protection which is also sufficient to a wide range of applications that requires corrosion protection. For technical data regarding both types of coatings, please refer to **table 6**.

This product range enables two combinations. The coated rail can be combined with both nickel-plated and standard carriages. A combination of coated rail and standard carriage can be used where the rails are exposed to slightly corrosive media only and the carriages are sufficiently shielded through the adjacent structure or other measures (e.g. machines during transport, installations in contact with weak cleaning solutions).

When used in combination with standard carriages, the catalogue load ratings can be used for the life calculation without change. For this design variant, users should bear in mind that preload increases slightly due to the layer thickness.

When using coated rails in combination with nickel-plated carriages, the load ratings for dynamic loads and moments will be reduced by 30 % and for static loads and moments by 20 %. The preload classes T0 and T1 are available as standard. Systems with coated rails can have a slightly higher preload and friction. This will be partly eliminated after a short running time.

Availability

- Rail sizes: 15–45
- Coated rails: maximum length of about 4 000 mm
- Cut-to-length rail: standard – cut edges not coated
- Cut-to-length rail: possible – cut edges coated

Table 6

Technical data and ordering designations of coated components

Properties	Rail		Carriage
Designation	LLTHR ... HD (Europe) LLTHR ... HA (USA/CAN)	LLTHR ... HT	LLTHC ... A HN LLTHC ... R HN LLTHC ... U HN
Coating	TDC	Trivalent Chrome	Nickel
Colour	matt grey	glossy silver	glossy silver
Layer hardness	900 HV – 1300 HV	700 HV - 800 HV	550 HV - 800 HV
Corrosion protection	72 h [1]	24 h [2]	72 h [2]
RoHS compliant	yes	yes	yes
Stainless steel ball			Material no. 1.4125 (X105CrMo17)

[1] DIN EN ISO 9227
[2] ASTM B-117 (equivalent to DIN EN ISO 9227)

Table 7

Available coated carriages

Size	Type [1] A	R	U	SA	SU	LA	LR	LU
15	O	O	O	–	O	–	–	–
20	O	–	O	–	–	O	–	–
25	O	O	O	O	O	O	–	O
30	O	O	O	–	O	O	O	–
35	O	O	O	–	O	O	–	–
45	O	O	O	–	–	O	–	–

[1] Other type are available on request.

NOTE: Where coated LLT rails are used, glossy areas may appear on the raceways after running-in. The corrosion protection properties are not compromised. Coated rails are not completely covered with a complete layer of TDC and Trivalent chromee at the non-machined bottom rail area and inside the mounting holes. Due to the coating process, the coating color might appear in different shades at the rail bottom side.

All components are delivered with preservative ex works. The nickel-plated carriages are delivered unlubricated and must be greased by the customer prior to use and re-lubricated at regular intervals.

Please refer to **4.4.2 for lubrication information**.

NOTE: The carriages of sizes 15 and 20, in combination with TDC coated rails, are supplied with a low friction S0 shield as standard. Optionally, they can also be combined with an additional S7 front seal. In these cases, a slight increase in carriage length must be taken into account (↳ **page 65**).

NOTE: The availability of coated carriages in different sizes and types is shown in **table 7.**

2.1.8 Jointed rail tracks

If the requested rail length exceeds the available delivery length of LLT rails, specially paired and jointed rails can be supplied as ready-to-mount sets consisting of two or more rails (per rail track). In this case, the rails are marked in order to avoid mix-up during mounting. For specific dimensions of the joint(s), please add a drawing. The maximum length for a deliverable rail track is 50 m. Please contact Ewellix to inquire about longer individual rail tracks. If replacement is required, the complete set should be exchanged to provide full functionality.

For designation, refer to Ordering key rails (↳ **page 104**).

For joint rail availability, see **table 8**.

Parallel use of jointed rails.

When the jointed rails are use by parallelly, we suggest to avoid the joint points which are between in the same position (↳ **fig. 3**).

Table 8

Availability of joint rails

Rail	Carriage	P5	P3	P1
Standard rail	Standard carriage	O	O	–
Coated rail	Standard carriage	O	O	–
Standard rail	Coated carriage	O	–	–
Coated rail	Coated carriage	O	–	–

2

Fig. 2

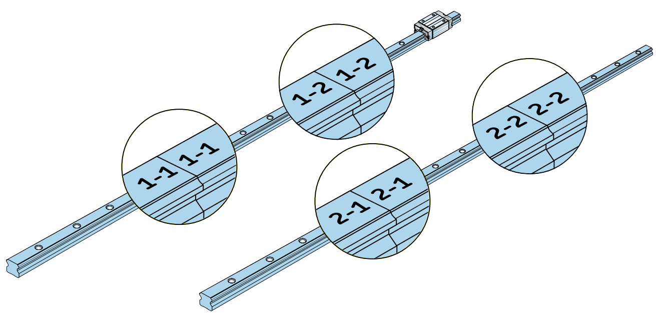
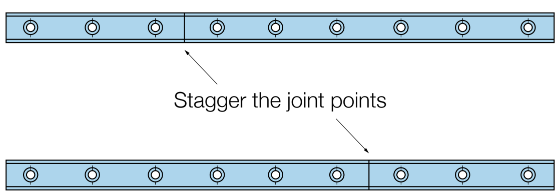


Fig. 3



2.2 Calculation of bearing loads

2.2.1 Calculation bases

The calculation methods described in this chapter must take into account all actual loads and forces acting on the individual bearings.

Static safety factor

The static safety factor is expressed as the relationship between the static load rating and the maximum static bearing load including preload (↳ **page 27**). The load conditions (↳ **page 31**) acting on the guiding system during operation must also be taken into account. The static safety factor indicates the level of safety against permanent plastic deformation of the rolling elements and raceways and is calculated according to **formula 2**.

(2) $$s_0 = \frac{C_0}{P_0} = \frac{C_0}{f_d\,F_{res\,max}}$$

where

C_0 = static load rating [N]

f_d = factor for load conditions

$F_{res\,max}$ = maximum resulting load [N]

P_0 = maximum static load [N]

s_0 = static safety factor

Based on practical experience, guideline values have been specified for the static safety factor, which depend on the operating mode and other external factors. (↳ **table 9**).

If, for example, the guiding system is exposed to vibrations from the machining process, higher safety factors should be applied. Moreover, the load transfer paths between a profile rail guide and its support structure should be taken into account. In particular, the bolted connections must be examined for sufficient safety. See also the chapter 4 **Mounting instruction and maintenance** (↳ **page 74**).
For overhead installations of LLT ball profile rail guides, higher safety factors should be applied. In any case, all provided attachment holes in carriage and rail are to be used in the application to make sure that loads applied on the linear guide will safely be taken and transferred.

NOTE: The maximum resulting load $F_{res\,max}$ should be calculated based on the combined static bearing load $F_{comb\,stat}$ determined according to the chapter **Combined static bearing load**, on **page 27**.

NOTE: The general technical rules and standards in the respective industrial sector must also be observed.

Table 9

Static safety factor depending on operating conditions

Operating conditions	s_0
Normal conditions	min. 2
Smooth, vibration-free operation	> 2–4
Medium vibrations or impact loads	3–5
High vibrations or impact loads	> 5
Overhead installations	The general technical rules and standards in the respective industrial sector must be observed. And if the application poses a risk of serious injury, the user must take appropriate design and safety measures that will prevent the carriage from becoming detached from the rail (e.g. due to loss of rolling elements or failure of screw connections).

Basic rating life L_{10}

Under controlled laboratory conditions, seemingly identical bearings operating under identical conditions have different individual endurance lives. A clearer definition of the term “bearing life” is therefore essential to calculate bearing size.

Important: All information presented by Ewellix with regard to load ratings is based on the life that 90 % of a sufficiently large group of apparently identical bearings can be expected to attain or exceed.

Basic rating life at constant speed

If the speed is constant, the basic rating life, L_s or L_h, can be calculated using formulae 3 and 5:

(3) $$L_{10s} = \left(\frac{C}{P}\right)^3 100$$

(4) $$P = \frac{f_d}{f_i \sqrt[3]{f_s}} F_{res}$$

(5) $$L_{10h} = \frac{5 \times 10^7}{l_s\, n\, 60} \left(\frac{C}{P}\right)^3$$

where

C	= dynamic load rating [N]
f_d	= factor for load conditions
f_i	= factor for number of carriages per rail
F_{res}	= resulting load [N]
f_s	= factor for stroke length
L_{10h}	= basic rating life [h]
L_{10s}	= basic rating life [km]
n	= stroke frequency [double strokes/min]
P	= equivalent dynamic load [N]
l_s	= single stroke length [mm]

Applying a preload

Depending on the combined bearing load and preload class, the resulting load has to be calculated according to the following methodology to get the impact on the life of LLT ball profile rail guides.

Load case 1

$F_{comb} \leq 2{,}8\, F_{Pr}$ (F_{Pr} ↳ **table 10**)

(6) $$F_{res} = \left(\frac{F_{comb}}{2{,}8\, F_{pr}} + 1\right)^{1{,}5} F_{pr}$$

Load case 2

$F_{comb} > 2{,}8\, F_{Pr}$ (F_{Pr} ↳ **table 9**)

(7) $$F_{res} = F_{comb}$$

where

F_{comb}	= combined, static or dynamic bearing load [N]
F_{Pr}	= preload force [N]
F_{res}	= resulting load [N]

Table 10

Determining preload values according to preload class

Preload class	Preload force F_{Pr}
T0	**Zero to light preload** For extremely smooth-running profile rail guide systems requiring low friction. This preload class is only available in P5 and P3 precision classes.
T1	**F_{Pr} = 2 % of C** For precise profile rail guide systems with low and medium external loads and a high degree of rigidity.
T2	**F_{Pr} = 8 % of C** For precise profile rail guide systems with high external load and high requirements for overall rigidity. Also recommended for single-rail systems. Additional common moment loads are absorbed without any significant elastic deformation.

2.2.2 Constant mean load

General calculation formulae

Equivalent dynamic mean load

The rating life calculation formulae are based on the assumption that the load and the speed are constant. In reality the external loads, positions and speeds are changing in most cases and the workflow has to be separated into load phases with constant or approximately constant conditions along their individual strokes (**diagram 3**). All single load phases are summarized to the equivalent dynamic mean load P_m depending on their individual stroke length (**formulae 8 and 9**).

(8) $$P_m = \sqrt[3]{\frac{\sum_{j=1}^{v} |P_j^3|\, s_i}{s_{tot}}}$$

(9) $$s_{tot} = s_1 + s_2 + \dots + s_n$$

where

P_m = equivalent dynamic mean load [N]
P = equivalent dynamic load[N]
j = counter for load phases
V = amount of load phases
s_i = individual stroke length [mm]
s_{tot} = total stroke length [mm]

Maximum resulting load

The maximum value of F_{res} is required for calculating the static safety factor s . To this end, all loads must be calculated for the individual stroke lengths. With these figures, the maximum resulting load $F_{res\,max}$ can be calculated and then inserted in the equation for s_0 (**formula 2**).

(10) $$F_{res\,max} = \underset{j=1}{\overset{v}{MAX}} |F_{res,j}|$$

where

$F_{res\,max}$ = maximum resulting load [N]
$F_{res,j}$ = resulting load for load phase [N]
j = counter for load phase
V = amount of load phases

Combined bearing loads

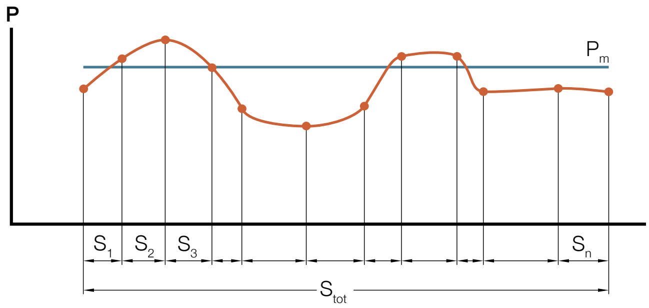
The following chapter describes the method to calculate the combined bearing load with possible combinations of forces and moments. All load components must be constant in magnitude to enable their calculation as one load phase.

If one of the load proportions varies significantly in magnitude over the length of the stroke, a separate load phase must be calculated according to the same method.

NOTE: For the following four calculations, a load, acting on the carriage at any angle, must be broken down into the proportions F_y and F_z. These proportions are then inserted into the respective formula.

Diagram 3

Variable load acting on a carriage



Combined static bearing load

For static vertical and horizontal loads, the combined static bearing load $F_{comb,stat}$ can be calculated using **formula 11** (↳ **fig. 4**).

Formula 11 applies to a system with two rails and four carriages (no torque loads can occur).

(11) $$F_{comb,stat} = |F_y| + |F_z|$$

where

$F_{comb,stat}$ = combined static bearing load [N]

F_y, F_z = external bearing loads in y- and z-direction [N]

For combined static bearing loads – both vertical and horizontal – in combination with static moments, the combined static bearing load $F_{comb,stat}$ can be calculated using **formula 12** (↳ **fig. 5**).

(12) $$F_{comb,\,stat} = |F_y| + |F_z| + C_0 \left(\left| \frac{M_x}{M_{xC_0}} \right| + \left| \frac{M_y}{M_{yC_0}} \right| + \left| \frac{M_z}{M_{zC_0}} \right| \right)$$

where

C_0 = static load rating [N]

$F_{comb,stat}$ = combined static bearing load [N]

F_y, F_z = external bearing loads in y- and z-direction [N]

M_x, M_y, M_z = bearing moment loads at respective coordinates [Nm]

M_{xC_0}, M_{yC_0}, M_{zC_0} = permissible static moment loads [Nm]

Formula 12 can be used for the following systems:

- One rail with one carriage (all types of moment loads can occur)
- Two rails with one carriage each (M_x cannot occur)
- One rail with two carriages (M_y, M_z cannot occur)

NOTE: The maximum value of $F_{comb,stat}$ is required for calculating the static safety factor s_0. To this end, all loads must be calculated for the individual stroke lengths. With these figures, the maximum resulting load $F_{res\ max}$ can be calculated and then inserted in the equation for s_0 (**formula 2**).

Combined dynamic bearing load

For loads – both vertical and horizontal (↳ **fig. 4**) – the combined dynamic bearing load $F_{comb,dyn}$ is calculated by means of **formula 13.**

Formula 13 applies to a system with two rails and four carriages.

(13) $$F_{comb,dyn} = |F_y| + |F_z|$$

where

$F_{comb,dyn}$ = combined dynamic bearing load [N]

F_y, F_z = external bearing loads in y- and z-direction [N]

NOTE: The design of the profile rail guide permits this simplified calculation. If different load stages exist for F_y and F_z, then F_y and F_z must be considered individually in **formula 8**.

When combined dynamic bearing loads and dynamic moments are present, the combined dynamic bearing load $F_{comb,dyn}$ can be calculated using **formula 14** (↳ **fig. 5**).

(14) $$F_{comb,\,dyn} = |F_y| + |F_z| + C \left(\left| \frac{M_x}{M_{xC}} \right| + \left| \frac{M_y}{M_{yC}} \right| + \left| \frac{M_z}{M_{zC}} \right| \right)$$

where

C = dynamic load rating [N]

$F_{comb,dyn}$ = combined dynamic bearing load [N]

F_y, F_z = external bearing loads in y- and z-direction [N]

M_x, M_y, M_z = bearing moment loads at respective coordinates [Nm]

M_{xC}, M_{yC}, M_{zC} = permissible dynamic moment loads [Nm]

Formula 14 can be used for the following systems:

- One rail with one carriage (all types of moment loads can occur)
- Two rails with one carriage each (M_x cannot occur)
- One rail with two carriages (M_y, M_z cannot occur)

Fig. 4

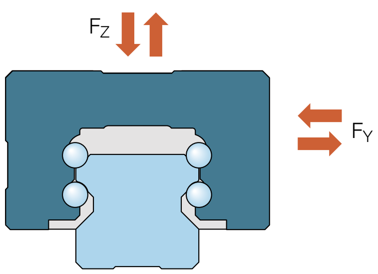
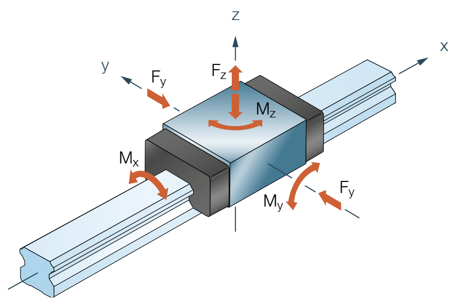


Fig. 5

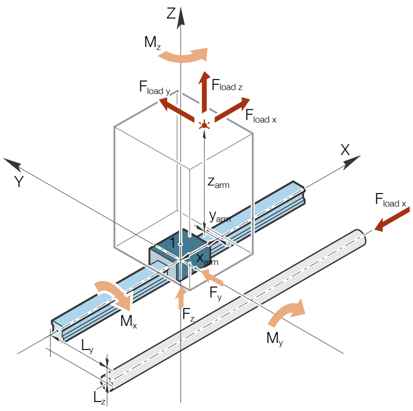


Calculation examples for typical profile rail guide systems

The calculation formulas for determining the loads of carriages are shown on the following tables.

Fig. 6

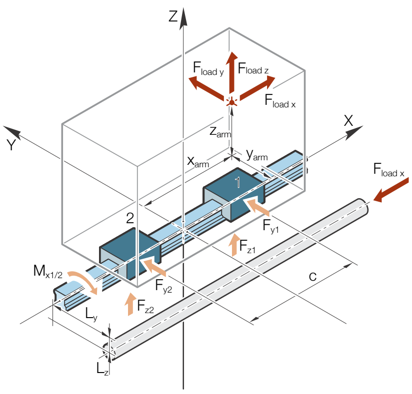
Loads on a system with 1 guide rail and 1 carriage



Carriage	Formula
1	Load: Force in z-direction $F_z = \sum_{j=1}^{k} F_{load\ z,\ j}$
1	Load: Force in y-direction $F_y = \sum_{j=1}^{k} F_{load\ y,\ j}$
1	Load: Moment about X-axis $M_x = \sum_{j=1}^{k} (F_{load\ y,\ j} \cdot z_{arm,\ j}) - \sum_{j=1}^{k} (F_{load\ z,\ j} \cdot y_{arm,\ j})$
1	Load: Moment about Y-axis $M_y = \sum_{j=1}^{k} (F_{load\ x,\ j} \cdot (z_{arm,\ j} - L_z)) - \sum_{j=1}^{k} (F_{load\ z,\ j} \cdot x_{arm,\ j})$
1	Load: Moment about Z-axis $M_z = -\sum_{j=1}^{k} (F_{load\ x,\ j} \cdot (y_{arm,\ j} - L_y)) + \sum_{j=1}^{k} (F_{load\ y,\ j} \cdot x_{arm,\ j})$

Fig. 7

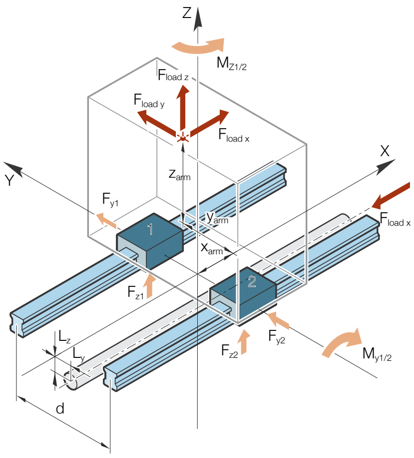
Loads on a system with 1 guide rail and 2 carriages



Carriage	Formula
1	Load: Force in z-direction $F_{z1} = \frac{\sum_{j=1}^{k} F_{load\ z,\ j}}{2} - \frac{\sum_{j=1}^{k} (F_{load\ x,\ j} \cdot (z_{arm,\ j} - L_z)) - \sum_{j=1}^{k} (F_{load\ z,\ j} \cdot x_{arm,\ j})}{c}$
2	Load: Force in z-direction $F_{z2} = \frac{\sum_{j=1}^{k} F_{load\ z,\ j}}{2} + \frac{\sum_{j=1}^{k} (F_{load\ x,\ j} \cdot (z_{arm,\ j} - L_z)) - \sum_{j=1}^{k} (F_{load\ z,\ j} \cdot x_{arm,\ j})}{c}$
1	Load: Force in y-direction $F_{y1} = \frac{\sum_{j=1}^{k} F_{load\ y,\ j}}{2} - \frac{\sum_{j=1}^{k} (F_{load\ x,\ j} \cdot (y_{arm,\ j} - L_y)) - \sum_{j=1}^{k} (F_{load\ y,\ j} \cdot x_{arm,\ j})}{c}$
2	Load: Force in y-direction $F_{y2} = \frac{\sum_{j=1}^{k} F_{load\ y,\ j}}{2} + \frac{\sum_{j=1}^{k} (F_{load\ x,\ j} \cdot (y_{arm,\ j} - L_y)) - \sum_{j=1}^{k} (F_{load\ y,\ j} \cdot x_{arm,\ j})}{c}$
1/2	Load: Moment about X-axis $M_{x1} = M_{x2} = \frac{\sum_{j=1}^{k} (F_{load\ y,\ j} \cdot z_{arm,\ j}) - \sum_{j=1}^{k} (F_{load\ z,\ j} \cdot y_{arm,\ j})}{2}$

Fig. 8

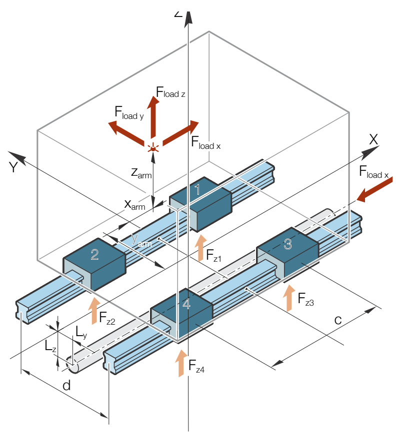
Loads on a system with 2 guide rails and 2 carriages



Carriage	Formula
1	Load: Force in z-direction $F_{z1} = \frac{\sum_{j=1}^{k} F_{load\,z,j}}{2} - \frac{\sum_{j=1}^{k} (F_{load\,y,j} \cdot z_{arm,j}) - \sum_{j=1}^{k} (F_{load\,z,j} \cdot y_{arm,j})}{d}$
2	Load: Force in z-direction $F_{z2} = \frac{\sum_{j=1}^{k} F_{load\,z,j}}{2} + \frac{\sum_{j=1}^{k} (F_{load\,y,j} \cdot z_{arm,j}) - \sum_{j=1}^{k} (F_{load\,z,j} \cdot y_{arm,j})}{d}$
1/2	Load: Force in y-direction $F_{y1} = F_{y2} = \frac{\sum_{j=1}^{k} F_{load\,y,j}}{2}$
1/2	Load: Moment about Y-axis $M_{y1} = M_{y2} = \frac{\sum_{j=1}^{k} (F_{load\,x,j} \cdot (z_{arm,j} - L_z)) - \sum_{j=1}^{k} (F_{load\,z,j} \cdot x_{arm,j})}{2}$
1/2	Load:Moment about Z-axis $M_{z1} = M_{z2} = \frac{-\sum_{j=1}^{k} (F_{load\,x,j} \cdot (y_{arm,j} - L_y)) + \sum_{j=1}^{k} (F_{load\,y,j} \cdot y_{arm,j})}{2}$

Fig. 9

Loads on a system with 2 guide rails and 4 carriages



Carriage	Formula
1	Load: Force in z-direction $F_{z1} = \frac{\sum_{j=1}^{k} F_{load\,z,j}}{4} + \frac{\sum_{j=1}^{k} (F_{load\,z,j} \cdot y_{arm,j}) - \sum_{j=1}^{k} (F_{load\,y,j} \cdot z_{arm,j})}{2 \cdot d} + \frac{\sum_{j=1}^{k} (F_{load\,z,j} \cdot x_{arm,j}) - \sum_{j=1}^{k} (F_{load\,x,j} \cdot (z_{arm,j} - L_z))}{2 \cdot c}$
2	Load: Force in z-direction $F_{z2} = \frac{\sum_{j=1}^{k} F_{load\,z,j}}{4} + \frac{\sum_{j=1}^{k} (F_{load\,z,j} \cdot y_{arm,j}) - \sum_{j=1}^{k} (F_{load\,y,j} \cdot z_{arm,j})}{2 \cdot d} + \frac{\sum_{j=1}^{k} (F_{load\,x,j} \cdot (z_{arm,j} - L_z)) - \sum_{j=1}^{k} (F_{load\,z,j} \cdot x_{arm,j})}{2 \cdot c}$
3	Load: Force in z-direction $F_{z3} = \frac{\sum_{j=1}^{k} F_{load\,z,j}}{4} + \frac{\sum_{j=1}^{k} (F_{load\,y,j} \cdot z_{arm,j}) - \sum_{j=1}^{k} (F_{load\,z,j} \cdot y_{arm,j})}{2 \cdot d} + \frac{\sum_{j=1}^{k} (F_{load\,z,j} \cdot x_{arm,j}) - \sum_{j=1}^{k} (F_{load\,x,j} \cdot (z_{arm,j} - L_z))}{2 \cdot c}$
4	Load: Force in z-direction $F_{z4} = \frac{\sum_{j=1}^{k} F_{load\,z,j}}{4} + \frac{\sum_{j=1}^{k} (F_{load\,y,j} \cdot z_{arm,j}) - \sum_{j=1}^{k} (F_{load\,z,j} \cdot y_{arm,j})}{2 \cdot d} + \frac{\sum_{j=1}^{k} (F_{load\,x,j} \cdot (z_{arm,j} - L_z)) - \sum_{j=1}^{k} (F_{load\,z,j} \cdot x_{arm,j})}{2 \cdot c}$

2.2.3 Factors of influence

Requisite reliability

Factor c_1 is used for lifetime calculations where a reliability higher than 90 % is needed. The corresponding values can be found in (↳ **table 11**).

Operating conditions

The lubrication effectiveness is strongly dependent on the degree of separation between the rolling elements and raceway surfaces in the contact zones. A specific minimum viscosity is required for the formation of an effectively separating lubricating film at operating temperature, taking into account the kinematic conditions. Assuming a normal level of cleanliness of the profile rail guide as well as effective sealing, factor c_2 depends on the viscosity ratio κ exclusively. κ designates the ratio between the actual kinematic viscosity and the requisite minimum viscosity (↳ **formula 15**).

(15) $$\kappa = \frac{v}{v1}$$

where

κ = viscosity ratio

v = actual kinematic viscosity [mm²/s]

v_1 = requisite minimum viscosity [mm²/s]

The requisite minimum viscosity v_1 for LLT guides depends on the mean speed (↳ **diagram 4**).

The value for v_1 can be related to the actual viscosity v according to formula 15 in order to obtain κ. Now c_2 can be taken from (↳ **diagram 5**). If the viscosity ratio κ is less than 1, a lubricant with EP additives is recommended. If lubricant with EP additives are used, the higher value for c_2 can be used for calculation.

Table 11

Factor c_1 for reliability

Reliability %	L_{ns}	c_1
90	L_{10s}	1
95	L_{5s}	0,62
96	L_{4s}	0,53
97	L_{3s}	0,44
98	L_{2s}	0,33
99	L_{1s}	0,21

Diagram 4

Determining the requisite minimum viscosity v_1

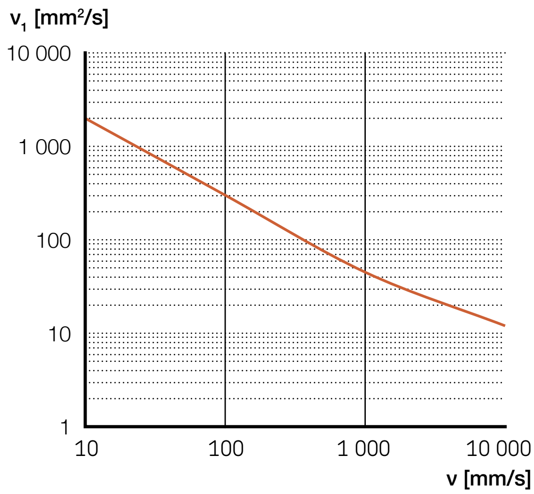
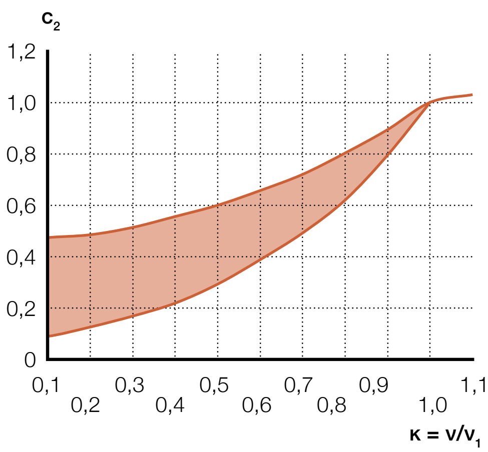


Diagram 5

Determining factor c_2 for operating conditions



2.2.4 Load conditions

The load acting on an LLT ball profile rail guide is resulting from acceleration, impact loads and vibration. It is extremely difficult to quantify these additional dynamic forces. To approximate the impact these indeterminate loads will have on the life of the system, the load must be multiplied by factor f_d. Depending on the mean speed and strength of the impact load, values listed in **table 12** can be selected for f_d.

Number of carriages per rail

Most profile rail guide configurations feature two or more carriages mounted on one rail. The load distribution on these various carriages is strongly influenced by the mounting precision, the manufacturing quality of the adjacent components, and particularly, the distance between the carriages. Factor f_i takes these influences on carriage loading into account based on the number of carriages per rail and their distance relative to each other (↳ **table 13** and **fig. 10**).

Impact of stroke length

Strokes that are shorter than the metal body of the carriage (dimension L_2) have a negative influence on the achievable life of a guiding system. If the stroke is longer than the carriage metal body length, the factor is $f_s = 1$. Sequenced load phases with identical moving direction deliver a sub stroke length (S_s) according to **formula 16** to determine f_s. Based on the ratio of the sub stroke lengths (S_s) to the metal body of the carriage L_2, the factor f_s is determined according to **table 14**.

(16)

$$S_s = \sum_{j=A}^{B} S_j$$

where

S_s = sub stroke length [mm]
S_j = individual stroke length [mm]
j = counter for load phases
A = starting point of movement in one direction
B = next reversal point

2

Table 12

Factor f_d for load conditions

Load conditions	f_d from	up to
Smooth operation, no or light impact loads Speed ≤ 2 m/s	1,0	1,5
High impact loads Speed > 2 m/s	1,5	3,0

Table 13

Factor f_i for number of carriages per rail

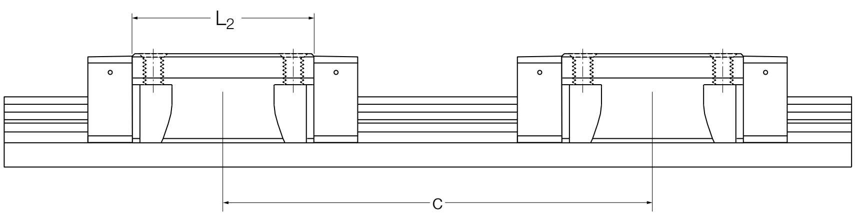
Number of carriages	If $c \geq 1{,}5 \cdot L_2$ f_i	If $c < 1{,}5 \cdot L_2$ f_i
1	1	1
2	1	0,81
3	1	0,72

Table 14

Factor f_s depending on the ratio S_s/L_2

S_s/L_2	f_S
1,0	1,0
0,9	0,91
0,8	0,82
0,7	0,73
0,6	0,63
0,5	0,54
0,4	0,44
0,3	0,34
0,2	0,23

Fig. 10



2.2.5 Modified basic rating life

If the load situation is known and the factors have been determined, then the modified basic rating life can be calculated with **formula 17**

(17) $$L_{ns} = 100\ c_1\ c_2\ f_s \left(\frac{f_i\ C}{f_d\ F_{res}}\right)^3$$

In the presence of varying forces as described in the section **2.2.1 Calculation bases** (↳ **page 24**), **formula 17** is extended to account for the impacts of operating conditions and loads per phase. This is described in **formula 18:**

(18) $$L_{ns} = 100\ c_1\ c_2 \frac{(f_i\ C)^3\ s_{tot}}{\sum_{j=1}^{V}\left(\left|\frac{f_{d,j}\ F_{res,j}}{\sqrt[3]{f_{s,j}}}\right|^3 s_j\right)}$$

where

C	= dynamic load rating [N]
c_1	= factor for reliability
c_2	= factor for operating conditions
f_d	= factor for load conditions
f_{dj}	= factor for load conditions for load phase j
f_i	= factor for number of carriages per rail
F_{res}	= resulting load [N]
$F_{res,j}$	= resulting load for load phase j [N]
f_s	= factor for stroke length
f_{sj}	= factor for stroke length for load phase j
j	= counter for load phases
L_{ns}	= modified basic rating life [km]
s_i	= individual stroke length [mm]
s_{tot}	= total stroke length [mm]
V	= amount of load phases

ALMOTION

EWELLIX

2.2.6 Linear guide calculation tools

Ewellix calculation program

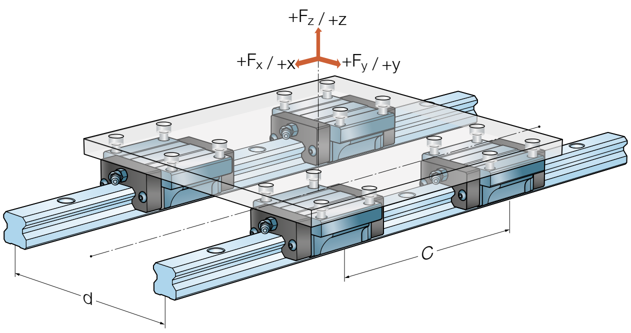
Details pertaining to all the relevant load situations and the specification of the general design conditions are crucial for precisely calculating the life expectancy and static load safety of an LLT profile rail guide system in a specific application. Ultimately, this information determines the size and carriage type of the LLT profile rail guide. This design process can be quite extensive for complex applications.

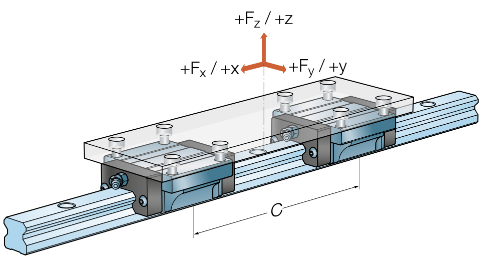
Therefore, Ewellix offers the “Linear guide select” calculation program which is available at www.ewellix.com. This calculation program supports the user and is extremely effective in the design of LLT profile rail guide systems.

The following information must be available prior to starting a calculation:

- number of load cases
- moved masses as well as operating loads including coordinates
- travel proportions of operating loads
- reaction forces accommodated by the drive system (in the direction of travel)
- selection of preload applied to the guide
- layout (number of rails and carriages)
- geometry of linear axis (distance between rails relative to each other and carriages relative to each other)

NOTE: If the user is free to select the application coordinate system, Ewellix recommends using the coordinate system in the program. This facilitates the analysis of all operating loads and the resulting reaction forces in the carriages and prevents transformation errors.





Representation of results

When the calculation routine is complete, the user will receive the following data in a clearly structured form:

- all input data
- load values per carriage in the y- and z-direction and external loads for all conceivable load cases
- calculation of equivalent dynamic load per carriage
- basic rating life of carriages
- static load safety of carriages

Depending on the expected life or static load safety, various carriage sizes can be selected for printout.

2

2.2.7 Legend

Legend	
C	dynamic load capacity; also dynamic load rating [N]
C_0	static load capacity; also static load rating [N]
c_1	factor for reliability
c_2	factor for operating conditions
f	factor for load conditions
f_{d1}, f_{d2} ... f_{dn}	factor for load conditions during stroke length s1, s2 ... sn
f_i	factor for number of carriages per rail
f_s	factor for stroke length
F	external bearing load [N]
F_y, F_z	external bearing loads in y- and z-direction [N]
F_{Pr}	preload force [N]
F_{res}	resulting load [N]
$F_{res\,1}$, $F_{res\,2}$ … $F_{res\,n}$	resulting load during stroke length s_1, s_2, …, s_n [N]
$F_{res\,max}$	maximum resulting load [N]
F_m	constant mean load [N]
κ	viscosity ratio
L_{10h}	basic rating life [h]
L_{10s}	basic rating life [km]
L_{ns}	modified basic rating life [km]
M_x, M_y, M_z	moment loads at respective coordinates [Nm]
M_{xC}, M_{yC}, M_{zC}	permissible dynamic moment loads [Nm]
M_{xC_0}, M_{yC_0}, M_{zC_0}	permissible static moment loads [Nm]
n	stroke frequency [double strokes/min]
n	actual kinematic viscosity [mm²/s]
n_1	requisite minimum viscosity [mm²/s]
P	equivalent dynamic load [N]
P_0	maximum static load [N]
l_s	single stroke length [mm]
s_0	static safety factor
s_j	individual stroke length per phase [mm]
S_s	sub stroke length [mm]
S_{tot}	total stroke length [mm]
t_1, t_2 … t_n	time proportions for v_1, v_2 … v_n [%]
v_1, v_2 … v_n	speed [m/min]
v_m	mean speed [m/min]
V	amount of load phases
c	center distance of carriages [mm]
d	center distance between the rails [mm]

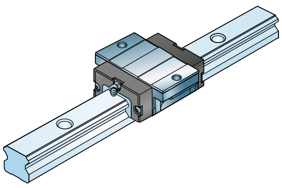
3

Product range

3.1 Carriage data

LLTHC ... SA

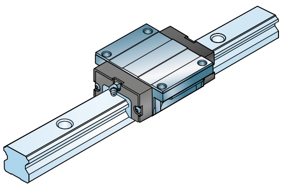
Flanged carriage, short length, standard height



Size [1)]	Load ratings	
	C	C_0
–	N	
15	5 800	9 000
20	9 240	14 400
25	13 500	19 600
30	19 200	26 600
35	25 500	34 800
45	–	–

LLTHC ... A

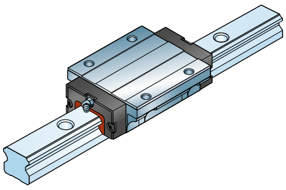
Flanged carriage, standard length, standard height



Size [1)]	Load ratings	
	C	C_0
–	N	
15	8 400	15 400
20	12 400	24 550
25	18 800	30 700
30	26 100	41 900
35	34 700	54 650
45	59 200	91 100

LLTHC ... LA

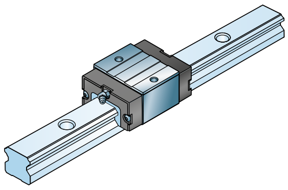
Flanged carriage, extended length, standard height



Size [1)]	Load ratings	
	C	C_0
–	N	
15	–	–
20	15 200	32 700
25	24 400	44 600
30	33 900	60 800
35	45 000	79 400
45	72 400	121 400

LLTHC ... SU

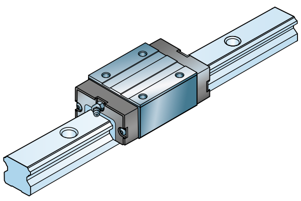
Slim-line carriage, short length, standard height



Size [1)]	Load ratings	
	C	C_0
–	N	
15	5 800	9 000
20	9 240	14 400
25	13 500	19 600
30	19 200	26 600
35	25 500	34 800
45	–	–

LLTHC ... U

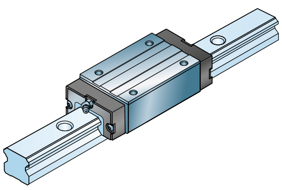
Slim-line carriage, standard length, standard height



Size [1)]	Load ratings	
	C	C_0
–	N	
15	8 400	15 400
20	12 400	24 550
25	18 800	30 700
30	26 100	41 900
35	34 700	54 650
45	59 200	91 100

LLTHC ... LU

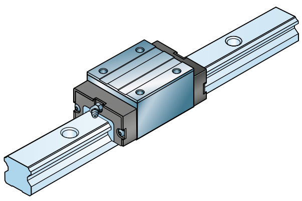
Slim-line carriage, extended length, standard height



Size [1)]	Load ratings	
	C	C_0
–	N	
15	–	–
20[2)]	15 200	32 700
25	24 000	44 600
30	33 900	60 800
35	45 000	79 400
45	72 400	121 400

LLTHC ... R

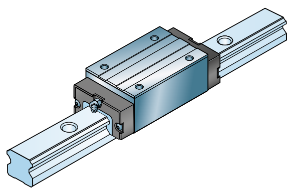
Slim-line carriage, standard length, extended height



Size [1)]	Load ratings	
	C	C_0
–	N	
15	8 400	15 400
20	–	–
25	18 800	30 700
30	26 100	41 900
35	34 700	54 650
45	59 200	91 100

LLTHC ... LR

Slim-line carriage, extended length, extended height



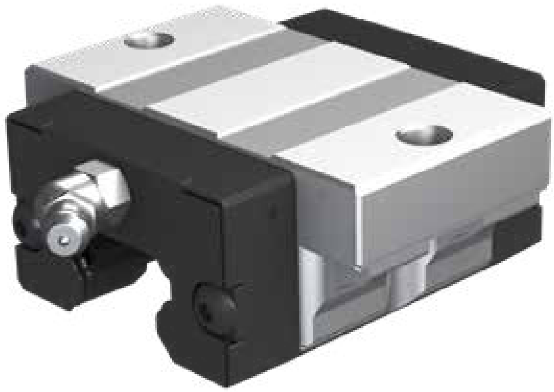
Size [1)]	Load ratings	
	C	C_0
–	N	
15	–	–
20[2)]	15 200	32 700
25	24 400	44 600
30	33 900	60 800
35	45 000	79 400
45	72 400	121 400

[1)] Front seal appearance can slightly deviate by size.
[2)] LLLTHC 20 LU and LLTHC 20 LR is the same product

3.1.1 Carriage LLTHC ... SA

Flanged carriage, short length, standard height.

Carriages from size 15 to 30 are also available with low friction S0 shield. Dimensions are the same as standard version. For designation, refer to **Ordering key carriages** (↳ **page 103**).

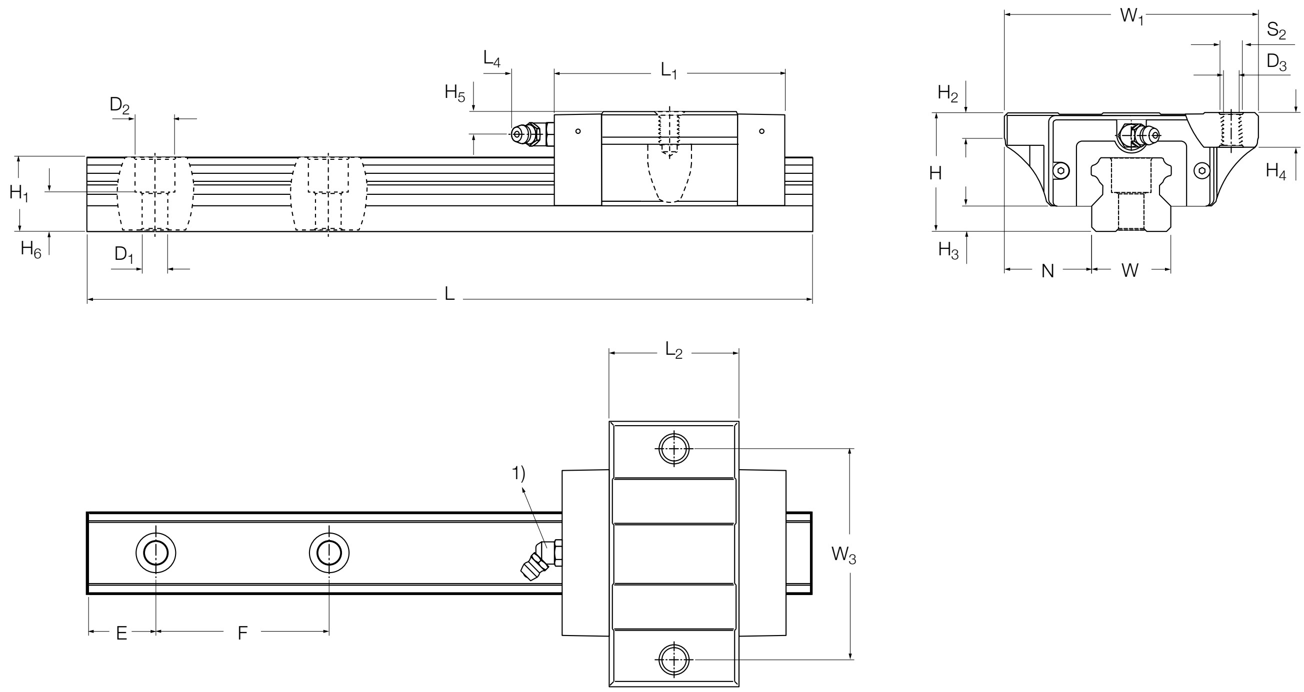


Technical data

Size	Precision class	Designation [1] Preload class T0	T1
–		–	
15	P5	**LLTHC 15 SA T0 P5**	**LLTHC 15 SA T1 P5**
	P3	**LLTHC 15 SA T0 P3**	**LLTHC 15 SA T1 P3**
	P1		**LLTHC 15 SA T1 P1**
20	P5	**LLTHC 20 SA T0 P5**	**LLTHC 20 SA T1 P5**
	P3	**LLTHC 20 SA T0 P3**	**LLTHC 20 SA T1 P3**
	P1		**LLTHC 20 SA T1 P1**
25	P5	**LLTHC 25 SA T0 P5**	**LLTHC 25 SA T1 P5**
	P3	**LLTHC 25 SA T0 P3**	**LLTHC 25 SA T1 P3**
	P1		**LLTHC 25 SA T1 P1**
30	P5	**LLTHC 30 SA T0 P5**	**LLTHC 30 SA T1 P5**
	P3	**LLTHC 30 SA T0 P3**	**LLTHC 30 SA T1 P3**
	P1		**LLTHC 30 SA T1 P1**
35	P5	**LLTHC 35 SA T0 P5**	**LLTHC 35 SA T1 P5**
	P3	**LLTHC 35 SA T0 P3**	**LLTHC 35 SA T1 P3**
	P1		**LLTHC 35 SA T1 P1**

[1] • **Preferred range**.
• Only available as system.
For designation, please refer to designation system.

Dimensional drawing



Size	Assembly dimensions					Carriage dimensions							
	W_1	N	H	H_2	H_3	L_1	L_2	L_4	W_3	H_4	H_5	D_3	S_2
–	mm												
15	47	16	24	5,7	4,6	48,9	25,6	4,3	38	8	4,3	4,3	M5×0,8
20	63	21,5	30	6,7	5	55,4	32,1	15	53	9	5,7	5,2	M6×1,0
25	70	23,5	36	10,8	7	66,2	38,8	16,6	57	12	6,5	6,7	M8×1,25
30	90	31	42	8,8	9	78	45	14,6	72	11,5	8	8,5	M10×1,5
35	100	33	48	12,1	9,5	88,8	51,4	14,6	82	13	8	8,5	M10×1,5

Size	Rail dimensions									Weight		Load ratings [2]		Moments [2]			
										carriage	rail	dynamic	static	dynamic	static	dynamic	static
	W	H_1	H_6	F	D_1	D_2	E_{min} ±0,75	E_{max} ±0,75	L_{max} ±1,5			C	C_0	M_{xC}	M_{xC_0}	$M_{yC}=M_{zC}$	$M_{yC_0}=M_{zC_0}$
–	mm									kg	kg/m	N		Nm			
15	15	14	8,5	60	4,5	7,5	10	50	3 920	0,12	1,4	5 800	9 000	39	60	21	32
20	20	18	9,3	60	6	9,5	10	50	3 920	0,25	2,3	9 240	14 400	83	130	41	64
25	23	22	12,3	60	7	11	10	50	3 920	0,38	3,3	13 500	19 600	139	202	73	106
30	28	26	13,8	80	9	14	12	70	3 944	0,56	4,8	19 200	26 600	242	335	120	166
35	34	29	17	80	9	14	12	70	3 944	0.83	6,6	25 500	34 800	393	536	182	248

[1] For detailed information on grease nipples, please refer to **page 70** .
[2] Dynamic load capacities and moments are based on a travel life of 100 km. Please refer to **page 15** for further details.

3.1.2 Carriage LLTHC ... A

Flanged carriage, standard length, standard height.

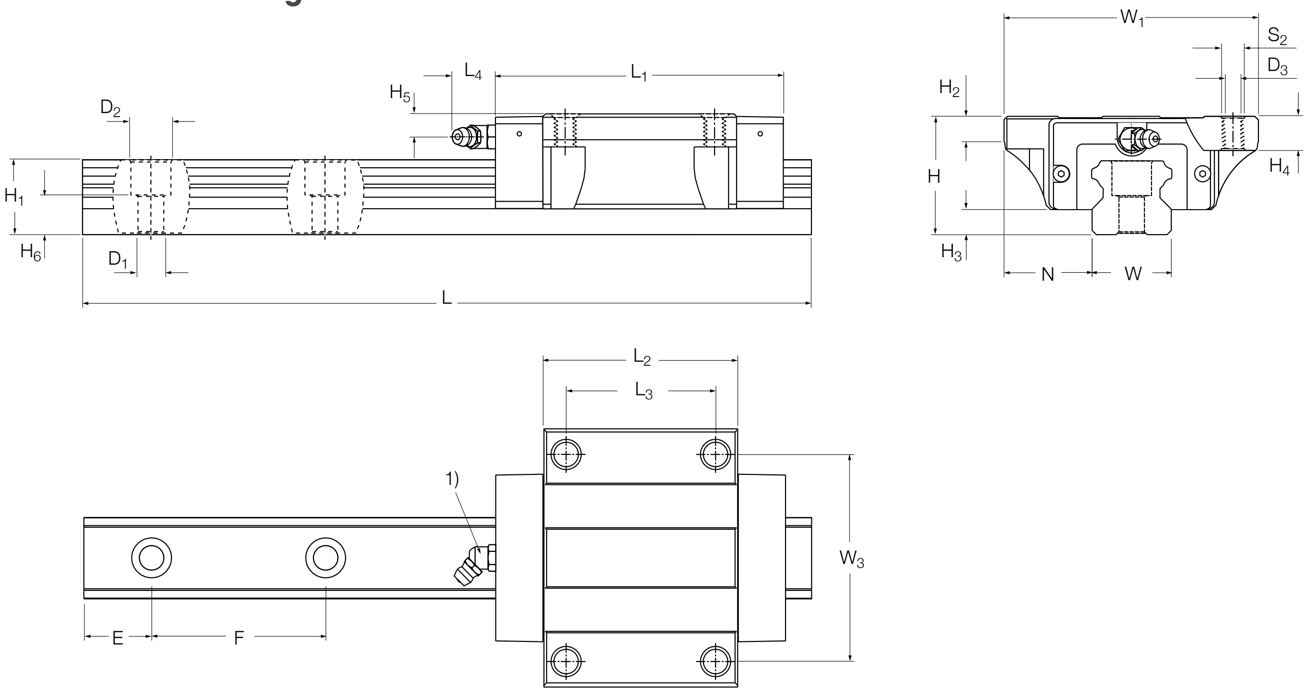
Carriages from size 15 to 30 are also available with low friction S0 shield. Dimensions are the same as standard version. For designation, refer to **Ordering key carriages** (↳ **page 103**).

Technical data

Size	Precision class	Designation [1] Preload class T0	T1	T2
–		–		
15	P5	**LLTHC 15 A T0 P5**	**LLTHC 15 A T1 P5**	**LLTHC 15 A T2 P5**
	P3	**LLTHC 15 A T0 P3**	**LLTHC 15 A T1 P3**	**LLTHC 15 A T2 P3**
	P1		**LLTHC 15 A T1 P1**	**LLTHC 15 A T2 P1**
20	P5	**LLTHC 20 A T0 P5**	**LLTHC 20 A T1 P5**	**LLTHC 20 A T2 P5**
	P3	**LLTHC 20 A T0 P3**	**LLTHC 20 A T1 P3**	**LLTHC 20 A T2 P3**
	P1		**LLTHC 20 A T1 P1**	**LLTHC 20 A T2 P1**
25	P5	**LLTHC 25 A T0 P5**	**LLTHC 25 A T1 P5**	**LLTHC 25 A T2 P5**
	P3	**LLTHC 25 A T0 P3**	**LLTHC 25 A T1 P3**	**LLTHC 25 A T2 P3**
	P1		**LLTHC 25 A T1 P1**	**LLTHC 25 A T2 P1**
30	P5	**LLTHC 30 A T0 P5**	**LLTHC 30 A T1 P5**	**LLTHC 30 A T2 P5**
	P3	**LLTHC 30 A T0 P3**	**LLTHC 30 A T1 P3**	**LLTHC 30 A T2 P3**
	P1		**LLTHC 30 A T1 P1**	**LLTHC 30 A T2 P1**
35	P5	**LLTHC 35 A T0 P5**	**LLTHC 35 A T1 P5**	**LLTHC 35 A T2 P5**
	P3	**LLTHC 35 A T0 P3**	**LLTHC 35 A T1 P3**	**LLTHC 35 A T2 P3**
	P1		**LLTHC 35 A T1 P1**	**LLTHC 35 A T2 P1**
45	P5	**LLTHC 45 A T0 P5**	**LLTHC 45 A T1 P5**	**LLTHC 45 A T2 P5**
	P3	**LLTHC 45 A T0 P3**	**LLTHC 45 A T1 P3**	**LLTHC 45 A T2 P3**
	P1		**LLTHC 45 A T1 P1**	**LLTHC 45 A T2 P1**

[1] • **Preferred range**.
• **Only available as system**.
For designation, please refer to designation system.

Dimensional drawing



Size	Assembly dimensions					Carriage dimensions								
	W_1	N	H	H_2	H_3	L_1	L_2	L_3	L_4	W_3	H_4	H_5	D_3	S_2
–	mm													
15	47	16	24	5,7	4,6	63,3	40	30	4,3	38	8	4,3	4,3	M5×0,8
20	63	21,5	30	6,7	5	73,3	50	40	15	53	9	5,7	5,2	M6×1,0
25	70	23,5	36	10,8	7	84,4	57	45	16,6	57	12	6,5	6,7	M8×1,25
30	90	31	42	8,8	9	100,4	67,4	52	14,6	72	11,5	8	8,5	M10×1,5
35	100	33	48	12,1	9,5	114,4	77	62	14,6	82	13	8	8,5	M10×1,5
45	120	37,5	60	12,1	14	136,5	96	80	14,6	100	15	8,5	10,4	M12×1,75

Size	Rail dimensions									Weight		Load ratings [2]		Moments [2]			
										carriage	rail	dynamic	static	dynamic	static	dynamic	static
	W	H_1	H_6	F	D_1	D_2	E_{min} ±0,75	E_{max} ±0,75	L_{max} ±1,5			C	C_0	M_{xC}	M_{xC_0}	$M_{yC}=M_{zC}$	$M_{yC_0}=M_{zC_0}$
–	mm									kg	kg/m	N		Nm			
15	15	14	8,5	60	4,5	7,5	10	50	3 920	0,21	1,4	8 400	15 400	56	103	49	90
20	20	18	9,3	60	6	9,5	10	50	3 920	0,4	2,3	12 400	24 550	112	221	90	179
25	23	22	12,3	60	7	11	10	50	3 920	0,57	3,3	18 800	30 700	194	316	155	254
30	28	26	13,8	80	9	14	12	70	3 944	1,1	4,8	26 100	41 900	329	528	256	410
35	34	29	17	80	9	14	12	70	3 944	1,6	6,6	34 700	54 650	535	842	388	611
45	45	38	20,8	105	14	20	16	90	3 917	2,7	11,3	59 200	91 100	1215	1869	825	1 270

[1] For detailed information on grease nipples, please refer to **page 70**.
[2] Dynamic load capacities and moments are based on a travel life of 100 km. Please refer to **page 15** for further details.

3.1.3 Carriage LLTHC ... LA

Flanged carriage, extended length, standard height.

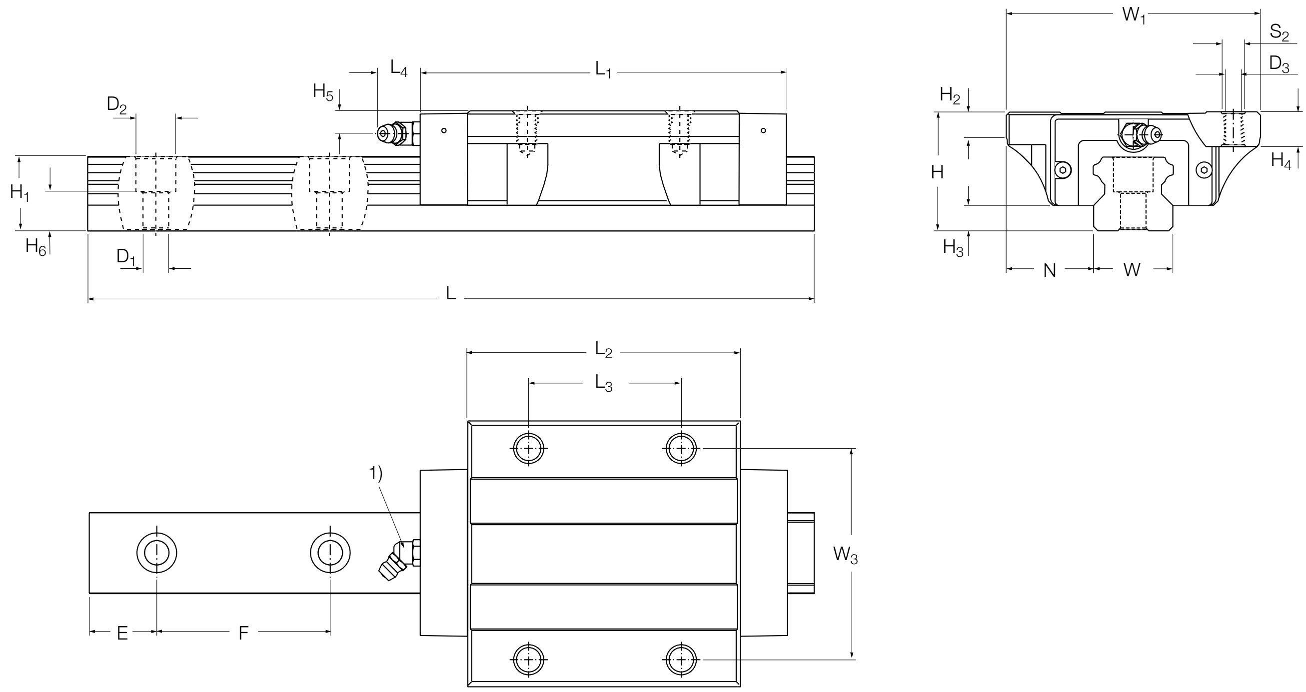
Carriages from size 20 to 30 are also available with low friction S0 shield. Dimensions are the same as standard version. For designation, refer to **Ordering key carriages**
(↳ **page 103**).

Technical data

Size	Precision class	Designation [1)] Preload class T0	T1	T2
–		–		
20	P5	**LLTHC 20 LA T0 P5**	**LLTHC 20 LA T1 P5**	**LLTHC 20 LA T2 P5**
	P3	**LLTHC 20 LA T0 P3**	**LLTHC 20 LA T1 P3**	**LLTHC 20 LA T2 P3**
	P1		**LLTHC 20 LA T1 P1**	**LLTHC 20 LA T2 P1**
25	P5	**LLTHC 25 LA T0 P5**	**LLTHC 25 LA T1 P5**	**LLTHC 25 LA T2 P5**
	P3	**LLTHC 25 LA T0 P3**	**LLTHC 25 LA T1 P3**	**LLTHC 25 LA T2 P3**
	P1		**LLTHC 25 LA T1 P1**	**LLTHC 25 LA T2 P1**
30	P5	**LLTHC 30 LA T0 P5**	**LLTHC 30 LA T1 P5**	**LLTHC 30 LA T2 P5**
	P3	**LLTHC 30 LA T0 P3**	**LLTHC 30 LA T1 P3**	**LLTHC 30 LA T2 P3**
	P1		**LLTHC 30 LA T1 P1**	**LLTHC 30 LA T2 P1**
35	P5	**LLTHC 35 LA T0 P5**	**LLTHC 35 LA T1 P5**	**LLTHC 35 LA T2 P5**
	P3	**LLTHC 35 LA T0 P3**	**LLTHC 35 LA T1 P3**	**LLTHC 35 LA T2 P3**
	P1		**LLTHC 35 LA T1 P1**	**LLTHC 35 LA T2 P1**
45	P5	**LLTHC 45 LA T0 P5**	**LLTHC 45 LA T1 P5**	**LLTHC 45 LA T2 P5**
	P3	**LLTHC 45 LA T0 P3**	**LLTHC 45 LA T1 P3**	**LLTHC 45 LA T2 P3**
	P1		**LLTHC 45 LA T1 P1**	**LLTHC 45 LA T2 P1**

[1)] • **Preferred range**.
• **Only available as system**.
For designation, please refer to designation system.

Dimensional drawing



Size	Assembly dimensions					Carriage dimensions								
	W_1	N	H	H_2	H_3	L_1	L_2	L_3	L_4	W_3	H_4	H_5	D_3	S_2
–	mm													
20	63	21,5	30	6,7	5	89,5	66,2	40	15	53	9	5,7	5,2	M6×1,0
25	70	23,5	36	10,8	7	106,5	79,1	45	16,6	57	12	6,5	6,7	M8×1,25
30	90	31	42	8,8	9	125,4	92,4	52	14,6	72	11,5	8	8,5	M10×1,5
35	100	33	48	12,1	9,5	142,9	105,5	62	14,6	82	13	8	8,5	M10×1,5
45	120	37,5	60	12,1	14	168,5	128	80	14,6	100	15	8,5	10,4	M12×1,75

Size	Rail dimensions									Weight		Load ratings 2)		Moments 2)			
										carriage	rail	dynamic	static	dynamic	static	dynamic	static
	W	H_1	H_6	F	D_1	D_2	E_{min} ±0,75	E_{max} ±0,75	L_{max} ±1,5			C	C_0	M_{xC}	M_{xC_0}	$M_{yC}=M_{zC}$	$M_{yC_0}=M_{zC_0}$
–	mm									kg	kg/m	N		Nm			
20	20	18	9,3	60	6	9,5	10	50	3 920	0,52	2,3	15 200	32 700	137	295	150	322
25	23	22	12,3	60	7	11	10	50	3 920	0,72	3,3	24 400	44 600	252	460	287	525
30	28	26	13,8	80	9	14	12	70	3 944	1,4	4,8	33 900	60 800	428	767	466	836
35	34	29	17	80	9	14	12	70	3 944	2	6,6	45 000	79 400	694	1 224	706	1 246
45	45	38	20,8	105	14	20	16	90	3 917	3,6	11,3	72 400	121 400	1 485	2 491	1 376	2 308

[1] For detailed information on grease nipples, please refer to **page 70**.
[2] Dynamic load capacities and moments are based on a travel life of 100 km. Please refer to **page 15** for further details.

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3.1.4 Carriage LLTHC ... SU

Slim-line carriage, short length, standard height.

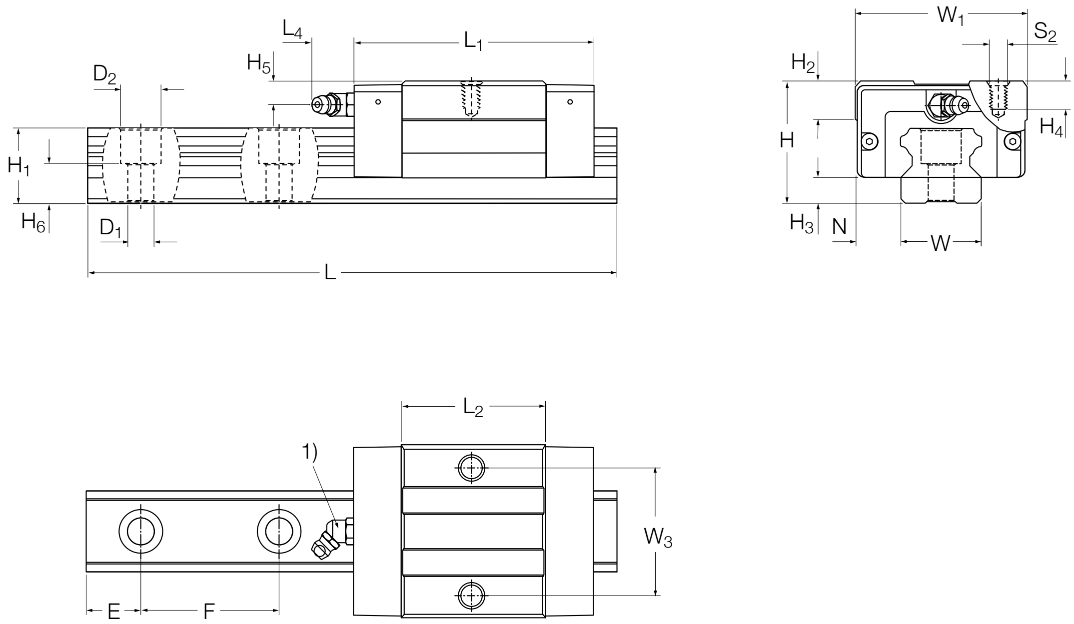
Carriages from size 15 to 30 are also available with low friction S0 shield. Dimensions are the same as standard version. For designation, refer to **Ordering key carriages**
(↳ **page 103**).

Technical data

Size	Precision class	Designation 1) Preload class T0	T1
–		–	
15	P5	**LLTHC 15 SU T0 P5**	**LLTHC 15 SU T1 P5**
	P3	**LLTHC 15 SU T0 P3**	**LLTHC 15 SU T1 P3**
	P1		**LLTHC 15 SU T1 P1**
20	P5	**LLTHC 20 SU T0 P5**	**LLTHC 20 SU T1 P5**
	P3	**LLTHC 20 SU T0 P3**	**LLTHC 20 SU T1 P3**
	P1		**LLTHC 20 SU T1 P1**
25	P5	**LLTHC 25 SU T0 P5**	**LLTHC 25 SU T1 P5**
	P3	**LLTHC 25 SU T0 P3**	**LLTHC 25 SU T1 P3**
	P1		**LLTHC 25 SU T1 P1**
30	P5	**LLTHC 30 SU T0 P5**	**LLTHC 30 SU T1 P5**
	P3	**LLTHC 30 SU T0 P3**	**LLTHC 30 SU T1 P3**
	P1		**LLTHC 30 SU T1 P1**
35	P5	**LLTHC 35 SU T0 P5**	**LLTHC 35 SU T1 P5**
	P3	**LLTHC 35 SU T0 P3**	**LLTHC 35 SU T1 P3**
	P1		**LLTHC 35 SU T1 P1**

1) • **Preferred range**.
• **Only available as system**.
For designation, please refer to designation system.

Dimensional drawing



Size	Assembly dimensions					Carriage dimensions						
	W_1	N	H	H_2	H_3	L_1	L_2	L_4	W_3	H_4	H_5	S_2
–	mm											
15	34	9,5	24	4,8	4,6	48,9	25,6	4,3	26	4	4,3	M4×0,7
20	44	12	30	9,3	5	55,4	32,1	15	32	6,5	5,7	M5×0,8
25	48	12,5	36	9,6	7	66,2	38,8	16,6	35	6,5	6,5	M6×1,0
30	60	16	42	12,6	9	78	45	14,6	40	8,5	8	M8×1,25
35	70	18	48	12,3	9,5	88,8	51,4	14,6	50	10	8	M8×1,25

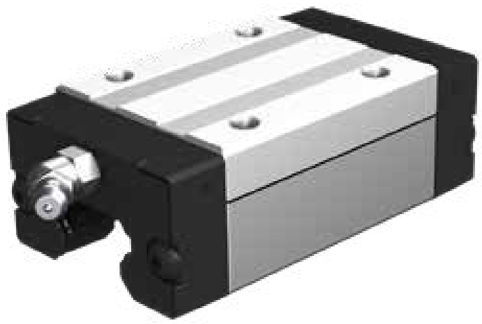
Size	Rail dimensions									Weight		Load ratings [2]		Moments [2]			
										carriage	rail	dynamic	static	dynamic	static	dynamic	static
	W	H_1	H_6	F	D_1	D_2	E_{min} ±0,75	E_{max} ±0,75	L_{max} ±1,5			C	C_0	M_{xC}	M_{xC_0}	$M_{yC}=M_{zC}$	$M_{yC_0}=M_{zC_0}$
–	mm									kg	kg/m	N		Nm			
15	15	14	4,5	60	7,5	8,5	10	50	3 920	0,1	1,4	5 800	9 000	39	60	21	32
20	20	18	6	60	9,5	9,3	10	50	3 920	0,17	2,3	9 240	14 400	83	130	41	64
25	23	22	7	60	11	12,3	10	50	3 920	0,21	3,3	13 500	19 600	139	202	73	106
30	28	26	9	80	14	13,8	12	70	3 944	0,48	4,8	19 200	26 600	242	335	120	166
35	34	29	9	80	14	17	12	70	3 944	0,8	6,6	25 500	34 800	393	536	182	248

[1] For detailed information on grease nipples, please refer to **page 70**.
[2] Dynamic load capacities and moments are based on a travel life of 100 km. Please refer to **page 15** for further details.

3.1.5 Carriage LLTHC ... U

Slim-line carriage, standard length, standard height.

Carriages from size 15 to 30 are also available with low friction S0 shield. Dimensions are the same as standard version. For designation, refer to **Ordering key carriages** (↳ **page 103**).

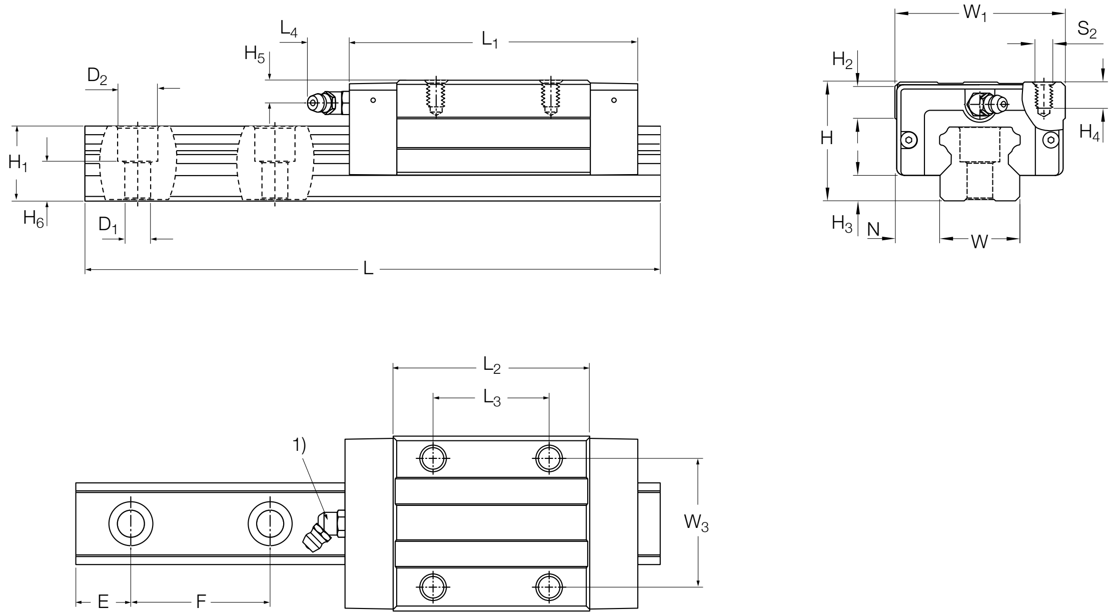


Technical data

Size	Precision class	Designation [1] Preload class T0	T1	T2
–		–		
15	P5	LLTHC 15 U T0 P5	LLTHC 15 U T1 P5	LLTHC 15 U T2 P5
	P3	LLTHC 15 U T0 P3	LLTHC 15 U T1 P3	LLTHC 15 U T2 P3
	P1		LLTHC 15 U T1 P1	LLTHC 15 U T2 P1
20	P5	LLTHC 20 U T0 P5	LLTHC 20 U T1 P5	LLTHC 20 U T2 P5
	P3	LLTHC 20 U T0 P3	LLTHC 20 U T1 P3	LLTHC 20 U T2 P3
	P1		LLTHC 20 U T1 P1	LLTHC 20 U T2 P1
25	P5	LLTHC 25 U T0 P5	LLTHC 25 U T1 P5	LLTHC 25 U T2 P5
	P3	LLTHC 25 U T0 P3	LLTHC 25 U T1 P3	LLTHC 25 U T2 P3
	P1		LLTHC 25 U T1 P1	LLTHC 25 U T2 P1
30	P5	LLTHC 30 U T0 P5	LLTHC 30 U T1 P5	LLTHC 30 U T2 P5
	P3	LLTHC 30 U T0 P3	LLTHC 30 U T1 P3	LLTHC 30 U T2 P3
	P1		LLTHC 30 U T1 P1	LLTHC 30 U T2 P1
35	P5	LLTHC 35 U T0 P5	LLTHC 35 U T1 P5	LLTHC 35 U T2 P5
	P3	LLTHC 35 U T0 P3	LLTHC 35 U T1 P3	LLTHC 35 U T2 P3
	P1		LLTHC 35 U T1 P1	LLTHC 35 U T2 P1
45	P5	LLTHC 45 U T0 P5	LLTHC 45 U T1 P5	LLTHC 45 U T2 P5
	P3	LLTHC 45 U T0 P3	LLTHC 45 U T1 P3	LLTHC 45 U T2 P3
	P1		LLTHC 45 U T1 P1	LLTHC 45 U T2 P1

[1] • **Preferred range**.
• **Only available as system**.
For designation, please refer to designation system.

Dimensional drawing



Size	Assembly dimensions					Carriage dimensions							
	W_1	N	H	H_2	H_3	L_1	L_2	L_3	L_4	W_3	H_4	H_5	S_2
–	mm												
15	34	9,5	24	4,8	4,6	63,3	40	26	4,3	26	4	4,3	M4×0,7
20	44	12	30	9,3	5	73,3	50	36	15	32	6,5	5,7	M5×0,8
25	48	12,5	36	9,6	7	84,4	57	35	16,6	35	6,5	6,5	M6×1,0
30	60	16	42	12,6	9	100,4	67,4	40	14,6	40	8,5	8	M8×1,25
35	70	18	48	12,3	9,5	114,4	77	50	14,6	50	10	8	M8×1,25
45	86	20,5	60	12,7	14	136,5	96	60	14,6	60	12	8,5	M10×1,5

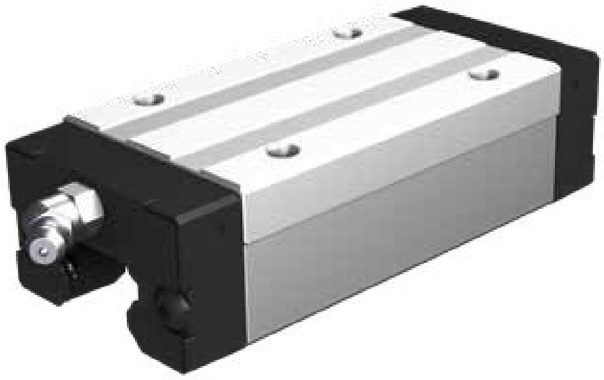
Size	Rail dimensions									Weight		Load ratings [2]		Moments [2]			
										carriage	static	dynamic	static	dynamic	static	dynamic	static
	W	H_1	H_6	F	D_1	D_2	E_{min} ±0,75	E_{max} ±0,75	L_{max} ±1,5			C	C_0	M_{xC}	M_{xC_0}	$M_{yC}=M_{zC}$	$M_{yC_0}=M_{zC_0}$
–	mm						mm			kg	kg/m	N		Nm			
15	15	14	8,5	60	4,5	7,5	10	50	3 920	0,17	1,4	8 400	15 400	56	103	49	90
20	20	18	9,3	60	6	9,5	10	50	3 920	0,26	2,3	12 400	24 550	112	221	90	179
25	23	22	12,3	60	7	11	10	50	3 920	0,38	3,3	18 800	30 700	194	316	155	254
30	28	26	13,8	80	9	14	12	70	3 944	0,81	4,8	26 100	41 900	329	528	256	410
35	34	29	17	80	9	14	12	70	3 944	1,2	6,6	34 700	54 650	535	842	388	611
45	45	38	20,8	105	14	20	16	90	3 917	2,1	11,3	59 200	91 100	1 215	1 869	825	1 270

[1] For detailed information on grease nipples, please refer to **page 70**.
[2] Dynamic load capacities and moments are based on a travel life of 100 km. Please refer to **page 15** for further details.

3.1.6 Carriage LLTHC ... LU

Slim-line carriage, extended length, standard height.

Carriages from size 25 to 30 are also available with low friction S0 shield. Dimensions are the same as standard version. For designation, refer to **Ordering key carriages** (↳ **page 105**).

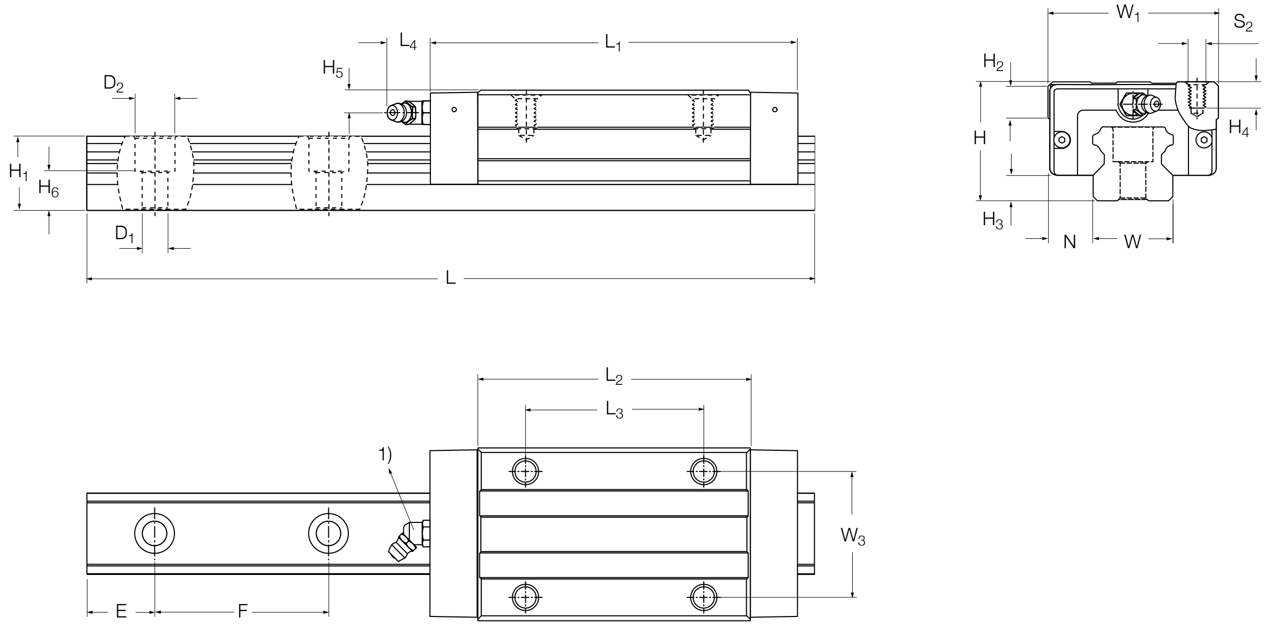


Technical data

Size	Precision class	Designation [1] Preload class T0	T1	T2
–		–		
25	P5	**LLTHC 25 LU T0 P5**	**LLTHC 25 LU T1 P5**	**LLTHC 25 LU T2 P5**
	P3	**LLTHC 25 LU T0 P3**	**LLTHC 25 LU T1 P3**	**LLTHC 25 LU T2 P3**
	P1		**LLTHC 25 LU T1 P1**	**LLTHC 25 LU T2 P1**
30	P5	**LLTHC 30 LU T0 P5**	**LLTHC 30 LU T1 P5**	**LLTHC 30 LU T2 P5**
	P3	**LLTHC 30 LU T0 P3**	**LLTHC 30 LU T1 P3**	**LLTHC 30 LU T2 P3**
	P1		**LLTHC 30 LU T1 P1**	**LLTHC 30 LU T2 P1**
35	P5	**LLTHC 35 LU T0 P5**	**LLTHC 35 LU T1 P5**	**LLTHC 35 LU T2 P5**
	P3	**LLTHC 35 LU T0 P3**	**LLTHC 35 LU T1 P3**	**LLTHC 35 LU T2 P3**
	P1		**LLTHC 35 LU T1 P1**	**LLTHC 35 LU T2 P1**
45	P5	**LLTHC 45 LU T0 P5**	**LLTHC 45 LU T1 P5**	**LLTHC 45 LU T2 P5**
	P3	**LLTHC 45 LU T0 P3**	**LLTHC 45 LU T1 P3**	**LLTHC 45 LU T2 P3**
	P1		**LLTHC 45 LU T1 P1**	**LLTHC 45 LU T2 P1**

[1] • **Preferred range**.
• **Only available as system**.
For designation, please refer to designation system.

Dimensional drawing



Size	Assembly dimensions					Carriage dimensions							
	W_1	N	H	H_2	H_3	L_1	L_2	L_3	L_4	W_3	H_4	H_5	S_2
–	mm												
25	48	12,5	36	9,6	7	106,5	79,1	50	16,6	35	6,5	6,5	M6×1,0
30	60	16	42	12,6	9	125,4	92,4	60	14,6	40	8,5	8	M8×1,25
35	70	18	48	12,3	9,5	142,9	105,5	72	14,6	50	10	8	M8×1,25
45	86	20,5	60	12,7	14	168,5	128	80	14,6	60	12	8,5	M10×1,5

Size	Rail dimensions									Weight		Load ratings [2]		Moments [2]			
										carriage	rail	dynamic	static	dynamic	static	dynamic	static
	W	H_1	H_6	F	D_1	D_2	E_{min} ±0,75	E_{max} ±0,75	L_{max} ±1,5			C	C_0	M_{xC}	M_{xC_0}	$M_{yC}=M_{zC}$	$M_{yC_0}=M_{zC_0}$
–	mm						mm			kg	kg/m	N		Nm			
25	23	22	12,3	60	7	11	10	50	3 920	0,47	3,3	24 400	44 600	252	460	287	525
30	28	26	13,8	80	9	14	12	70	3 944	0,82	4,8	33 900	60 800	428	767	466	836
35	34	29	17	80	9	14	12	70	3 944	1,26	6,6	45 000	79 400	694	1 224	706	1 246
45	45	38	20,8	105	14	20	16	90	3 917	2,11	11,3	72 400	121 400	1 485	2 491	1 376	2 308

[1] For detailed information on grease nipples, please refer to **page 70**.
[2] Dynamic load capacities and moments are based on a travel life of 100 km. Please refer to **page 15** for further details.

3

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3.1.7 Carriage LLTHC … R

Slim-line carriage, standard length, extended height.

Carriages from size 15 to 30 are also available with low friction S0 shield. Dimensions are the same as standard version. For designation, refer to **Ordering key carriages**
(↳ **page 103**).

Technical data

Size	Precision class	Designation [1] Preload class T0	T1	T2
–		–		
15	P5	LLTHC 15 R T0 P5	LLTHC 15 R T1 P5	LLTHC 15 R T2 P5
	P3	LLTHC 15 R T0 P3	LLTHC 15 R T1 P3	LLTHC 15 R T2 P3
	P1		LLTHC 15 R T1 P1	LLTHC 15 R T2 P1
25	P5	LLTHC 25 R T0 P5	LLTHC 25 R T1 P5	LLTHC 25 R T2 P5
	P3	LLTHC 25 R T0 P3	LLTHC 25 R T1 P3	LLTHC 25 R T2 P3
	P1		LLTHC 25 R T1 P1	LLTHC 25 R T2 P1
30	P5	LLTHC 30 R T0 P5	LLTHC 30 R T1 P5	LLTHC 30 R T2 P5
	P3	LLTHC 30 R T0 P3	LLTHC 30 R T1 P3	LLTHC 30 R T2 P3
	P1		LLTHC 30 R T1 P1	LLTHC 30 R T2 P1
35	P5	LLTHC 35 R T0 P5	LLTHC 35 R T1 P5	LLTHC 35 R T2 P5
	P3	LLTHC 35 R T0 P3	LLTHC 35 R T1 P3	LLTHC 35 R T2 P3
	P1		LLTHC 35 R T1 P1	LLTHC 35 R T2 P1
45	P5	LLTHC 45 R T0 P5	LLTHC 45 R T1 P5	LLTHC 45 R T2 P5
	P3	LLTHC 45 R T0 P3	LLTHC 45 R T1 P3	LLTHC 45 R T2 P3
	P1		LLTHC 45 R T1 P1	LLTHC 45 R T2 P1

[1] • **Preferred range**.
• **Only available as system**.
For designation, please refer to designation system.

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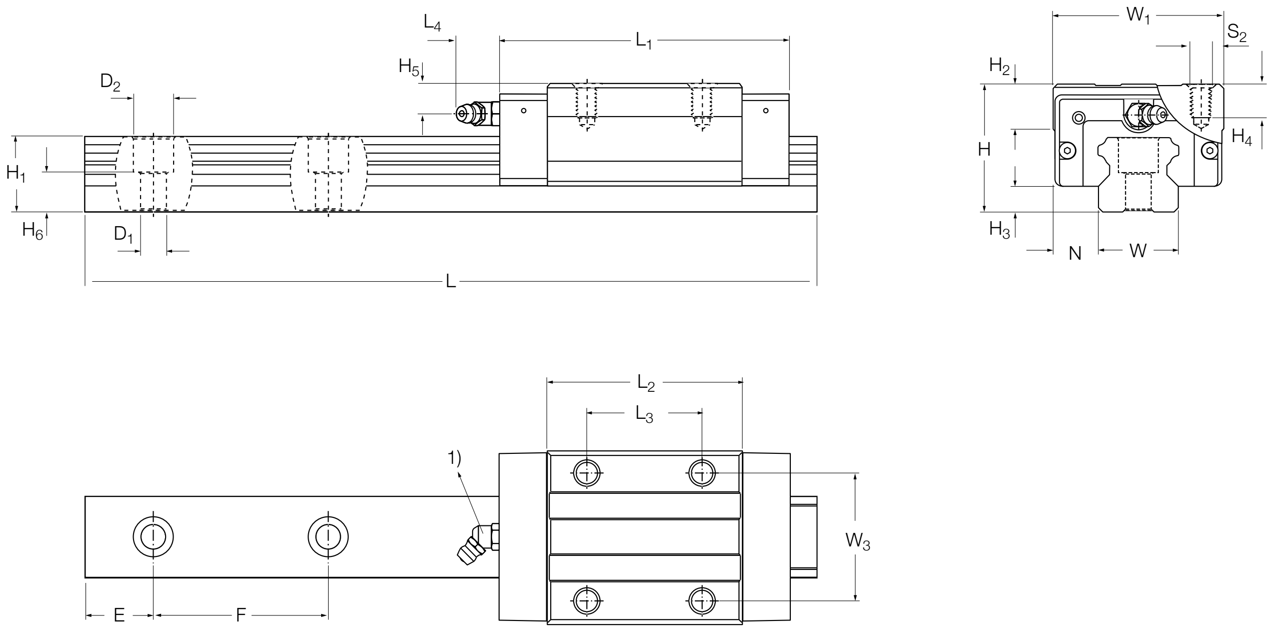
Dimensional drawing



Size	Assembly dimensions					Carriage dimensions							
	W1	N	H	H2	H3	L1	L2	L3	L4	W3	H4	H5	S2
–	mm												
15	34	9,5	28	8,8	4,6	63,3	40	26	15	26	7,5	8,3	M4×0,7
25	48	12,5	40	13,6	7	84,4	57	35	16,6	35	10	10,5	M6×1,0
30	60	16	45	15,6	9	100,4	67,4	40	14,6	40	11,2	11	M8×1,25
35	70	18	55	19,3	9,5	114,4	77	50	14,6	50	17	15	M8×1,25
45	86	20,5	70	22,7	14	136,5	96	60	14,6	60	20,5	18,5	M10×1,5

Size	Rail dimensions									Weight		Load ratings [2]		Moments [2]			
										carriage	rail	dynamic	static	dynamic	static	dynamic	static
	W	H_1	H_6	F	D_1	D_2	E_{min} ±0,75	E_{max} ±0,75	L_{max} ±1,5			C	C_0	M_xC	M_{xC_0}	$M_{yC}=M_{zC}$	$M_{yC_0}=M_{zC_0}$
–	mm				Ø		mm			kg	kg/m	N		Nm			
15	15	14	8,5	60	4,5	7,5	10	50	3 920	0,19	1,4	8 400	15 400	56	103	49	90
25	23	22	12,3	60	7	11	10	50	3 920	0,45	3,3	18 800	30 700	194	316	155	254
30	28	26	13,8	80	9	14	12	70	3 944	0,91	4,8	26 100	41 900	329	528	256	410
35	34	29	17	80	9	14	12	70	3 944	1,5	6,6	34 700	54 650	535	842	388	611
45	45	38	20,8	105	14	20	16	90	3 917	2,3	11,3	59 200	91 100	1 215	1 869	825	1 270

[1] For detailed information on grease nipples, please refer to **page 70**.
[2] Dynamic load capacities and moments are based on a travel life of 100 km. Please refer to **page 15** for further details.

3

3.1.8 Carriage LLTHC ... LR

Slim-line carriage, extended length, extended height.

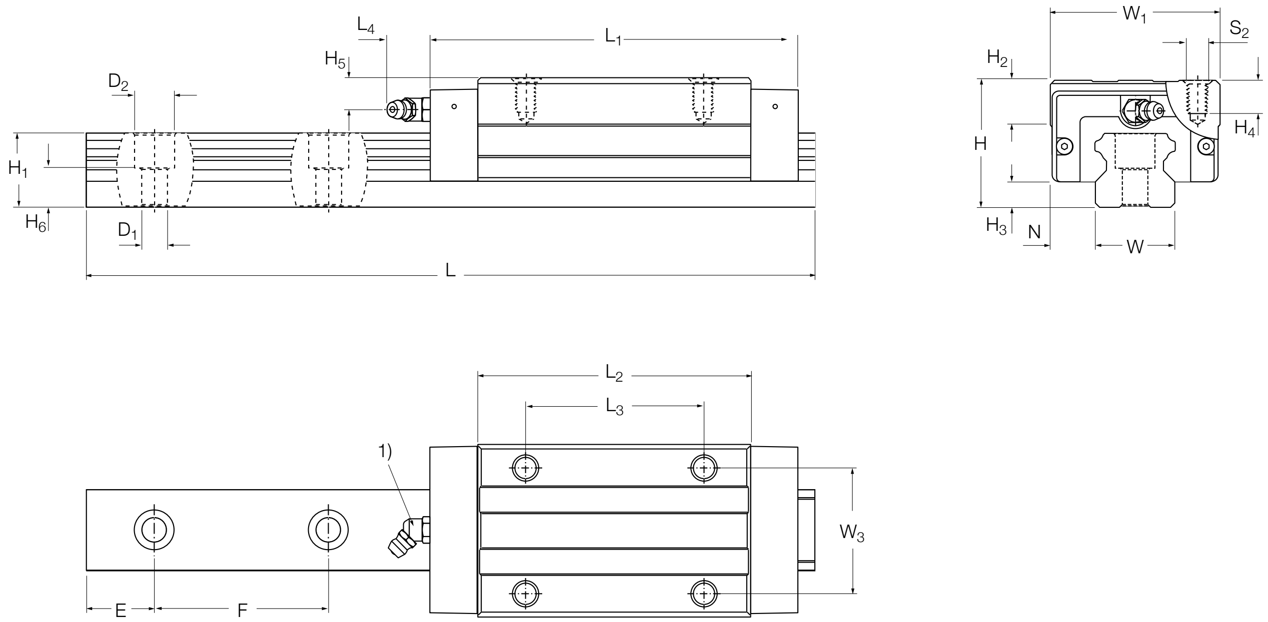
Carriages from size 20 to 30 are also available with low friction S0 shield. Dimensions are the same as standard version. For designation, refer to **Ordering key carriages** (↳ **page 103**).

Technical data

Size	Precision class	Designation [1]		
		Preload class		
		T0	T1	T2
–		–		
20	P5	**LLTHC 20 LR T0 P5**	**LLTHC 20 LR T1 P5**	**LLTHC 20 LR T2 P5**
	P3	**LLTHC 20 LR T0 P3**	**LLTHC 20 LR T1 P3**	**LLTHC 20 LR T2 P3**
	P1		**LLTHC 20 LR T1 P1**	**LLTHC 20 LR T2 P1**
25	P5	**LLTHC 25 LR T0 P5**	**LLTHC 25 LR T1 P5**	**LLTHC 25 LR T2 P5**
	P3	**LLTHC 25 LR T0 P3**	**LLTHC 25 LR T1 P3**	**LLTHC 25 LR T2 P3**
	P1		**LLTHC 25 LR T1 P1**	**LLTHC 25 LR T2 P1**
30	P5	**LLTHC 30 LR T0 P5**	**LLTHC 30 LR T1 P5**	**LLTHC 30 LR T2 P5**
	P3	**LLTHC 30 LR T0 P3**	**LLTHC 30 LR T1 P3**	**LLTHC 30 LR T2 P3**
	P1		**LLTHC 30 LR T1 P1**	**LLTHC 30 LR T2 P1**
35	P5	**LLTHC 35 LR T0 P5**	**LLTHC 35 LR T1 P5**	**LLTHC 35 LR T2 P5**
	P3	**LLTHC 35 LR T0 P3**	**LLTHC 35 LR T1 P3**	**LLTHC 35 LR T2 P3**
	P1		**LLTHC 35 LR T1 P1**	**LLTHC 35 LR T2 P1**
45	P5	**LLTHC 45 LR T0 P5**	**LLTHC 45 LR T1 P5**	**LLTHC 45 LR T2 P5**
	P3	**LLTHC 45 LR T0 P3**	**LLTHC 45 LR T1 P3**	**LLTHC 45 LR T2 P3**
	P1		**LLTHC 45 LR T1 P1**	**LLTHC 45 LR T2 P1**

[1] • **Preferred range,**
• Only available as system.
For designation, please refer to designation system.

Dimensional drawing



Size	Assembly dimensions					Carriage dimensions							
	W_1	N	H	H_2	H_3	L_1	L_2	L_3	L_4	W_3	H_4	H_5	S_2
–	mm												
20	44	12	30	9,3	5	89,5	66,2	50	15	32	6,5	5,7	M5×0,8
25	48	12,5	40	13,6	7	106,5	79,1	50	16,6	35	10	10,5	M6×1,0
30	60	16	45	15,6	9	125,4	92,4	60	14,6	40	11,2	11	M8×1,25
35	70	18	55	19,3	9,5	142,9	105,5	72	14,6	50	17	15	M8×1,25
45	86	20,5	70	22,7	14	168,5	128	80	14,6	60	20,5	18,5	M10×1,5

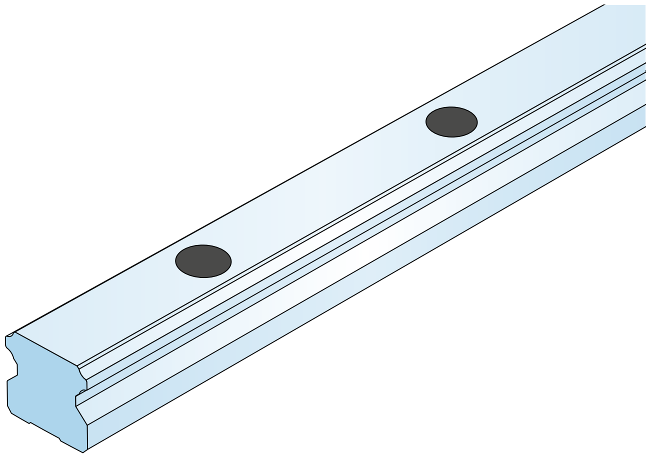
Size	Rail dimensions									Weight		Load ratings[2]		Moments[2]			
										carriage	rail	dynamic	static	dynamic	static	dynamic	static
	W	H_1	H_6	F	D_1	D_2	E_{min} ±0,75	E_{max} ±0,75	L_{max} ±1,5			C	C_0	M_{xC}	M_{xC_0}	$M_{yC}=M_{zC}$	$M_{yC_0}=M_{zC_0}$
–	mm				Ø		mm			kg	kg/m	N		Nm			
20	20	18	9,3	60	6	9,5	10	50	3 920	0,47	2,3	15 200	32 700	137	295	150	322
25	23	22	12,3	60	7	11	10	50	3 920	0,56	3,3	24 400	44 600	252	460	287	525
30	28	26	13,8	80	9	14	12	70	3 944	1,2	4,8	33 900	60 800	428	767	466	836
35	34	29	17	80	9	14	12	70	3 944	1,9	6,6	45 000	79 400	694	1 224	706	1 246
45	45	38	20,8	105	14	20	16	90	3 917	2,8	11,3	72 400	121 400	1 485	2 491	1 376	2 308

[1] For detailed information on grease nipples, please refer to **page 70**.
[2] Dynamic load capacities and moments are based on a travel life of 100 km. Please refer to **page 15** for further details.

3.2 Rail data

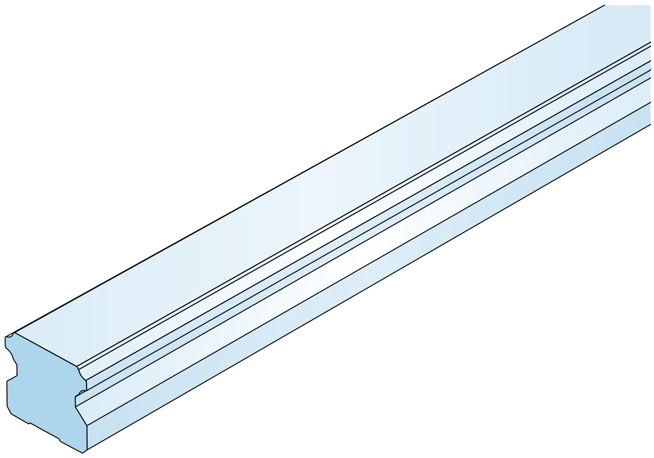
LLTHR rails

Supplied with protective plastic caps for mounting from above.



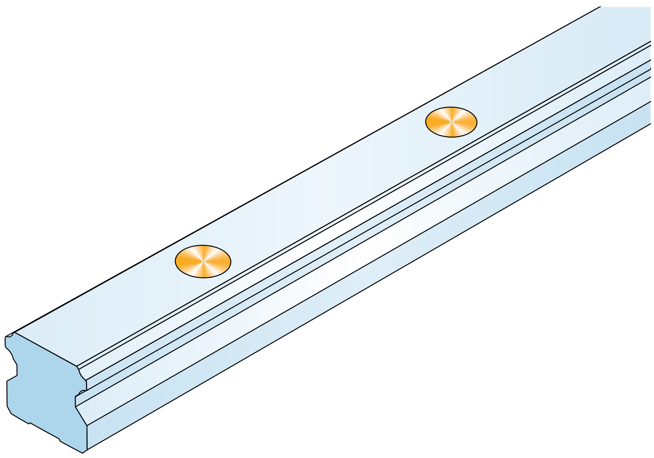
LLTHR ... D4 rails

With blind holes for mounting from below.



LLTHR ... D6 rails

Supplied with protective metal plugs for mounting from above.



3.2.1 LLTHR rails

Rails are supplied with protective plastic caps for mounting from above. For designation, refer to **Ordering key rails** (↳ **page 104**).

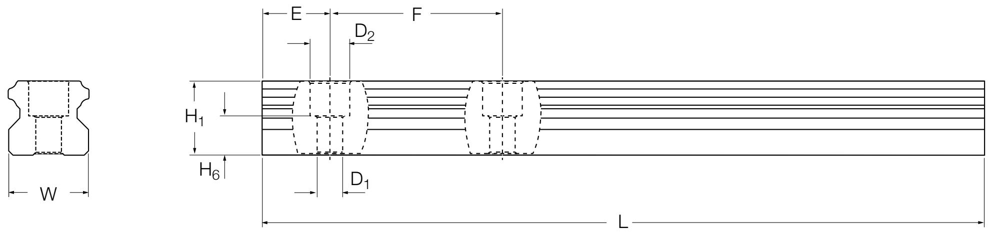
NOTE: If a rail length is required that exceeds the maximum length available, jointed rails can be ordered. These rails are manufactured so they match seamlessly to each other.

Technical data

Size	Precision class	Designation [1]		Pitch
		One-piece rail	Multi–piece rail	F
–	–	–		mm
15	P5	LLTHR 15 - ... P5	LLTHR 15 - ... P5 A	60
	P3	LLTHR 15 - ... P3	LLTHR 15 - ... P3 A	
	P1	LLTHR 15 - ... P1	LLTHR 15 - ... P1 A	
20	P5	LLTHR 20 - ... P5	LLTHR 20 - ... P5 A	60
	P3	LLTHR 20 - ... P3	LLTHR 20 - ... P3 A	
	P1	LLTHR 20 - ... P1	LLTHR 20 - ... P1 A	
25	P5	LLTHR 25 - ... P5	LLTHR 25 - ... P5 A	60
	P3	LLTHR 25 - ... P3	LLTHR 25 - ... P3 A	
	P1	LLTHR 25 - ... P1	LLTHR 25 - ... P1 A	
30	P5	LLTHR 30 - ... P5	LLTHR 30 - ... P5 A	80
	P3	LLTHR 30 - ... P3	LLTHR 30 - ... P3 A	
	P1	LLTHR 30 - ... P1	LLTHR 30 - ... P1 A	
35	P5	LLTHR 35 - ... P5	LLTHR 35 - ... P5 A	80
	P3	LLTHR 35 - ... P3	LLTHR 35 - ... P3 A	
	P1	LLTHR 35 - ... P1	LLTHR 35 - ... P1 A	
45	P5	LLTHR 45 - ... P5	LLTHR 45 - ... P5 A	105
	P3	LLTHR 45 - ... P3	LLTHR 45 - ... P3 A	
	P1	LLTHR 45 - ... P1	LLTHR 45 - ... P1 A	

[1] • **Preferred range,**
• Only available as system.
By rail length in mm, e.g. LLTHR 15 -1000 P5

Dimensional drawing



Size	Dimensions									Weight
	W	H_1	H_6	D_1	D_2	E_{min} ±0,75	E_{max} ±0,75	F	L_{max} ±1,5	
–	mm									kg/m
15	15	14	8,5	4,5	7,5	10	50	60	3 920	1,4
20	20	18	9,3	6	9,5	10	50	60	3 920	2,3
25	23	22	12,3	7	11	10	50	60	3 920	3,3
30	28	26	13,8	9	14	12	70	80	3 944	4,8
35	34	29	17	9	14	12	70	80	3 944	6,6
45	45	38	20,8	14	20	16	90	105	3 917	11,3

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

Calculation of number of attachment holes in rail guide

(1) $n_{real} = \frac{L}{F}$

(2) Round down of n_{real} to n

(3) n + 1 = z

F = Distance of attachment holes

L = Rail length

n_{real} = Real calculation value number of hole distances

z = Number of attachment holes in rail

Determination of E dimension based on z

(4) $E_{real} = \frac{L - F\,(z - 1)}{2}$

E_{real} = Real calculation value for E-dimension

E_{min} = Minimum E-dimension according to catalogue

Comparison with catalogue value of E_{min}

(4.1) If $E_{real} \geq E_{min}$
Usage of E_{real} from **formula 4**

(4.2) If $E_{real} < E_{min}$
Calculation of E_{real} according to **formula 5**

(5) $E_{real} = \frac{L - F\,(z - 2)}{2}$

3.2.2 LLTHR rails ... D4 rails

For mounting from below. For designation, refer to **Ordering key rails** (↳ **page 104**).

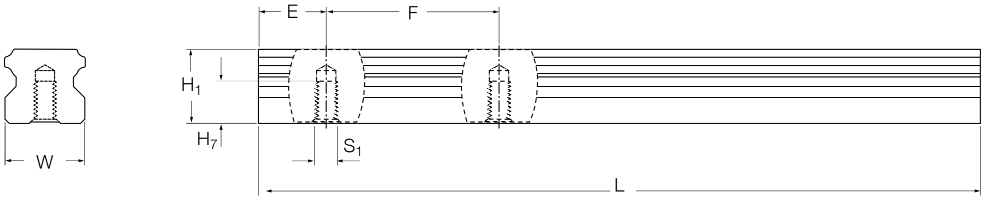
NOTE: If a rail length is required that exceeds the maximum length available, jointed rails can be ordered. These rails are manufactured so they match seamlessly to each other.

Technical data

Standard rail size	Precision class	Designation 1)		Pitch
		One-piece rail	Multi–piece rail	F
–	–	–		mm
15	P5	**LLTHR 15 - ... P5 D4**	**LLTHR 15 - ... P5 A D4**	60
	P3	**LLTHR 15 - ... P3 D4**	**LLTHR 15 - ... P3 A D4**	
	P1	**LLTHR 15 - ... P1 D4**	**LLTHR 15 - ... P1 A D4**	
20	P5	**LLTHR 20 - ... P5 D4**	**LLTHR 20 - ... P5 A D4**	60
	P3	**LLTHR 20 - ... P3 D4**	**LLTHR 20 - ... P3 A D4**	
	P1	**LLTHR 20 - ... P1 D4**	**LLTHR 20 - ... P1 A D4**	
25	P5	**LLTHR 25 - ... P5 D4**	**LLTHR 25 - ... P5 A D4**	60
	P3	**LLTHR 25 - ... P3 D4**	**LLTHR 25 - ... P3 A D4**	
	P1	**LLTHR 25 - ... P1 D4**	**LLTHR 25 - ... P1 A D4**	
30	P5	**LLTHR 30 - ... P5 D4**	**LLTHR 30 - ... P5 A D4**	80
	P3	**LLTHR 30 - ... P3 D4**	**LLTHR 30 - ... P3 A D4**	
	P1	**LLTHR 30 - ... P1 D4**	**LLTHR 30 - ... P1 A D4**	
35	P5	**LLTHR 35 - ... P5 D4**	**LLTHR 35 - ... P5 A D4**	80
	P3	**LLTHR 35 - ... P3 D4**	**LLTHR 35 - ... P3 A D4**	
	P1	**LLTHR 35 - ... P1 D4**	**LLTHR 35 - ... P1 A D4**	
45	P5	**LLTHR 45 - ... P5 D4**	**LLTHR 45 - ... P5 A D4**	105
	P3	**LLTHR 45 - ... P3 D4**	**LLTHR 45 - ... P3 A D4**	
	P1	**LLTHR 45 - ... P1 D4**	**LLTHR 45 - ... P1 A D4**	

1) **● Preferred range,**
● Only available as system.
replace "..." by rail length in mm, e. g. LLTHR 15 - 1000 P5 D4

Dimensional drawing



Size	Dimensions								Weight
	W	H_1	H_7	S_1	E_{min} ±0,75	E_{max} ±0,75	F	L_{max} ±1,5	
–	mm								kg/m
15	15	14	8	M5	10	50	60	3 920	1,4
20	20	18	10	M6	10	50	60	3 920	2,4
25	23	22	12	M6	10	50	60	3 920	3,4
30	28	26	15	M8	12	70	80	3 944	5,0
35	34	29	17	M8	12	70	80	3 944	6,8
45	45	38	24	M12	16	90	105	3 917	11,8

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

Calculation of number of attachment holes in rail guide

(1) $n_{real} = \frac{L}{F}$

(2) Round down of n_{real} to n

(3) n + 1 = z

F = Distance of attachment holes

L = Rail length

n_{real} = Real calculation value for number of hole distances

z = Number of attachment holes in rail

Determination of E dimension based on z

(4) $E_{real} = \frac{L - F (z - 1)}{2}$

E_{real} = Real calculation value for E-dimension

E_{min} = Minimum E-dimension according to catalogue

Comparison with catalogue value of E_{min}

(4.1) If $E_{real} \geq E_{min}$
Usage of E_{real} from **formula 4**

(4.2) If $E_{real} < E_{min}$
Calculation of E_{real} according to **formula 5**

(5) $E_{real} = \frac{L - F (z - 2)}{2}$

3

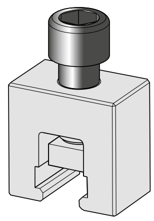
3.2.3 LLTHR ... D6 rails

Rails are supplied with protective metal caps for mounting from above. For designation, refer to **Ordering key rails** (↳ **page 104**).

Protective metal plugs ensure that no residues of dirt, swarf, cooling water and other contaminants remain in the area of the attachment holes. After insertion, these plugs align flush with the surface of the profile rail guide to provide effective wiping. The use of additional scraper plates in combination with these protective metal plugs is an option which will further enhance protection (↳ **page 62**).

NOTE: If a rail length is required that exceeds the maximum length available, jointed rails can be ordered. These rails are manufactured so they match seamlessly to each other.

Size-specific mounting tools from Ewellix are needed for installing the protective metal plugs. Please refer to **page 104** for ordering the mounting tool.



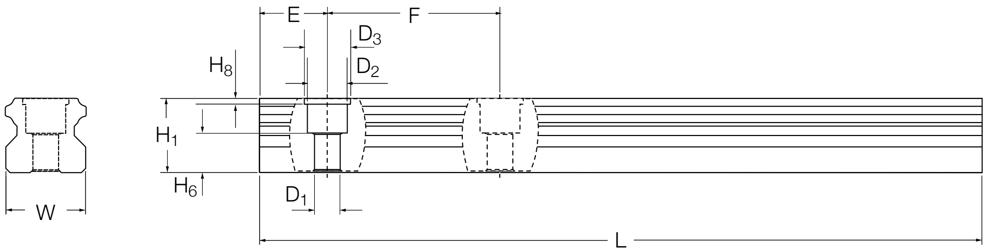
Mounting tool for installing protective metal plugs

Technical data

Standard rail size	Precision class	Designation [1]		Pitch
		One-piece rail	Multi–piece rail	F
–	–	–		mm
25	P5	**LLTHR 25 - ... P5 D6**	**LLTHR 25 - ... P5 A D6**	60
	P3	**LLTHR 25 - ... P3 D6**	**LLTHR 25 - ... P3 A D6**	
	P1	**LLTHR 25 - ... P1 D6**	**LLTHR 25 - ... P1 A D6**	
30	P5	**LLTHR 30 - ... P5 D6**	**LLTHR 30 - ... P5 A D6**	80
	P3	**LLTHR 30 - ... P3 D6**	**LLTHR 30 - ... P3 A D6**	
	P1	**LLTHR 30 - ... P1 D6**	**LLTHR 30 - ... P1 A D6**	
35	P5	**LLTHR 35 - ... P5 D6**	**LLTHR 35 - ... P5 A D6**	80
	P3	**LLTHR 35 - ... P3 D6**	**LLTHR 35 - ... P3 A D6**	
	P1	**LLTHR 35 - ... P1 D6**	**LLTHR 35 - ... P1 A D6**	
45	P5	**LLTHR 45 - ... P5 D6**	**LLTHR 45 - ... P5 A D6**	105
	P3	**LLTHR 45 - ... P3 D6**	**LLTHR 45 - ... P3 A D6**	
	P1	**LLTHR 45 - ... P1 D6**	**LLTHR 45 - ... P1 A D6**	

[1] • **Preferred range,**
• Only available as system.
replace "..." by rail length in mm, e. g. LLTHR 15 - 1000 P5 D4

Dimensional drawing



Size	Dimensions											Weight
	W	H_1	H_6	H_8	D_1	D_2	D_3	E_{min} ±0,75	E_{max} ±0,75	F	L_{max} ±1,5	
–	mm											kg/m
25	23	22	12,3	2,2	7	11	13	10	50	60	3 920	3,3
30	28	26	13,8	2,2	9	14	16	12	70	80	3 944	4,8
35	34	29	17	2,2	9	14	16	12	70	80	3 944	6,6
45	45	38	20,8	2,2	14	20	25	16	90	105	3 917	11,3

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

Calculation of number of attachment holes in rail guide

(1) $n_{real} = \frac{L}{F}$

(2) Round down of n_{real} to n

(3) n + 1 = z

F = Distance of attachment holes

L = Rail length

n_{real} = Real calculation value for number of hole distances

z = Number of attachment holes in rail

Determination of E dimension based on z

(4) $E_{real} = \frac{L - F (z - 1)}{2}$

E_{real} = Real calculation value for E-dimension

E_{min} = Minimum E-dimension according to catalogue

Comparison with catalogue value of E_{min}

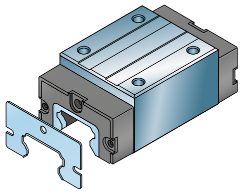
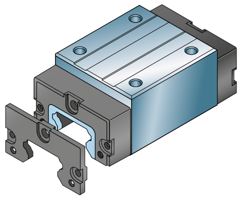
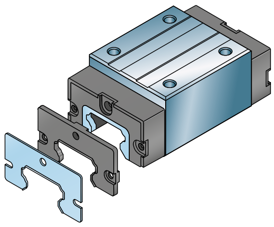
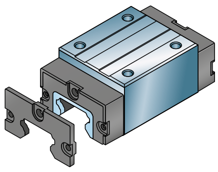
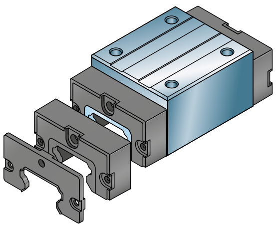
(4.1) If $E_{real} \geq E_{min}$
Usage of E_{real} from **formula 4**

(4.2) If $E_{real} < E_{min}$
Calculation of E_{real} according to **formula 5**

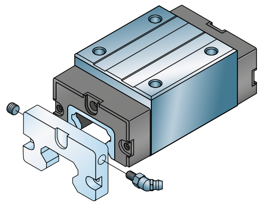
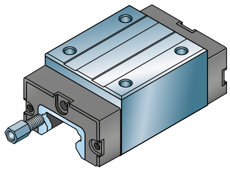
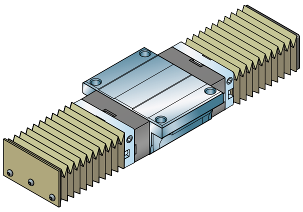
(5) $E_{real} = \frac{L - F (z - 2)}{2}$

3

3.3 Accessories

Accessories Item name	Illustration [1]	Purpose
Scraper plate **LLTHZ ... S1**		Scraper plates are spring-steel, non-contact components. They protect the front seal from coarse contaminants or hot metal chips.
Additional front seal **LLTHZ ... S7**		Additional front seals are contact seals that can be attached to the carriage end faces. They are single-lip seals consisting of special heavy-duty material and offer additional protection against liquids and smaller contaminants. An additional front seal, in combination with carriages equipped with a low friction S0 shield, result in a sealed system with lower friction.
Seal kit **LLTHZ ... S3**		The seal kit consists of a metal scraper and an additional front seal. It is intended for applications involving exposure to coarse and fine dirt as well as liquids.
Low friction shield **LLTHZ ... S0**		The low friction shield has no contact with the rail. It replaces the standard front seal and results in a reduced friction force. Since the sealing function is not in place at the front ends of the carriage, the lubrication interval is reduced. The low friction shield is available for carriages from size 15 to 30.
Lube element **LLTHZ ... S6**		The lube element is designed to enhance the service life of a profile rail guide system. It provides an additional lubrication reservoir which consists of foam filled with oil in permanent contact with the raceways at the rail. By capillary attraction of the foam, the oil is constantly dosed in the correct amount. The ball elements roll through the applied oil film, whereby the optimal tribological conditions are maintained. The lube element is mounted on the end plate. The use of the originally delivered front seal keeps the dirt outside and the lubricant inside the carriage.

[1] Appearance can vary slightly depending on the size

Accessories Item name	Illustration [1]	Purpose
Adapter plate **LLTHZ ... PL**		Adapter plates provide a side lubrication point, either for a grease nipple or for central lubrication systems. The interface of the adapter plate is the same on both sides. The adapter plate can be mounted on both end sides of the carriage. Usually only one adapter plate is used per carriage. Please note that this accessory is also part of the bellow sets.
Lubrication connector **LLTHZ ... VN UA**		The lubrication connector is used to provide an interface for central lubrication systems. The lubrication connector can be mounted on both end sides of the carriage. Usually only one lubrication connector is used per carriage. Please note that the lubrication connector cannot be used in combination with additional seals (scraper plate, additional front seal, seal kit and adapter plate).
Bellows **LLTHZ ... B**		Bellows protect the entire system against solid and liquid contaminants from above. They are suitable for highly contaminated environments like machining centres in the woodworking and metals industries.

[1] Appearance can vary slightly depending on the size

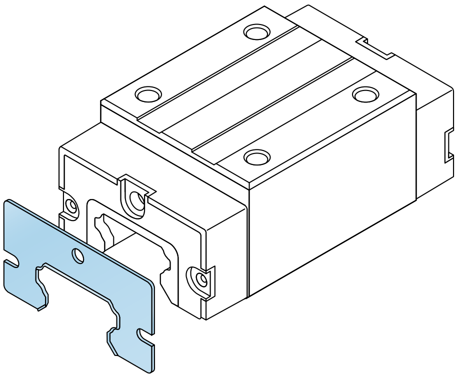
3.3.1 Scraper plate (S1)

- Material: spring steel according to DIN EN 10088
- Appearance: black
- Designed with a specified maximum gap of 0,2 to 0,3 mm

Mounting

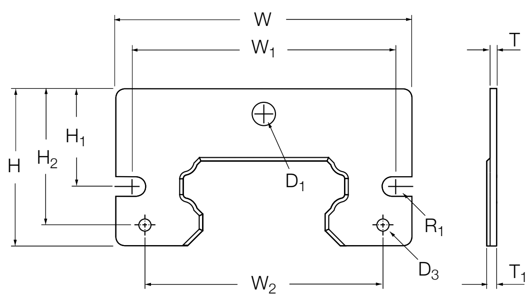
Mounting screws and grease nipple are included. When mounting, be sure there is an even space between the rail and scraper plate.

NOTE: Can be ordered in combination with an additional front seal as a kit. For designation, refer to **Ordering key accessories (↳ page 104).**



Appearance can vary slightly depending on the size.

Dimensional drawing



Size	Part designation	Dimensions										
		D_1	D_3	R_1	W	W_1	W_2	H	H_1	H_2	T	T_1
–	–	mm										
15	**LLTHZ 15 S1**	3,6	–	1,75	31,6	25,8	–	18,5	12	–	1,5	2,3
20	**LLTHZ 20 S1**	5,5	–	1,75	42,6	35	–	24,2	14,8	–	1,5	2,3
25	**LLTHZ 25 S1**	5,5	–	2,25	46,6	39,6	–	27,7	16,8	–	1,5	2,3
30	**LLTHZ 30 S1**	6,5	–	1,75	57	50	–	30,4	19,3	–	1,5	2,3
35	**LLTHZ 35 S1**	6,5	3,4	2,25	67,3	59,2	52	36,3	22,1	30,1	1,5	2,3
45	**LLTHZ 45 S1**	6,5	3,4	2,75	83,3	72	67	44,2	27,5	38,3	1,5	2,3

3.3.2 Additional front seal (S7)

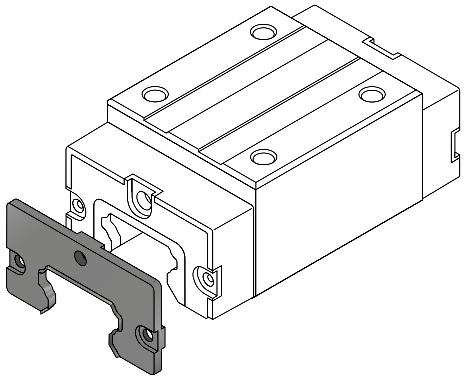
- Material: Elastomer
- Design: single-lip seal

Mounting

Mounting screws and grease nipple are included.

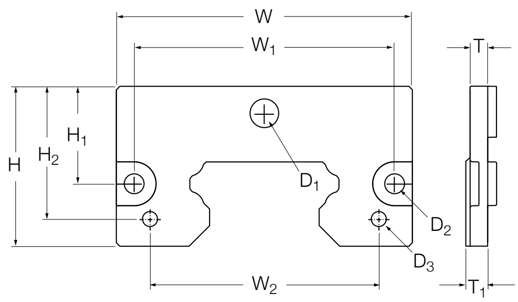
NOTE: Can be ordered in combination with a scraper plate as a kit. For designation, refer to
Ordering key accessories (↳ page 104).

An additional front seal in combination with carriages equipped with low friction S0 shield results in a sealed system with lower friction.



Appearance can vary slightly depending on the size.

Dimensional drawing



Size	Part designation	Dimensions										
		D_1	D_2	D_3	W	W_1	W_2	H	H_1	H_2	T	T_1
–	–	mm										
15	**LLTHZ 15 S7**	3,6	3,4	–	31,6	25,8	–	18,5	12	–	3	4
20	**LLTHZ 20 S7**	5,5	3,4	–	42,6	35	–	24,2	14,8	–	3	4
25	**LLTHZ 25 S7**	5,5	4,5	–	46,6	39,6	–	27,7	16,8	–	3	4
30	**LLTHZ 30 S7**	6,5	3,4	–	57,9	50	–	31,5	19.3	–	4	5
35	**LLTHZ 35 S7**	6,5	4,5	3,4	67,3	59,2	52	36,3	22,1	30,1	4	5
45	**LLTHZ 45 S7**	6,5	5,5	3,4	83,3	72	67	44,2	27,5	38,3	4	5

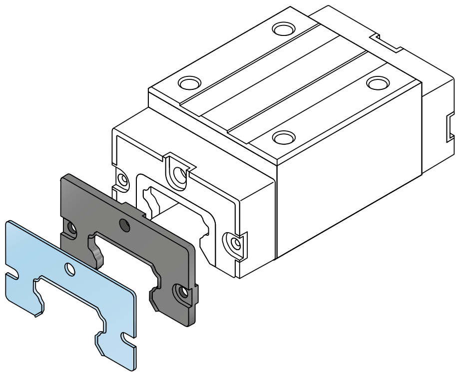
3.3.3 Seal kit (S3)

The seal kit consists of the following components:

- Scraper plate
- Additional front seal

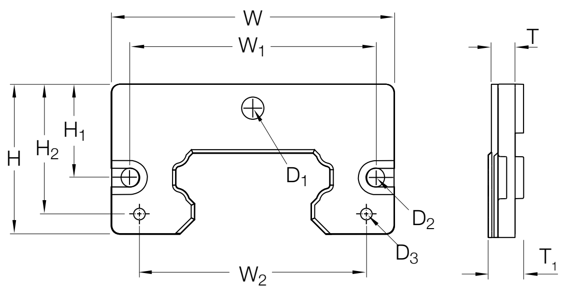
Mounting

Mounting screws and grease nipple are included. For designation, refer to **Ordering key accessories** **(↳ page 104).**



Appearance can vary slightly depending on the size.

Dimensional drawing



Size	Part designation	Dimensions										
		D_1	D_2	D_3	W	W_1	W_2	H	H_1	H_2	T	T_1
–	–	mm										
15	**LLTHZ 15 S3**	3,6	3,4	–	31,6	25,8	–	18,5	12	–	4,5	5,3
20	**LLTHZ 20 S3**	5,5	3,4	–	42,6	35	–	24,2	14,8	–	4,5	5,3
25	**LLTHZ 25 S3**	5,5	4,5	–	46,6	39,6	–	27,7	16,8	–	4,5	5,3
30	**LLTHZ 30 S3**	6,5	3,4	–	57,9	50	–	31,5	19,3	–	5,5	6,3
35	**LLTHZ 35 S3**	6,5	4,5	3,4	67,3	59,2	52	36,3	22,1	30,1	5,5	6,3
45	**LLTHZ 45 S3**	6,5	5,5	3,4	83,3	72	67	44,2	27,5	38,3	5,5	6,3

3.3.4 Low friction shield (S0)

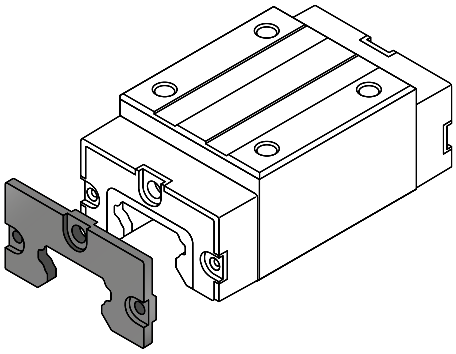
- Material: PA6.6
- Size: 15 to 30
- Non-contact component

Mounting

The low friction shield (S0) replaces the standard front seal.

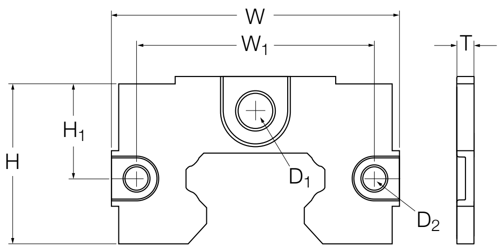
The dimensions for the mounting screws and the grease nipple remain unchanged.

NOTE: A low friction shield (S0) combined with the additional front seal (S7) results in a sealed system with lower friction.



Appearance can vary slightly depending on the size.

Dimensional drawing

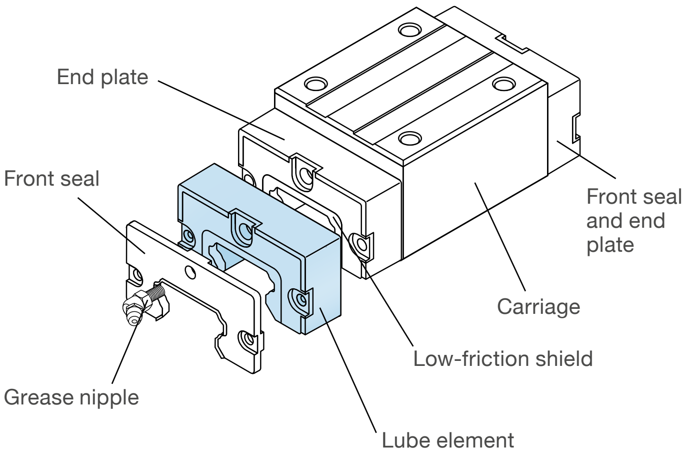


Size	Part designation	Dimensions						
		D_1	D_2	W	W_1	H	H_1	T
–	–	mm						
15	**LLTHZ 15 S0**	3,4	3,4	31,3	25,8	18,3	11,2	2
20	**LLTHZ 20 S0**	5,4	3,4	42,4	35	24,1	13,8	2
25	**LLTHZ 25 S0**	5,4	4,4	46,4	39,6	27,1	15,7	2,5
30	**LLTHZ 30 S0**	6,3	3,4	57,2	50	31,3	18,1	4

3.3.5 Lube element (S6)

Benefits

- Longer relubrication intervals
- Less maintenance costs
- Easy mounting and replacement by clicking onto/over the rail
- Applicable for horizontal and vertical mounting
- Can be combined and ordered with standard LLT accessories, such as seal kit
- Suitable for all carriage types of size 15 to 35
- Delivered ready to mount with all needed parts and filled with oil



Technical data

The relubrication interval of 5 000 km with lube element is valid for all sizes and under following pre-conditions:

Load ratio:	$F_m \leq 0{,}3C$
Speed:	≤ 1 m/s
Temperature:	+10 up to +50 °C
Mounting:	One lube element per lubricated carriage

The lube element is filled with high quality oil which has the right viscosity and is compatible with the grease of the carriage. Other oil types can be validated by Ewellix on request. The lube element housing is made of POM. By mounting a grease nipple to the lube element, the carriage can be regularly greased. It is not possible to refill the lube element. For ideal function the lube element should be replaced after 5 000 km of travel distance, unless regular greasing is given through the grease nipple.

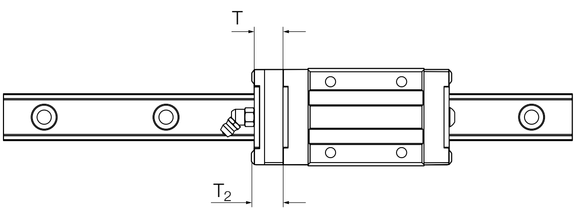
Because of the contact of the foam to the raceways of the rail, a slight increase of friction can occur.

A lube set LLTHZ S6 consists of one low-friction shield (S0), one lube element and two screws. The permissible storage temperature is –15 up to +50 °C. The maximum storage duration in a warehouse is two years under the above mentioned conditions.

In case of different pre-conditions in the application, the performance may differ. Please contact Ewellix for further information.

Dimensional drawing

The carriage length increases by value T_2, when a lube element is used



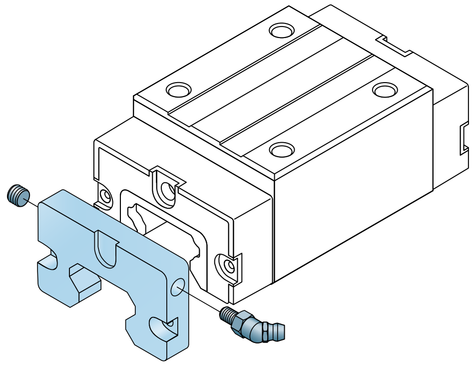
Size	T	T_2 (including screw head)	Tightening torque of mounting screws
–	mm	mm	Nm
15	10,5	11,0	0,20
20	12,5	13,0	0,20
25	14,5	15,0	0,20
30	14,5	15,0	0,38
35	17,5	18,0	0,38

3.3.6 Adapter plate (PL)

- Material: Aluminium
- Appearance: Natural aluminium, non-anodized

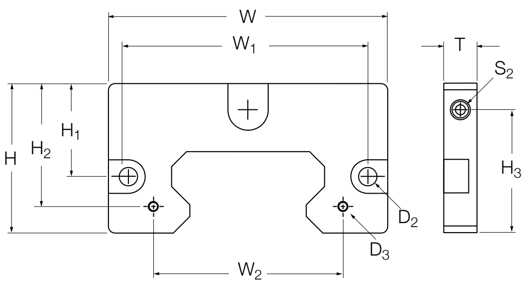
Mounting

Mounting screws, sealing ring and grease nipple are included. For designation, refer to **Ordering key accessories (** **↳ page 104).**



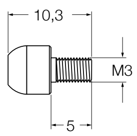
Appearance can vary slightly depending on the size.

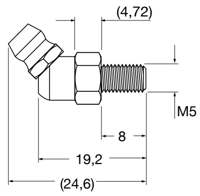
Dimensional drawing

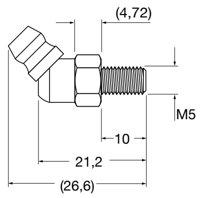


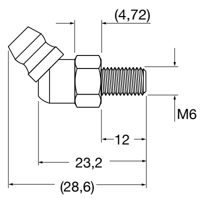
Size	Part designation	Dimensions										
		S_2	D_2	D_3	W	W_1	W_2	H	H_1	H_2	H_3	T
–	–	mm										
15	**LLTHZ 15 PL**	M5×0,8	3,4	M2×0,4	32	25,8	20	18,9	12,2	16,4	13,7	10
20	**LLTHZ 20 PL**	M5×0,8	3,4	M3×0,5	43	35	28	24,5	15	20	17,5	10
25	**LLTHZ 25 PL**	M5×0,8	4,5	M3×0,5	47	39,6	32	28	17	23	22,5	10
30	**LLTHZ 30 PL**	M6×1,0	3,5	M3×0,5	58,5	50	38	32	19,5	26	25	10
35	**LLTHZ 35 PL**	M6×1,0	4,5	M3×0,5	68	59,2	45	37	22,5	29,5	30	10
45	**LLTHZ 45 PL**	M6×1,0	5,5	M3×0,5	84	72	57	45	28	37	37	10

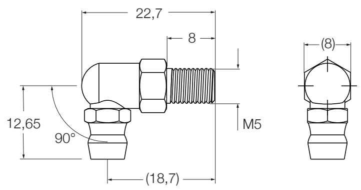
3.3.7 Lubrication connectors

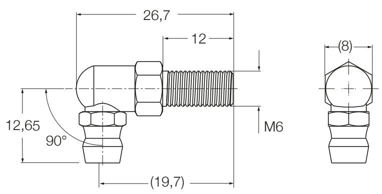


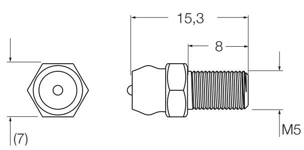




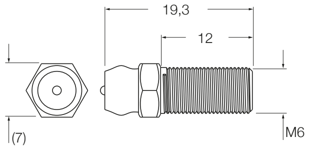




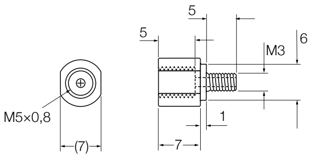




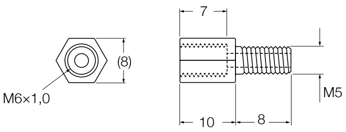
Ordering key	Material	Size	Description
VN-M3-5	Steel, coated	15	**1.** Standard grease nipple for size 15. **2.** It cannot be used in combination with additional seals. **3.** According to standard JIS 1575:2000 **4.** One grease nipple for manual relubrication is supplied along with the carriage, while the opposite side is secured by a set screw.
VN-M5-8-45	Steel, coated	20	**1.** Standard grease nipple for size 20. **2.** It cannot be used in combination with additional seals. **3.** According to standard JIS 1575:2000 **4.** One grease nipple for manual relubrication is supplied along with the carriage, while the opposite side is secured by a set screw.
VN-M5-10-45	Steel, coated	25	**1.** Standard grease nipple for size 25. **2.** It cannot be used in combination with additional seals. **3.** According to standard JIS 1575:2000 **4.** One grease nipple for manual relubrication is supplied along with the carriage, while the opposite side is secured by a set screw.
VN-M6-12-45	Steel, coated	30/35/45	**1.** Standard grease nipple for size 30/35/45. **2.** It cannot be used in combination with additional seals. **3.** According to standard JIS 1575:2000 **4.** One grease nipple for manual relubrication is supplied along with the carriage, while the opposite side is secured by a set screw
VN-M5-8-90	Steel, coated	20	**1.** 90 degree grease nipple for size 20 **2.** It cannot be used in combination with additional seals. **3.** The lubrication connector is used to provide an interface for central lubrication systems
VN-M6-12-90	Steel, coated	30/35/45	**1.** 90 degree grease nipple for size 30/35/45 **2.** It cannot be used in combination with additional seals. **3.** The lubrication connector is used to provide an interface for central lubrication systems
VN-M5-8	Steel, coated	20	**1.** Straight grease nipple for size 20 **2.** It cannot be used in combination with additional seals. **3.** The lubrication connector is used to provide an interface for central lubrication systems



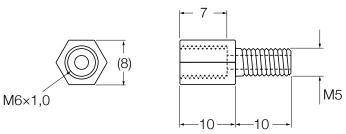
VN-M6-12	Steel, coated	30/35/45	**1.** Straight grease nipple for size 30/35/45 **2.** It cannot be used in combination with additional seals. **3.** The lubrication connector is used to provide an interface for central lubrication systems



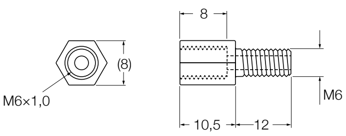
VN-UA-M3-05-01	Steel, coated	15	**1.** Straight lubrication connectors for size 15 **2.** It cannot be used in combination with additional seals. **3.** The lubrication connector is used to provide an interface for central lubrication systems



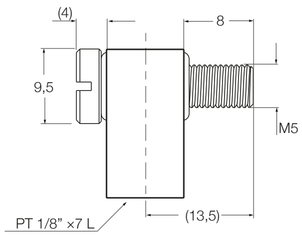
VN-UA-M5-08-01	Steel, coated	20	**1.** Straight lubrication connectors for size 20 **2.** It cannot be used in combination with additional seals. **3.** The lubrication connector is used to provide an interface for central lubrication systems



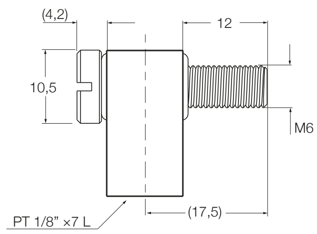
VN-UA-M5-10-01	Steel, coated	25	**1.** Straight lubricationconnectors for size 25 **2.** It cannot be used in combination with additional seals. **3.** The lubrication connector is used to provide an interface for central lubrication systems



VN-UA-M6-12-01	Steel, coated	30/35/45	**1.** Straight lubrication connectors for size 30/35/45 **2.** It cannot be used in combination with additional seals. **3.** The lubrication connector is used to provide an interface for central lubrication systems



VN-M5-8-OIL	Brass	20	**1.** 90 degree lubrication connectors for size 20 **2.** It cannot be used in combination with additional seals. **3.** The lubrication connector is used to provide an interface for central lubrication systems



LLTHP30-0G-02	Brass	30/35/45	**1.** 90 degree lubrication connectors for size 30/35/45 **2.** It cannot be used in combination with additional seals. **3.** The lubrication connector is used to provide an interface for central lubrication systems

3.3.8 Bellows

Material and Temperature

Temperature resistance

Temperature resistance t_{max} = 90 °C.

During continuous operation, the permissible operating temperature is between –20 and 80 °C. Special materials for higher temperature resistance are available.

Special material LAS: available for size 15–30. Temperature limit is 160 °C for a very short period.

Special material WEL: available for size 35–45. Temperature limit is 260 °C for a very short period.

For all applications, please note the maximum temperature range for LLT systems (↳ **page 19**).

Material

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

Bellows parts

Bellows kit contents (↳ **fig. 1**)

1. Adapter plate
2. Grease nipple
3. Sealing ring
4. Set screw
5. Mounting screws
6. Bellows with all plates

NOTE: Rail ends must be prepared with threaded holes.

NOTE: The bellows is only available in Europe.

Mounting

The bellows are delivered unmounted with mounting screws and necessary plates.

NOTE: Prior to mounting, the grease nipples on the carriage must be removed.

For bellow arrangement type 2 (↳ **table. 1**), the end faces of the rails have to be equipped with threaded attachment holes.

Fig .1

Delivery scope

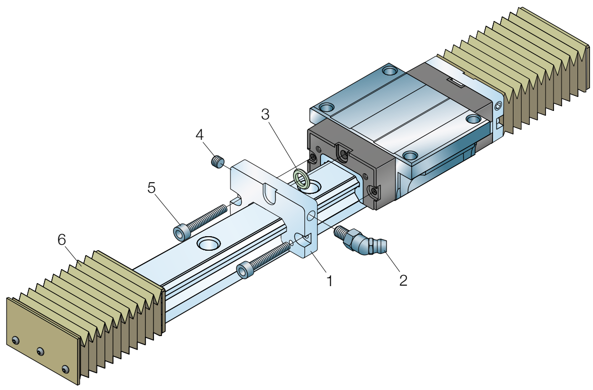
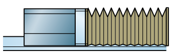
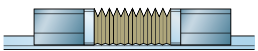
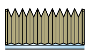


Table 1

Bellows designations [1)]







Size	Type 2	Type 4	Type 9
	with adapter plates for the carriage and end plate for the rail	with two adapter plates for the carriages	loose bellows (spare part)
–	–		
15	LLTHZ 15 B2 ..	LLTHZ 15 B4 ..	LLTHZ 15 .. B9
20	LLTHZ 20 B2 ..	LLTHZ 20 B4 ..	LLTHZ 20 .. B9
25	LLTHZ 25 B2 ..	LLTHZ 25 B4 ..	LLTHZ 25 .. B9
30	LLTHZ 30 B2 ..	LLTHZ 30 B4 ..	LLTHZ 30 .. B9
35	LLTHZ 35 B2 ..	LLTHZ 35 B4 ..	LLTHZ 35 .. B9
45	LLTHZ 45 B2 ..	LLTHZ 45 B4 ..	LLTHZ 45 .. B9

[1)] Replace “..” by number of folds per bellow.

Calculation of bellow and rail

Calculation of the bellows type 2 [1)]

$$n = \frac{L - L_A}{W_{4\,min} + W_{4\,max}} + F$$

See **table 2** and **3**

[1)] Calculation for maximum possible stroke. Calculation of bellow type 4 on request, specifications on stroke length required.

Calculation of the rail length

$L = (n - F)\,(W_{4\,min} + W_{4\,max}) + L_A$

$L_{min} = n\,W_{4\,min}$

$L_{max} = n\,W_{4\,max}$

$Stroke = n\,S_F$

rail length < 500 mm	F=2
500 mm < rail length < 1 000 mm	F=3
rail length > 1000 mm	F=4

where

L_A = Carriage length L_1 (please refer to the dimension tables of the carriages) plus 2×10 mm for the adapter plates.

L = Rail length [mm]

L_{max} = Bellow stretched

L_{min} = Bellow pushed together

n = Total number of folds per carriage side

S_F = Stroke per fold

$S_F = W_{4\,max} - W_{4\,min}$ [mm]

Stroke = Stroke [mm]

W_4 = Maximum and minimum extension per fold

3

Table 2

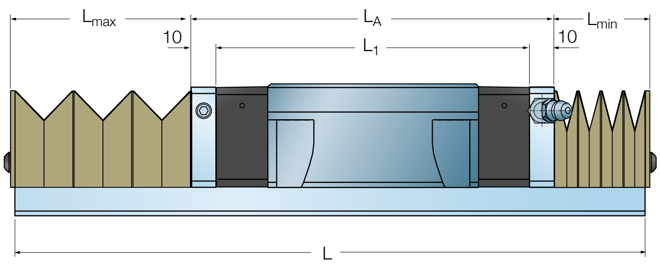
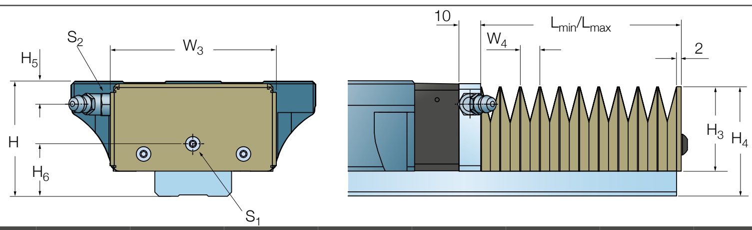


Table 3

Dimensions of the bellows



Size	Dimensions									STD	LAS	WEL	
–	W_3 mm	H [1)]	H [2)]	H_3	H_4	H_5	H_6	S_1	S_2	$W_{4\,min}$	$W_{4\,min}$	$W_{4\,min}$	$W_{4\,max}$ [3)]
15	32	24	28	18,9	23,5	3,8	8,8	M4 × 8	M5	2,5	3	–	9,6
20	43	30	30	24,5	29,5	5,2	12	M4 × 8	M5	2,5	3	–	12
25	47	36	40	28	35	5,5	15,5	M4 × 8	M5	2,5	3	–	12
30	58	42	45	32	41	7	19	M4 × 8	M6	2,5	3	–	16,9
35	68	48	55	37	47	6,5	21,5	M4 × 8	M6	2,5	–	4	21
45	84	60	70	45	59	7,5	28,5	M4 × 8	M6	2,5	–	4	25,2

[1)] For carriages of type SA, A, LA, SU, U, LU
[2)] For carriages of type R, LR
[3)] $W_{4\,max}$ valid for all types of material (standard material, LAS, WEL)

4

Mounting instruction and maintenance

4.1 Design rules

The following mounting instructions are applicable to all carriage types.

To maintain the high precision of Ewellix LLT profile rail guides, the carriages must be handled carefully during transport and mounting.

To provide protection during transport, storage and assembly, LLT rails and carriages are coated with a corrosion inhibiting compound. This compound does not need to be removed if the recommended lubricants are used.

Fig. 1

Mounting with laterally fixed rails and carriages

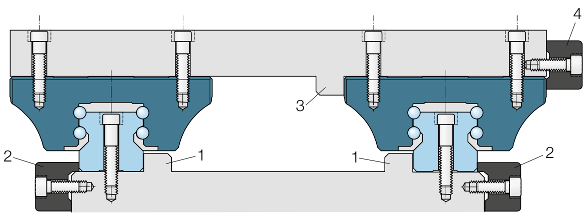
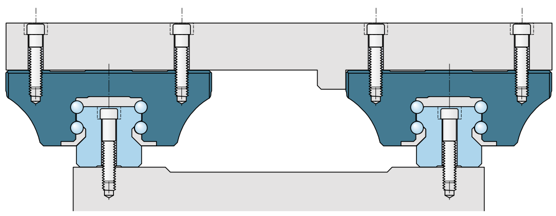


Fig. 2

Mounting without lateral rail support



4.1.1 Typical mounting examples

Rails

Each rail has ground reference edges on both sides.

Options for securing the rails laterally (↳ fig. 1)

1. Stop edges
2. Retaining strips

Rails that are not laterally fixed must be installed straight and parallel. Ewellix recommends using a support strip to maintain the rail's position during installation.

NOTE: Rail ends must be chamfered to prevent seal damage during installation. If two rails are to be joined, do not chamfer either of the mating ends.

Guideline values for the permissible lateral loads for unsupported rails are listed on **page 77, table 3.**

Carriage

Each carriage has one ground reference side (please refer to dimension H2 in the drawings of the carriages) (↳ **page 39**).

Options for securing the carriages laterally (↳ fig. 1)

3. Stop edges
4. Retaining strips

NOTE: If mounted correctly, the carriage should move easily on the rail when pushed.

During assembly, secure the carriage to prevent it from falling. Guideline values for the permissible lateral loads for unsupported carriages are shown in **page 77, table 3.**

4.1.2 Interface design, screw sizes and tightening torques

- Flange-type carriages can be fastened from above (↳ **fig. 3**) or below (↳ **fig. 4**)
- Slim-type carriages can be fastened from above (↳ **fig. 5**)
- Rails can be fastened from above (↳ **fig. 4** and **5**) or below (↳ **fig. 3,** rail type **LLTHR … D4**).

Fig. 3

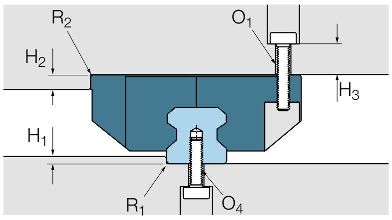


Fig. 4

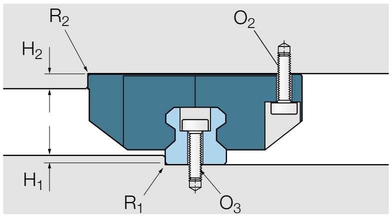


Fig.5

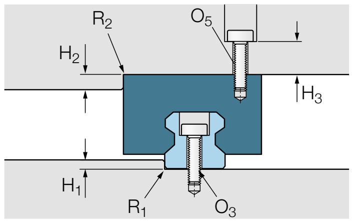


Table 1

Stop edges, corner radii and screw sizes

Size	Dimensions						Screw				
	H_1 min	H_1 max	R_1 max	H_2	R_2 max	H_3 1)	O_1 ISO 4762 4 Piece	O_2	O_3 1) Rail	O_4 1)	O_5 2)
–	mm										
15	**2,5**	3,5	0,4	4	0,6	6	M5 x 12	M4 × 12	M4 × 20	M5 × 12	M4 × 12
20	**2,5**	4,0	0,6	5	0,6	9	M6 x 16	M5 × 16	M5 × 25	M6 × 16	M5 × 16
25	**3,0**	5,0	0,8	5	0,8	10	M8 x 20	M6 × 18	M6 × 30	M6 × 20	M6 × 18
30	**3,0**	5,0	0,8	6	0,8	10	M10 x 20	M8 × 20	M8 × 30	M8 × 20	M8 × 20
35	**3,5**	6,0	0,8	6	0,8	13	M10 x 25	M8 × 25	M8 × 35	M8 × 25	M8 × 25
45	**4,5**	8,0	0,8	8	0,8	14	M12 x 30	M10 ×30	M12 × 45	M12 × 30	M10 × 30

1) The stated values are only recommendations
2) For carriage type SU + SA, two screws are sufficient to withstand the maximum load .

Table 2

Tightening torques for mounting screws

	Screw strength class	Screw					
		M4	M5	M6	M8	M10	M12
	–	Nm					
for counterparts made out of steel or cast iron	8,8	2,9	5,75	9,9	24	48	83
	12,9	4,95	9,7	16,5	40	81	140
for counterparts made out of aluminium	8,8	1,93	3,83	6,6	16	32	55
	12,9	3,3	6,47	11	27	54	93

Table 3

Dimensions and guide values for permissible lateral forces without additional lateral support (↳ fig. 2)

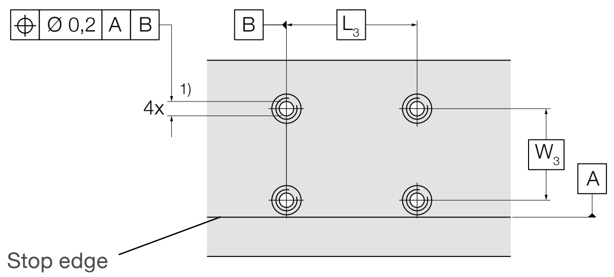
Carriages	Screw strength class	Carriages				
		O_1	O_2	O_5	O_3	O_4
A, U, R	8,8	23 % C	11 % C	11 % C	6 % C	6 % C
	12,9	35 % C	18 % C	18 % C	10 % C	10 % C
LA, LU, LR	8,8	18 % C	8 % C	8 % C	4 % C	4 % C
	12,9	26 % C	14 % C	14 % C	7 % C	7 % C
SA, SU	8,8	12 % C	8 % C	8 % C	9 % C	9 % C
	12,9	21 % C	13 % C	13 % C	15 % C	15 % C

4.1.3 Position tolerances for attachment holes

The attachment holes of all surrounding parts have to match the tolerances shown in **figure 6** and **7.**

Fig. 6

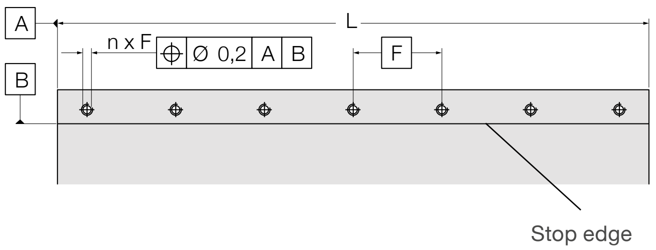
Attachment structure for carriages



1) in case of carriage types SA, SU: 2x

Fig. 7

Attachment structure for profile rail guides



4

4.1.4 Permissible height deviation

The values for height deviation are applicable for all carriage types.

If the values for height deviation S_1 (↳ **table 4**) and S_2 (↳ **table 5**) are within the specified range, the service life of the rail guide system will not be influenced.

For permissible height deviation in the lateral direction (↳ table 4)

S_1 = d Y

where

S_1 = Permissible height deviation [mm]

d = Distance between the rails [mm]

Y = Calculation factor lateral direction

NOTE: The height tolerance of H for the carriages has to be taken into account. For additional information on height tolerance, see **pages 17, table 2.** If the difference S_1–2 x tolerance H < 0, a new product selection is necessary (other preload, precision).

For permissible height deviation in the longitudinal direction (↳ table 5)

S_2 = c X

where

S_2 = Permissible height deviation [mm]

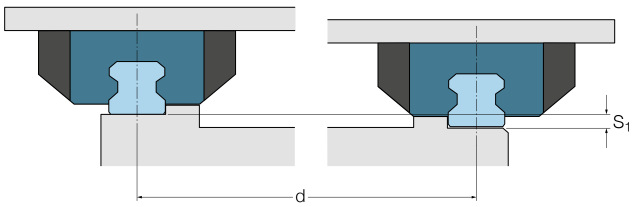
c = Distance between the carriages [mm]

X = Calculation factor longitudinal direction

NOTE: The maximum difference ΔH for the carriages has to be taken into account. For additional information, **pages 17, table 2**. If the difference S_2 – ΔH < 0, a new product selection is necessary (other preload, precision).

Table 4

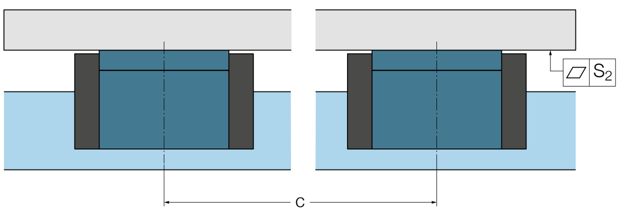
Permissible height deviation in lateral direction



Calculation factor	Preload T0	T1 Preload (2 % C)	T2 Preload (8 % C)
Y	$5,2 \times 10^{-4}$	$3,4 \times 10^{-4}$	$2,0 \times 10^{-4}$
Y (SA and SU carriage types)	$6,2 \times 10^{-4}$	$4,1 \times 10^{-4}$	–

Table 5

Permissible height deviation in longitudinal direction



Calculation factor	Carriage length short	normal	long
X	$6,6 \times 10^{-5}$	$4,7 \times 10^{-5}$	$3,3 \times 10^{-5}$

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4.1.5 Parallelism

The parallelism of mounted rails is measured on the rails and the carriages. The values for the deviation in parallelism P_a are applicable to all carriage types.

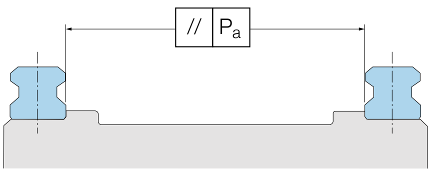
Deviation in parallelism P_a increases the internal load. If the values are within the specified range in **table 6**, the service life of the profile rail guide system will not be influenced.

For typical applications, the mounting surface can be slightly resilient.

However, for high-precision applications, the mounting surface must be rigid and the values in the table have to be cut in half.

Table 6

Deviation in parallelism P_a



Size	Preload class		
	T0	T1 (2 % C)	T2 (8 % C)
–			
15	0,030	0,018	0,010
20	0,036	0,022	0,012
25	0,038	0,024	0,014
30	0,042	0,028	0,018
35	0,046	0,030	0,020
45	0,056	0,038	0,024
Carriage type SA + SU			
15	0,036	0,022	–
20	0,044	0,026	–
25	0,046	0,028	–
30	0,050	0,034	–
35	0,056	0,036	–

4

4.2 Mounting profile rail guides

4.2.1 Packaging (Shipment)

Profile rails and carriages are delivered in their own packaging. Unwrap these components carefully and remove the foam from the carriage. Do not recycle the packaging until the installation is complete. The packaging can be used to protect the components from damage during the mounting process.

4.2.2 Mounting the carriages

Screw in the grease nipple on the desired end plate and adjust the direction with the right washer (different thickness). Be sure that the ends of the rail are chamfered and deburred to avoid damaging the front seals or internal components. Apply a small amount of oil or grease to chamfers and the front seal of the carriage. Slide the carriage straight and carefully onto the profile rail, avoiding any misalignment.

4.2.3 Preparation

The threaded holes on the base plate must be first prepared according to the rail size.

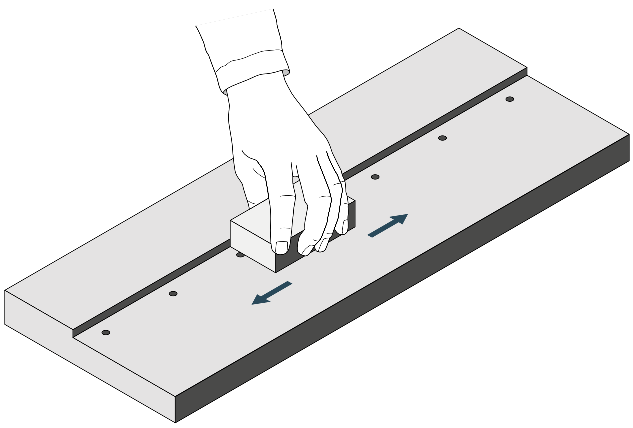
Make sure that the contact surfaces are flat and free of any damage or burrs. Use an oil stone to smooth them if necessary (↳ **fig. 8**). Check the stop edges for dimensional and position precision and inspect the corner radii (↳ **page 76, table 1**).

Clean the contact surfaces thoroughly. Coat them with a thin coat of light oil to prevent corrosion.

Make sure that the rails, carriages, base plate, mounting plate and fastening screws all have the same temperature during installation.

Remove the corrosion inhibiting compound from the rail or carriage surfaces that are in contact with other parts. Then apply a thin coat of light oil to these surfaces. Be sure that all drilled and tapped holes are clean and free of debris prior to mounting.

Fig. 8



4.2.4 Mounting the master rail

1. Place the profile rail gently onto the base plate.
2. Insert the screws, making sure that they are unobstructed, e.g. the mounting holes are properly aligned.
3. Partially tighten the screws so that the rail is still loose.
4. Push the rail against the stop edge (↳ **fig. 9**). The stop edge can be directly machined in the mounting surface or an external/mobile support strip that is only there for mounting. If necessary, hold the rail in place with a retaining strip (↳ **4.2.6 Mounting a retaining strip, page 84**). In cases where no lateral support is provided, use an external reference surface **(↳ fig. 10)** or a straight edge for alignment.
5. Using a torque wrench, tighten the centre mounting screw. Then, tighten the remaining screws using an alternating pattern **(↳ fig. 11)**. Torque values are listed in **table 2, page 76.**
6. Check the parallelism of the fastened master rail to the specific reference. Result should be better than values in **table 6, page 79**.

Fig. 9

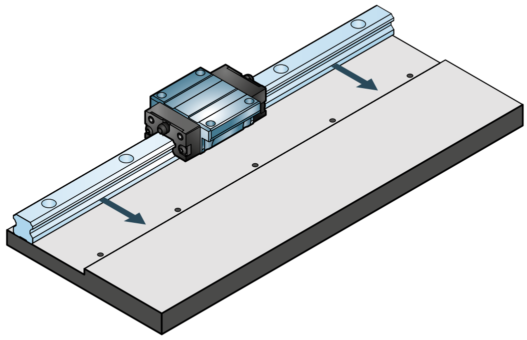


Fig. 10

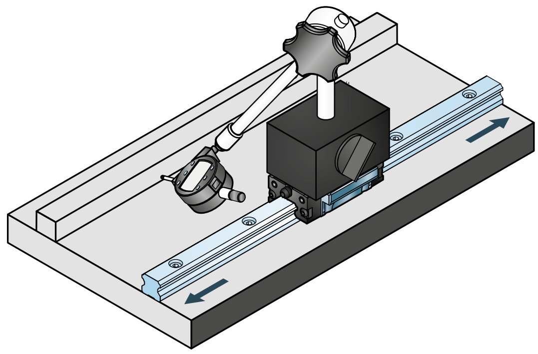
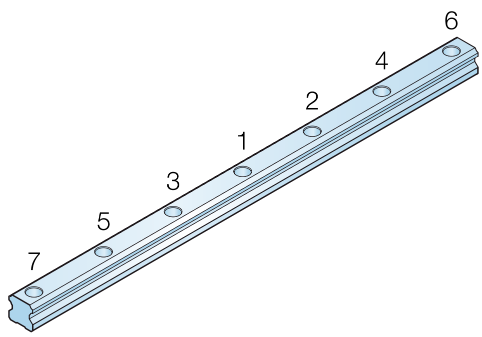


Fig. 11



4.2.5 Parallel alignment of subsidiary rail

The already aligned and fastened rail is defined as the master rail. Depending on the base plate design, there are several options for mounting subsidiary rails. Please choose the suitable option listed below.

Option I

Mounting with two stop edges on the base plate

If stop edges are provided on both sides of the base plate (↳ **fig. 12**), please proceed as described above in **3.4 Mounting the master rail.**

Option II

Mounting with two stop edges on the mounting plate

If there is no stop edge for the subsidiary rail on the base plate, the second rail can be aligned using a mounting plate with two stop edges.

1. Push in the carriage against the stop edge of the mounting plate (↳ **fig. 13**).
2. Using a torque wrench, tighten the mounting screws to the designated value (↳ **table 2, page 76**).
3. Place the subsidiary rail into position on the base plate.
4. Insert the screws, making sure that they are unobstructed, e.g. the mounting holes are properly aligned. (↳ **fig. 14**).
5. Partially tighten the screws so that the rail is still loose.
6. Slide the mounting plate with the already fastened carriages onto the rails and move it over the full stroke (↳ **fig. 15**).
7. Starting at one end of the rail, pre-tighten the rail screws to approximately 1/3 of their torque value. To maintain parallelism, be sure that the carriage is very close to the screws being tightened. (↳ **fig. 16**).

Double-check for parallelism by running the carriages along their full stroke. Then, using a torque wrench, tighten the centre mounting screw. Tighten the remaining screws using the alternating pattern (↳ **fig.11, page 81**). Torque values are listed in **table 2, page 76.**

NOTE: The resulting parallelism has to be according the values in **table 6, page 79**.

Fig. 12

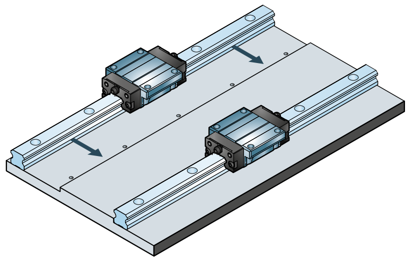


Fig.13

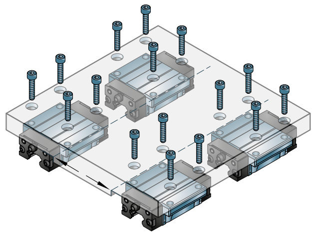


Fig.14

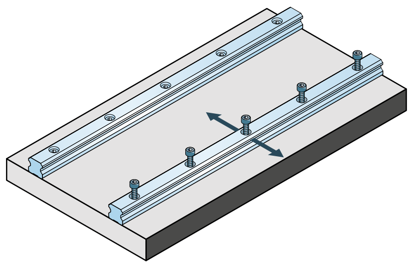


Fig. 15

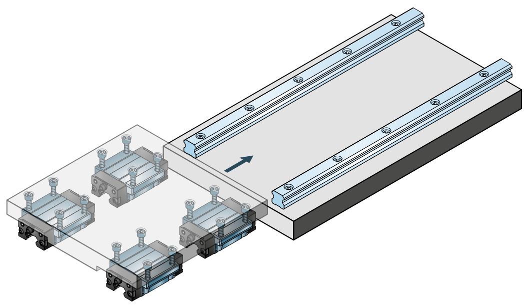
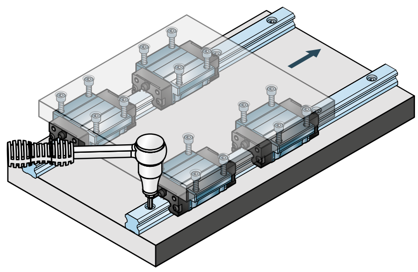


Fig. 16



Option III

Mounting with no stop edges

If there are no stop edges for the subsidiary rail on the base plate and no stop edges for the carriages on the mounting plate, then proceed as follows:

1. Place the subsidiary rail onto the base plate.
2. Insert the screws, making sure that they are unobstructed, e.g. the mounting holes are properly aligned (↳ **fig. 17**).
3. Partially tighten the screws so that the rail is still loose.
4. Slide a carriage onto the mounted master rail and affix a dial indicator to the top of the carriage. Place the tip of the indicator at the center of the ground reference edge of the subsidiary rail (↳ **fig. 18**).

Do the alignment and pre-fasten the screws with $^{1}/_{3}$ torque (↳ **fig. 19**).

5. Tighten all rail screws, beginning from the center, alternating to the ends (↳ **fig. 11 page 81**), with designated torque (↳ **table 2, page 76**) by using a torque wrench. Double check the parallelism along the full stroke.

NOTE: The resulting parallelism has to be according the values in **table 6, page 79**.

Fig.17

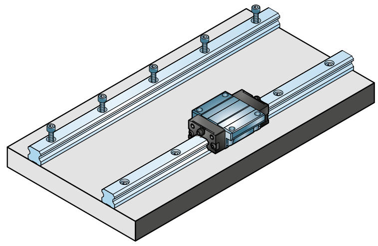


Fig.18

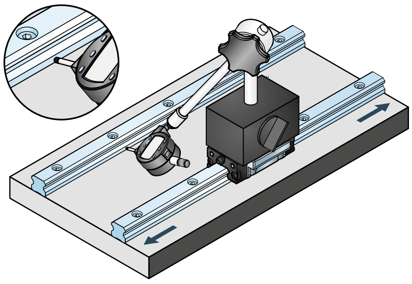
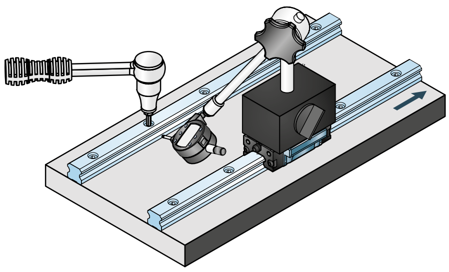


Fig. 19



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4.2.6 Mounting a retaining strip

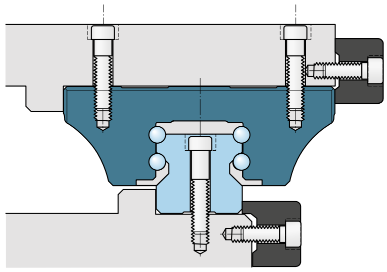
Profile rail guides can also be mounted without a retaining strip. However, guides are recommended because they absorb lateral forces and reduce the effort to straighten the rails. By using a retaining strip, the load capacity does not have to be reduced as shown on **page 77, table 3**. For details, refer to **pages 75** to **79.**

Before the retaining strips can be mounted, be sure that all screws are in place and slightly tightened.

1. Tighten the retaining strip screws(↳ **fig. 20**) with a torque wrench.
2. Then, tighten the rail/carriage screws with a torque wrench. For permitted torque values, see **page 76**, **table 2.** Dimensions of the retaining strip, screws and distance between the screw holes depend on each specific customer case.

Check the straightness of the rail with a dial indicator by using a straight edge or an external reference edge (↳ **page 81, fig. 10).**

Fig. 20



4.2.7 Mounting jointed rails

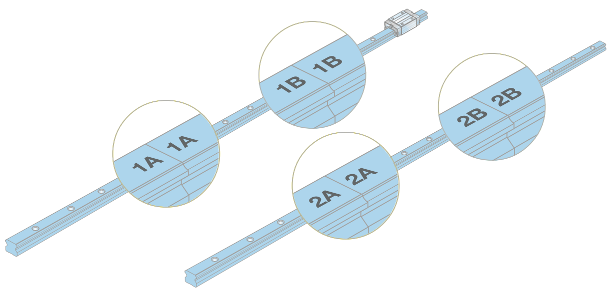
Jointed rails are generally used when the longest rail length available (approximately 4 000 mm) is insufficient. When joining rails, Ewellix recommends grinding the base plate and stop edge which will significantly improve raceway alignment. As always, the bottom-side and the reference-edge of the rail are used for alignment. Do not use the top of the rail as a reference surface.

If the base plate does not have a stop edge, use clamps and a straight-edge during the entire installation process so that the rail being installed does not move out of position.

Make sure that the joined rails are well aligned. The gap between two jointed rails should not exceed 20 µm. All rail sections are numbered continuously and close to the joint to avoid mounting errors (↳ **fig. 21**).

Before using the system, move the carriage over the rail joints. There should be no perceptible difference in terms of noise or resistance. If there is a difference, please repeat the mounting process.

Fig. 21



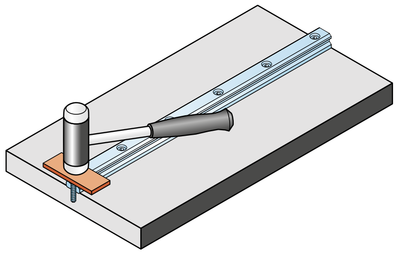
4.2.8 Installing plastic caps

The plastic caps supplied with each rail guide must be installed flush with the rail surface.

NOTE: Caps sticking above the rail surface can damage the seal, generate debris and reduce the service life of the rail guide system. Caps that are sunk below the surface of the rail can collect dirt.

To install the caps, use a rubber mallet and a soft, e.g. plastic or aluminium , flat transition piece. Avoid sharp edges that could damage the rail (↳ **fig. 22**).

Fig. 22



4.2.9 Installing metal plugs

1. Slide the mounting tool (↳ **fig. 23**) onto the rail (↳ **fig. 24**). Slide the mounting tool onto the rail, but remove all brass chips from the press block in advance.
2. Match the center of the mounting tool with the center of the metal plug, then use a hexagonal wrench to tighten the bolt (↳ **fig. 25**). Stop tightening the bolt when the plug is flush with the rail surface.
   Do not overtighten the bolt. 5–10 Nm is sufficient. Repeat this step for the remaining metal plugs.
   Important: Before pressing in the plug and during plug alignment, make sure the top surface of the plug is parallel to the top surface of the rail.
   After pressing the plugs into the rail, check that they are all flush with the rail surface. Then clean the rail to remove any debris.
   With fastened rails the plugs have to be destroyed for removal.

Fig. 23

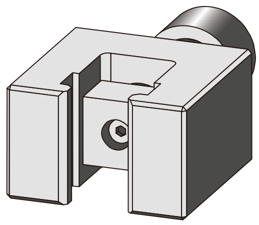


Fig. 24

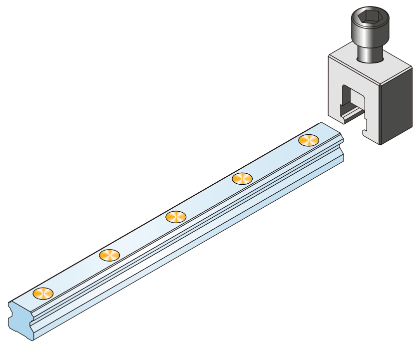
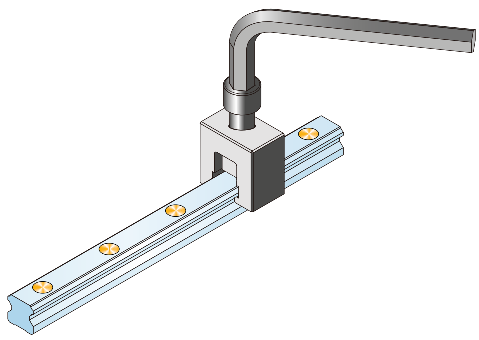


Fig. 25

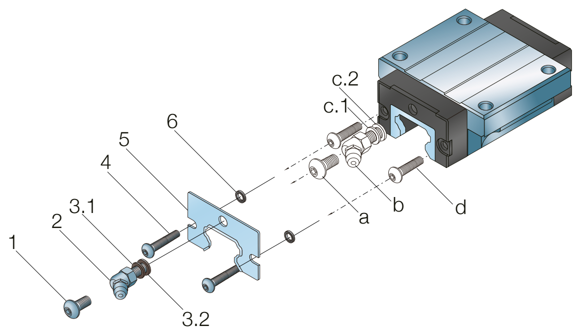


4.3 Mounting accessories

4.3.1 Mounting the scraper plate (S1)

1. Remove the grease nipple (**b**) and washers (**c.1 and c.2**), or the set screw (**a**) (↳ **fig. 26**).
2. Remove the mounting screws (**d**)
3. Put the washers for mounting screws (**6**) into the fixation hole on each side.
4. Attach the metal scraper plate (**5**) onto the end plate, and position it accurately against the latter.
5. Install the mounting screws (**4**)
6. Install the grease nipple (**2**) and washers (**3.1 and 3.2**) if necessary.
7. If a grease nipple is not required, install a set screw (**1**) instead.

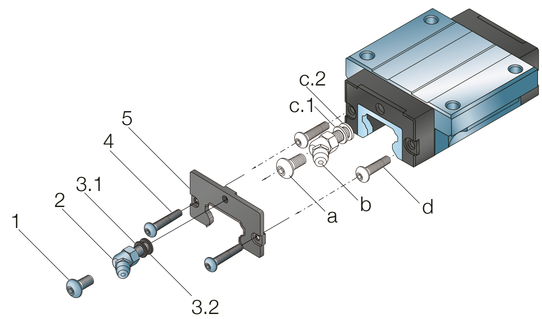
Fig. 26



4.3.2 Mounting an additional front seal (S7)

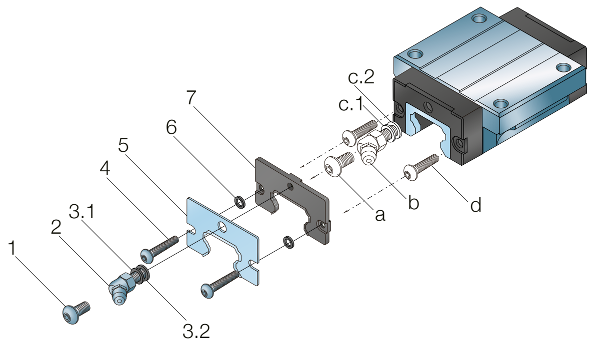
1. Remove the grease nipple (**b**) and washers (**c.1 and c.2**), or the set screw (**a**) (↳ **fig. 27)**
2. Remove the mounting screws **(d)**
3. Attach the additional front seal (**5**) onto the end plate, and position it accurately against the latter.
4. Install the mounting screws (**4**)
5. Install the grease nipple (**2**) and washers (**3.1 and 3.2**) if necessary.
6. If a grease nipple is not required, install a set screw (**1**) instead.

Fig. 27



4.3.3 Mounting the seal kit (S3)

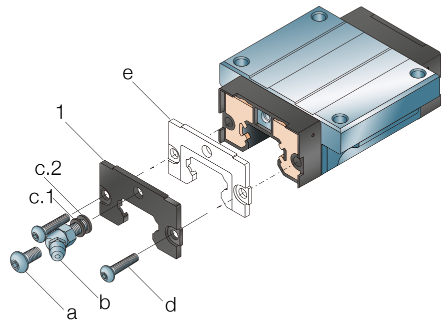
Fig. 28



1. Remove the grease nipple (**b**) and washers (**c.1 and c.2**), or the set screw (**a**) (↳ **fig. 28**)
2. Remove the mounting screws (**d**)
3. Attach the additional front seal (**7**) onto the end plate, and position it accurately against the latter.
4. Put the washers for mounting screws (**6**) on both sides. The washers are put between the metal scraper (**5**) and the additional front seal (**7**)
5. Attach the metal scraper plate (**5**) on the additional front seal (**7**), and align them with each other.
6. Install the mounting screws (**4**)
7. Install the grease nipple (**2**) and washers (**3.1 and 3.2**) if necessary.
8. If a grease nipple is not required, install a set screw (**1**) instead.

4.3.4 Mounting the low friction shield (S0)

Fig. 29



1. Remove the grease nipple (**b**) and washer (**c.1 and c.2**), or the set screw (**a**) (↳ **fig. 29**)
2. Remove the mounting screws (**d**)
3. Remove the front seal (**e**) and replace it with the low friction shield (**1**).
   NOTE: Make sure that the foam remains in its correct place.
4. Re-install the mounting screws (**d**)
5. Install back the grease nipple (**b**) and washers (**c.1** and **c.2**) if necessary.
6. If a grease nipple is not required, install a set screw (**a**) instead.

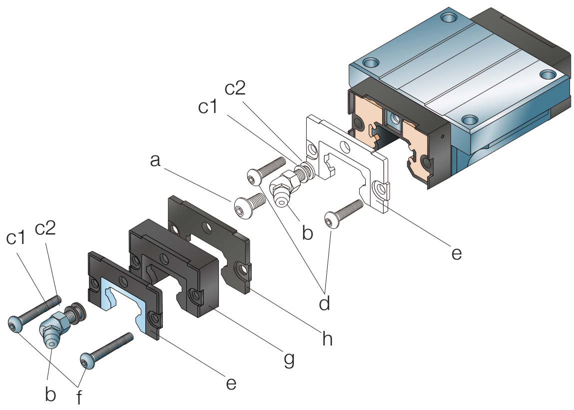
4

4.3.5 Mounting the LLT Lube element (S6)

Mounting

1. Remove grease nipple (**b**) and washers (**c1, c2**) or the set screw (**a**) (↳ **fig. 30**)
2. Remove the mounting screws (**d**) Remove the front seal (**e**) and replace it with the low-friction shield (**h**)
3. Position the lube element (**g**) in front of the low-friction shield (**h**)
4. Add the front seal (**e**) to the lube element (**g**)
5. Install the new mounting screws (**f**) and tighten them with the given torque
6. Move the carriage with the mounted lube element on the rail and check the sealing function (if bad, adjust the seal)
7. Install the grease nipple (**b**) and washers (**c1, c2**) if necessary
8. If the grease nipple (**b**) is not required, install the set screw (**a**) instead

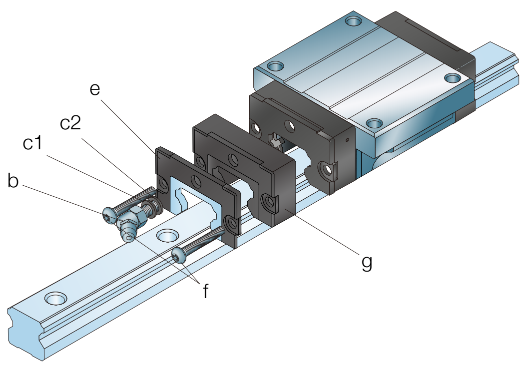
Fig. 30



Replacement

1. Remove grease nipple (**b**) and washers (**c1, c2**) or the set screw (↳ **fig. 31**)
2. Remove the mounting screws (**f**)
3. Pull the front seal (**e**) away from the old lube element
4. Pull the old lube element away from the carriage and remove from the rail
5. Position the new lube element (**g**) onto the rail as shown
6. Push the front seal (**e**) together with the new lube element to the carriage
7. Install the mounting screws (**f**) and tighten them with the given torque
8. Move the carriage with the mounted lube element on the rail and check the sealing function (if bad, adjust the seal)
9. Install the grease nipple (**b**) and washers (**c1, c2**) if necessary
10. Re-grease the carriage as described on **page 93**
11. If grease nipple (**b**) is not required, install a set screw after re-greasing instead

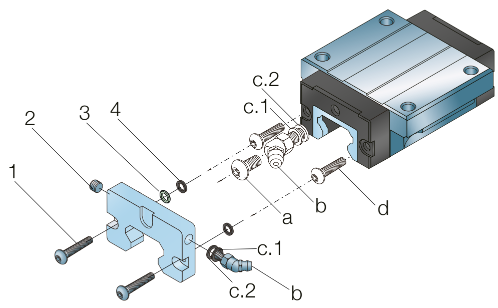
Fig. 31



4.3.6 Mounting an adapter plate (PL)

1. Remove the grease nipple (**b**) and washers (**c.1 and c.2**), or the set screw (**a**) (↳ **fig. 32**)
2. Remove the mounting screws (**d**)
3. Attach the adapter plate with sealing ring (**3**) onto the end plate, and position it accurately against the latter.
4. Put the washers (**4**) for mounting screws on both sides.
5. Install the mounting screws (**1**)
6. Install the original grease nipple (**b**) and washers (**c.1 and c.2**) on the lateral side of the adapter plate.
7. Install the set screw (**2**) on the other side of the adapter plate.

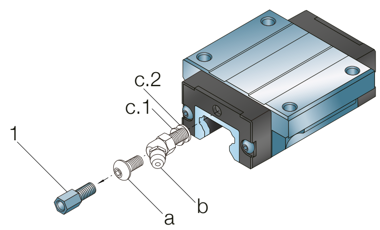
Fig. 32



4.3.7 Mounting the grease nipple and lubrication connector (VN UA)

1. Remove the grease nipple (**b**) and washers (**c.1 and c.2**), or the set screw (**a**) (↳ **fig. 33**)
2. Install the lubrication connector (**1**) onto the lube port.

Fig. 33



4.3.8 Mounting the bellows

Bellows are available for all sizes of profile rail guides. The bellows are used to provide additional protection against dirt, dust and splashed liquids over the entire rail length.

Grease nipples are applied laterally and are accessible without disconnecting the bellows.

Pre-assemble the adapter set

See 4.3.6 Mounting an adapter plate.

Assemble the bellows on the system

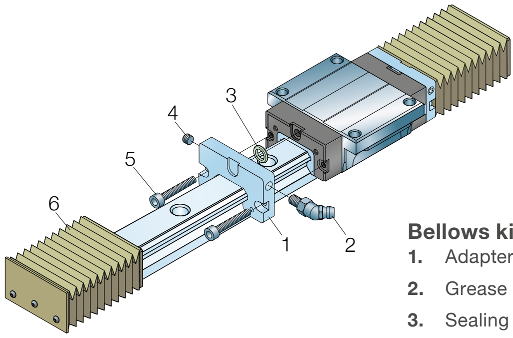
Move the carriage to the end of the rail. Then put the fixation plate (**14**) behind the last frame and tighten it together with the bellow and the screws (**13**) into the adapter plate on the carriage (↳ **fig. 35**).

Take the end plate (**8**), the fixation plate (**9**), the screws (**11**) and the bellow and put the fixation plate behind the first frame of the bellow and screw all the parts together (↳ **fig. 36**).

At least fix the end plate (**8**) with the screw (**12**) to the threaded hole at the end of the rail (**15**).

NOTE: To have a look onto the rail, remove the screw (**12**) at the end of the rail (↳ **fig. 36**) and lift the bellow carefully from the rail or move to the end of the rail.

Fig. 34



Bellows kit contents

1. Adapter plate
2. Grease nipple
3. Sealing ring
4. Set screw
5. Mounting screws
6. Bellows with all plates

Fig. 35

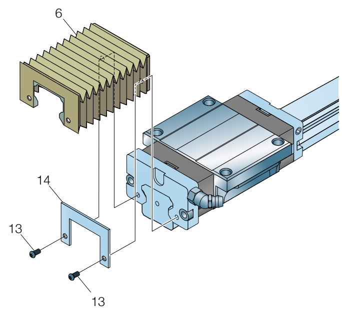
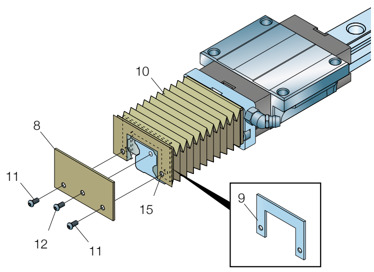


Fig. 36



4.4 Maintenance and repairs

4.4.1 Preventative maintenance

To avoid dirt from adhering to and embedding into the rails, the rails should be cleaned regularly with a cleaning stroke. Ewellix recommends a cleaning stroke over the entire length of the rails twice a day or at least after eight hours of operation.

Perform a cleaning stroke each time when switching the machine on or off.

4.4.2 Lubrication

The appropriate type and amount of lubricant is required for rolling bearings to function reliably. To reduce wear, the lubricant prevents direct metal-to-metal contact between the rolling elements and the raceways. In addition, the lubricant protects the rail and carriage from corrosion.

The guidance system can only realize its optimum operating temperature when a minimum amount of lubricant to reliably lubricate the profile rail guide is applied.

Grease lubrication

Under normal operating conditions, LLT profile rail guides should be lubricated with grease. The advantage of grease is that it is more easily retained in the bearing, which is particularly important when the axis of travel is inclined or vertical. Moreover, it contributes to sealing the bearing against the ingress of liquid contaminants or humidity.

Base oil viscosity

The viscosity of a lubricating oil is key to the formation of the hydrodynamic film that separates the rolling elements from the raceways.

In general, the viscosity of lubricating oils is based on the flow rate at 40 °C. These values also apply to the mineral base oils contained in lubricating greases.

The base oils of commercially available rolling bearing greases have viscosity values between 15 and 500 mm²/s (at 40 °C). Greases with higher base oil viscosities often release too slowly to sufficiently lubricate bearings.

Consistency class

Lubricating greases are divided into various consistency classes according to a scale by the National Institute of Grease Lubrication (NLGI). These are also reflected in DIN 51 818 and DIN 51 825.

4

Table 7

A selection of SKF rolling bearing greases

Properties	Lubricant (designation)			
	LGEP 2	LGMT 2	LGLT 2	LGFP 2
Thickener	Li	Li	Li	Al complex soap
Base oil	Mineral oil	Mineral oil	Di-ester oil	Medical white oil
Operating temperature, °C (steady state)	–20 up to +110	–30 up to +120	–55 up to +110	–20 up to +110
Kinematic viscosity of base oil mm²/s	200	110	15	130
Consistency class (acc. to NLGI)	2	2	2	2
Temperature range / Application range	Grease with extreme pressure (EP) additives > best grease for standard environment	normal temperature	low temperature	food compatible

Greases with a metallic soap thickener with a consistency of 2 or 3 on the NLGI scale are particularly suitable for use with Ewellix profile rail guides. The grease consistency should not vary too much with changing operating temperatures or stress levels. Greases that soften at higher temperatures can leak from the bearing position, while greases that get stiffer at lower temperatures can impede the operation of the linear guidance system.

Specific requirements are placed on the lubricating grease's purity, composition and compatibility if the grease is to be used in special applications, for instance in the food sector, medical engineering, etc. In such cases, criteria should be further specified for the lubricant in addition to viscosity and consistency class.

Temperature range

The temperature range over which a lubricant can be used depends largely on the type of base oil and thickener as well as the additives.

The low temperature limit, the lowest temperature at which the grease enables the bearing to be started up without difficulty, is largely determined by the type of base oil and its viscosity. The high temperature limit is determined by the type of thickener and its dropping point. The dropping point is the temperature at which a grease changes its consistency and becomes a fluid.

NOTE: Grease will age with increasing rapidity at higher operating temperatures. The resulting by-products have a detrimental effect on the grease's lubrication properties and conditions in the rolling contact zone.

Lubricating greases with synthetic base oils can be used both at higher and lower temperatures than lubricants with a mineral oil base.

Corrosion inhibiting additives in lubricants

Lubricants typically contain additives to inhibit corrosion. In addition, the type of thickener is crucially important in this regard.

Lithium-base and calcium-soap greases provide excellent corrosion protection properties. They are also resistant to water wash-out.

In applications where corrosion protection is a key operational parameter, Ewellix recommends coated LLT profile rail guides and a grease with a good rust preservative (↳ **page 22**).

SKF bearing greases

The assortment of SKF greases has been developed based on the latest information about rolling bearing lubrication and has undergone extensive testing both in the laboratory and under field conditions.

Table 7 page 91 lists those SKF greases that are particularly well-suited for LLT profile rail guides. Additional information and special lubricant recommendations are available from Ewellix upon request.

NOTE: Tests have shown that SKF LGEP 2 grease will perform satisfactorily in the majority of applications.

Factory pre-lubrication

LLT carriages are normally supplied pre-lubricated with SKF LGEP 2 grease. The technical data for this grease can be found in **page 91, table 7**. A preservative is applied to the LLT rails and carriages to protect them during transport, storage and mounting. When using the recommended lubricants, it is not necessary to remove this preservative.

NOTE: The nickel-plated carriages are delivered unlubricated and must be greased by the customer prior to use and re-lubricated at regular intervals.

NOTE: In addition, there are unlubricated carriages available on request that are completely protected with a preservative. These carriages must be greased by the customer.

Initial lubrication

Initial lubrication is not required since Ewellix profile rail guides are delivered pre-greased and ready to install unless specified otherwise. In cases where a different type of grease is required, the carriages should be thoroughly cleaned and regreased prior to mounting. Alternatively, the carriages can be ordered without grease. Please refer to **table 8** for appropriate grease quantity.

This initial grease fill should be applied three times according to the steps below:

1. Grease each carriage according to the quantities listed (↳ **table 8**).
2. Move the carriage three times backwards and forwards with stroke longer than carriage length.
3. Repeat steps **1** and **2**, twice more.
4. Check if a lubricating film is visible on the rail.

Relubrication

The lubrication intervals for profile rail guides depend primarily on the average running speed, operating temperature and grease quality.

The intervals recommended for fixed operating conditions are listed in **table 9**. For appropriate grease quantity refer to **table 8**. Where contamination, use of coolants, vibration, shock loads etc. form part of the environmental conditions, it is advisable to reduce relubrication intervals accordingly.

NOTE: For P_m determination, please use **formula 8** to calculate constant mean load described on **page 26**. Also, consider recommended lubrication intervals in **table 9**.

Table 8

Size	Grease quantity		
	Carriage type A, U, R	LA, LU, LR	SA, SU
–	cm³		
15	0,4	–	0,3
20	0,7	0,9	0,6
25	1,4	1,8	1,1
30	2,2	2,9	1,8
35	2,2	2,9	1,8
45	4,7	6,1	–

Table 9

Size	Lubrication intervals [1)]	
	Under normal operating conditions, v ≤ 1 m/s Travel under load	
	$P_m \leq 0{,}15$ C	$P_m \leq 0{,}3$ C
–	km	
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
45	10 000	2 400

1) NLGI 00 grease reduces the relubrication intervals to 75 % of the stated values

4

Short stroke applications

If the stroke is less than twice the carriage length, both lube ports must be used, each filled equally with the grease quantity stated for initial lubrication or relubrication.

Example

- Short stroke application
- Carriage type A
- Size 25

Apply 3 × 1,4 cm^3 into the left and 3 × 1,4 cm^3 into the right grease nipple.

Important: To avoid serious damage to the rail guides, it is important to consider the miscibility of greases when changing from one lubricant to another.

Moreover, you must also consider the possibility of reduced relubrication intervals when performing at a short stroke operation and reduced load carrying capacity as well as the possibility of chemical interaction with synthetic materials, lubricants and preservatives.

Please refer to the grease manufacturer's instructions. In case of incompatibility between lubricants employed, the carriages should be thoroughly cleaned before re-greasing.

Central lubrication systems

If the application features a central lubrication system using greases with a consistency of 2 or higher on the NLGI scale, contact Ewellix.

Initial lubrication with adapter plate or bellow

During the first relubrication of a carriage with adapter plate, it is important to increase the amount of lubricant according to **table 10**.

4.4.3 Replacement

If the LLT profile rail guide system has reached the end of its service life and has to be replaced, Ewellix recommends replacing the whole system.

Please locate the name of the ordering key written on the carriage and measure the rail length and the E-dimension (the distance from the rail end to the first hole) for re-ordering.

Table 10

Size	Additional grease quantity
–	cm^3
15	0,2
20	0,4
25	0,4
30	0,5
35	0,6
45	0,7

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4.5 Typical application areas

Typical application areas

Applications	Precision classes			Preload classes			Special requirements on	
	P5	P3	P1	T0	T1	T2	Speed	Sealing
Handling								
Linear robotics	•	•		•	•		•	
Linear tables	•	•	•	•	•	•	•	
Modules and axis	•	•		•	•			
Pneumatic automation	•	•		•	•		•	
Plastic injection moulding								
Clamping / injecting	•	•		•	•		•	
Machine hood	•			•				
Woodworking								
Portal and gantry	•	•	•	•	•	•	•	•
Machine hood	•			•				
Printing								
Cutting and transport systems	•			•	•			•
Packaging								
Labelling	•	•		•				
Stacking/palletizing	•	•		•	•		•	
Medical								
X-ray	•	•		•	•			
Patient tables	•	•		•	•			•
Laboratory automation	•	•		•	•			•
Machine tool								
Cutting	•	•	•	•	•	•	•	•
Sawing	•	•		•	•	•	•	

4

4.6 Customized solution

Basic customization

The basic design option can be implemented quickly and easily:

- Special E value (e.g., small than Emin…etc.)
- Special laser mark for rails/carriages
- Pitch of rail's mounting holes
- Bulk packages
- Smaller tolerance for E value
- Non initial lubrication carriage

Advanced customization

The design option are more complex and require a dedicated project with the customer:

- Dimensions of rail's mounting holes
- Special carriage's mounting holes
- Dowel pin hole for the rails/carriages
- Shorter length of carriages
- Special preload class

Fig. 37

Special carriage's mounting holes

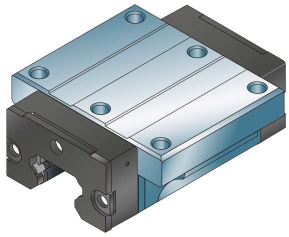


Fig. 38

Shorter length of carriages

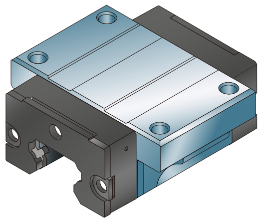


Fig. 39

Special Rail mounting holes

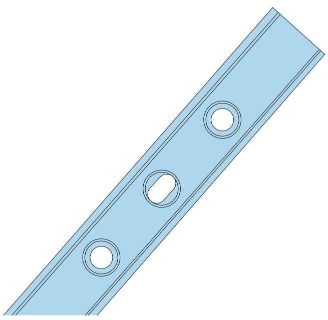
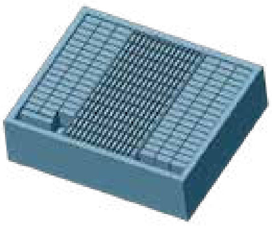


Fig. 40

Bulk packages



4.7 FAQ

What is a profile rail guide?

Profile rail guide systems, consisting of rails and carriages, are high precision linear guidings and can be found in almost all kinds of machines. Main characteristics are high load and moment carrying capacity, positioning accuracy and virtually unlimited stroke due to recirculating rolling elements. Available in a wide range of sizes, carriage types and accessories as well as in various preload and accuracy classes, LLT profile rail guides facilitate the adaptation to individual application demands.

What is the maximum permissible operating temperature?

LLT rail guides can operate continuously at temperatures ranging from –20 to 80 °C. They can operate at temperatures up to 100 °C for brief periods only.

What is a Precision Class?

Precision classes define the maximum permissible tolerance range of a rail system in terms of height, width and parallelism. Ewellix manufactures its LLT profile rail guides in three accuracy classes. This choice determines the positioning accuracy of the system within the application (↳ **page 17**).

Which main constructional differences can be found on the market for Profile rail guides?

The market offer is separated into PRG with either X – or O-arrangement of the recirculating ball rows. The technical characteristics of these two arrangements are the same except for their behaviour when subjected to a torsional moment. Generally they show no difference in behaviour when it comes to compressive loads, lift-off loads and side loads or under longitudinal moments. The profile rail guides from Ewellix feature an X-arrangement (↳ **fig. 41**). The advantage of this arrangement is that deviations in parallelism and height, which usually appear in multi-axis systems, can be more effectively compensated for (↳ **fig. 42**). Due to the design-related smaller lever arm, the X-arrangement provides better self-aligning capability. In combination with a two-point contact of the rolling elements, running friction is kept to a minimum. This results in smooth and stick-slip-free operation of the guidance system.

Fig. 41

Schematic illustration of the different ball-arrangements

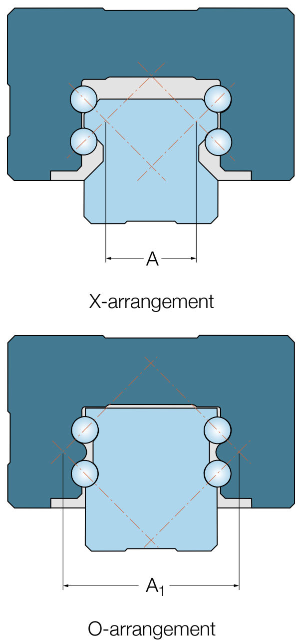
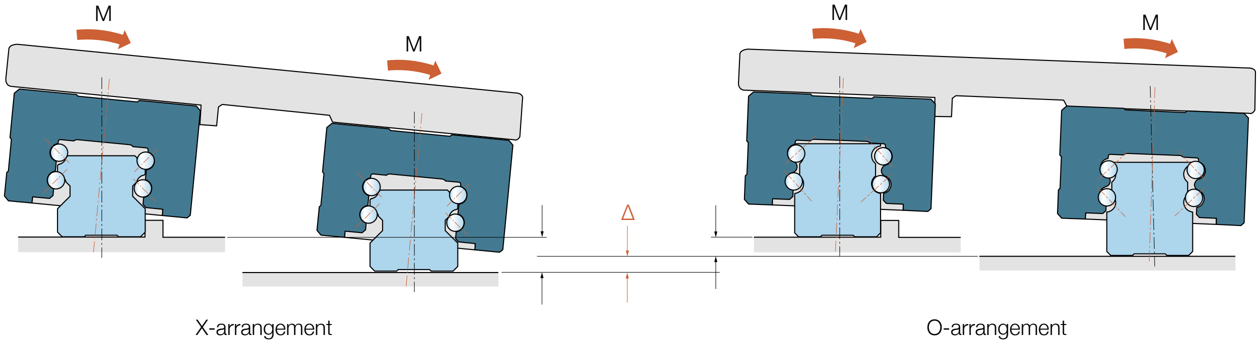


Fig. 42

Self-aligning capability in comparison

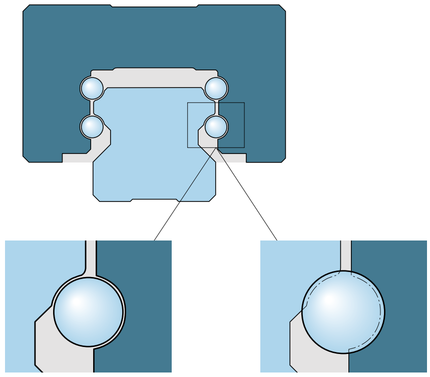


What is preload? Which influence has preload within a Profile rail guide system?

Preload is an initial load or "negative clearance" given to a profile rail guide. This results in the rolling element and raceway surfaces being under constant elastic compressive forces at their contact points. To adjust a profile rail guide to the specific demands of a given application, it is advisable to choose an appropriate preload. This will positively affect the operating behaviour of the entire linear guidance system. Preload increases the stiffness of linear guides and thus reduces the deviation under load. The preload should not amount to more than 1/3 of the bearing load F to avoid negative effects on the guide's service life. Preload can not be adjusted by the customer!

Fig. 43

Generation of preload



Which preload classes does Ewellix offer?

T0 – Zero preload (zero to light preload)

For extremely smooth-running rail guide systems with low friction and low external influences. This preload class is only available in P5 and P3 accuracy classes.

T1 – Light preload (2 % of dynamic preload C)

For precise rail guide systems with low external load and high requirements for overall stiffness.

T2 – Medium preload (8 % of dynamic preload C)

For precise rail guide systems with high external load and high requirements for 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.

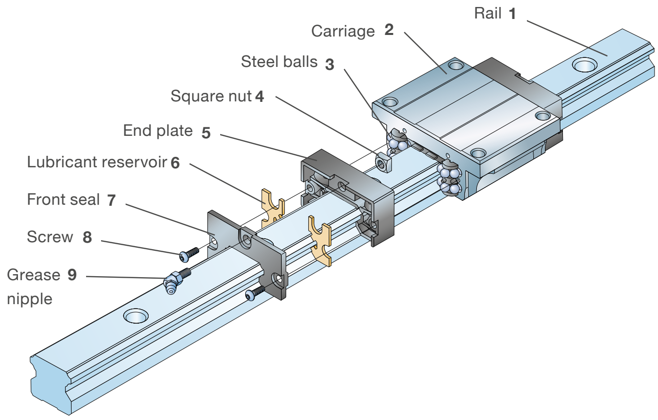
What materials are used for the profile rail guides?

Material specifications.

The different parts of a profile rail guide system are shown in **fig. 44**.

1. Steel, inductive hardened
2. Steel, case hardened
3. Bearing steel
4. Steel, zinc coated
5. POM, reinforced
6. EPU foam
7. Elastomer
8. Steel
9. Steel, nickel coated

Fig. 44



What are the friction values for a LLT profile rail guide system?

The friction coefficient for lubricated LLT profile rail guides is typically between μ = 0,003 and 0,005. This is valid for carriages without seals. The use of seals increases the friction. An overview of the impact on the friction force is available at **page 20 and 21.**

What is the maximum rail length without joints?

The maximum length of a single rail Lmax is approximately 4 000 mm. The exact dimensions are shown at **page 57**.
For virtually unlimited stroke joint rails are available. The end faces of joint rails are ground and marked accordingly.

Can profile rail guides be equipped with a clamping element?

Yes - on request. Profile rail guides can be equipped with pneumatic, hydraulic, electric and manual operating brakes.

How can the profile rail guide be protected from contamination?

For protection several accessories are available
(↳ **page 62**).

Accessories:

S1 = Scraper plate

S3 = Seal kit, additional front seal with scraper plate

S7 = Additional front seal

B = Bellows

Can the rails be mounted from below?

Yes, we offer LLTHR … D4 rails with blind holes
(↳ **page 58**).

Lubricant specification

LLT carriages are factory pre-lubricated with SKF LGEP 2 grease of consistency class NLGI 2, which is in accordance with DIN 51 825.

We recommend LAGG 18AE SKF Mobile grease pump for frequent use, or the Grease Gun LAGH 400 with the UMETA nozzle pipe for infrequent use.

Is a centralized lubrication possible?

Both ends of the carriage have metal threaded lubrication ports to accommodate an automatic relubrication system The Lubrication connectors which are for the centralized lubrication system are referred to **page 70.**

Is it possible to lubricate the carriages from the side / lateral?

Lubrication from the side is only possible by using an additional adapter plate (component of the bellows kit see **page 72).**

What has to be considered concerning the lifetime of the lubricant?

The temperature range of -20°C to 80°C should not be exceeded for longer periods.

If the stroke is less than twice the carriage length, both lube ports must be used, each filled equally with the grease quantity stated for initial lubrication or re-lubrication.

For lubrication information please refer to **chapter 4.4.2**.

Is it possible to pull the carriage off the rail?

It is possible to remove the carriage from the rail. The demounting of a profile rail guide must be done carefully and requires the original mounting sleeve.

In case of remounting systems make sure that each carriage is mounted on the rail from which it was removed, in the same mounting direction.

Does the customer need to mount the carriage to the rail?

Yes, if a standard system is ordered. Optionally LLT systems can be ordered as an assembled system using “M” in the designation code.

What should be considered to make the right choice regarding a profile rail guide?

The specification sheet at **page 107** guides you through the dimensioning of a profile rail guide. It asks for all relevant information which includes loads, velocities, orientation, intended use, environment, etc. and results in the appropriate system.

Is it possible to replace only the carriage or the rail of a system that was in use?

Yes, due to our profile rail guide concept, the exchange is possible for the most common technical specifications. All carriages and rails of the same size and precision class P5 or P3 can be combined with each other while maintaining the initial precision class.

NOTE:

1. Precision class P1 is only as profile rail guide system available. Rails and carriages with precision class P1 are not interchangeable.
2. Preload/Precision class T2 P3 is only as profile rail guide system available. Rails and carriages with Preload/Precision class T2 P3 are not interchangeable.
3. It is recommended to replace the entire profile rail guide system when confirmation of a particular condition is required(e.g. end of life-cycle) even if only one part of it is damaged.

Why can dynamic load ratings deviate when comparing competitor products, especially of Asian companies, although the relevant dimensions are comparable?

The basic dynamic load rating and moment load rating of LLT is based on 100 km (according to ISO 14728 Part 1). However, the values of some other manufactures are frequently based on only 50 km. When comparing values, multiply the C values for LLT profile rail guides by 1.26.

What has to be considered in case of short-stroke application (stroke < 2x carriage length)?

If the given application stroke is less than twice the carriage length, both lube ports must be used, each filled equally with the grease quantity stated for initial lubrication or re-lubrication.

In case of oscillating motion or short-stroke it is recommendable to move the carriages frequently for a full stroke or at least more than twice the carriage length.

If the application desires short strokes, shocks loads or high speeds it is advisable to reduce the relubrication intervals accordingly. And EP/AW additive and NLGI 1 grease are recommended in this kind of application.

Is it possible to replace balls in case of accidental ball loss?

That is not recommended. The preload class depends on the ball diameter which varies minimally from carriage to carriage to meet the technical specifications. As long as the carriage is undamaged, balls will not fall out.

What could be causes for noise during the operation of a profile rail guide?

If a profile rail guide causes noise, different causes or a combination of them should be considered:

- Velocity exceeds the permitted maximum values
- Inaccurate mounting
- Interface construction not stiff enough
- Surface of interface construction not according to recommendations at **page 78 and 79**
- Wrong or insufficient grease

What is the stick-slip phenomenon?

Stick-slip (or "slip-stick") refers to the phenomenon of a spontaneous jerking motion that can occur while two objects are sliding over each other. This can lead to an undesirable noise. Stick-slip is caused by the surfaces alternating between sticking to each other and sliding over each other (mixed friction), with a corresponding change in the force of friction. Typically, the static friction coefficient between two surfaces is larger than the kinetic friction coefficient. If an applied force is large enough to overcome the static friction, then the reduction of the friction to the kinetic friction can cause a sudden jump in the velocity of the movement. Stick-slip phenomenon is comparative untypical for profile rail guides but can rarely occur when the actuator is lean / small designed or the system is moving slow.

4.8 Ordering key

4.8.1 Ordering key system

LLTH	S	25	A	2	T2	1000	P5	HD	S0	A	B0	D4	E0	M	S1	C	M

Size
15, 20, 25, 30, 35, 45

Carriage type [1]

SA	Flanged carriage, short length, standard height
A	Flanged carriage, standard length, standard height
LA	Flanged carriage, extended length, standard height
SU	Slim-line carriage, short length, standard height
U	Slim-line carriage, standard length, standard height
LU	Slim-line carriage, extended length, standard height
R	Slim-line carriage, standard length, extended height
LR	Slim-line carriage, extended length, extended height

Number of carriages per rail
1, 2, 4, 6, …

Preload class

T0	Zero preload
T1	Light preload, 2 % C
T2	Medium preload, 8 % C

Rail length
80 mm up to maximum rail length (1 mm steps)

Precision class

P5	Standard
P3	Medium
P1	High

Coating [2,3,4,5,11] (no code for standard: non coated rails and carriages)

HD	Thin dense chrome rail with non coated carriage, available in Europe
HA	Thin dense chrome rail with non coated carriage, available in USA/CAN
HT	Trivalent chrome rail with non coated carriage.
HDN	Thin dense chrome rail with nickel plated carriage, available in Europe
HAN	Thin dense chrome rail with nickel plated carriage, available in USA/CAN
HTN	Trivalent chrome rail with nickel plated carriage

Sealing [9,10] (no code for standard sealing)

S0	Low friction shield

Jointed rail track [6] (if not selected – no code)

A	Yes

Prepared for bellows (if not selected – no code)

B0	Rails prepared for bellows (for ordering the bellow see ordering key bellows), available in Europe

Rail

D	Rail, if customized according to drawing number
D4	Rail with blind holes
D6 [7]	Rail with metal plugs

Distance between end face and the center of the first mounting hole of the rail

E0	If no “E” specified, the holes at both rail ends will be positioned equidistantly from either end of the rail (shortest possible “E” dimension)
Exx	“E” dimension to be specified, for calculation and minimum “E” dimension (↳ **page 57**)

LLTH	S	25	A	2	T2	1000	P5	HD	S0	A	B0	D4	E0	M	S1	C	M

Carriage mounted on rail (if not selected – no code)

M Yes

Additional seals, when part of a system (other and separate available parts see ordering key accessories)

S1 Scraper plate
S3 Seal kit, additional front seal with scraper plate
S7 Additional front seal
S6 Lube element
61 Lube element + Scraper plate
63 Lube element + Seal kit, additional front seal with scraper plate
67 Lube element + Additional front seal

Quantity of additional seals

C (2) seals per carriage
S (2) seals per system, outer surface of carriages to have seal mounted

Additional seals mounted on carriage [8] (if not selected – no code)

M Yes

1) Not all combinations of preload / precision class available for each carriage type. Please refer to **pages 38 to 53**.
2) Available coated carriage types refer to **page 22** (**table7**).
3) Only available in preload classes T1 and precision class P5.
4) Please note: a system with coated rail can have a slightly higher preload and friction. This will be partly eliminated after a short running time. Be aware, that the end of the rail is not normally coated.
5) For size 15 and 20, only carriages with low friction S0 shield shall be used. If seal function is needed, a combination with additional front seal S7 is recommended.
6) Jointed rail code should be selected if the ordered rail length exceeds the maximum standard rail length (defined in dimension tables, **pages 38 to 53**). Availability defined in **table 8, page 23**.
7) Available for size 25–45. Mounting tool needs to be ordered separately (↳ **ordering key accessories**).
8) Additional seals can only be mounted on carriage if full system is ordered (Carriage mounted on rail = Yes).
9) Not for size 35 and 45.
10) LLTH 15 and 20 HN are always equipped with S0 as STANDARD.
11) Without lubricant, corrosion protected only.

4.8.2 Ordering key carriages

LLTH	C	25	A	T2	P5	HN	S0

Size

15, 20, 25, 30, 35, 45

Carriage type [1]

SA Flanged carriage, short length, standard height
A Flanged carriage, standard length, standard height
LA Flanged carriage, extended length, standard height
SU Slim-line carriage, short length, standard height
U Slim-line carriage, standard length, standard height
LU Slim-line carriage, extended length, standard height
R Slim-line carriage, standard length, extended height
LR Slim-line carriage, extended length, extended height

Preload class

T0 Zero preload
T1 Light preload, 2 % C
T2 Medium preload, 8 % C

Precision class

P5 Standard
P3 Medium
P1 High

Coating [2] [3] [4] [7] (no code for standard: non coated carriage)

HN Nickel plated carriage

Sealing [5] [6] (no code for standard sealing)

S0 Low friction shield

1) Not all combinations of preload / precision class available for each carriage type. Please refer to **pages 38 to 53**.
2) Only available for preload class T1, precision class P5. For an overview of the available carriages with coating, please refer to **page 22**, **table 7**.
3) Please note: a system with coated rails can have a slightly higher preload and friction. This will be partly eliminated after a short running time.
4) For size 15 and 20, only carriages with low friction S0 shield shall be used. If seal function is needed, a combination with additional front seal S7 is recommended.
5) Not for size 35 and 45.
6) LLTH 15 and 20 HN are always equipped with S0 as STANDARD.
7) Without lubricant, corrosion protected only.

4.8.3 Ordering key rails

LLTH	R	25	1000	P5	HD	A	B0	D4	E0

Size
15, 20, 25, 30, 35, 45

Rail length
80 mm up to maximum rail length (1 mm steps)

Precision class
P5 Standard
P3 Medium
P1 High

Coating [1] [2] (no code for standard: non coated rail)
HD Thin dense chrome rail, available in Europe
HA Thin dense chrome rail, available in USA/CAN
HT Trivalent chrome rail, available world wide

Jointed rail track [3]
A Yes

Prepared for Bellows
B0 Rails prepared for bellows. To order, see "ordering key bellows.", available in Europe

Rail [4]
D Rail, if customized according to drawing number
D4 Rail with blind holes
D6 [5] Rail with metal plugs

Distance between end face and the center of the first mounting hole of the rail
E0 If no "E" specified, the holes at both rail ends will be positioned equidistantly from either end of the rail (shortest possible "E" dimension)
Exx "E" dimension to be specified, for calculation and minimum "E" dimension, (↳ **page 57**)

[1] Only available in precision class P5.
[2] Please note: a system with coated rail can have a slightly higher preload and friction. This will be partly eliminated after a short running time. Be aware that, as standard, the end of the rail is not coated.
[3] Jointed rail code should be selected if the ordered rail length exceeds the maximum standard rail length (defined in dimension tables, **pages 38 to 53**). Availability defined in **table 8, page 23**.
[4] Plastic and metal plugs available as spare parts. Please contact Ewellix for further information.
[5] Available for sizes 25–45. Mounting tool needs to be ordered separately (see ↳ **ordering key accessories**).

4.8.4 Ordering key accessories (delivered separately)

LLTH	Z	25	S1

Size
15, 20, 25, 30, 35, 45

Accessories (will be delivered as single units)
S0 [1] Low friction shield
S1 Scraper plate
S3 Seal kit, additional front seal with scraper plate
S7 Additional front seal
PL Adapter plate, used for side lubrication
VN UA [2] Lubrication connector
D6 [3] Mounting tool for metal plugs
S6 Lube element
61 Lube element + Scraper plate
63 Lube element + Seal kit, additional front seal with scraper plate
67 Lube element + Additional front seal

[1] Available for sizes 15–30 to replace standard front seal.
[2] Fits for all types of carriages (↳ **page 37**), but not in combination with additional seals (S1/S3/S7).
[3] Available for sizes 25–45.

4.8.5 Ordering key bellows

LLTH	B	25	B	(xxx/xxx/xxx)	LAS

Size
15, 20, 25, 30, 35, 45

Bellows [1)]
B Combination of bellows to cover the complete system
B2 Kit, type 2 (carriage to the end of the rail)
B4 Kit, type 4 (between two carriages)
B9 Bellow as spare part (without any fastening system)

Bellows: definition of number of folds (max 150 folds per single bellow)
xxx Number of folds
/ Splitting of sections
- No bellows in this section

Bellows material
STD Standard material “PUR”, (temperature resistance +90 °C)
LAS [2)] Special material suitable for laser applications – self fading, (temperature resistance +160 °C)
WEL [3)] Special material suitable for welding applications, (temperature resistance +260 °C)

The bellows is only available in Europe.
[1)] Will be delivered unmounted
[2)] Available for sizes 15-30
[3)] Available for sizes 35-45

4

ALMOTION

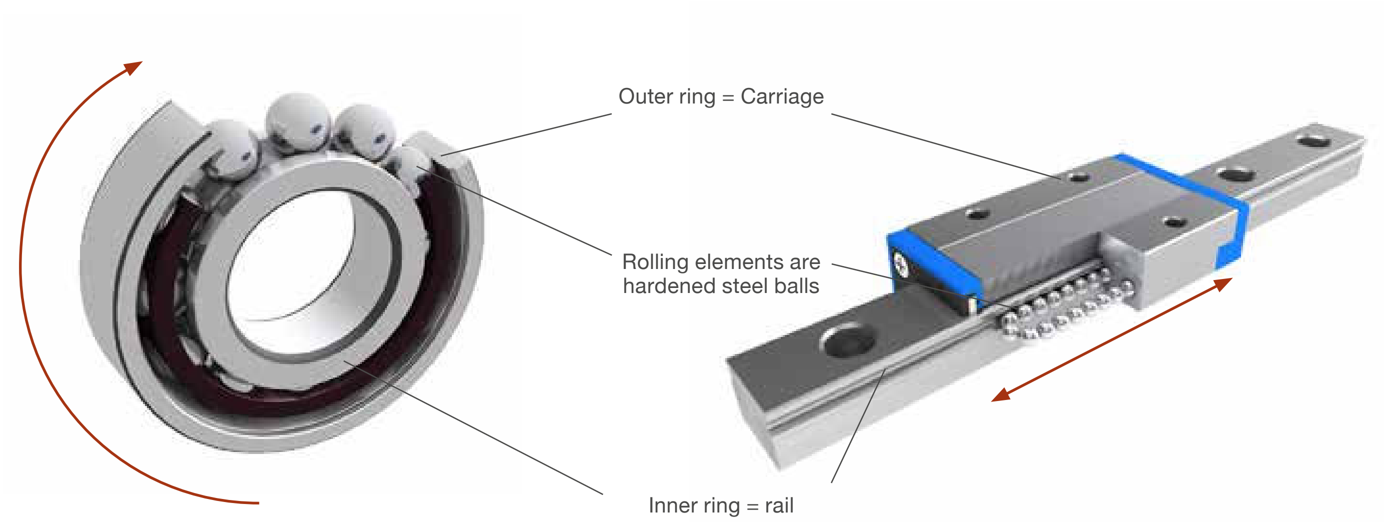
EWELLIX

A Schaeffler Company

Miniature profile rail guides – LLS catalogue

1.2 Function and basic design

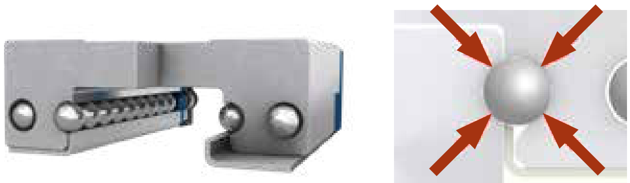
Miniature profile rail guides are translating rolling motion into linear motion. Like a ball bearing, the rolling elements are allowing nearly frictionless linear movements even under load. For that function a profile rail system consists of two elements; a carriage and a rail. In most applications, the rail is fixed to a ground and the carriage is moving. The carriage contains the rolling elements and a ball recirculation system. The ball recirculation system allows in principal unlimited stroke of the carriage along the rail.



Ball bearing   *Carriage and rail*

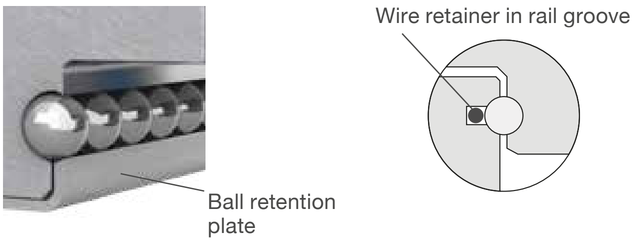
The miniature profile rail is made with a two-row ball recirculation. To guarantee precise motion within a two-ball row design, Ewellix is using a gothic arch shape in the ball contact zone at carriages and rails. This four-point ball contact design ensures a compact design that delivers high performance (↳ **fig. 1**).

Fig. 1



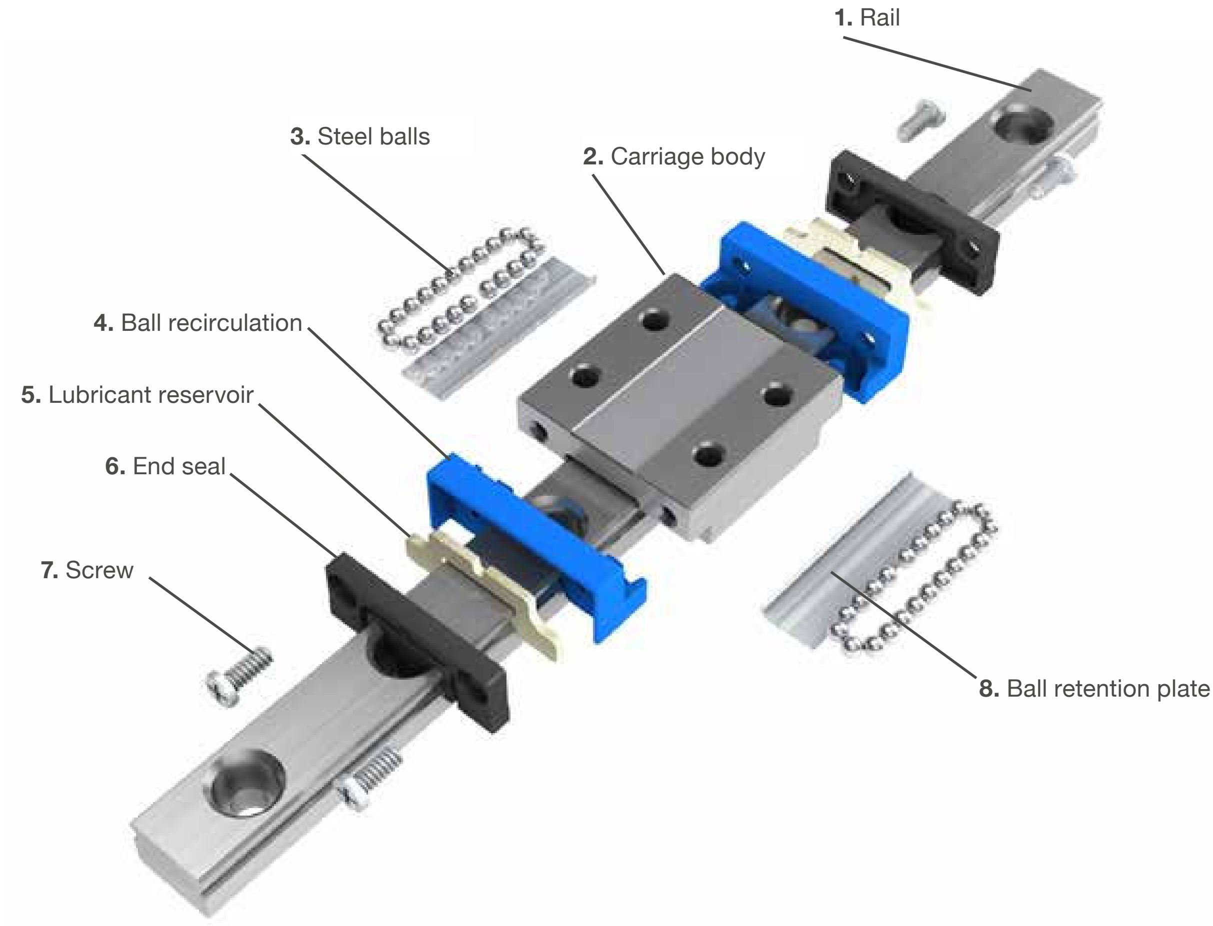
The innovative new ball retention system obtains the highest sealing performance, the utmost safe mounting process and the highest quality ball retention system (↳ **fig. 2**).

Fig. 2



Ewellix design   *Other designs*

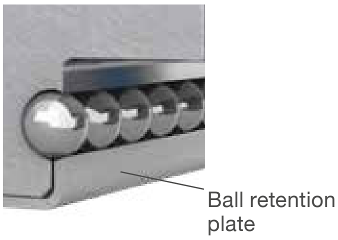
1.3 Components and materials



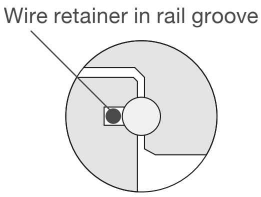
Material specifications

1. Profile rail, stainless steel (hardened)
2. Carriage body, stainless steel (hardened)
3. Steel balls, stainless steel (hardened)
4. Ball recirculation, plastic (POM)
5. Lubricant reservoirs, foam
6. End seals or shields, elastomer and plastic
7. Mounting screws, stainless steel
8. Ball retention plates, stainless steel

1.4 Features and benefits



Ewellix design



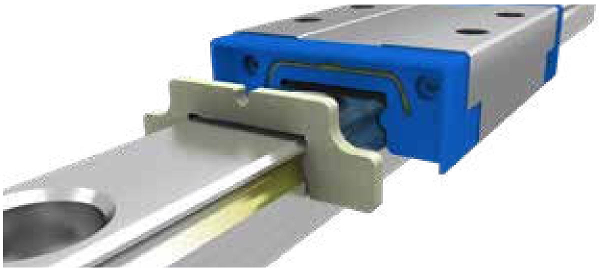
Other designs

Safe and robust innovative ball retention

The invention of the new ball retention system is setting milestones in terms of the highest safety during the mounting procedure.

The ball retention plate is attached to the carriage and is keeping the balls safely in position.

In comparison to other designs like the wire retention, it does not need an additional groove in the raceways of the rail, which is an entry point for contamination.

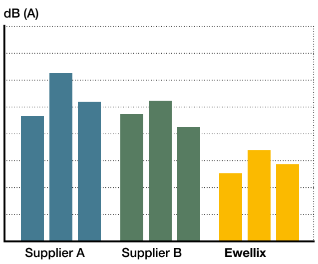


Up to 20 000 km of service life

Carriages and systems of the LLS miniature profile rail guide series are ready to use, while factory pre-lubricated with FDA level oil.

Even better, with the two integrated lubricant reservoirs on either carriage sides, the carriage can be maintenance-free for up to 20 000 km in service life.

The reservoir is in contact with the raceways of the rails and during motion is constantly oiling the ball contact point.



Silent and smooth precise motion

The optimized design has up to 50 % less noise emission when compared to other miniature profile rail products. That includes very smooth carriage running behaviour realized by the new optimized ball recirculation and retention.

Specific in medical and office environment applications, you will directly hear and feel the difference when compared to other miniature profile rails.

Stainless steel material

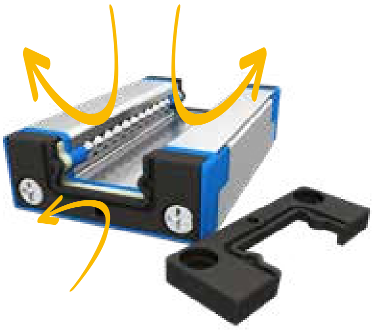
The LLS series is made for applications requesting clean environment and corrosion protection such as medical laboratory or office environment as well as automation and electronic industry production.

To protect carriage, rail and rolling elements from immediate initial rust, they are made from high alloy stainless steel material.

Low friction long life seal design

With seals made from highly abrasion resistant material, the miniature profile rail is perfectly protected from outside contamination. The seals are designed for the longest life and lowest possible friction force.

Even contamination from the carriage bottom side is restricted by the minimal gap seal between the rail and ball retention plate. All in all, it provides safe and long life protection.

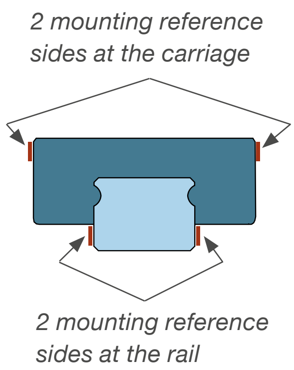


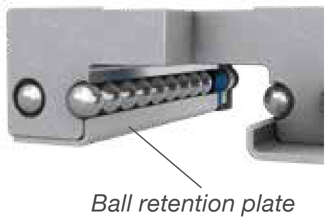
Secure, safe and quick mounting

Do you want to boost your mounting productivity? Then the LLS series is the right choice.

Due to the innovative ball retention, no mounting sleeves must be used and there is no risk of losing balls during mounting as with other solutions.

With each 2-mounting reference sides on carriage and rail, the mounting of such a linear guide system is fail safe proof that, as during mounting, no wrong side can be chosen.





Interchangeable carriages and rails

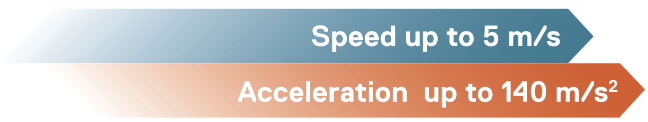
With the new Zero Rail Concept (ZRC), Ewellix is increasing the flexibility in availability, stocking and repair because of interchangeable carriages on rails.

Within the Zero Rail Concept, any carriage can be mounted together with the rail of the same size. The realisation of a needed system is getting easier and delivery times are shorter, as Zero Rail Concept carriages and rails are stored and delivered separately.

Higher performance for more productivity

The new design with optimized ball contact point geometry and a ball recirculation system is adding much more performance to the guide system's ability.

The miniature profile rail series LLS is supporting speeds up to 5 m/s and accelerations up to 140 m/s². These performance parameters paired with the right drive system can accelerate your machine performance towards more productivity.



1.5 Product range

1.5.1 Standard carriages and rails

Range with standard rail width for most compact applications, type LLSH, contains two variants of carriage length each in a shielded version with only rolling friction and a sealed version with very low friction. For more technical dimensions and details, please have a look at **chapter 3**.

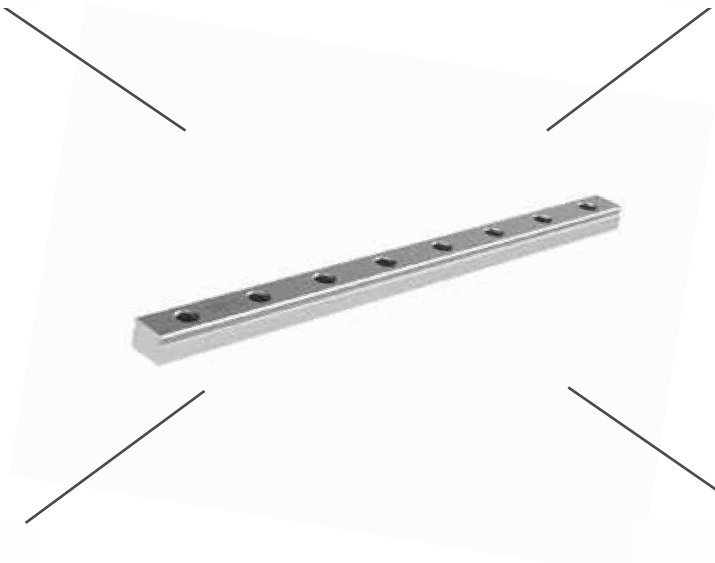
Carriage LLSHC ... TA

Standard length - TA
Shielded with only rolling friction (no code)

Carriage LLSHC ... TA R

Standard length - TA
Sealed with very low friction - R

Detailed view at shielded carriage



Detailed view at sealed carriage

Carriage LLSHC ... LA

Extended length - LA
Shielded with only rolling friction (no code)

Carriage LLSHC ... LA R

Extended length - LA
Sealed with very low friction - R

1.5.2 Wide carriages and rails

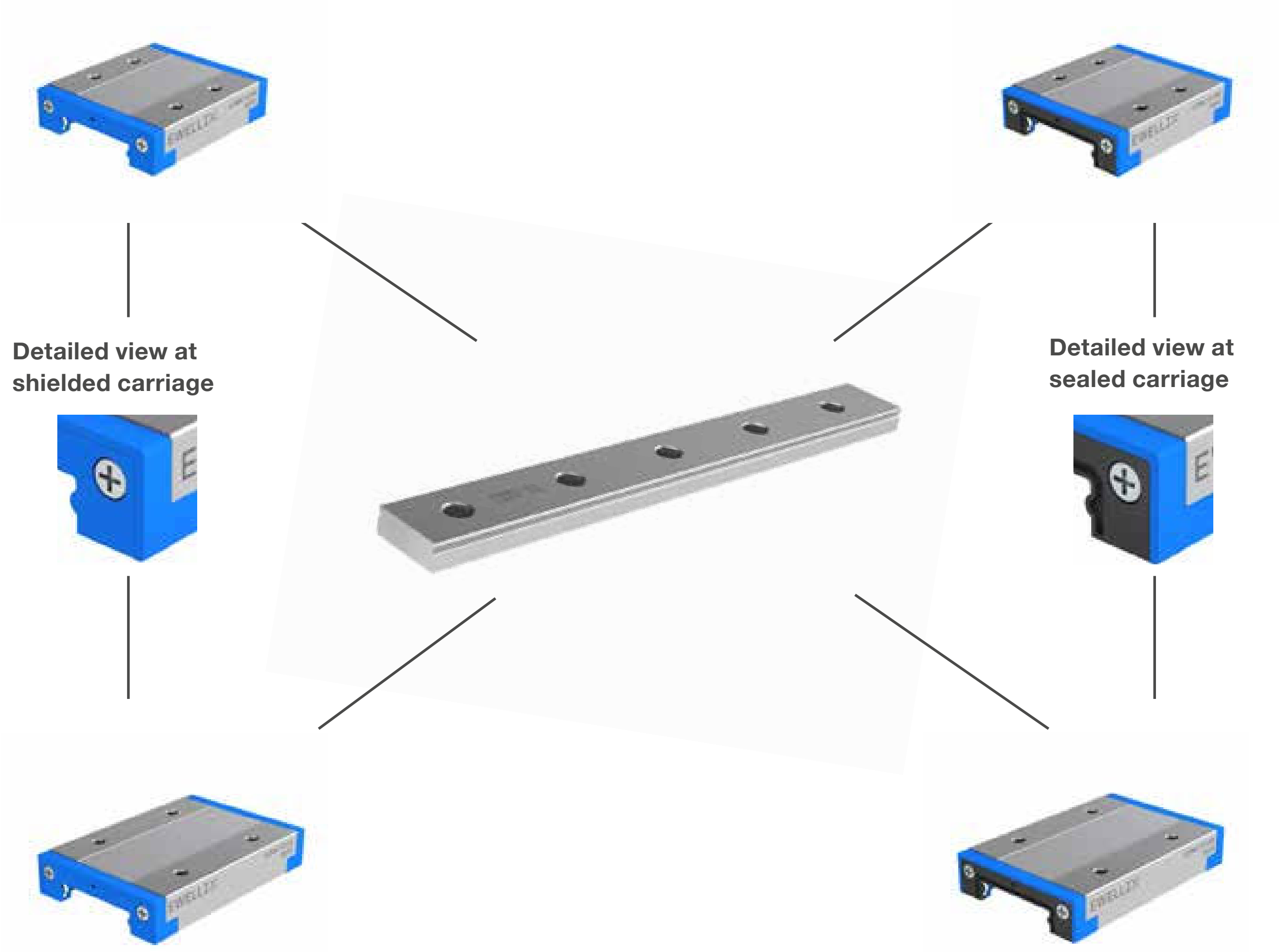
Range with wide rail width for highest performance on one rail solutions, type LLSW, contains two variants of carriage length each in a shielded version with only rolling friction and a sealed version with very low friction. For more technical dimensions and details, please have a look at **chapter 3**.

Carriage LLSWC ... TA

Standard length - TA
Shielded with only rolling friction (no code)

Carriage LLSWC ... TA R

Standard length - TA
Sealed with very low friction - R



Carriage LLSWC ... LA

Extended length - LA
Shielded with only rolling friction (no code)

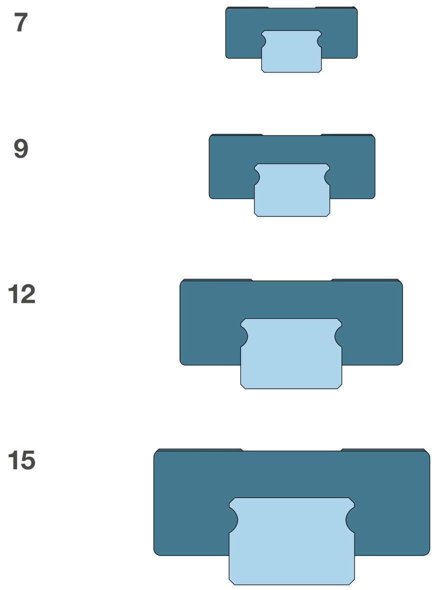
Carriage LLSWC ... LA R

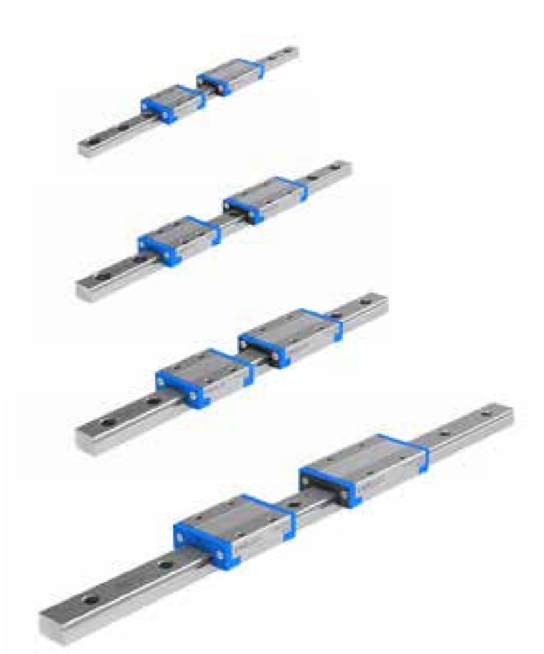
Extended length - LA
Sealed with very low friction - R

1.5.3 Product size options

Standard sizes

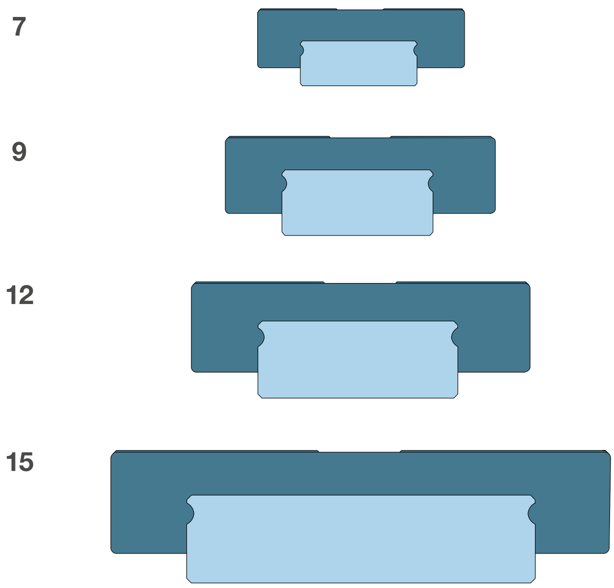
On the standard range, type LLSH, the size of the rails is defining the size of the miniature profile rails system. Today, the range is available from 7 to 15 mm rail width.

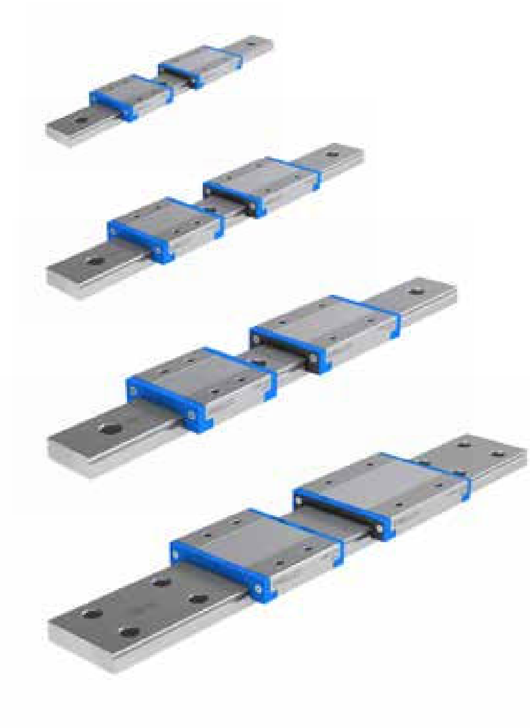




Wide sizes

The wide range, type LLSW, is defined as the double width of the standard rail with the exception of size 15, which is 42 mm wide.



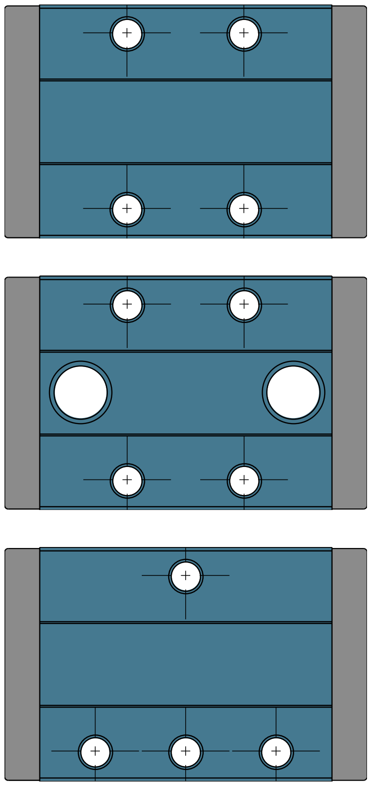


1.5.4 Customized options

On request, Ewellix can offer the following customized solutions to make the linear guide fit to the application.

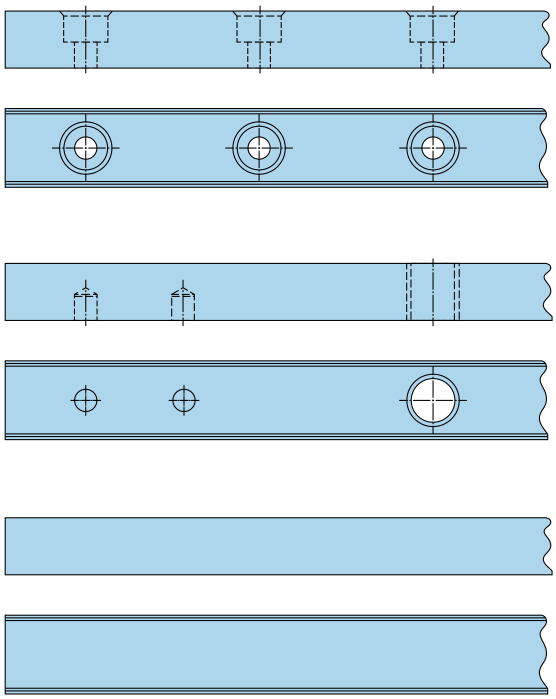
Carriage examples

- Carriages without standard oil lubrication or carriages with customized lubricant according to specific application needs or specific lubrication holes for central lube systems.
- Carriages with hole patterns in the middle section used for rail or other mounting procedures when stroke is extremely short.
- Carriages with customized mounting threads to adapt to the design needs of a specific machine. The threads must fit a possible of general design.



Rail examples

- Variable mounting hole distances according to drawings to adapt to specific needs or only mounting holes at the end of the rail for easy mounting.
- Blind threads for bottom mounting for clean upside rail surfaces. Or blind holes or through holes for exact position of the rail at a certain position to maintain tolerances.
- Rails without any fixation holes being used for alternative fixation methods like glueing or other fixation alternatives.



1.5.5 Zero Rail Concept (ZRC) range

The newly developed Ewellix Zero Rail Concept (ZRC) offers flexibility and availability. Within the Zero Rail Concept , any carriage can be mounted together with the rail of the same size. Spare parts can be handled much quicker and due to standardization, delivery times are shorter in comparison to system configurations.

Zero Rail Concept carriages and rails are delivered separately. The ZRC offer is standardized for precision class P5 (Standard precision) together with preload class T0 (Light clearance) and T1 (Light preload). Any carriage or rail from this range must be ordered with the suffix ZRC in the ordering key. For detail technical dimensions, please have look at **chapter 3**. For technical documentation like preload classes, please see **chapter 2**.

LLS range overview - ZRC [1]

Series	Range	Type	Size	Length [2]	Shielded or sealed	Preload class	Precision class	Zero Rail Concept
	H	**C, R**	**7, 9 , 12, 15**	**TA, LA**	**No code, R**	**T0, T1**	**P5**	**ZRC**
LLS	Standard rail width	Carriage	7	Standard	No code , R	T0, T1	P5	ZRC
				Extended	No code , R	T0, T1	P5	ZRC
			9	Standard	No code , R	T0, T1	P5	ZRC
				Extended	No code , R	T0, T1	P5	ZRC
			12	Standard	No code , R	T0, T1	P5	ZRC
				Extended	No code , R	T0, T1	P5	ZRC
			15	Standard	No code , R	T0, T1	P5	ZRC
				Extended	No code , R	T0, T1	P5	ZRC
		Rail	7	max. 1000 mm	–––	–––	P5	ZRC
			9	max. 2000 mm	–––	–––	P5	ZRC
			12	max. 2000 mm	–––	–––	P5	ZRC
			15	max. 2000 mm	–––	–––	P5	ZRC
	W	**C, R**	**7, 9 , 12, 15**	**TA, LA**	**No code, R**	**T0, T1**	**P5**	**ZRC**
LLS	Wide rail width	Carriage	7	Standard	No code , R	T0, T1	P5	ZRC
				Extended	No code , R	T0, T1	P5	ZRC
			9	Standard	No code , R	T0, T1	P5	ZRC
				Extended	No code , R	T0, T1	P5	ZRC
			12	Standard	No code , R	T0, T1	P5	ZRC
				Extended	No code , R	T0, T1	P5	ZRC
			15	Standard	No code , R	T0, T1	P5	ZRC
				Extended	No code , R	T0, T1	P5	ZRC
		Rail	7	max. 2000 mm	–––	–––	P5	ZRC
			9	max. 2000 mm	–––	–––	P5	ZRC
			12	max. 2000 mm	–––	–––	P5	ZRC
			15	max. 2000 mm	–––	–––	P5	ZRC

[1] For detail information about the complete ordering key, please have a look at **chapter 5**.
[2] Rails manufactured as cut to length items might not be able to be delivered with the max. length due to the E dimension.

Ordering and designation example:
Carriage: LLSHC 12 TAR T0 P5 ZRC
Rail: LLSHR 12-550 P5 E0 ZRC

1

1.5.6 System range

While the ZRC rails and carriages are delivered separately, the system range offers you complete mounted guide systems of carriages and rails. Beside the readiness of the systems, more variations of preload and precision classes as well as optimized parallel running systems can be selected from the standard.

For detail technical dimension, please have look at **chapter 3**. For technical documentation like preload classes, please see **chapter 2**.

LLS range overview - SYSTEM [1)]

Series	Range	Type	Size	Carriage length	Shielded or sealed	Preload class	Rail length [2)]	Precision class	Parallel mounted rails
	H	**S**	**7, 9 , 12, 15**	**TA, LA**	**No code, R**	**T0, T1, T2**	**[mm]**	**P5, P1**	**No code ,W2, Wx**
LLS	Standard rail width	System of carriage and rail ready mounted	7	Standard	No code , R	T0, T1, T2	max. 1 000	P5, P1	No code, W2, Wx
				Extended	No code , R	T0, T1, T2	max. 1 000	P5, P1	No code, W2, Wx
			9	Standard	No code , R	T0, T1, T2	max. 2 000	P5, P1	No code, W2, Wx
				Extended	No code , R	T0, T1, T2	max. 2 000	P5, P1	No code, W2, Wx
			12	Standard	No code , R	T0, T1, T2	max. 2 000	P5, P1	No code, W2, Wx
				Extended	No code , R	T0, T1, T2	max. 2 000	P5, P1	No code, W2, Wx
			15	Standard	No code , R	T0, T1, T2	max. 2 000	P5, P1	No code, W2, Wx
				Extended	No code , R	T0, T1, T2	max. 2 000	P5, P1	No code, W2, Wx

Series	Range	Type	Size	Carriage length	Shielded or sealed	Preload class	Rail length	Precision class	Parallel mounted rails
	W	**S**	**7, 9 , 12, 15**	**TA, LA**	**No code, R**	**T0, T1**	**[mm]**	**P5, P1**	**No code ,W2, Wx**
LLS	Wide rail width	System of carriage and rail ready mounted	7	Standard	No code , R	T0, T1, T2	max. 2 000	P5, P1	No code, W2, Wx
				Extended	No code , R	T0, T1, T2	max. 2 000	P5, P1	No code, W2, Wx
			9	Standard	No code , R	T0, T1, T2	max. 2 000	P5, P1	No code, W2, Wx
				Extended	No code , R	T0, T1, T2	max. 2 000	P5, P1	No code, W2, Wx
			12	Standard	No code , R	T0, T1, T2	max. 2 000	P5, P1	No code, W2, Wx
				Extended	No code , R	T0, T1, T2	max. 2 000	P5, P1	No code, W2, Wx
			15	Standard	No code , R	T0, T1, T2	max. 2 000	P5, P1	No code, W2, Wx
				Extended	No code , R	T0, T1, T2	max. 2 000	P5, P1	No code, W2, Wx

[1)] For detail information about the complete ordering key, please have a look at **chapter 5**.
[2)] Rails manufactured as cut to length items might not be able to be delivered with the max. length due to the E dimension.

Ordering and designation example:
System 1: LLSHS9TA2T0-260P5/E0
System 1: LLSHS12LAR3T1-850P1/W2E10

1.6 Miniature guide applications

Laboratory analysers – Medical industry

Liquid handling and probe loading at chemical or biomedical analysers for testing blood, or other human or veterinary materials

Why miniature profile rail guides LLS:

- Nearly no maintenance, when pre-lubricated
- Low noise in office environment
- Smooth running for precise motion
- Up to 20 000 km of service life

Mini slides - Automation industry

For secure positioning with mini slides in automation applications of pick and place or testing. Used as a guide element to support pneumatic slide function.

Why miniature profile rail guides LLS:

- High rigidity due to optimized carriage design
- High performance with new ball recirculation
- Long seal life with highly abrasive resistant material
- Most failproof and quick mounting

3D printing – Additive manufacturing

Precise manufacturing of parts in 3D printers. Linear guide for y-z motion of the printing nozzle and exact positioning of the printing plate.

Why miniature profile rail guides LLS:

- High performance in acceleration for productivity
- Smooth running at low friction for high precision
- Low noise for office environments
- Stainless steel material for corrosion resistance

Dental imaging – Medical industry

Allows elliptic rotation function of the imaging device around the patient head, while the collimator is automatically shielding the x-ray beam.

Why miniature profile rail guides LLS:

- Silent motion for medical applications
- Corrosion resistance with stainless steel material
- Factory pre-lubricated and ready to use
- Secure and safe mounting with robust ball retention

CNC milling machine – Machine tool

Small 3-axis CNC milling machine with miniature profile rail guides to realize precise accurate motion for the production of small work pieces.

Why miniature profile rail guides LLS:

- Secure and safe mounting with robust ball retention
- Rigid guide system with high performance
- High position accuracy with low friction
- Sealed guide system for long life

Tonometer – Ophthalmic industry

To detect fluid pressure inside the eyes, a non-contact tonometer is often used with an automatic detection function based on linear guides.

Why miniature profile rail guides LLS:

- Maintenance-free operation
- Precise guiding with low friction
- Clean components made from stainless steel
- Smooth running with high repeatability

Automated optical inspection (AOI) – Electronic industry

Two camera system adjustable with miniature guides allowing a two-side inspection of circuit boards placed at the conveyer belt system while passing the machine.

Why miniature profile rail guides LLS:

- Maintenance-free with up to 20 000 km of service life
- High performance with acceleration and speed
- High rigidity paired with low friction motion
- Stainless steel metal components for cleanliness

Dental CAD-CAM – Medical industry

Production of prosthetics at the dental office or in a laboratory after imaging patient data. The patient data deliver the input for the milling process.

Why miniature profile rail guides LLS:

- Sealed guide system with low friction
- High position accuracy with smooth motion
- Up to 20 000 km of service life
- Easy and safe mounting for high accuracy

2

Selection guide

2.1 Technical data

2.1.1 Load ratings

The load ratings stated in this catalogue have been calculated for all products based on the ISO 14728 standards. The calculation model prescribed in these standards has been complemented and verified by Ewellix through internal simulations.

Basic dynamic load rating

The basic dynamic load rating C is the radial load, constant in magnitude and direction, which a linear rolling bearing can theoretically accommodate for a basic rating life represented by a travelled distance of 100 km. All Ewellix linear guides load ratings are based on 100 km travel distance. According to ISO 14728, it is also possible to define a reference travel distance of 50 km. In this case, a conversion factor should be applied in order to enable proper comparison of the two load rating values (↳ **formula 1**).

(1) $$C = C_{100} = \frac{C_{50}}{1{,}26}$$ (for ball guided systems)

where

C	= dynamic load rating (N)
C_{100}	= dynamic load rating for 100 km travel distance (N)
C_{50}	= dynamic load rating for 50 km travel distance (N)

Basic static load rating

The basic static load rating C_0 is the static load in the direction of loading which corresponds to a calculated stress at the centre of the most heavily loaded contact point between the rolling element and each of the raceways of carriage and rail. This stress produces a permanent total deformation of the rolling element and the raceway of approximately 0,0001 times of the rolling element diameter.

Table 1

Load ratings

Range	Size	Standard carriage TA, TAR		Extended length carriage LA, LAR	
		C	C_0	C	C_0
		N	N	N	N
Standard LLSH	7	915	1 460	1 270	2 400
	9	1 700	2 800	2 280	4 300
	12	2 500	3 900	3 550	6 300
	15	3 900	5 850	5 500	9 800
Wide LLSW	7	1 220	2 200	1 660	3 450
	9	2 160	4 050	2 850	5 850
	12	3 100	5 300	4 250	8 300
	15	5 000	8 500	6 550	12 500

2.1.2 Preload classes

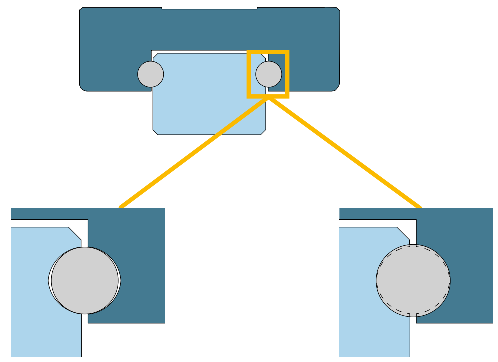
To adjust a profile rail guide to the specific requirements of a given application, it is advisable to choose an appropriate preload. Preload can enhance the performance of an entire linear guidance system and increase the rigidity of the carriage under load.

Preload is reached by using oversized rolling elements between carriage and rail raceways. The determination of the appropriate preload depends on the operation conditions. The preload class is mainly influencing the carriage rigidity and friction.

Ewellix recommends T0 preload class for applications with smooth running performance and low friction. For applications characterized by shock loads, vibration and alternating loads or torques, it is advisable to select the T1 preload class. The maximum preload T2 class is advisable to use only on the highest rigidity, torque or vibration demands regardless of the friction. In that case, Ewellix recommends you contact your local service partner for more detailed technical advice and support.

Fig. 1

Generation of preload



System with clearance *System with preload*

Table 2

Preload class	Characteristics	Preload force
T0	Light clearance, best smoothness running and lowest friction	F_{Pr} = 0 % of C
T1	Light preload, good smooth running and preloaded	F_{Pr} = 2 % of C
T2	Medium preload, higher preload force and rigidity	F_{Pr} = 8 % of C

2.1.3 Precision classes

Precision classes

Ewellix offers LLS miniature profile rail guides in two precision classes. These precision classes define the maximum tolerance range of a profile rail system in terms of height, width and running parallelism. This choice determines the running accuracy of the system within the application (↳ **table 3** and **diagram 1**).

When performing measurements of height, width or running parallelism, any clearance between rail and carriage has to be eliminated or controlled in a suitable way to get correct results.

Running parallelism

The running parallelism P_a is the tolerance between the two reference planes of the rail and carriage when the carriage is moved along the entire rail length, the rail being screwed to the reference plane. Please refer to **figure 2** and **diagram 1** for detailed information.

Fig. 2

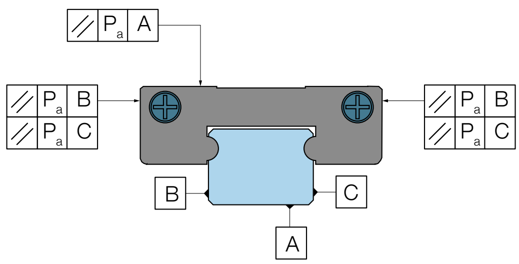
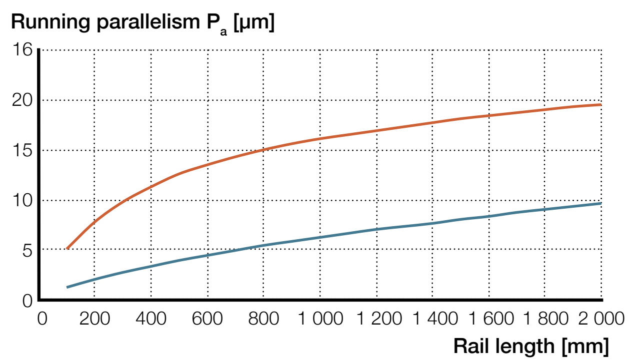


Diagram 1



— Accuracy class P1 — Accuracy class P5

Width and height precision

The dimension N determines the maximum deviation in width from the carriage to the rail in lateral direction. Both sides of the rail and the carriage can be used as the reference side (↳ **fig. 3**).

The dimension H determines the maximum deviation in height between the mounting surface of the carriage and the ground bottom surface of the rail (↳ **fig. 3**).

The tolerances H and N in **table 3** are valid for any carriage on any rail using ZRC components or between single systems (↳ **fig. 4**). The deviations ΔH and ΔN result, when multiple carriages are mounted on the same rail at one position (↳ **fig. 5**).

If the height deviation between systems is very important for an application, Ewellix is proposing to order parallel mounted rails. When ordering the rail arrangement "Wx" of parallel mounted rails, the height deviation ΔH is kept between different systems.

Combination of rails and carriages

All ZRC range carriages and rails of the same size in precision class P5 can be combined with each other while maintaining precision class P5. They are fully interchangeable. Precision class P1 can be delivered as a mounted system only.

Fig. 3

Definition of N and H

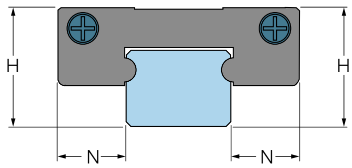


Fig. 4

For any combination of carriages and rails

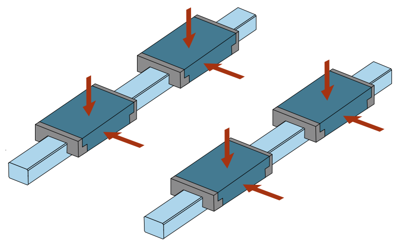


Fig. 5

For different carriages on the same rail position

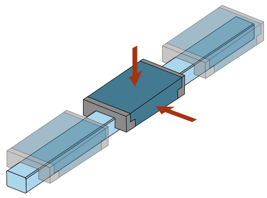


Table 3

Precision class	Tolerance between ZRC components or single systems [1)]		Dimensional deviations of carriages on the same rail		Dimensional deviations on parallel mounted rails (Wx)
	Any carriage on any rail		Multiple carriages on same rail at one position		Multiple carriages on number of ordered systems at one position
	H	N	ΔH	ΔN	ΔH
–	µm				
P5	±20	±25	15	15	15
P1	±10	±15	7	7	7

[1)] Measured at the center in length direction at both carriage surfaces

2.1.4 Rigidity

The rigidity of LLS miniature profile rail guides, in addition to their load carrying capacity, is an important criteria for product selection.

Rigidity can be defined as the deformation characteristics of a guidance system under external load. The rigidity of a system depends on the magnitude and direction of the external load, the type of guidance system (size, carriage type, preload) and the mechanical properties of the adjacent support structure.

The elasticity of the support structure, the screw connections and the joints between components impacts the overall rigidity at the bearing point.

Therefore, the overall rigidity at the bearing point is lower than that of the used guiding system.

The deformation behavior in top load direction of an LLS miniature profile rail guide system can be selected by the following diagrams (↳ **diagram 2 to 9**).

Rigidity values given in the diagrams are valid for one carriage of the shown types, for data on other types please contact Ewellix.

Diagram 2

Deformation for standard size LLSH 7 TA

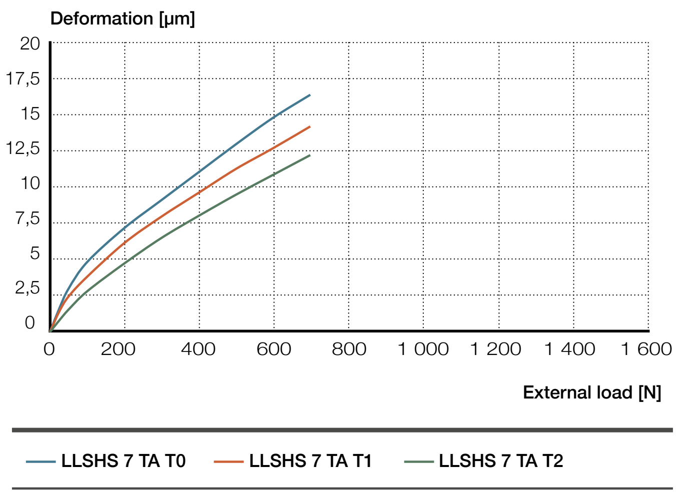


Diagram 3

Deformation for standard size LLSH 9 TA

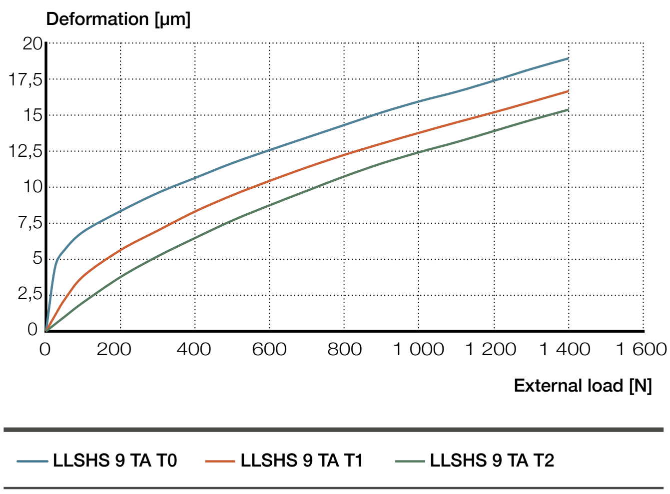


Diagram 4

Deformation for standard size LLSH 12 TA

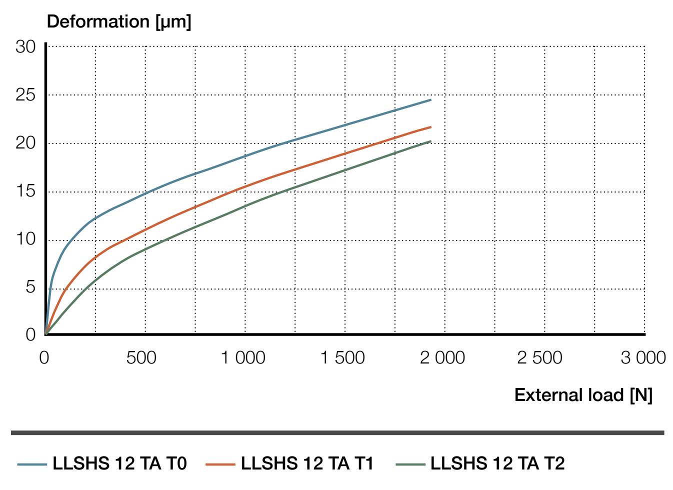


Diagram 5

Deformation for standard size LLSH 15 TA

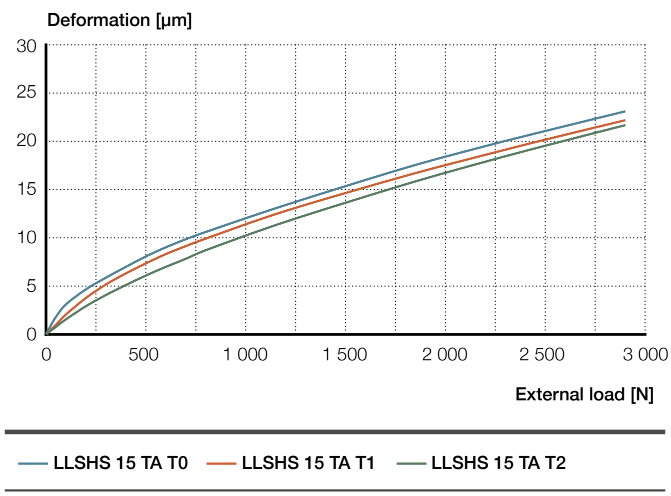


Diagram 6

Deformation for standard size LLSW 7 TA

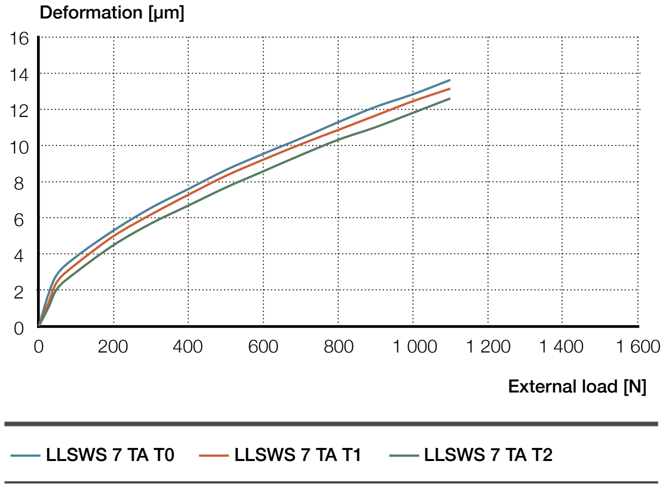


Diagram 7

Deformation for standard size LLSW 9 TA

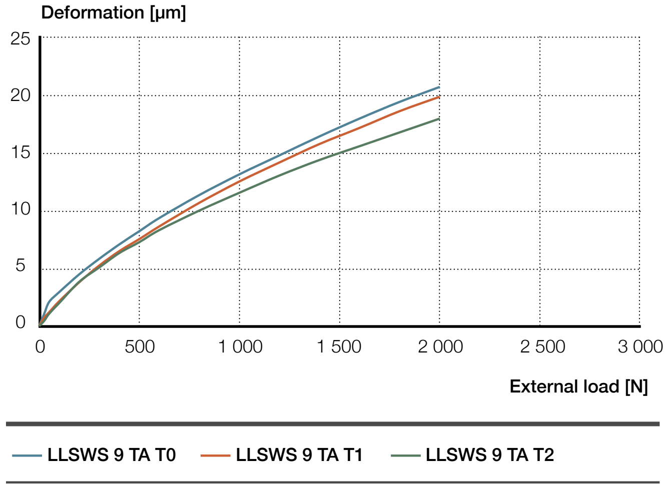


Diagram 8

Deformation for standard size LLSW 12 TA

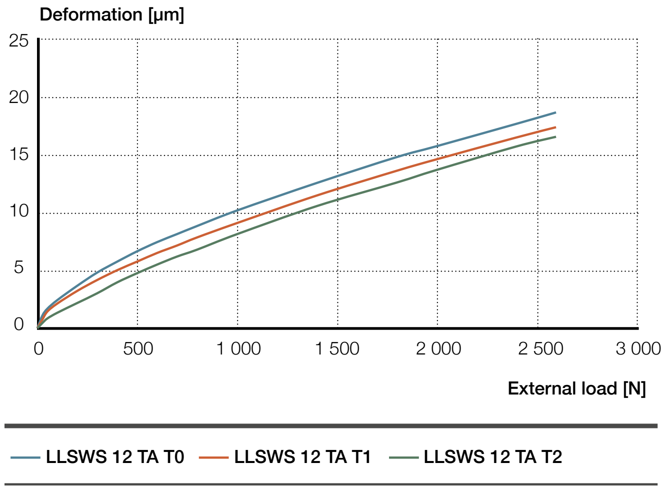
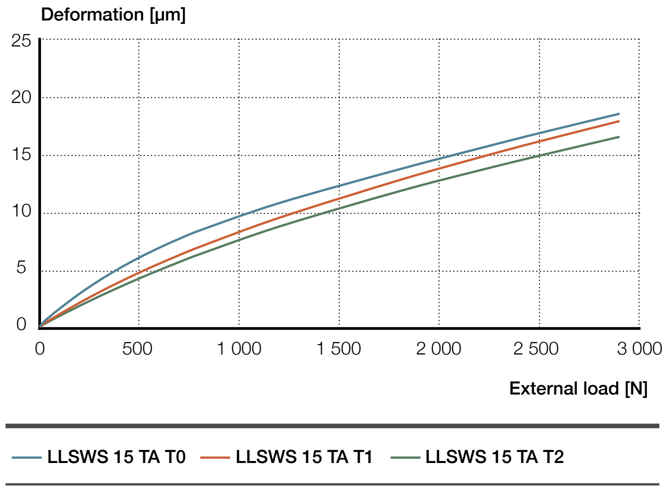


Diagram 9

Deformation for standard size LLSW 15 TA



2

2.1.5 Performance data

The function of LLS miniature profile rail guides can be ensured if they are used inside the limits of the below performance parameters. The dimensioning and calculations of miniature profile rails are valid when operating within these conditions.

Table 4

Performance

Speed	5 m/s
Acceleration	140 m/s^2
Preload class	T0, T1, T2
Accuracy class	P5, P1
Temperature (shielded)	-20° to + 100° C
Temperature (sealed)	-20° to + 80° C
Maximum load	< 0,5 C
Minimum load	> 0,001 C

Table 5

Material

Rail	Stainless steel, hardened
Carriage body	Stainless steel, hardened
Balls	Stainless steel, hardened
Ball recirculation	POM
Ball retention	Stainless steel
Seal	Elastomer, POM
Shield	POM
Lubrication reservoir	Foamed material
Factory lubrication with	Klüber Paraliq P 460
Compliance with	RoHS, REACH

Speed and acceleration

LLS miniature profile rail guides can be used up to a maximum speed of

v_{max} = 5 m/s

and a maximum acceleration of

a_{max} = 140 m/s^2

For applications with high acceleration, Ewellix is recommending a higher load than the minimum requested load or the use of preloaded carriages. Otherwise, the service life might be shorter than expected.

Minimum load

To ensure the slip-free running of profile rail guides, they must be subjected to a certain minimum load. The general guideline is a minimum value of P = 0,001 C. The minimum load is of special importance in profile rail guides which operate at high speed or with high acceleration. In such cases, the inertia forces of the balls as well as the rolling friction in the lubricant can have an adverse effect on the rolling conditions in the guide and can lead to damaging slip conditions between the balls and raceways

Maximum load

According to ISO 14728, Part 1, the calculation of bearing life is correct only when the equivalent dynamic load of a profile rail guide does not exceed 50% of the dynamic load rating C. In addition, the maximum load should never exceed 50% of the static load rating C_0, as stated in ISO 14728, Part 2.

Higher loads lead to an imbalance of stress distribution which can have a negative effect on bearing life. In case such conditions occur, please seek advice from your local Ewellix support team.

Operating temperature

The permissible temperature range for LLS miniature profile rail guides is:

Carriages with protection shields

–20 to 100 °C for continuous operation

Carriages with low friction front seals

–20 to +80 °C for continuous operation

In case you use your own choice of lubricant, be sure to check prior to use that the temperature limits of the lubricant can withstand elevated temperatures.

When planning to use the linear guide carriages outside the given temperature range, please get in contact with the Ewellix support team.

2.1.6 Friction

The friction in a guidance system is determined by a number of factors. For example, the preload class, external loads, speed of travel and viscosity of the lubricant should be taken into consideration.

Another factor is the sliding friction of the front seals in contact with the profile rail. The friction generated by the seals will, however, decrease after the running-in phase. The friction can be reduced to a minimum when shielded carriages are used. Due to the gap sealing ability, shielded carriages should only be considered for applications in clean environments.

Moreover, the mounting precision of the rails relative to each other plays an important part, just like the flatness of the carriage mounting plate or the evenness of the rail mounting surface.

The coefficient of friction for lubricated profile rail guides is typically between μ = 0,003 and 0,005. Lower values are valid for higher loads, and higher values for lower loads. The different friction forces for miniature profile rails are shown in **tables 6** and **7**.

Table 6

*Friction force of a **shielded** carriage with standard grease, precision class P5 or P1*

Range	**Size**	**Carriage type**	**Running friction force (N) max. per preload class**		
	–	–	T0	T1	T2
Standard LLSHS	7	Standard length TA	0,7	1,4	2,7
		Extended length LA	0,7	1,4	2,7
	9	Standard length TA	0,7	1,4	2,7
		Extended length LA	0,7	1,4	2,7
	12	Standard length TA	0,8	1,5	2,8
		Extended length LA	0,8	1,5	2,8
	15	Standard length TA	0,9	1,5	2,8
		Extended length LA	0,9	1,5	2,8
Wide LLSWS	7	Standard length TA	0,7	1,7	3,2
		Extended length LA	0,7	1,7	3,2
	9	Standard length TA	0,7	1,7	3,2
		Extended length LA	0,7	1,7	3,2
	12	Standard length TA	0,8	2,2	4,3
		Extended length LA	0,8	2,2	4,3
	15	Standard length TA	0,9	3,0	4,3
		Extended length LA	0,9	3,0	4,3

Table 7

*Friction force of a **sealed** carriage with standard grease, precision class P5 or P1*

Range	**Size**	**Carriage type**	**Running friction force (N) max. per preload class**		
	–	–	T0	T1	T2
Standard LLSHS	7	Standard length TA	1,0	1,7	3,0
		Extented length LA	1,0	1,7	3,0
	9	Standard length TA	1,0	1,7	3,0
		Extented length LA	1,0	1,7	3,0
	12	Standard length TA	1,1	1,8	3,1
		Extented length LA	1,1	1,8	3,1
	15	Standard length TA	1,2	1,8	3,1
		Extented length LA	1,2	1,8	3,1
Wide LLSWS	7	Standard length TA	1,0	2,0	3,5
		Extended length LA	1,0	2,0	3,5
	9	Standard length TA	1,0	2,0	3,5
		Extended length LA	1,0	2,0	3,5
	12	Standard length TA	1,1	2,5	4,6
		Extended length LA	1,1	2,5	4,6
	15	Standard length TA	1,2	3,3	4,6
		Extended length LA	1,2	3,3	4,6

NOTE: All information presented by Ewellix with regard to running friction force is based on the validation result without load with lubricant viscosity grade 460 under room temperature..

2.2 Selection of profile rail guides

The selection process for a suitable linear guide system is recommended to be done according to the following steps:

a. External force calculation (↳ **chapter 2.2.4**)
b. Selection of suitable type (↳ **chapter 3.1**)
c. Bearing load calculations (↳ **chapter 2.2.3**)
d. Rating life calculation (↳ **chapter 2.2.1**)
e. Static safety factor calculation (↳ **chapter 2.2.5**)

During this process, decisions on preload and precision class must be made as well as rigidity and performance data that must be checked. (↳ **chapter 2.1**)

Ewellix will explain the process by starting with the rating life followed by the influence factors, then explaining the bearing loads and external force calculations to finally reach the static calculation.

Linear guide on-line calculation tool

Ewellix is supporting the total calculation process from external forces to bearing loads, rating life and static safety factors with the linear guide calculator e-tool. The online calculation tool is free of charge, please follow the **QR code** link below. For more information, please have a look at **chapter 2.2.6**.

Linear guides select

2.2.1 Rating life

The rating life of a linear guide with rolling elements is defined as the total linear distance travelled by the linear guide before the first sign of material fatigue occurs at raceways or with rolling elements. For the selection of a linear guide based on rating life calculations, the dynamic load rating C should be used. It is expressed as the load that results in a bearing life of 100 km travel distance. To learn about the influence on other travel distances, at rating life calculations, please see **chapter 2.1.1**.

The basic rating life L is defined as 90 % of a large group of identical linear bearings under the same conditions that are expected to exceed or attain a travel distance of 100 km.

When all loads and motion parameters are known, the basic rating life of the selected linear guide can be calculated in kilometers or operating hours using the following formula:

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

(3) $$L_h = \frac{5 \cdot 10^7}{S_{sin} \cdot n \cdot 60} \left(\frac{C}{P}\right)^p$$

The basic rating life might be different taking all design and load conditions of an application into consideration. Also, the factors of influence described in **chapter 2.2.2** must be detected. With that information, the modified rating life can be calculated as follows:

(4) $$L = 100\, f_s \left(\frac{f_i \cdot C}{f_d \cdot F_{res}}\right)^p$$

where:

L = modified basic rating life [km]
L_h = modified basic rating life [h]
C = dynamic load rating [N]
P = equivalent dynamic load [N]
p = life exponent; p = 3 for balls
n = stroke frequency [double strokes/min]
S_{sin} = single stroke length [mm]
f_i = factor for bearing distance
f_s = factor for stroke length
f_d = factor for load conditions
F_{res} = resulting load [N] (↳ **chapter 2.2.3**)
100 = basic travel distance [km]

Ewellix recommends that to calculate the basic rating life for the carriage with the highest load, equation (**4**) can be directly used, when the load is constant in magnitude and direction. If the load and motion conditions vary, they must be split up in sequences with average load conditions as shown in **chapter 2.2.3**.

NOTE: According to ISO 14728, the rating life calculation is only valid if the dynamic load P does not exceed 50 % of the dynamic load rating C.

Service life

Compared to the calculated rating life, the service life describes the travel distance a linear guiding remains operational under the real application conditions. The service life might be higher or lower than the calculated rating life. That depends very much on:

- Proportion of material wear out
- Environmental conditions like temperature
- Contamination and seal functionality
- Correct lubrication and oil viscosity
- Stress and loads from misalignments
- Unknown loads or other forces or vibrations

If needed, the service life can be quantified under real machine test conditions or by comparison with similar applications.

2.2.2 Influence factors

The factors of influence are correcting the impact of design, motion and load conditions on the calculated rating life. Vast application experience and various test have resulted in the definition of the correction factors.

Stroke length factor

Strokes that are shorter than the carriage length have a negative impact on the achievable service life. If the stroke S is longer than the carriage length, the stroke length factor $f_s = 1$.

When the ratio between stroke S to carriage length L_2 (↳ **fig. 6**) is lower than 1,0, the stroke length factor can be taken from **table 8**.

Sub strokes at sequenced load phases with identical moving direction can be added together to one sub stroke S. For each sequenced load phase, the right factor f_s must be applied.

Table 8

Factor f_s for stroke length

S/L_2	f_s
1,0	1,0
0,9	0,91
0,8	0,82
0,7	0,73
0,6	0,63
0,5	0,54
0,4	0,44
0,3	0,34
0,2	0,23

Load condition factor

The load acting on a linear guide is resulting from acceleration, impact loads and vibration. Often it is difficult to quantify these additional dynamic forces exactly. For that reason, the load must be multiplied by factor f_d.

Depending on the speed or mean speed and strength of the impact load as well as on the vibrations which are relevant for the application, the values for f_d can be taken from **table 9.**

Table 9

Factor f_d for load conditions

Load conditions	f_d from	up to
Smooth operation, no or light impact loads Speed ≤ 2 m/s	1,0	1,5
High impact loads Speed > 2 m/s	1,5	3,0

Bearing distance factor

Most linear guide applications use two or more carriages on one rail to distribute load. The load distribution on the carriages is strongly influenced by the carriage distance c (↳ **fig. 6**) and the manufacturing quality of the adjacent components.

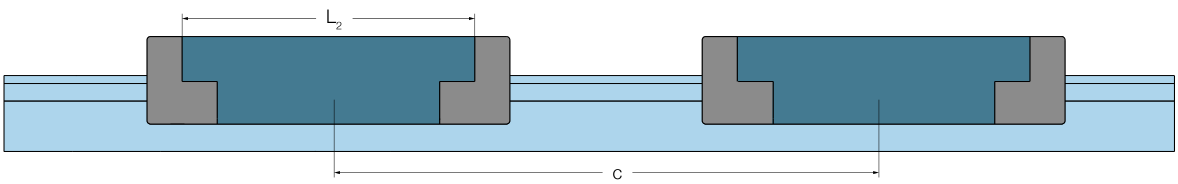
The bearing distance factor f_i takes the influences on carriage load distribution into account based on the number of carriages per rail and their distance relative to each other (↳ **table 10** and **fig. 6**)

Table 10

Factor f_i for bearing distance

Number of carriages	If $c \geq 1,5{*}L_2$ f_i	If $c < 1,5{*}L_2$ f_i
1	1	1
2	1	0,81
3	1	0,72

Fig. 6



2.2.3 Dynamic bearing loads

To calculate the dynamic bearing load, all loads and forces acting on the linear guide system must be taken into consideration. When load is constant in size, F_{res} or F_{comb} might be used to get the expected rating life. For most applications, different load phases and stroke sequences are the reality. In these cases, an equivalent dynamic mean load has to be determined to be used in the life calculation.

Equivalent dynamic mean load

For the equivalent dynamic mean load P_m, the various load and motions have to be separated into load phases with constant or approximately constant conditions along their individual strokes ((↳ **diagram 10**). All single load phases are summarized by the equivalent dynamic mean load depending on their individual stroke length. For each individual phase the factor for load condition as well as the factor for stroke length might be different and have to be determined accordingly. Normally, the factor of bearing distance stays constant during all load phases. ((↳ **formulae 5, 6 and 7**).

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

(6) $$S_{tot} = S_1 + S_2 + S_3 + \dots + S_j + \dots + S_v$$

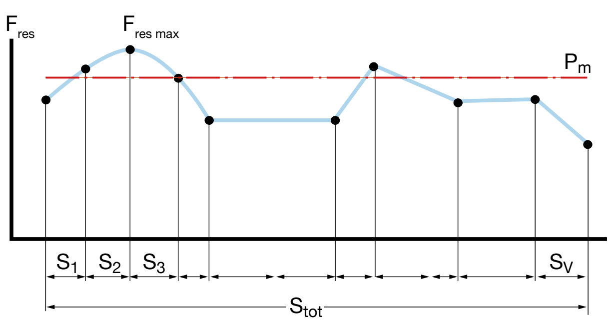
(7) $$P_j^p = \cdot \frac{F_{res,j}^{\ p} \cdot f_{d,j}}{f_i \cdot f_{s,j}^{1/p}}$$

where

P_m = equivalent dynamic mean load [N]
P_j = equivalent dynamic load of load phase [N]
j = counter of load phase
V = number of load phase
S_j = stroke length of load phase [mm]
$f_{d,j}$ = factor for load conditions of load phase
$f_{s,j}$ = factor for stroke length of load phase
f_i = factor for bearing distance
$F_{res,j}$ = resulting load of load phase j [N]
S_{tot} = total stroke length [mm]
p = life exponent; p = 3 for balls

Diagram 10

Variable load acting on a linear bearing



Resulting load and preload influence

The resulting load F_{res} for the total stroke or per load phase depends on the combined bearing load F_{comb} and the chosen preload class of the linear guide system. For linear guides with T0 preload, class F_{res} is equal to F_{comb}.

For preloaded systems, the preload force F_{Pr} has to be detected and taken into consideration according to the following differentiated load cases in **formula 8**.

(8a) $F_{res} = F_{comb}$ if $F_{comb} > 2{,}8\ F_{Pr}$

or

(8b) $F_{res} = \left(\frac{F_{comb}}{2{,}8 \cdot F_{Pr}} + 1\right)^{1{,}5} F_{Pr}$ if $F_{comb} \leq 2{,}8\ F_{Pr}$

where

F_{comb} = combined, static or dynamic bearing load [N]
F_{Pr} = preload force [N]
F_{res} = resulting load [N]

Table 11

Preload class	Preload force F_{Pr}
T0	F_{Pr} = 0 % of C
T1	F_{pr} = 2 % of C
T2	F_{pr} = 8 % of C

Combined bearing load

To calculate the combined bearing load F_{comb}, all bearing loads must be considered. All load components must be constant in magnitude to enable their calculation as one load phase. If one of the load proportions varies significantly in magnitude over the length of the stroke, a separate load phase must be created (↳ **diagram 10**). F_{comb} is used to calculate the resulting load F_{res}. The calculation formula is different depending on the chosen linear guide configuration.

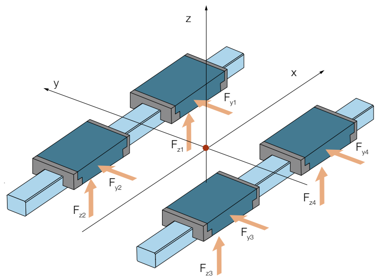
Normally the most loaded bearing point or carriage has to be taken into consideration for the calculation.

2

Configuration 24

Linear guide system with 2 carriages on each of the 2 guide rails

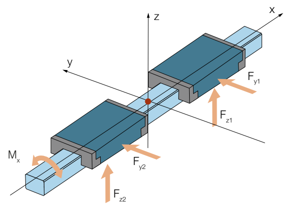
(9a) $$F_{comb} = |F_y| + |F_z|$$



Configuration 12

Linear guide system with 2 carriages on 1 guide rail

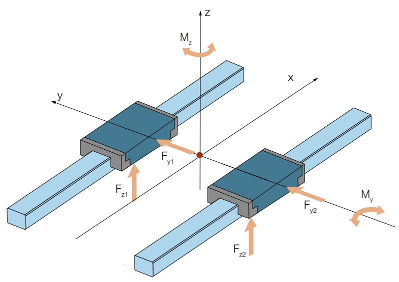
(9b) $$F_{comb} = |F_y| + |F_z| + C \left(\left| \frac{M_x}{M_{xC}} \right| \right)$$



Configuration 22

Linear guide system with 1 carriage on each of the 2 guide rails

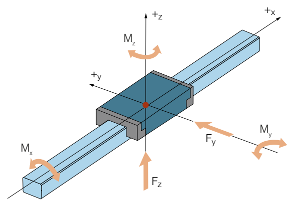
(9c) $$F_{comb} = |F_y| + |F_z| + C \left(\left| \frac{M_y}{M_{yC}} \right| + \left| \frac{M_z}{M_{zC}} \right| \right)$$



Configuration 11

Linear guide system with 1 carriage on 1 guide rail

(9d) $$F_{comb} = |F_y| + |F_z| + C \left(\left| \frac{M_x}{M_{xC}} \right| + \left| \frac{M_y}{M_{yC}} \right| + \left| \frac{M_z}{M_{zC}} \right| \right)$$



where

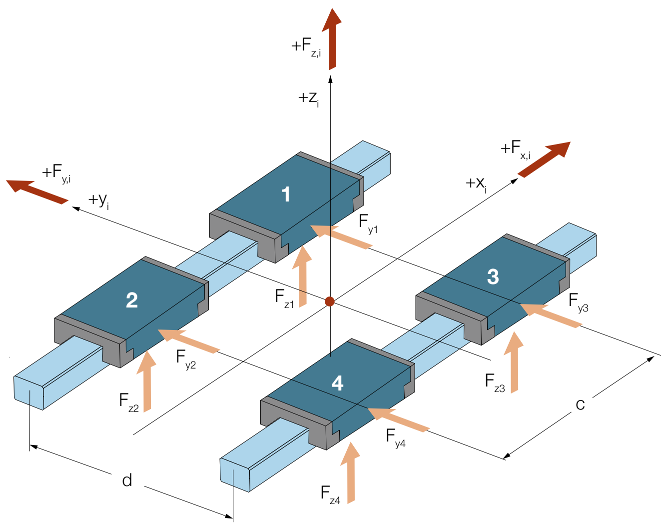
F_{comb} = combined bearing load
F_y = bearing load in y-direction [N]
F_z = bearing load in z-direction [N]
C = dynamic load rating [N]
M_x = bearing torque load of x-axis [Nmm]
M_y = bearing torque load of y-axis [Nmm]
M_z = bearing torque load of z-axis [Nmm]
M_{xC} = torque load rating of x-axis [Nmm]
M_{yC} = torque load rating of y-axis [Nmm]
M_{zC} = torque load rating of z-axis [Nmm]

2.2.4 External force calculation

The external force calculation is the translation of all loads to the bearing points. According to the selected linear guide configuration, the formulas for load determination are shown in this chapter. All loads acting on the guiding system must be broken down into the proportions F_x, and F_z. These proportions are then inserted into the respective formula.

Configuration 24

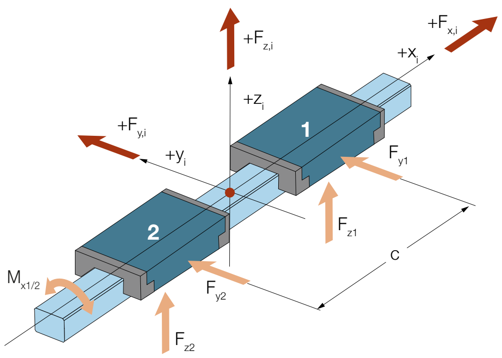
Loads on a system with 2 guide rails and 4 carriages



Carriage	Formula
1	Bearing load in z-direction $F_{z1}=\frac{\sum_{i=1}^{U}F_{z,i}}{4}+\frac{\sum_{i=1}^{U}(F_{z,i}\cdot y_i)-\sum_{i=1}^{U}(F_{y,i}\cdot z_i)}{2\cdot d}+\frac{\sum_{i=1}^{U}(F_{z,i}\cdot x_i)-\sum_{i=1}^{U}(F_{x,i}\cdot z_i)}{2\cdot c}$
2	Bearing load in z-direction $F_{z2}=\frac{\sum_{i=1}^{U}F_{z,i}}{4}+\frac{\sum_{i=1}^{U}(F_{z,i}\cdot y_i)-\sum_{i=1}^{U}(F_{y,i}\cdot z_i)}{2\cdot d}+\frac{\sum_{i=1}^{U}(F_{x,i}\cdot z_i)-\sum_{i=1}^{U}(F_{z,i}\cdot X_i)}{2\cdot c}$
3	Bearing load in z-direction $F_{z3}=\frac{\sum_{i=1}^{U}F_{z,i}}{4}+\frac{\sum_{i=1}^{U}(F_{y,i}\cdot z_i)-\sum_{i=1}^{U}(F_{z,i}\cdot y_i)}{2\cdot d}+\frac{\sum_{i=1}^{U}(F_{z,i}\cdot x_i)-\sum_{i=1}^{U}(F_{x,i}\cdot z_i)}{2\cdot c}$
4	Bearing load in z-direction $F_{z4}=\frac{\sum_{i=1}^{U}F_{z,i}}{4}+\frac{\sum_{i=1}^{U}(F_{y,i}\cdot z_i)-\sum_{i=1}^{U}(F_{z,i}\cdot y_i)}{2\cdot d}+\frac{\sum_{i=1}^{U}(F_{x,i}\cdot z_i)-\sum_{i=1}^{U}(F_{z,i}\cdot x_i)}{2\cdot c}$
1/3	Bearing load in y-direction $F_{y1}=F_{y3}=\frac{\sum_{i=1}^{U}F_{y,i}}{4}+\frac{\sum(F_{y,i}\cdot x_i)-\sum(F_{x,i}\cdot y_i)}{2\cdot c}$
2/4	Bearing load in y-direction $F_{y2}=F_{y4}=\frac{\sum_{i=1}^{U}F_{y,i}}{4}-\frac{\sum(F_{y,i}\cdot x_i)-\sum(F_{x,i}\cdot y_i)}{2\cdot c}$

Configuration 12

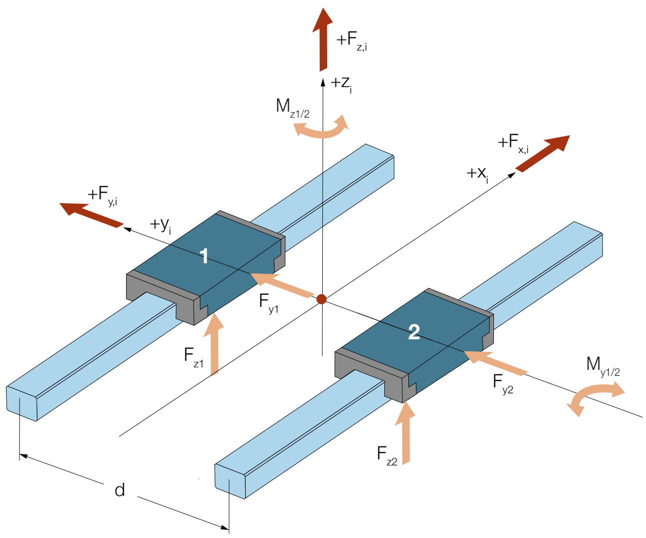
Loads on a system with 1 guide rail and 2 carriages



Carriage	Formula
1	Bearing load in z-direction $F_{z1}=\frac{\sum_{i=1}^{U}F_{z,i}}{2}-\frac{\sum_{i=1}^{U}(F_{x,i}\cdot z_i)-\sum_{i=1}^{U}(F_{z,i}\cdot x_i)}{c}$
2	Bearing load in z-direction $F_{z2}=\frac{\sum_{i=1}^{U}F_{z,i}}{2}+\frac{\sum_{i=1}^{U}(F_{x,i}\cdot z_i)-\sum_{i=1}^{U}(F_{z,i}\cdot x_i)}{c}$
1	Bearing load in y-direction $F_{y1}=\frac{\sum_{i=1}^{U}F_{y,i}}{2}-\frac{\sum_{i=1}^{U}(F_{x,i}\cdot y_i)-\sum_{i=1}^{U}(F_{y,i}\cdot x_i)}{c}$
2	Bearing load in y-direction $F_{y2}=\frac{\sum_{i=1}^{U}F_{y,j}}{2}+\frac{\sum_{i=1}^{U}(F_{x,i}\cdot y_i)-\sum_{i=1}^{U}(F_{y,i}\cdot x_i)}{c}$
1/2	Bearing torque load of x-axis $M_{x1}=M_{x2}=\frac{-\sum_{l=1}^{U}(F_{y,l}\cdot z_l)+\sum_{l=1}^{U}(F_{z,l}\cdot y_l)}{2}$

Configuration 22

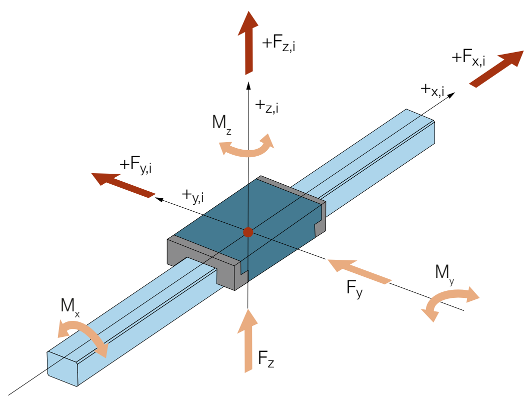
Loads on a system with 2 guide rails and 2 carriages



Carriage	Formula
1	Bearing load in z-direction $F_{z1} = \frac{\sum_{j=1}^{U} F_{z,j}}{2} - \frac{\sum_{j=1}^{U} (F_{y,j} \cdot z_j) - \sum_{j=1}^{U} (F_{z,j} \cdot y_j)}{d}$
2	Bearing load in z-direction $F_{z2} = \frac{\sum_{i=1}^{U} F_{z,i}}{2} + \frac{\sum_{i=1}^{U} (F_{y,i} \cdot z_i) - \sum_{i=1}^{U} (F_{z,i} \cdot y_i)}{d}$
1/2	Bearing load in y-direction $F_{y1} = F_{y2} = \frac{\sum_{i=1}^{U} F_{y,i}}{2}$
1/2	Bearing torque load of y-axis $M_{y1} = M_{y2} = \frac{\sum_{i=1}^{U} (F_{x,i} \cdot z_i) - \sum_{i=1}^{U} (F_{z,i} \cdot x_i)}{2}$
1/2	Bearing torque load of z-axis $M_{z1} = M_{z2} = \frac{-\sum_{i=1}^{U} (F_{x,i} \cdot y_i) + \sum_{i=1}^{U} (F_{y,i} \cdot y_i)}{2}$

Configuration 11

Loads on a system with 1 guide rail and 1 carriage

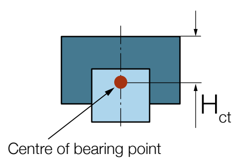


Carriage	Formula
1	Bearing load in z-direction $F_z = \sum_{i=1}^{U} F_{z,i}$
1	Bearing load in y-direction $F_y = \sum_{i=1}^{U} F_{y,i}$
1	Bearing torque load of x-axis $M_x = -\sum_{i=1}^{U} (F_{y,i} \cdot z_i) + \sum_{i=1}^{U} (F_{z,i} \cdot y_i)$
1	Bearing torque load of y-axis $M_y = \sum_{i=1}^{U} (F_{x,i} \cdot z_i) - \sum_{i=1}^{U} (F_{z,i} \cdot x_i)$
1	Bearing torque load of z-axis $M_z = -\sum_{i=1}^{U} (F_{x,i} \cdot y_i) + \sum_{i=1}^{U} (F_{y,i} \cdot x_i)$

Table 12

Bearing centre point

H_{ct} Values Type	 mm
LLSHS 7 TA / LA	4,6
LLSHS 9 TA / LA	5,1
LLSHS 12 TA / LA	6,5
LLSHS 15 TA / LA	9,0
LLSWS 7 TA / LA	5,1
LLSWS 9 TA / LA	7,0
LLSWS 12 TA / LA	7,9
LLSWS 15 TA / LA	9,0



where:

F_{y1} to Fy_4 = bearing load in y-direction at each bearing [N]
F_{z1} to F_{z4} = bearing load in z-direction at each bearing [N]
M_{1x}, M_{2x} = bearing torque load of x-axis [Nmm]
M_{1y}, M_{2y} = bearing torque load of y-axis [Nmm]
M_{1z}, M_{2z} = bearing torque load of z-axis [Nmm]
$F_{x,i}$, $F_{y,i}$, $F_{z,i}$ = external loads and accelerations in each direction [N]
x_i, y_i, z_i = lever arms of external loads [mm]
i = counter for external loads
U = number of loads that act simultaneously

2

2.2.5 Static bearing load

The static bearing load is the vertical load acting on a bearing point when the linear guide system is not in motion (↳ **Fig. 7**). For the static safety factor, the most loaded bearing point has to be checked against the static load rating. For that safety factor calculation it does not matter if the maximum load results from a static or dynamic impact. The maximum resulting force $F_{res\ max}$ has to be elaborated in the same way as the external force calculation and the dynamic bearing load determination in **chapter 2.2.4**. The results are used for the equivalent static bearing load.

Equivalent static bearing load

The maximum load P_{max} must include all forces acting on the bearing point. It is the point with the maximum resulting load $F_{res\ max}$ (↳ **diagram 10, chapter 2.2.3**) and must include the load condition factor as well as the preload calculation in **chapter 2.2.3** and can be calculated as follows.

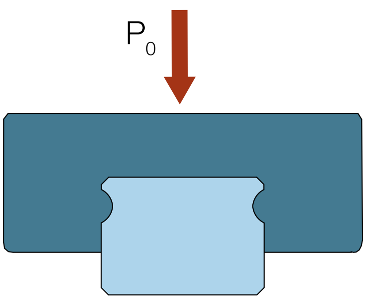
(10) $P_{max} = f_d \cdot F_{res\ max}$

where

P_{max} = maximum equivalent load
f_d = factor for load conditions
$F_{res\ max}$ = maximum resulting load

Fig. 7

Static load direction



Static safety factor

The static safety factor s_0 for linear guides is the relationship between the static load rating C_0 (↳ **chapter 2.1.1**) and the maximum vertical static bearing load P_0 or the maximum equivalent load P_{max}. For all applications, the safety factor should always be equal or above 2. The recommended safety factor per operating condition is defined in **table 12**.

For all linear guide selections, the calculation of the static safety factor has to be done according the formula below.

(11) $$s_0 = \frac{C_0}{P_0} = \frac{C_0}{P_{max}} = \frac{C_0}{f_d \cdot F_{res\ max}}$$

where

s_0 = static safety factor
C_0 = basic static load rating
P_0 = maximum vertical static load
P_{max} = maximum equivalent load
$F_{res\ max}$ = maximum resulting load
f_d = factor for load conditions

Table 12

Static safety factor recommendations

Operating conditions	s_0
Smooth operating conditions	≥ 2
Light vibrations or impact loads	2–4
Medium vibrations or impact loads	3–5
High vibrations or impact loads	> 5

IMPORTANT: Please always take into account the general technical rules and standards in the respective industry. If an application poses a risk of serious injury, the user must take appropriate design and safety measures that will prevent the linear guide from being detached or loosen from the structure.

2.2.6 Linear guide calculator

Ewellix linear guide calculator is a free online calculation tool. It is a self-explanatory e-tool to support all linear guide users perform a complete rating life and static bearing load calculation. The content of chapter 2 with all definitions, decisions and calculations has been transformed into this e-tool.

With that support it is much easier to determine what size of linear guide must be used for the given application. This online app makes product selection extremely efficient and supports the user in the design process.

The flow is like it is described in this catalogue:

1. Input of the motion cycles
2. Input of dynamic values of motion
3. Input of moved masses and operating loads
4. Input of drive forces
5. Decide on dimensional boundaries
6. Decide on preload class

When the input screens are completed, the user receives a clearly structured overview with results from which the final product can be selected as well as producing a report in pdf format. The detailed report contains:

- Summary input data
- Detailed dimensional drawings
- Load results per load phase
- List of factors of influence
- Modified basic rating life
- Results for static safety factor

And these calculations can be saved and reloaded for modification later on.

Follow the QR-code shown below to see this highly sophisticated online tool, free of charge at www.ewellix.com.

3

Product range

3.1 Carriage data

LLSHC ... TA

Standard carriage, shielded

Size	Load ratings	
	C	C_0
–	N	
7	915	1 460
9	1 700	2 800
12	2 500	3 900
15	3 900	5 850

LLSHC ... TA R

Standard carriage, sealed

Size	Load ratings	
	C	C_0
–	N	
7	915	1 460
9	1 700	2 800
12	2 500	3 900
15	3 900	5 850

LLSHC ... LA

Standard carriage extended length, shielded

Size	Load ratings	
	C	C_0
–	N	
7	1 270	2 400
9	2 280	4 300
12	3 550	6 300
15	5 500	9 800

LLSHC ... LA R

Standard carriage extended length, sealed

Size	Load ratings	
	C	C_0
–	N	
7	1 270	2 400
9	2 280	4 300
12	3 550	6 300
15	5 500	9 800

LLSWC ... TA

Wide carriage, shielded

Size	Load ratings	
	C	C_0
–	N	
7	1 220	2 200
9	2 160	4 050
12	3 100	5 300
15	5 000	8 500

LLSWC ... TA R

Wide carriage, sealed

Size	Load ratings	
	C	C_0
–	N	
7	1 220	2 200
9	2 160	4 050
12	3 100	5 300
15	5 000	8 500

LLSWC ... LA

Wide carriage extended length, shielded

Size	Load ratings	
	C	C_0
–	N	
7	1 660	3 450
9	2 850	5 850
12	4 250	8 300
15	6 550	12 500

LLSWC ... LA R

Wide carriage extended length, sealed

Size	Load ratings	
	C	C_0
–	N	
7	1 660	3 450
9	2 850	5 850
12	4 250	8 300
15	6 550	12 500

3.1.1 Standard carriage

LLSHC .. TA

- **Shielded** version with only rolling friction
- Available from size 7 to 15
- Available as system or separate as Zero Rail Concept type
- Made from stainless steel for corrosion protection
- Highest safety, with robust metal plate ball retention

LLSHC .. TA R

- **Sealed** version with very low friction seal
- Available from size 7 to 15
- Available as system or separate as Zero Rail Concept type
- Made from stainless steel for corrosion protection
- Highest safety, with robust metal plate ball retention

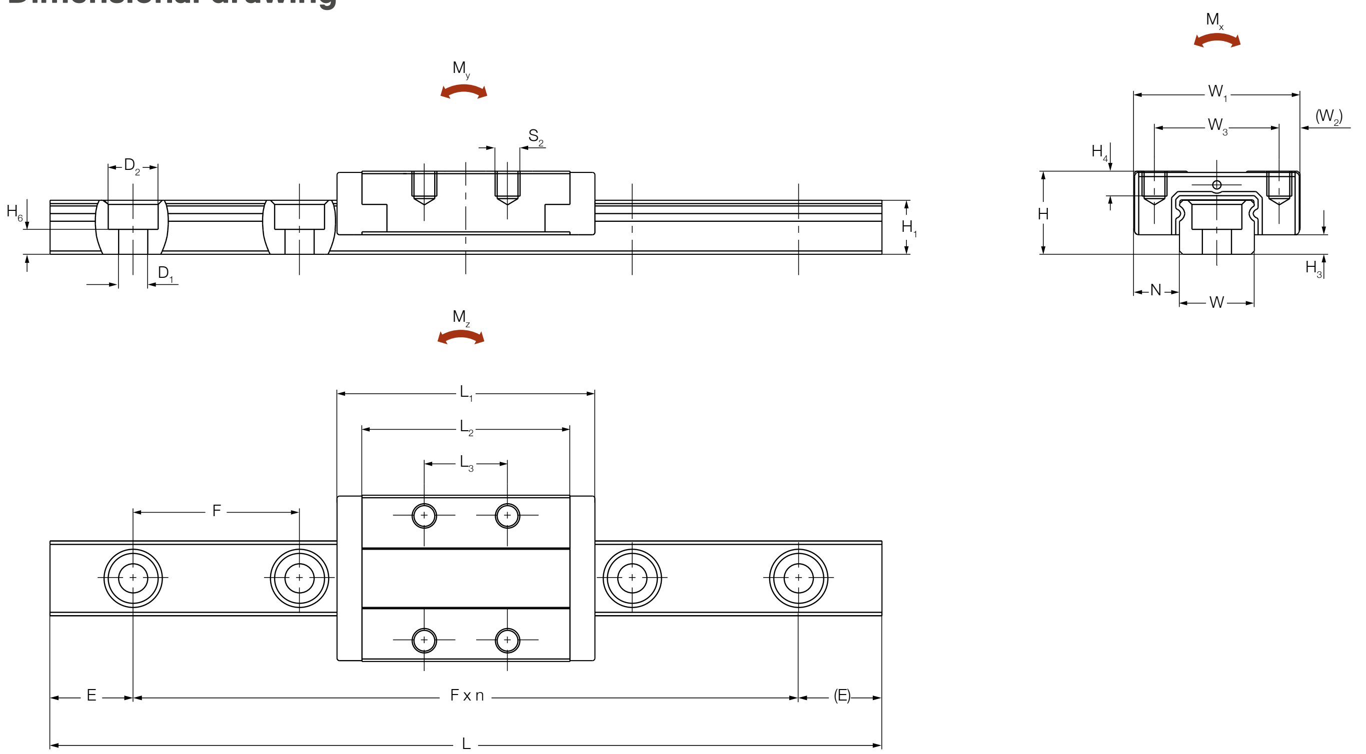
Range overview [1]

Series	Range	Type	Size	Carriage length	Shielded or Sealed	Preload class	Rail length [2]	Precision class	Parallel mounted rails	Zero Rail Concept
LLS	H	C, R, S	7, 9, 12, 15	TA	No code, R	T0, T1, T2	mm	P5, P1	No code ,W2,Wx	ZRC
Zero Rail concept series	Standard rail width	Carriage	**7**	Standard	No code, R	T0, T1	–	P5	–	ZRC
			9	Standard	No code, R	T0, T1	–	P5	–	ZRC
			12	Standard	No code, R	T0, T1	–	P5	–	ZRC
			15	Standard	No code, R	T0, T1	–	P5	–	ZRC
		Rail	**7**	–	–	–	max. 1 000	P5	–	ZRC
			9	–	–	–	max. 2 000	P5	–	ZRC
			12	–	–	–	max. 2 000	P5	–	ZRC
			15	–	–	–	max. 2 000	P5	–	ZRC
System series	Standard rail width	System	**7**	Standard	No code, R	T0, T1, T2	max. 1 000	P5, P1	No code ,W2,Wx	–
			9	Standard	No code, R	T0, T1, T2	max. 2 000	P5, P1	No code ,W2,Wx	–
			12	Standard	No code, R	T0, T1, T2	max. 2 000	P5, P1	No code ,W2,Wx	–
			15	Standard	No code, R	T0, T1, T2	max. 2 000	P5, P1	No code ,W2,Wx	–

[1] For detailed information about the complete ordering key and explanations, please have a look at **chapter 5.**
[2] Rails manufactured as cut to length might not be able to be delivered to the full length due to the E dimension.

Ordering and designation example:
Carriage: LLSHC 12 TA T0 P5 ZRC
Rail: LLSHR 12-550 P5 E0 ZRC
System : LLSHS9TA2T0-260P1/E0

Dimensional drawing



Technical data

Size	Assembly dimensions				Rail dimensions								
	W_1	H	N	H_3	W	H_1	H_6	F	D_1	D_2	E_{min} [1]	E_{max} [1]	L_{max} [2]
–	mm												
7	17	8	5	1,5	7	4,8	2,3	15	2,5	4,5	4	11	1 000
9	20	10	5,5	2,35	9	6,5	3	20	3,5	6	5	15	2 000
12	27	13	7,5	3,35	12	8,8	4,3	25	3,5	6	5	20	2 000
15	32	16	8,5	4	15	9,5	5	40	3,5	6	5	35	2 000

Size	Carriage dimensions							Weight		Load ratings [3]		Moments [3]			
								carriage	rail	dynamic	static	dynamic	static	dynamic	static
	L_1	L_2	L_3	W_2	W_3	S_2	H_4			C	C_0	M_{xC}	M_{xC_0}	$M_{yC}=M_{zC}$	$M_{yC_0}=M_{zC_0}$
–	mm							kg	kg/m	N		Nm			
7	23,5	18	8	2,5	12	M2	2,5	0,012	0,230	915	1 460	3	4,6	1,7	2,6
9	31	25	10	2,5	15	M3	3	0,021	0,395	1 700	2 800	7,1	11,5	4,6	7,5
12	35	29	15	3,5	20	M3	3,5	0,041	0,745	2 500	3 900	14	21,5	7,5	11,7
15	44	37	20	3,5	25	M3	4	0,080	1,035	3 900	5 850	23,6	38,9	14,3	23,9

[1] Tolerance of E dimension is ±0,5 mm. One of the E dimension will be produced within the given tolerance. The second (E) dimension is for reference only. Pls contact your Ewellix representative in case the tolerance of the (E) dimensions is relevant for your application.
[2] Rails manufactured as cut to length might not be able to be delivered to the full length due to the E dimension. Tolerance for rail cut to length is ±1,5 mm while the tolerance for standard rail length is on request.
[3] Dynamic load capacities and moments are based on a travel life of 100 km. Please refer to **chapter 2** for further details.

3

3.1.2 Standard carriage extended length

LLSHC .. LA

- Standard **long** carriage with higher performance
- **Shielded** version with only rolling friction
- Available from size 7 to 15
- Available as system or separate as Zero Rail Concept type
- Made from stainless steel for corrosion protection
- Highest safety, with robust metal plate ball retention

LLSHC .. LA R

- Standard **long** carriage with higher performance
- **Sealed** version with very low friction seal
- Available from size 7 to 15
- Available as system or separate as Zero Rail Concept type
- Made from stainless steel for corrosion protection
- Highest safety, with robust metal plate ball retention

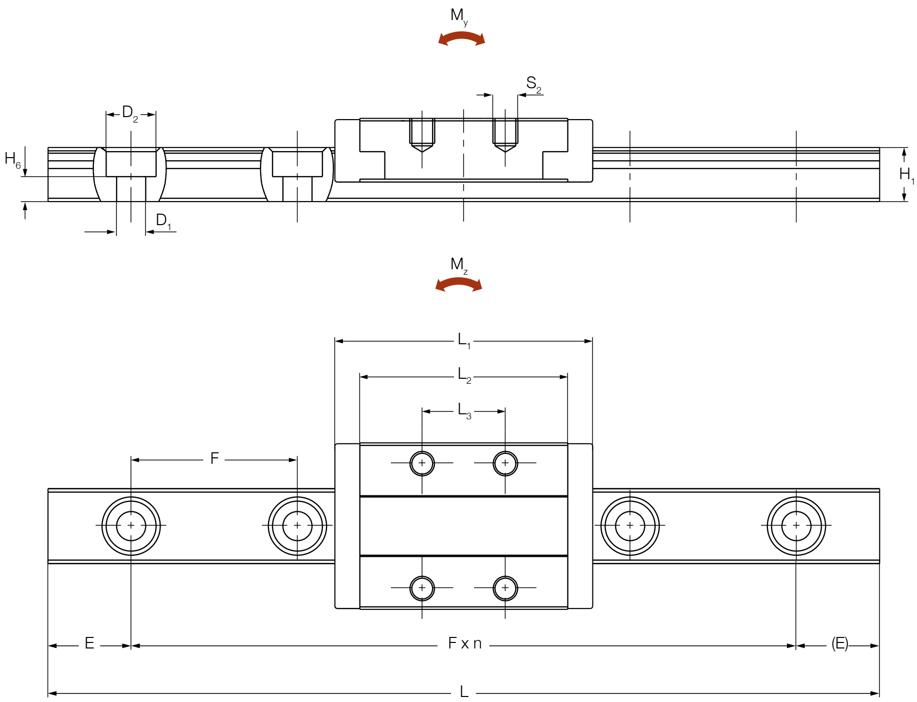
Range overview [1)]

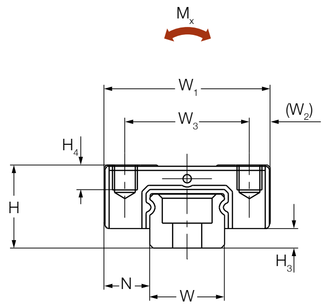
Series	**Range**	**Type**	**Size**	**Carriage length**	**Shielded or Sealed**	**Preload class**	**Rail length [2)]**	**Precision class**	**Parallel mounted rails**	**Zero Rail Concept**
LLS	H	C, R, S	7, 9, 12, 15	LA	No code, R	T0, T1, T2	mm	P5, P1	No code, W2, Wx	ZRC
Zero Rail concept series	Standard rail width	Carriage	**7**	Extended	No code, R	T0, T1	–	P5	–	ZRC
			9	Extended	No code, R	T0, T1	–	P5	–	ZRC
			12	Extended	No code, R	T0, T1	–	P5	–	ZRC
			15	Extended	No code, R	T0, T1	–	P5	–	ZRC
		Rail	**7**	–	–	–	max. 1 000	P5	–	ZRC
			9	–	–	–	max. 2 000	P5	–	ZRC
			12	–	–	–	max. 2 000	P5	–	ZRC
			15	–	–	–	max. 2 000	P5	–	ZRC
System series	Standard rail width	System	**7**	Extended	No code, R	T0, T1, T2	max. 1 000	P5, P1	No code,W2, Wx	–
			9	Extended	No code, R	T0, T1, T2	max. 2 000	P5, P1	No code,W2, Wx	–
			12	Extended	No code, R	T0, T1, T2	max. 2 000	P5, P1	No code,W2, Wx	–
			15	Extended	No code, R	T0, T1, T2	max. 2 000	P5, P1	No code,W2, Wx	–

[1)] For detailed information about the complete ordering key and explanations, please have a look at **chapter 5**.
[2)] Rails manufactured as cut to length might not be able to be delivered to the full length due to the E dimension.

Ordering and designation example:
Carriage: LLSHC 12 LAR T0 P5 ZRC
Rail: LLSHR 12-550 P5 E0 ZRC
System : LLSHS9LA2T0-260P1/E0

Dimensional drawing





3

Technical data

Size	Assembly dimensions				Rail dimensions								
	W_1	H	N	H_3	W	H_1	H_6	F	D_1	D_2	E_{min} 1)	E_{max} 1)	L_{max} 2)
–	mm												
7	17	8	5	1,5	7	4,8	2,3	15	2,5	4,5	4	11	1 000
9	20	10	5,5	2,35	9	6,5	3	20	3,5	6	5	15	2 000
12	27	13	7,5	3,35	12	8,8	4,3	25	3,5	6	5	20	2 000
15	32	16	8,5	4	15	9,5	5	40	3,5	6	5	35	2 000

Size	Carriage dimensions							Weight		Load ratings 3)		Moments 3)			
								carriage	rail	dynamic	static	dynamic	static	dynamic	static
	L_1	L_2	L_3	W_2	W_3	S_2	H_4			C	C_0	M_{xC}	M_{xC_0}	$M_{yC}=M_{zC}$	$M_{yC_0}=M_{zC_0}$
–	mm							kg	kg/m	N		Nm			
7	31,5	26	13	2,5	12	M2	2,5	0,017	0,230	1 270	2 400	3,9	7,9	4,2	8,7
9	40,5	34,5	16	2,5	15	M3	3	0,028	0,395	2 280	4 300	8,8	18,5	9,3	20,0
12	46,5	40,5	20	3,5	20	M3	3,5	0,057	0,745	3 550	6 300	18,5	35,9	17,0	33,4
15	62	55	25	3,5	25	M3	4	0,119	1,035	5 500	9 800	34,0	64,1	33,0	63,3

1) Tolerance of E dimension is ±0,5 mm. One of the E dimension will be produced within the given tolerance. The second (E) dimension is for reference only. Pls contact your Ewellix representative in case the tolerance of the (E) dimensions is relevant for your application.

2) Rails manufactured as cut to length might not be able to be delivered to the full length due to the E dimension. Tolerance for rail cut to length is ±1,5 mm while the tolerance for standard rail length is on request.

3) Dynamic load capacities and moments are based on a travel life of 100 km. Please refer to **chapter 2** for further details.

3.1.3 Wide carriage

LLSWC .. TA

- **Wide** carriage for higher moment load
- **Shielded** version with only rolling friction
- Available from size 7 to 15
- Available as system or separate as Zero Rail Concept type
- Made from stainless steel for corrosion protection
- Highest safety, with robust metal plate ball retention

LLSWC .. TA R

- **Wide** carriage for higher moment load
- **Sealed** version with very low friction seal
- Available from size 7 to 15
- Available as system or separate as Zero Rail Concept type
- Made from stainless steel for corrosion protection
- Highest safety, with robust metal plate ball retention

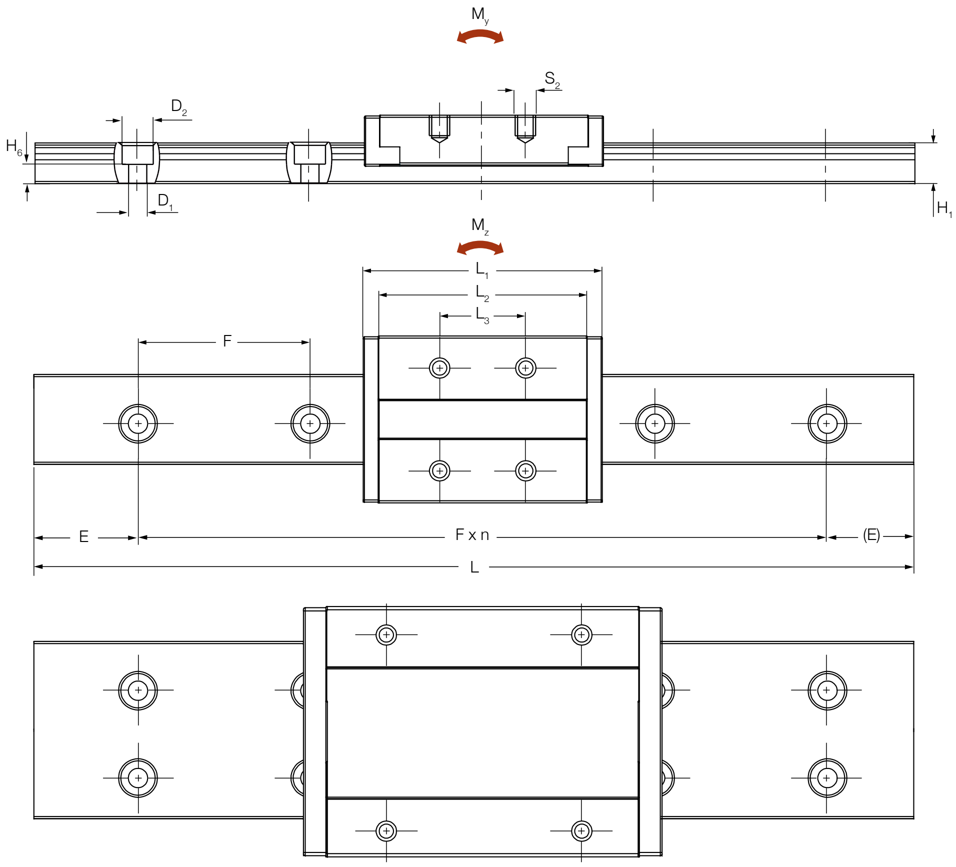
Range overview [1)]

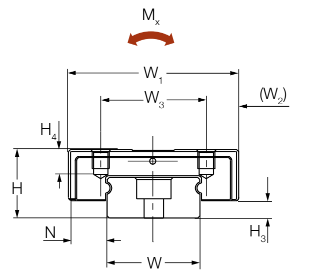
Series	Range	Type	Size	Carriage length	Shielded or Sealed	Preload class	Rail length [2)]	Precision class	Parallel mounted rails	Zero Rail Concept
LLS	W	C, R, S	7, 9, 12, 15	TA	No code, R	T0, T1, T2	mm	P5, P1	No code, W2, Wx	ZRC
Zero Rail concept series	Wide rail width	Carriage	**7**	Standard	No code, R	T0, T1	–	P5	–	ZRC
			9	Standard	No code, R	T0, T1	–	P5	–	ZRC
			12	Standard	No code, R	T0, T1	–	P5	–	ZRC
			15	Standard	No code, R	T0, T1	–	P5	–	ZRC
		Rail	**7**	–	–	–	max. 2000	P5	–	ZRC
			9	–	–	–	max. 2000	P5	–	ZRC
			12	–	–	–	max. 2000	P5	–	ZRC
			15	–	–	–	max. 2000	P5	–	ZRC
System series	Wide rail width	System	**7**	Standard	No code, R	T0, T1, T2	max. 2000	P5, P1	No code, W2, Wx	–
			9	Standard	No code, R	T0, T1, T2	max. 2000	P5, P1	No code, W2, Wx	–
			12	Standard	No code, R	T0, T1, T2	max. 2000	P5, P1	No code, W2, Wx	–
			15	Standard	No code, R	T0, T1, T2	max. 2000	P5, P1	No code, W2, Wx	–

1) For detailed information about the complete ordering key and explanations, please have a look at **chapter 5**.
2) Rails manufactured as cut to length might not be able to be delivered to the full length due to the E dimension.

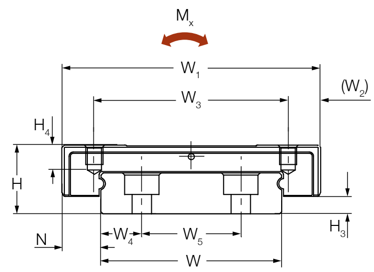
Ordering and designation example:
Carriage: LLSWC 12 TAR T0 P5 ZRC
Rail: LLSWR 12-550 P5 E0 ZRC
System: LLSWS9TA2T0-260P1/E0

Dimensional drawing





For LLSW 7/9/12



For LLSW 15

Technical data

Size	Assembly dimensions				Rail dimensions										
	W_1	H	N	H_3	W	W_4	W_5	H_1	H_6	F	D_1	D_2	E_{min} [1]	E_{max} [1]	L_{max} [2]
–	mm														
7	25	9	5,5	2	14	–	–	5,2	1,7	30	3,5	6	5	25	2 000
9	30	12	6	2,5	18	–	–	7	2,5	30	3,5	6	5	25	2 000
12	40	14	8	3	24	–	–	8,5	4	40	4,5	8	6	34	2 000
15	60	16	9	4	42	9,5	23	9,5	5	40	4,5	8	6	34	2 000

Size	Carriage dimensions							Weight		Load ratings [3]		Moments [3]			
								carriage	rail	dynamic	static	dynamic	static	dynamic	static
	L_1	L_2	L_3	W_2	W_3	S_2	H_4			C	C_0	M_{xC}	M_{xC_0}	$M_{yC}=M_{zC}$	$M_{yC_0}=M_{zC_0}$
–	mm							kg	kg/m	N		Nm			
7	31	25,5	10	3	19	M3	3	0,024	0,540	1 220	2 200	8,2	14,7	3,6	6,4
9	39	33	12	4,5	21	M3	3	0,051	0,940	2 160	4 050	17,4	36,2	8,2	17,3
12	43,5	37,5	15	6	28	M3	3,5	0,085	1,525	3 100	5 300	36,0	69,1	14,7	28,5
15	55,5	48,5	20	7,5	45	M4	4,5	0,169	2,960	5 000	8 500	94	178,8	28,4	54,3

[1] Tolerance of E dimension is ±0,5 mm. One of the E dimension will be produced within the given tolerance. The second (E) dimension is for reference only. Pls contact your Ewellix representative in case the tolerance of the (E) dimensions is relevant for your application.
[2] Rails manufactured as cut to length might not be able to be delivered to the full length due to the E dimension. Tolerance for rail cut to length is ±1,5 mm while the tolerance for standard rail length is on request.
[3] Dynamic load capacities and moments are based on a travel life of 100 km. Please refer to **chapter 2** for further details.

3.1.4 Wide carriage extended length

LLSWC .. LA

- **Wide long** carriage with higher performance
- **Shielded** version with only rolling friction
- Available from size 7 to 15
- Available as system or separate as Zero Rail Concept type
- Made from stainless steel for corrosion protection
- Highest safety, with robust metal plate ball retention

LLSWC .. LA R

- **Wide long** carriage with higher performance
- **Sealed** version with very low friction seal
- Available from size 7 to 15
- Available as system or separate as Zero Rail Concept type
- Made from stainless steel for corrosion protection
- Highest safety, with robust metal plate ball retention

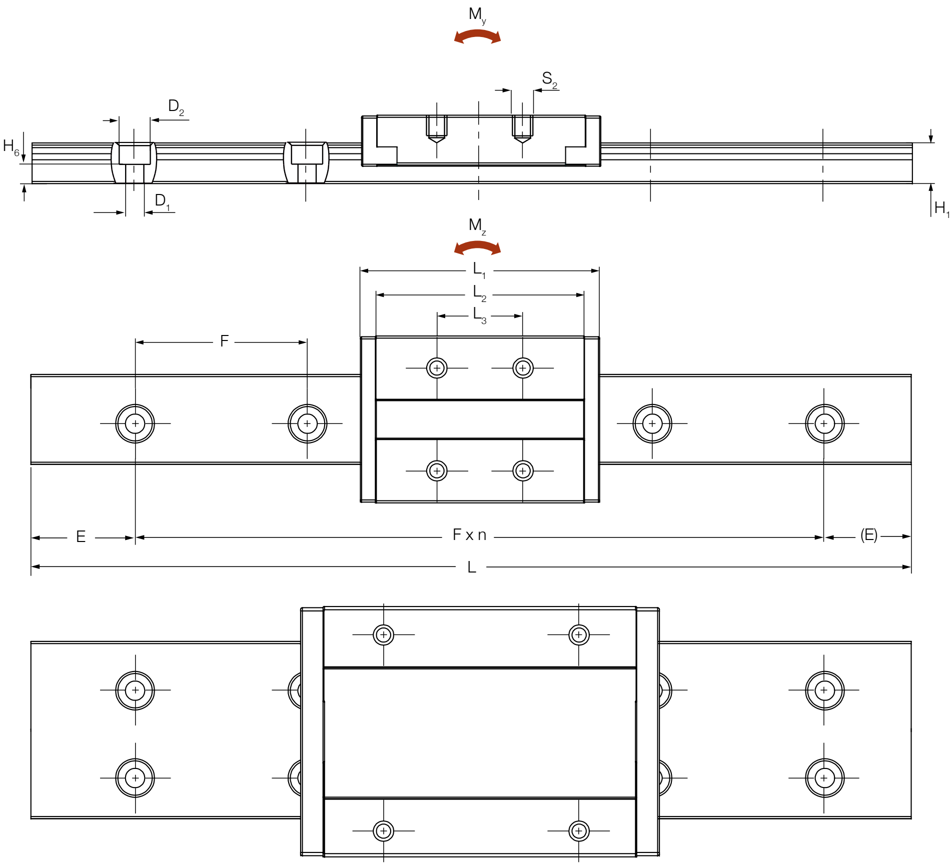
Range overview [1)]

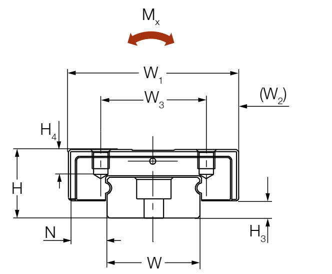
Series	Range	Type	Size	Carriage length	Shielded or Sealed	Preload class	Rail length [2)]	Precision class	Parallel mounted rails	Zero Rail Concept
LLS	W	C, R, S	7, 9, 12, 15	LA	No code, R	T0, T1, T2	mm	P5, P1	No code, W2, Wx	ZRC
Zero Rail concept series	Wide rail width	Carriage	**7**	Extended	No code, R	T0, T1	–	P5	–	ZRC
			9	Extended	No code, R	T0, T1	–	P5	–	ZRC
			12	Extended	No code, R	T0, T1	–	P5	–	ZRC
			15	Extended	No code, R	T0, T1	–	P5	–	ZRC
		Rail	**7**	–	–	–	max. 2 000	P5	–	ZRC
			9	–	–	–	max. 2 000	P5	–	ZRC
			12	–	–	–	max. 2 000	P5	–	ZRC
			15	–	–	–	max. 2 000	P5	–	ZRC
System series	Wide rail width	System	**7**	Extended	No code, R	T0, T1, T2	max. 2 000	P5, P1	No code, W2, Wx	–
			9	Extended	No code, R	T0, T1, T2	max. 2 000	P5, P1	No code, W2, Wx	–
			12	Extended	No code, R	T0, T1, T2	max. 2 000	P5, P1	No code, W2, Wx	–
			15	Extended	No code, R	T0, T1, T2	max. 2 000	P5, P1	No code, W2, Wx	–

[1)] For detailed information about the complete ordering key and explanation, please have a look at **chapter 5**.
[2)] Rails manufactured as cut to length might not be able to be delivered to the full length due to the E dimension.

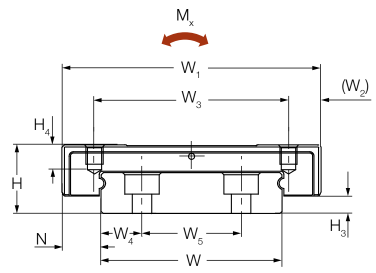
Ordering and designation example:
Carriage: LLSWC 12 LAR T0 P5 ZRC
Rail: LLSWR 12-550 P5 E0 ZRC
System : LLSWS9LA2T0-260P1/E0

Dimensional drawing





For LLSW 7/9/12



For LLSW 15

Technical data

Size	Assembly dimensions				Rail dimensions										
	W_1	H	N	H_3	W	W_4	W_5	H_1	H_6	F	D_1	D_2	E_{min} 1)	E_{max} 1)	L_{max} 2)
–	mm														
7	25	9	5,5	2	14	–	–	5,2	1,7	30	3,5	6	5	25	2000
9	30	12	6	2,5	18	–	–	7	2,5	30	3,5	6	5	25	2000
12	40	14	8	3	24	–	–	8,5	4	40	4,5	8	6	34	2000
15	60	16	9	4	42	9,5	23	9,5	5	40	4,5	8	6	34	2000

Size	Carriage dimensions							Weight		Load ratings 3)		Moments 3)			
								carriage	rail	dynamic	static	dynamic	static	dynamic	static
	L_1	L_2	L_3	W_2	W_3	S_2	H_4			C	C_0	M_{xC}	M_{xC_0}	$M_{yC}=M_{zC}$	$M_{yC_0}=M_{zC_0}$
–	mm							kg	kg/m	N		Nm			
7	41,5	36	19	3	19	M3	3	0,034	0,540	1660	3450	11,2	23,0	7,6	15,8
9	50,5	44,5	24	3,5	23	M3	3	0,068	0,940	2850	5850	22,6	51,7	15,6	36,1
12	58	52	28	6	28	M3	3,5	0,118	1,525	4250	8300	45,3	96,8	26,9	57,9
15	74,5	67,5	35	7,5	45	M4	4,5	0,236	2,960	6550	12500	116,5	241,8	50,5	105,5

1) Tolerance of E dimension is ±0,5 mm. One of the E dimension will be produced within the given tolerance. The second (E) dimension is for reference only. Pls contact your Ewellix representative in case the tolerance of the (E) dimensions is relevant for your application.
2) Rails manufactured as cut to length might not be able to be delivered to the full length due to the E dimension. Tolerance for rail cut to length is ±1,5 mm while the tolerance for standard rail length is on request.
3) Dynamic load capacities and moments are based on a travel life of 100 km. Please refer to **chapter 2** for further details.

3.2 Rail data

3.2.1 Standard rails

LLSHR

- Standard rail width for standard carriages
- Available from size 7 to 15
- Available as system or separate as Zero Rail Concept type
- Made from stainless steel for corrosion protection
- With two reference sides for flexible mounting

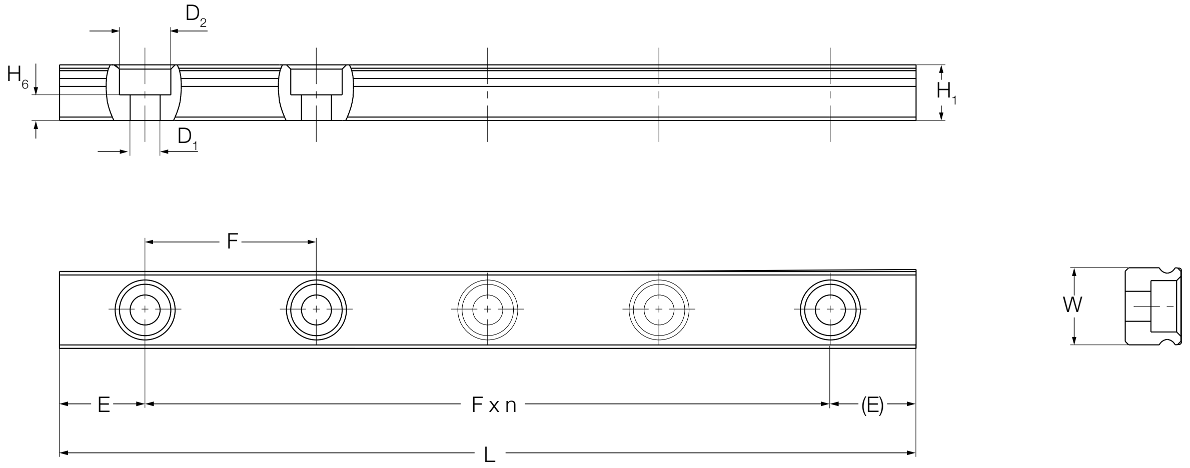
Range overview [1]

Series	Range	Type	Size	Rail length [2]	Precision class	Parallel mounted rails	Zero Rail Concept
LLS	H	C, R, S	7, 9, 12, 15	mm	P5, P1	No code, W2, Wx	ZRC
Zero Rail concept series	Standard rail width	Rail	**7**	max. 1 000	P5	–	ZRC
			9	max. 2 000	P5	–	ZRC
			12	max. 2 000	P5	–	ZRC
			15	max. 2 000	P5	–	ZRC
System series	Standard rail width	System	**7**	max. 1 000	P5, P1	No code, W2, Wx	–
			9	max. 2 000	P5, P1	No code, W2, Wx	–
			12	max. 2 000	P5, P1	No code, W2, Wx	–
			15	max. 2 000	P5, P1	No code, W2, Wx	–

[1] For detailed information about the complete ordering key and explanation, please have a look at **chapter 5**.
[2] Rails manufactured as cut to length might not be able to be delivered to the full length due to the E dimension.

Ordering and designation example:
Rail 1: LLSHR 12-550 P5 D E0 ZRC
Rail 2: LLSHR 12-1050 P5 E0 ZRC

Dimensional drawing



Technical data [1)]

Size	Rail dimensions									Weight rail
	W	H_1	H_6	F	D_1	D_2	E_{min} [2)]	E_{max} [2)]	L_{max} [3)]	
–	mm									kg/m
7	7	4,8	2,3	15	2,5	4,5	4	11	1 000	0,230
9	9	6,5	3	20	3,5	6	5	15	2 000	0,395
12	12	8,8	4,3	25	3,5	6	5	20	2 000	0,745
15	15	9,5	5	40	3,5	6	5	35	2 000	1,035

[1)] Suitable mounting screws and recommended tightening torques are listed in **chapter 4.1.3**.
[2)] Tolerance of E dimension is ±0,5 mm. One of the E dimension will be produced within the given tolerance. The second (E) dimension is for reference only. Pls contact your Ewellix representative in case the tolerance of the (E) dimensions is relevant for your application.
[3)] Rails manufactured as cut to length might not be able to be delivered to the full length due to the E dimension. Tolerance for rail cut to length is ±1,5 mm while the tolerance for standard rail length is on request.

3.2.2 Wide rails

LLSWR ..

- Wide rail width for wide carriages
- Available from size 7 to 15
- Available as system or separate as Zero Rail Concept type
- Made from stainless steel for corrosion protection
- With two reference sides for flexible mounting

Range overview [1)]

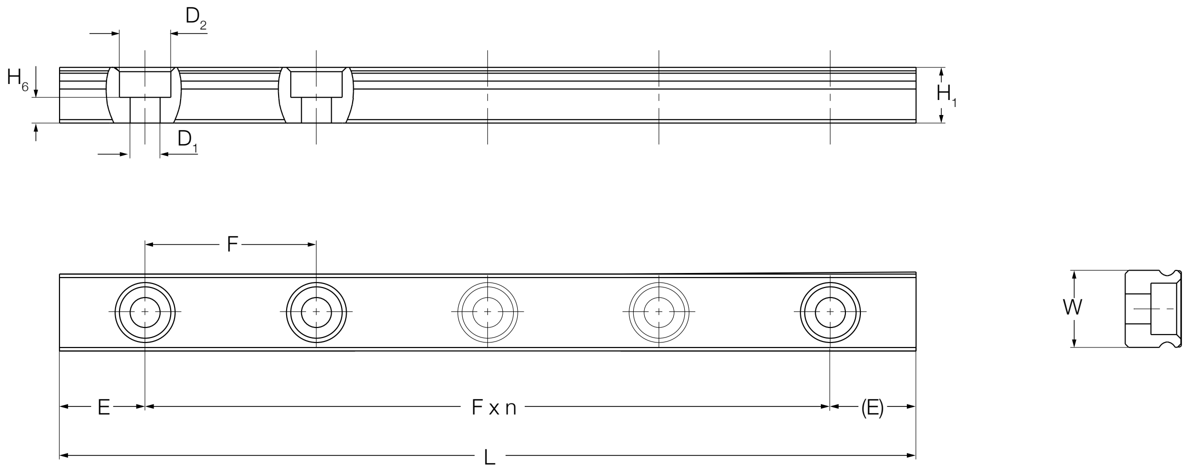
Series	Range	Type	Size	Rail length [2)]	Precision class	Parallel mounted rails	Zero Rail Concept
LLS	W	C, R, S	7, 9, 12, 15	mm	P5, P1	No code, W2, Wx	ZRC
Zero Rail concept series	Wide rail width	Rail	**7**	max. 2000	P5	–	ZRC
			9	max. 2000	P5	–	ZRC
			12	max. 2000	P5	–	ZRC
			15	max. 2000	P5	–	ZRC
System series	Wide rail width	System	**7**	max. 2000	P5, P1	No code, W2, Wx	–
			9	max. 2000	P5, P1	No code, W2, Wx	–
			12	max. 2000	P5, P1	No code, W2, Wx	–
			15	max. 2000	P5, P1	No code, W2, Wx	–

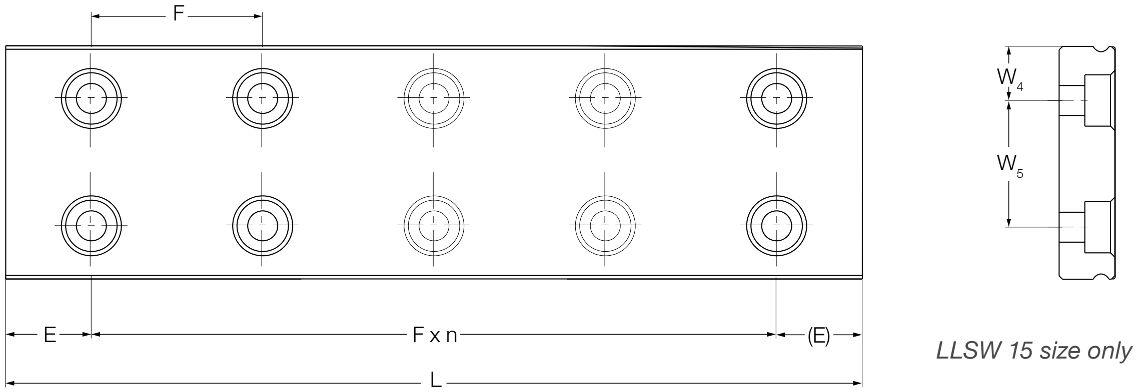
[1)] For detailed information about the complete ordering key and explanation, please have a look at **chapter 5**.
[2)] Rails manufactured as cut to length might not be able to be delivered to the full length due to the E dimension.

Ordering and designation example:
Rail 1: LLSWR 12-550 P5 D E0 ZRC
Rail 2: LLSWR 12-1050 P5 E0 ZRC

ALMOTION EWELLIX

Dimensional drawing





Technical data 1)

Size	Rail dimensions											Weight rail
	W	W_4	W_5	H_1	H_6	F	D_1	D_2	E_{min} [2)]	E_{max} [2)]	L_{max} [3)]	
–	mm											kg/m
7	14	–	–	5,2	1,7	30	3,5	6	5	25	2000	0,540
9	18	–	–	7	2,5	30	3,5	6	5	25	2000	0,940
12	24	–	–	8,5	4	40	4,5	8	6	34	2000	1,525
15	42	9,5	23	9,5	5	40	4,5	8	6	34	2000	2,960

1) Suitable mounting screws and recommended tightening torques are listed in **chapter 4.1.3**.
2) Tolerance of E dimension is ±0,5 mm. One of the E dimension will be produced within the given tolerance. The second (E) dimension is for reference only. Pls contact your Ewellix representative in case the tolerance of the (E) dimensions is relevant for your application.
3) Rails manufactured as cut to length might not be able to be delivered to the full length due to the E dimension. Tolerance for rail cut to length is ±1,5 mm while the tolerance for standard rail length is on request.

3

3.2.3 Number of holes and E-dimension

The “E” dimension is the distance from the rail end to centre of the first attachment hole. If no specific “E” dimension is requested, the rails are produced with similar "E" dimensions at both ends. The Number of rail attachment holes z and the "E" dimensions can be calculated as follows:

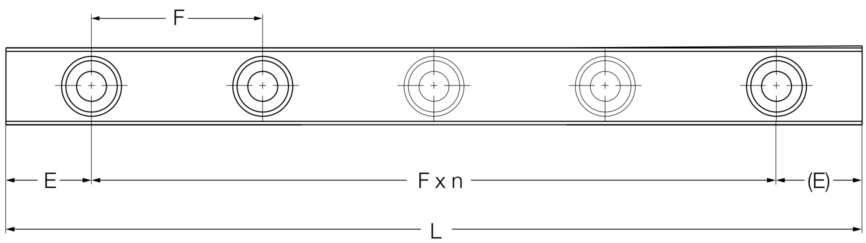
$$z = 1 + \mathrm{TRUNC}\left(\frac{L-2 \cdot E_{min}}{F}\right)$$

$$E = \left(\frac{L-F\,(z-1)}{2}\right)$$

z = Number of attachment holes in rail
F = Distance of attachment holes
L = Rail length
E_{min} = Minimum E-dimension according to catalogue
E = E-dimension

NOTE: "TRUNC" is the mathematical function that truncates a number to an integer by removing the fractional part of the number.

Dimension scheme on rails



Range	Size	F	E_{min} [1)]	E_{max} [1)]	L_{max} [2)]
	–	mm			
Standard type rail	**7**	15	4	11	1 000
	9	20	5	15	2 000
	12	25	5	20	2 000
	15	40	5	35	2 000
Wide type rail	**7**	30	5	25	2 000
	9	30	5	25	2 000
	12	40	6	34	2 000
	15	40	6	34	2 000

[1)] Tolerance of E dimension is ±0,5 mm. One of the E dimension will be produced within the given tolerance. The second (E) dimension is for reference only. Pls contact your Ewellix representative in case the tolerance of the (E) dimensions is relevant for your application.
[2)] Rails manufactured as cut to length might not be able to be delivered to the full length due to the E dimension. Tolerance for rail cut to length is ±1,5 mm while the tolerance for standard rail length is on request.

4

Mounting and maintenance

4.1 Design rules

4.1.1 Use of profile rails

To maintain the high precision of Ewellix LLS profile rail guides, the carriages and rails must be handled carefully during transport and mounting.

To provide protection during transport, storage and assembly, LLS rails and carriages are coated with a corrosion inhibiting compound. For details about the compound please see **table 1** below.

The corrosion protection does not need to be removed before using. For optimized running performance, Ewellix recommends removal of the anti-rust oil at the rails.

Tab. 1

Produce type	Compound type
System	Standard lubricant
ZRC range carriages	Standard lubricant
ZRC range cutted rails	Standard lubricant
ZRC range rails in 1 or 2 m length	Anti-rust oil

4.1.2 Typical mounting

Rails

Each rail has ground reference surfaces on both sides.

Options for securing the rails laterally (↳ fig. 1)

1. Stop edges
2. Retaining strips

Rails that are not lateral fixed must be installed straight and parallel **(↳ fig. 2)**. Ewellix recommends using retaining strips to maintain the position of the rails during installation.

Carriage

Each carriage has ground reference surfaces on both sides.

Options for securing the carriages lateral (↳ fig. 1)

3. Stop edges
4. Retaining strips

NOTE: If mounted correctly, the carriage should move easily on the rail when pushed.

Fig. 1

Mounting with lateral fixed rails and carriages

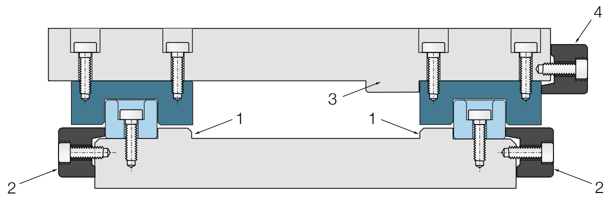
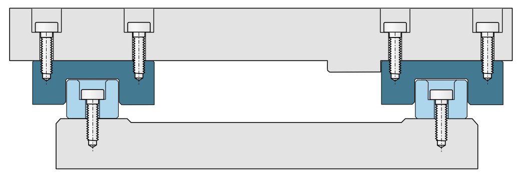


Fig. 2

Mounting without lateral rail support

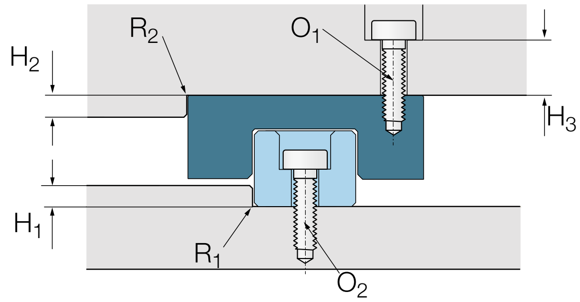


4.1.3 Interface design and bolt torque

Figure 3 shows the ideal mounting arrangement for LLS miniature profile rail guides. Carriages and rails can be mounted at both sides as they do have a reference surface on both sides. Ewellix recommends that you have the stop edges of the carriage and rail on the same side of the linear guide system.

To ensure the right tolerances to enable a perfect fit to the surrounding design, specific at the edges, Ewellix suggests you follow the detailed dimensions recommended in **table 3**.

Fig. 3



Tightening torque for bolts

Table 2 shows the maximum tightening torques for fixing bolts depending on the thread size.

Table 2

Tightening torque of fixing bolts	
Thread size	Maximum tightening torque Ncm
M2	32
M3	110
M4	260

Table 3

Size	**Dimensions**						**Screw**	
	H_1	H_1	R_1	H_2	R_2	H_3	O_1	O_2
	min	max	max		max			
-	mm							
7	1,1	1,3	0,3	2,2	0,2	2,8	M2 × 5	M2 × 5
9	1,3	1,6	0,3	2,5	0,2	5,3	M3 × 8	M3 × 8
12	2	2,6	0,4	3,5	0,2	6,8	M3 × 10	M3 × 10
15	3	3,6	0,4	4,5	0,4	6,8	M3 × 10	M3 × 10
7 wide	1,1	1,7	0,3	2,2	0,2	2,8	M3 × 5	M3 × 5
9 wide	1,3	1,9	0,3	2,5	0,2	5,3	M3 × 8	M3 × 8
12 wide	2	2,6	0,4	3,5	0,2	6,8	M3 × 10	M4 × 10
15 wide	3	3,6	0,4	4,5	0,4	6,0	M4 × 10	M4 × 12

4.1.4 Maximum height deviation

The values for height deviation in lateral and longitudinal direction are applicable for all carriage types.

If the values for height deviation S_1 (↳ **table 4**) and S_2 (↳ **table 5**) are within the specified range, the service life of the rail guide system will not be influenced.

Maximum lateral height deviation

The maximum height deviation in lateral direction S_1 on parallel rail installations is related to preload class and rail distance d (↳ **table 4**).

It can be calculated with the lateral factor Y for preload class and should never exceed the height tolerances described in **table 3** at **chapter 2.1.3**. Precision classes.

$S_1 = d \cdot Y$ and $S_1 < 2 \cdot H$ or $S_1 < \Delta H$

where

S_1 = Maximum lateral height deviation [mm]

d = Distance between parallel rails [mm]

Y = Calculation factor for lateral direction

H = System height tolerance per precision class [mm]

ΔH = Height deviation on parallel mounted rails [mm]

If the lateral height deviation S_1 exceeds 2 times of H or ΔH, a different preload class or precision class should be used. Another possibility is to order the miniature profile rails as parallel mounted rails "W2" in the ordering key to fulfill the requirements. When S_1 is still higher, then Ewellix recommends another design layout.

Maximum longitudinal height deviation

The maximum height deviation in longitudinal direction S2 on profile rail systems with more than one carriage on the same rail is related to the carriage type and distance c (↳ **table 5**).

It can be calculated with the longitudinal factor X for the different carriage types and should never exceed the height deviation ΔH described in **table 3** at **chapter 2.1.3**. Precision classes.

$S_2 = c \cdot X$ and $S_2 < \Delta H$

where

S_2 = Maximum lateral height deviation [mm]

c = Distance between carriages [mm]

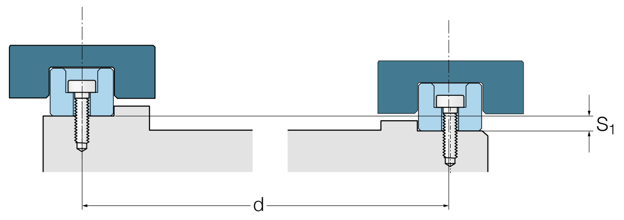
X = Calculation factor for longitudinal direction

ΔH = Height deviation of multiple carriages on same rail [mm]

If the longitudinal height deviation S_2 is exceeding ΔH, a different carriage type or precision class should be used. When S_2 is still higher, then Ewellix recommends another design layout.

Table 4

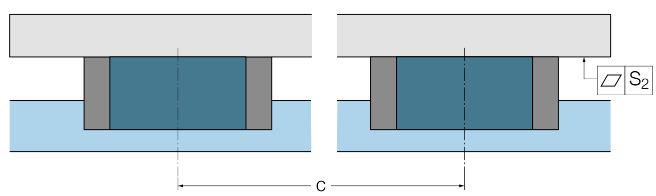
Height deviation in lateral direction



Lateral factor	**Preload class**		
	T0	T1	T2
Y	$3{,}0 \times 10^{-4}$	$1{,}5 \times 10^{-4}$	$1{,}0 \times 10^{-4}$

Table 5

Height deviation in longitudinal direction



Longitudinal factor	**Carriage length**	
	TA standard	LA extended
X	7×10^{-5}	7×10^{-5}

4.1.5 Parallelism of guide systems

The parallelism of mounted rails is measured on the rails and the carriages. The values for the deviation in parallelism S_3 are applicable to all carriage and rail types.

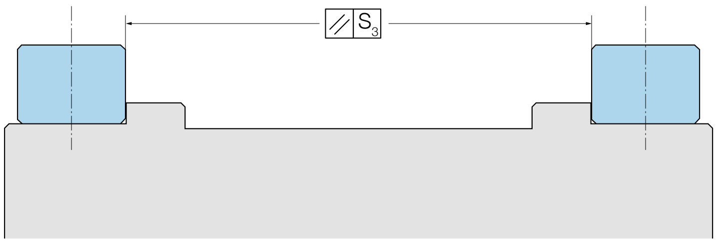
Deviations in parallelism S_3 increase the internal load. If the values are within the specified range in **table 4**, the service life of the profile rail guide system will not be influenced.

For typical applications, the mounting surface can be slightly resilient.

However, for very high-precision applications, the mounting surface must be rigid and the values in the table have to be cut in half.

Table 6

Maximum deviation in parallelism S_3



Size	Range	Preload class		
		T0	T1	T2
–		µm	µm	µm
7	standard / wide	5	2	1
9	standard / wide	6	3	2
12	standard / wide	7	4	2
15	standard / wide	10	7	4

4

4.1.6 Tolerance of rail mounting holes

For suitable designs of mounting threads or holes, please find below the tolerance of distances between the mounting holes of miniature profile rails .

For standard and wide rails with center mounting holes, please see **figure 4** and for wide size 15 with two mounting hole rows, please see **figure 5**.

Fig. 4

Standard and wide rails with center mounting holes

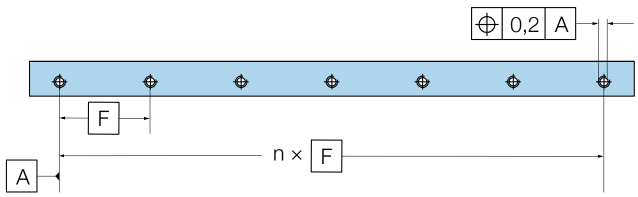
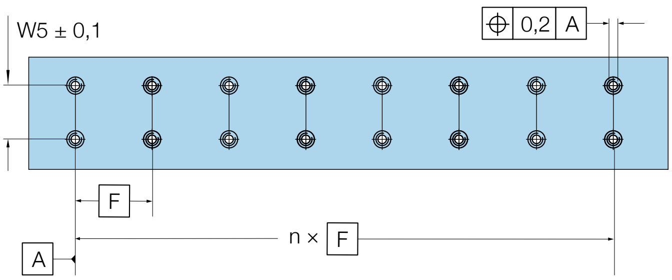


Fig. 5

15 wide rails with two mounting hole rows



4.2 Mounting profile rail guides

4.2.1 Packaging (Shipment)

For the systems, the carriages have been mounted on the rail, and the system will be wrapped in a plastic foil. For the ZRC carriages and ZRC rails, the rails and carriages are delivered in their own packaging. Unwrap these components carefully.

4.2.2 Mounting the ZRC carriages

Be sure the ends of the rail are deburred to avoid damaging the front seals or internal components. As both sides of the rail and carriage are the reference surfaces, the carriage can be mounted in both directions. The LLS carriages contain an innovative ball retention, so the carriage can be mounted without a mounting sleeve. Slide the carriage straight and carefully onto the rail, avoiding any misalignment (↳ **see beside QR-code**).

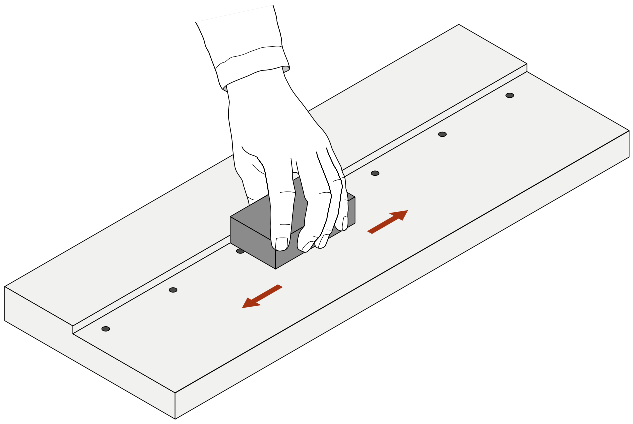
[Video: LLS - Miniature profile rail mounting]

4.2.3 Preparation

The threaded holes on the base plate must be first prepared according to the rail size. Make sure that the contact surfaces are flat and free of any damage or burrs. Use an oil stone to smooth them if necessary (↳ **fig 6**). Check the stop edges for dimensional and position precision and inspect the corner radii (↳ **4.1.3, table 3**). Clean the contact surfaces thoroughly. Coat them with a thin coat of light oil to prevent corrosion. Make sure that the rails, carriages, base plate, mounting plate and fastening screws all have the same temperature during installation.

Remove the corrosion inhibiting compound from the rail or carriage surfaces that are in contact with other parts. Then apply a thin coat of light oil to these surfaces. Be sure that all drilled and tapped holes are clean and free of debris prior to mounting.

Fig. 6



4

4.2.4 Mounting the rail

1. Place the rail gently onto the base plate.
2. Insert the screws, making sure that they are unobstructed, e.g. the mounting holes are properly aligned.
3. Partially tighten the bolts. Push the rail against the stop edge (↳ **fig. 7**). The stop edge can be directly machined in the mounting surface or an external/mobile support strip that is only there for mounting. If necessary, hold the rail in place with a retaining strip **(↳ 4.1.2, fig 1**). In cases where no lateral support is provided, use an external reference surface (↳**fig. 8**) or a straight edge for alignment.
4. Using a torque wrench, tighten the centre mounting screw. Then, tighten the remaining screws using an alternating pattern (↳ **fig. 9**). Torque values are listed in **4.1.3, table 2**.
5. Check the parallelism of the fastened rail to the specific reference. Result should be better than values in **4.1.5, table 6**.

4.2.5 Parallel alignment of rail

The already aligned and fastened rail is defined as the master rail. Depending on the base plate design, there are several options for mounting subsidiary rails. Please choose the suitable option listed below.

Mounting option I

Mounting with two stop edges on the base plate. If stop edges are provided on both sides of the base plate (↳ **fig 10**), please proceed as described above in **4.2.4, Mounting the rail**.

Fig. 7

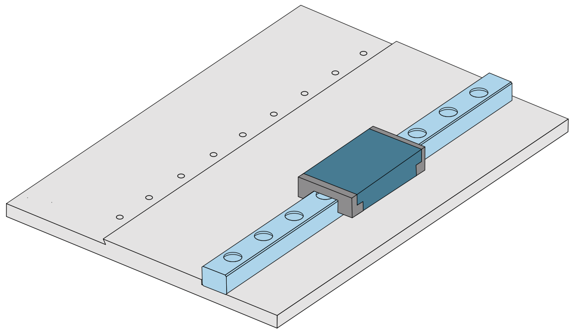


Fig. 8

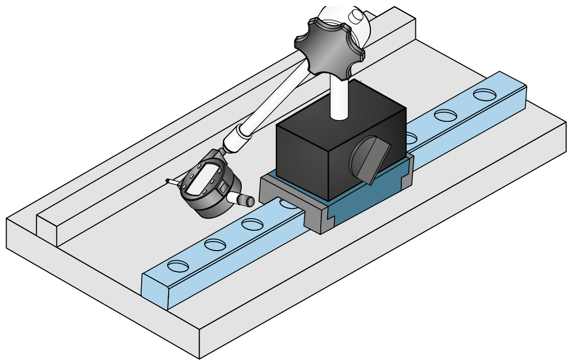


Fig. 9

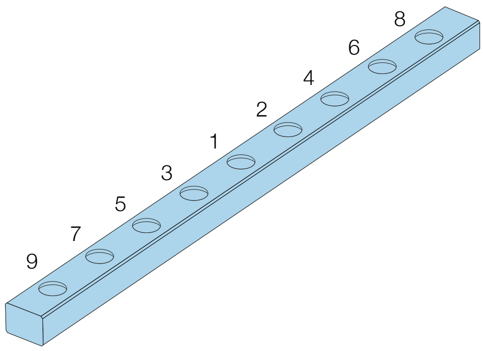
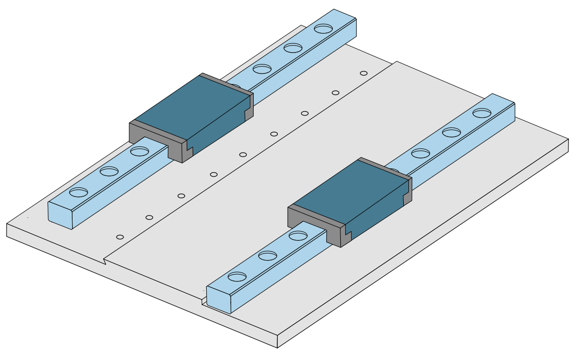


Fig. 10



Mounting option II

Mounting with two stop edges on the top carriage's mounting plate. If there is no stop edge for the subsidiary rail on the base plate, the second rail can be aligned using a carriage's mounting plate with two stop edges.

1. Push in the carriage against the stop edge of the mounting plate (↳ **fig. 11**).
2. Using a torque wrench, tighten the mounting screws to the designated value (↳ **4.1.3 table 2**).
3. Place the subsidiary rail onto the base plate.
4. Insert the screws, making sure that they are unobstructed, e.g. the mounting holes are properly aligned. (↳ **fig. 12**).
5. Partially tighten the screws so that the subsidiary rail is still loose.
6. Slide the mounting plate with the already fastened carriages onto the rails and move it over the full stroke (↳**fig. 13**).
7. Starting at one end of the subsidiary rail, pre-tighten the rail screws to approximately 1/3 of their torque value. To maintain parallelism, be sure that the carriage is very close to the screws being tightened. (↳ **fig. 14**). Double-check for parallelism by running the carriages along their full stroke. Then, using a torque wrench, tighten the centre mounting screw. Tighten the remaining screws using the alternating pattern (↳ **fig. 9**). Torque values are listed in **4.1.3 table 2**.

NOTE: The resulting parallelism has to be the values in **chapter 4.1.5** at **table 6**.

Fig. 11

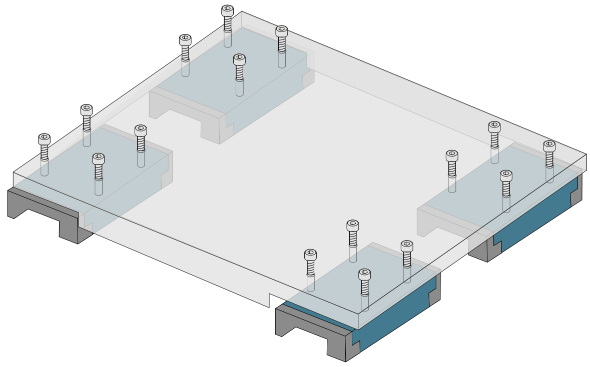


Fig. 12

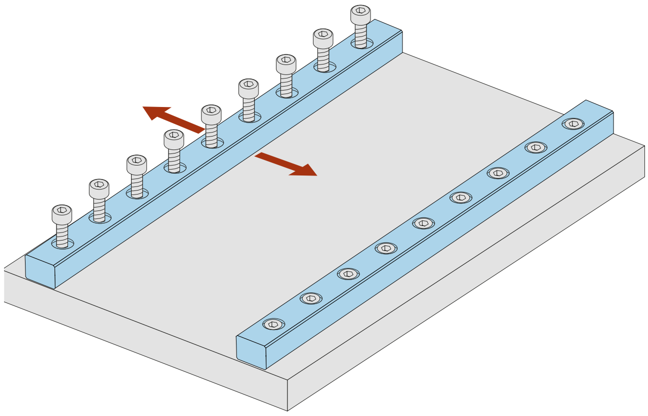


Fig. 13

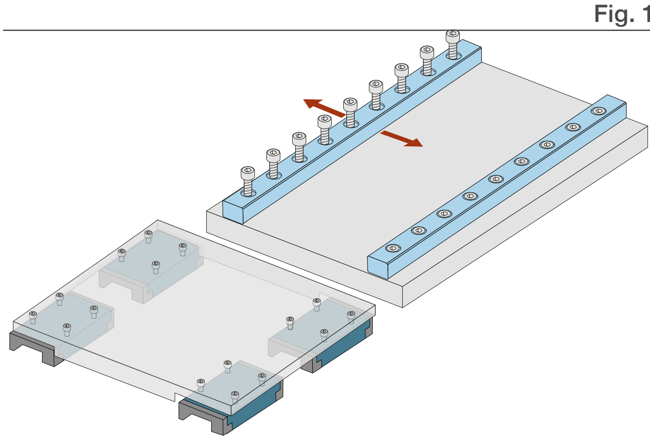
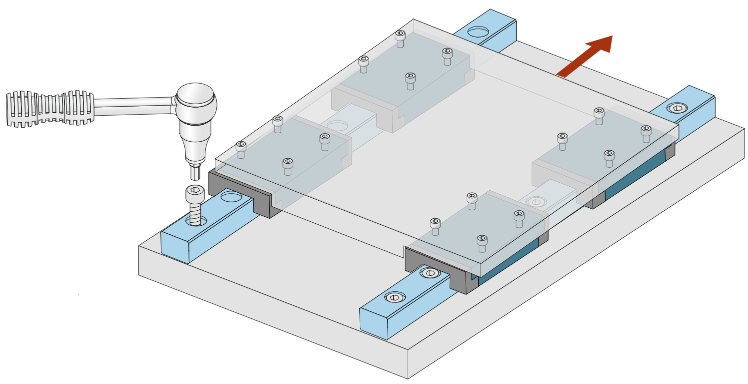


Fig. 14



4

Mounting option III

Mounting with no stop edges

If there are no stop edges for the subsidiary rail on the base plate and no stop edges for the carriages on the mounting plate, then proceed as follows:

1. Place the subsidiary rail onto the base plate.
2. Insert the screws, making sure that they are unobstructed, e.g. the mounting holes are properly aligned (↳ **fig. 15**).
3. Partially tighten the screws so that the rail is still loose.
4. Slide a carriage onto the mounted master rail and affix a dial indicator to the top of the carriage. Place the tip of the indicator at the center of the ground reference edge of the subsidiary rail (↳ **fig. 16**).
5. Do the alignment and pre-fasten the screws with 1/3 torque (↳ **fig. 17**).
6. Tighten all rail screws, beginning from the center, alternating to the ends (↳ **fig. 9**), with designated torque (↳ **4.1.3, table 3)** by using a torque wrench.
7. Double check the parallelism along the full stroke.

NOTE : The resulting parallelism has to be the values in **chapter 4.1.5** at **table 6**.

Fig. 15

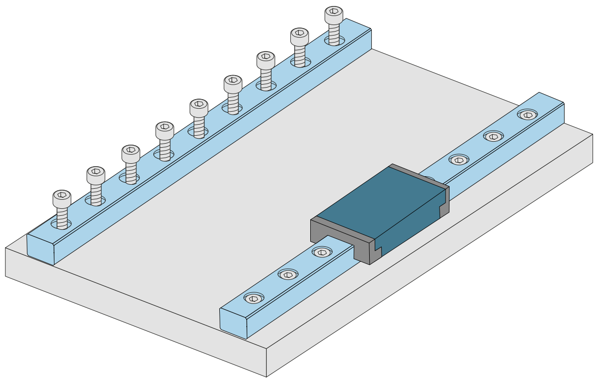


Fig. 16

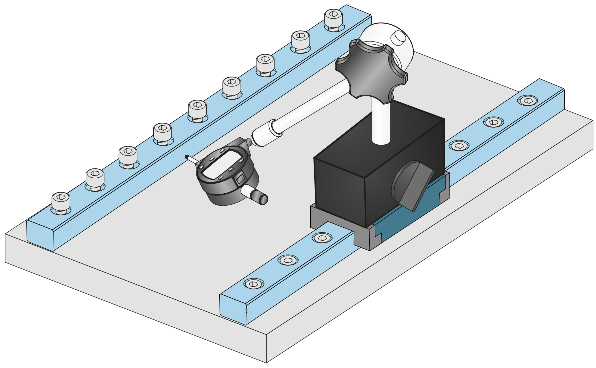
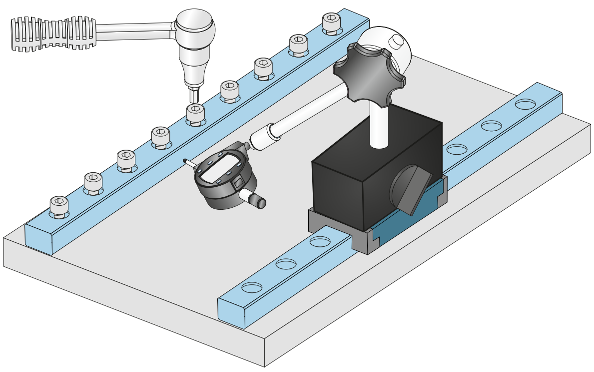


Fig. 17



4.3 Maintenance and repairs

4.3.1 Lubrication and maintenance

Ewellix miniature profile rail guides are factory pre lubricated and are ready for operation upon delivery.

They are lubricated with an NSF H1 registered oil complying with FDA 21 CFR § 178.3570. This oil is based on medical pure oil in accordance with European pharmacopeia (medical white oil). This oil was developed for incidental contact with products and packaging materials in the food-processing, cosmetics, pharmaceutical or animal feed industries.

The individual carriages can be relubricated via the front lubrication hole (↳ **fig. 18**). Please contact Ewellix sales if you need relubrication sets.

The relubrication intervals depend on the travel paths, cycles and ambient conditions.

4.3.2 Factory pre lubrication

LLS carriages are normally supplied pre lubricated with NSF H1 registered oil. The technical data for this grease can be found in **table 7**.

4.3.3 Correct relubrication

The lubricant must be topped up via both relubrication holes into the carriage. During lubrication, the carriage must be moved several times so that the lubricant is completely circulated.

The amount of relubrication depends on the applied conditions.

Table 8 provides guidelines on the amount of lubricant for relubrication for one carriage. The total amount should be split equally in the two lubrication holes if possible.

Fig. 18

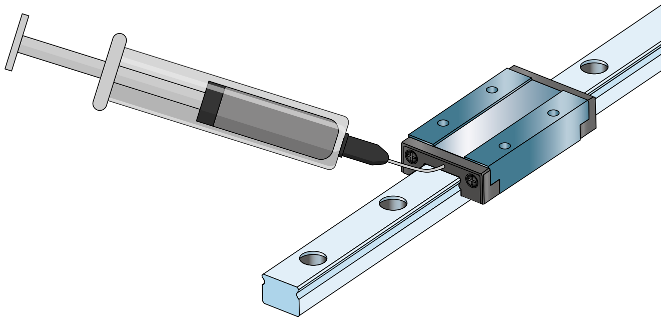


Table 7

Klüber PARALIQ P 460

Properties	Specification
Base oil	Paraffin mineral oil
Minimum operating temperature	–20 °C
Maximum operating temperature	100 °C
ISO Viscosity grade, DIN ISO 3448	460

Table 8

Type	Amount of lubricant
-	mm³
LLSHC 7 TA/LA	50
LLSHC 9 TA/LA	70
LLSHC 12 TA/LA	90
LLSHC 15 TA/LA	150
LLSWC 7 TA/LA	60
LLSWC 9 TA/LA	90
LLSWC 12 TA/LA	140
LLSWC 15 TA/LA	200

4.3.4 Relubrication interval

Re-greasing intervals are very much dependent on the application conditions, including load, speed, stroke and the environment, such as temperature, dust, etc.

Generally, re-greasing is recommended after 1 000 km of service or after 1 year of installation.

In lower demanding applications, it is recommended to relubricate either after 5 000 km of service or after 3 years of installation, whichever comes first.

4.4 Storage environment recommendations

LLS linear guide carriages and rails should be stored in the original package. Unpacking should be avoided until installation. Additionally, miniature profile rail guides should be stored where they are not exposed to contaminants, vibrations, shocks, humidity or other detrimental conditions. The storage environment recommendations are set forth in the table below.

Table 9

Item	Condition
Environment temperature	5 to 25 °C, and the temperature shall not change drastically
Relative humidity	< 60%

5

Ordering key

Ordering key systems

LLS	H	S	12	TA	R	2	T0	-	500	P5	/	W2		E10

LLS Miniature profile rail guide series

Range code
H Standard range
W Wide range

Type code
S System, mounted carriage on rail

Size
7, 9, 12, 15

Carriage type
TA Standard or Wide carriage, standard length
LA Standard or Wide carriage, extended length

Seal options
no code Shielded carriage
R Low friction sealed carriage

Number of carriages per rail
1, 2, 3, 4, 6

Preload Class
T0 Light clearance
T1 Light preload
T2 Medium preload

Rail Length
Up to 2 000 mm length in 1 mm steps, exception LLSH 7 with up to 1 000 mm length

Precision Class
P5 Standard precision
P1 High precision

Rail arrangement (Number of parallel mounted rails)
no code Arrangement of single rail as standard
W2 Arrangement of two parallel mounted rails
Wx Arrangement of x number of parallel mounted rails

Rail type
no code Standard rail
D Customized rail

Distance between end face and the center of the first mounting hole of the rail
E0 Standard "E"dimension, even when not selected. The holes at both rails end will be positioned equidistantly from either end of the rails with shortest possible distance
Exx Specified "E" dimension for one rail end with the dimension range per size as described in **chapter 3.2**

Ordering key ZRC carriages

LLS	H	C	12	TA	R	T0	P5	ZRC

LLS Miniature profile rail guide series

Range code

H	Standard range
W	Wide range

Type code

C	Carriage

Size

7, 9, 12, 15

Carriage type

TA	Standard or wide carriage, standard length
LA	Standard or wide carriage, extended length

Seal options

no code	Shielded carriage
R	Sealed carriage

Preload Class

T0	Light clearance
T1	Light preload

Precision Class

P5	Standard precision

Zero Rail Concept

ZRC	The Zero Rail Concept (ZRC) offers the interchangeability of carriages and rails. Any carriage does fit onto any rail of the same size, if both components belong to the Zero Rail Concept. ZRC components have the suffix ZRC and can be ordered as components only. Single carriages have ZRC as standard suffix.

Ordering key ZRC rails

LLS	H	R	9	-	1000	P5		E0	ZRC

LLS Miniature profile rail guide series

Range code
H Standard type
W Wide type

Type code
R Rail

Size
7, 9, 12, 15

Rail Length
up to 2 000 mm length in 1 mm steps, exception LLSH 7 with up to 1 000 mm length

Precision Class
P5 Standard precision

Rail type
no code Standard rail
D Customized rail

Distance between end face and the center of the first mounting hole of the rail
E0 Standard "E"dimension, even when not selected. The holes at both rails end will be positioned equidistantly from either end of the rails with shortest possible distance
Exx Specified "E" dimension for one rail end with the dimension range per size as described in **chapter 3.2**

Zero Rail Concept
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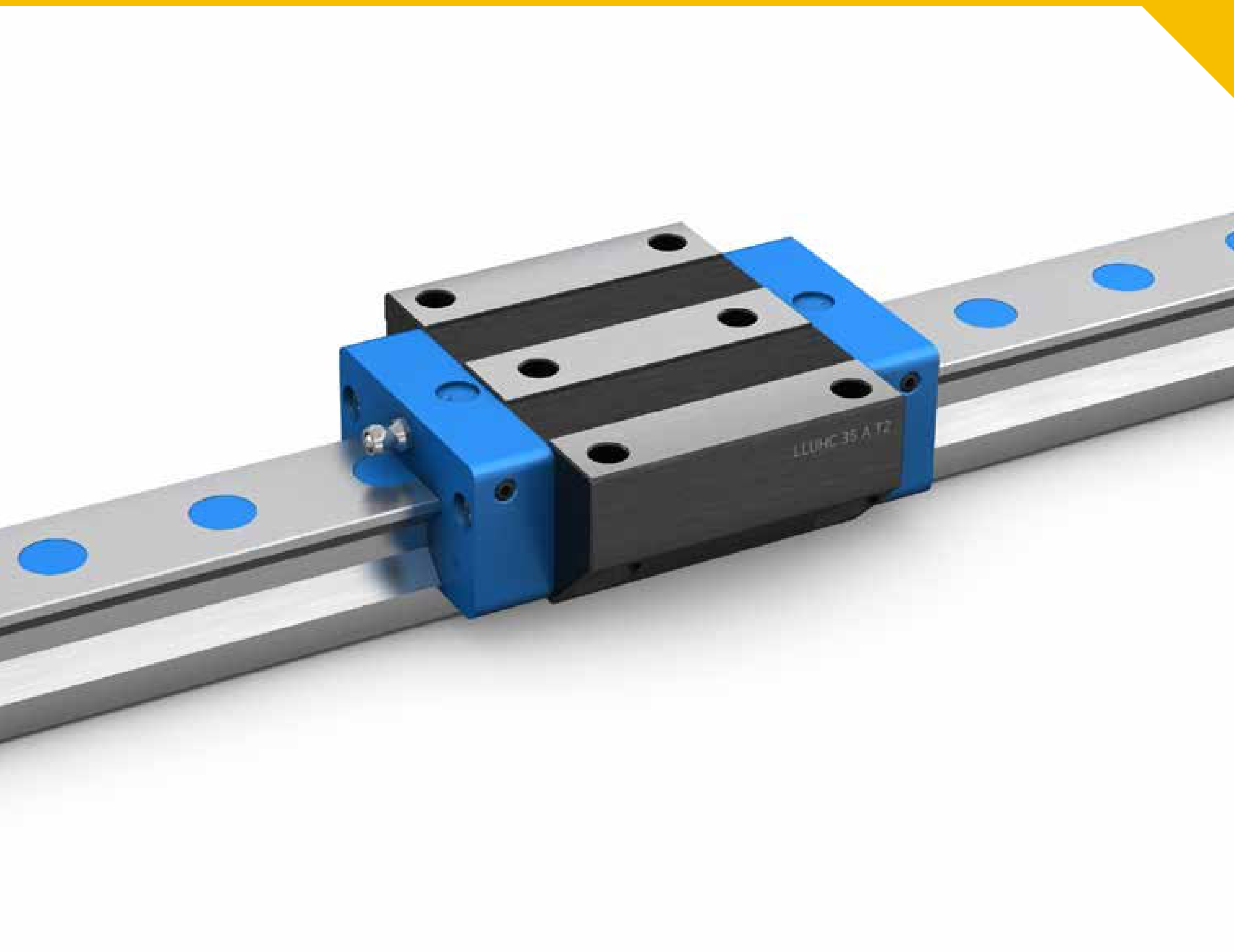
Profile rail guides - LLU catalogue



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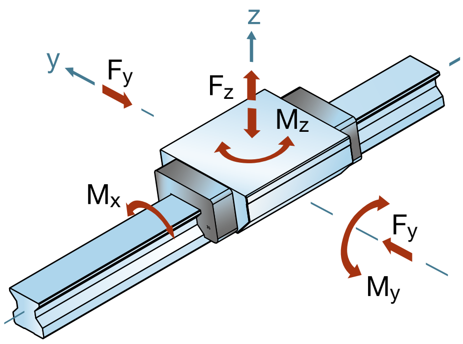
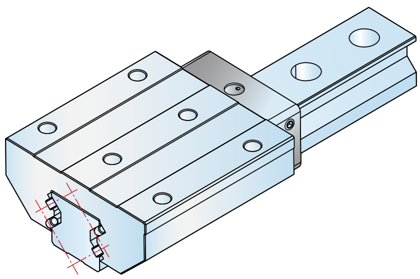
1.3 Features and benefits



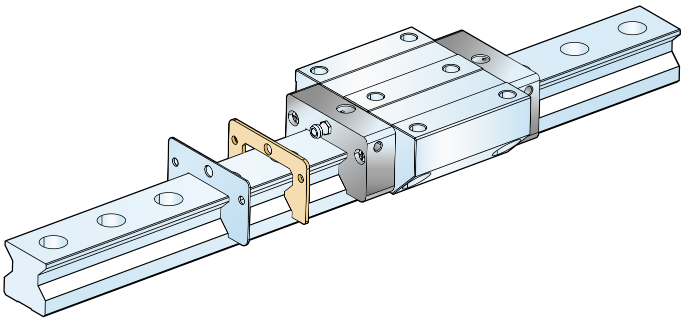
Rigidity, strength and accuracy for improved production processes

The LLU roller profile rail guide has four rows of cylindrical rollers in O-arrangement with the four raceways in 45° orientation towards the guiding base. This arrangement optimizes the load sharing in all four main load directions and is in accordance with ISO 14728. This feature provides a high degree of design flexibility. The ability to accommodate high loads and moment loads makes these rail guides ideal even for very demanding applications.



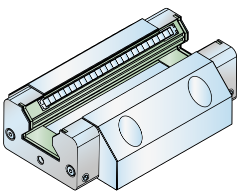
Smooth running performance

Optimized recirculations, raceways and the O-arrangement of the cylindrical rollers enable reliable, stick-slip-free operation for the whole life of the rail guide.



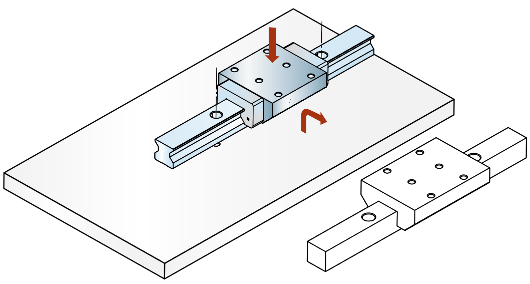
Modular concept for customized solutions

Applications have different load, precision and environmental requirements. As a result, Ewellix roller profile rail guides LLU use modular components so that cost-effective solutions can be built based on the needs of the application. Various precision and preload classes are available to meet the different needs. Furthermore, a wide range of accessories support its adaptation to specific environmental conditions.



Longer service life and reduced maintenance

Ewellix roller profile rail guide LLU carriages and rails are protected with anti-corrosion preservation for transport, storage and mounting. Both end plates of the carriage feature four (3+1) lube ports at different positions for manual lubrication or connection to automatic lubrication systems. One straight grease nipple is provided as standard with each carriage. The carriages are fully sealed with double lip seals on both ends and longitudinal seals along the rail. The seals have been proven to be highly effective against the ingress of contaminants and have low friction.



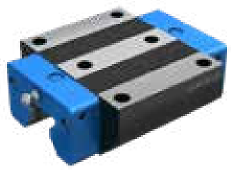
Interchangeability and global availability

The main dimensions of all Ewellix profile rail guides are in accordance with ISO 12090-1. This enables dimensional interchangeability with all ISO-compliant brands. Ewellix's global sales and distribution network results in availability of replacement parts and serviceability for all systems worldwide.

1.4 Product range

1.4.1 Product overview

LLUHC ... A
Flanged carriage
Standard length, standard height



Further information on **page 36**

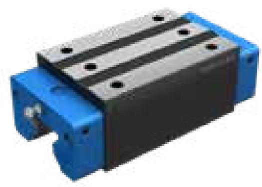
LLUHC ... LA
Flanged carriage
Extended length, standard height

Further information on **page 37**

LLUHU ... R
Slim-line carriage
Standard length, extended height

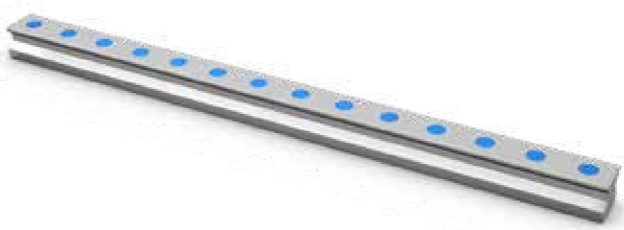
Further information on **page 38**

LLUHC ... LR
Slim-line carriage
Extended length, extended height



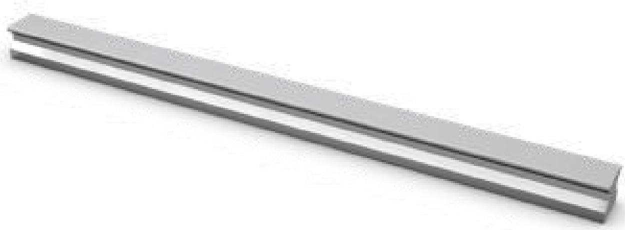
Further information on **page 39**

LLUHR
Profile rail with standard hole caps



Further information on **page 40**

LLUHR ... D4
Profile rail with blind holes

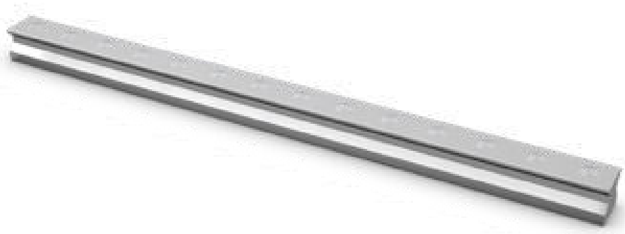


Further information on **page 40**

LLUHR ... D6
Profile rail with brass hole plugs

Further information on **page 40**

LLUHR ... D8
Profile rail with steel hole plugs



Further information on **page 40**

1.4.2 Preferred range

Carriage and rail types mentioned on this page belong to the preferred range meaning they are usually available from stock for prompt delivery.

Carriages

Size	Precision class	Preload class	Carriage type	Designations
25	P1	T2	A	LLUHC 25 A T2 P1
			LA	LLUHC 25 LA T2 P1
			R	LLUHC 25 R T2 P1
	P3	T2	A	LLUHC 25 A T2 P3
			LA	LLUHC 25 LA T2 P3
			R	LLUHC 25 R T2 P3
35	P1	T2	A	LLUHC 35 A T2 P1
			LA	LLUHC 35 LA T2 P1
			R	LLUHC 35 R T2-P1
	P3	T2	A	LLUHC 35 A T2 P3
			LA	LLUHC 35 LA T2 P3
			R	LLUHC 35 R T2 P3
45	P1	T2	A	LLUHC 45 A T2 P1
			LA	LLUHC 45 LA T2 P1
			R	LLUHC 45 R T2 P1
	P3	T2	A	LLUHC 45 A T2 P3
			LA	LLUHC 45 LA T2 P3
			R	LLUHC 45 R T2 P3

Rails

Size	Precision class	Rail length	Special	Designations
25	P1	4000		LLUHR 25 4000 P1
	P3	4000		LLUHR 25 4000 P3
	P1	4000	D4	LLUHR 25 4000 P1 D4
	P3	4000	D4	LLUHR 25 4000 P3 D4
35	P1	4000		LLUHR 35 4000 P1
	P3	4000		LLUHR 35 4000 P3
	P1	4000	D4	LLUHR 35 4000 P1 D4
	P3	4000	D4	LLUHR 35 4000 P3 D4
45	P1	4000		LLUHR 45 4000 P1
	P3	4000		LLUHR 45 4000 P3
	P1	4000	D4	LLUHR 45 4000 P1 D4
	P3	4000	D4	LLUHR 45 4000 P3 D4

2

Selection guide

2.1 Technical data

2.1.1 Load rating

Definition of the basic dynamic load rating C

The basic dynamic load rating C is the radial load, constant in magnitude and direction, which a linear rolling bearing can theoretically accommodate for a basic rating life represented by a travelled distance of 100 km (according to ISO 14728 Part 1).

NOTE: As per ISO 14728 Part 1, it is also permissible to reference a distance of 50 km travelled. In this case, a conversion factor of 1,23 for linear guides with roller recirculation should be applied in order to enable proper comparison of the two load rating values (↳ **formula 1**).

1) $$C_{100} = \frac{C_{50}}{1,23}$$

Definition of the basic static load rating C_0

The basic static load rating C0 is the static load in the direction of loading, which corresponds to a calculated stress at the center of the most heavily loaded contact point between the rolling element and each of the raceways of carriage and rail.

NOTE: This stress produces a permanent total deformation of the rolling element and the raceway, which corresponds to about 0,0001 times the rolling element diameter (according to ISO 14728 Part 2).

Verification and validation

The load ratings stated in this catalogue have been calculated for all product types based on the standards cited. The calculation model prescribed in the standards has been complemented and verified by Ewellix through internal simulations.

Ewellix carries out standardized durability examinations at regular intervals by means of selected reference sizes. These tests provide statistical evidence and documentation that the theoretically ascertained load ratings are valid under standardized practical test conditions.

In many cases, this Ewellix internal validation process saves the customer intensive field tests and offers high reliability for LLU roller profile rail guide designs.

Only in cases where the operating conditions are not known, as well as in cases where these conditions are more demanding than usual, are customers advised to conduct further field tests.

In practice, it is common to integrate results and experiences of existing and proven designs in new designs and apply them to new applications. When using LLU roller profile rail guides, it also makes sense for customers to build on previous application experience in the continuous development of their applications.

2.1.2 Preload classes

Preload and rigidity

To adjust a profile rail guide to the specific requirements of a given application, it is advisable to choose an appropriate preload. Preload can enhance the performance of an entire linear guiding system and increase the rigidity of the carriage under load. Preload is determined by oversizing between cylindrical rollers and raceways on carriage and rail track. This is ensured by state-of-the-art, high-precision grinding processes carefully matched with rolling elements.

Ewellix roller profile rail guides LLU are available in two different preload classes, as shown in **table 1**.

Table 1

Determining preload values according to preload class

Preload class	Preload force F_{Pr}
T2	**F_{Pr} = 8% of C** For precise profile rail guide systems with high rigidity and medium to higher bearing loads.
T3	**F_{Pr} = 13% of C** For precise profile rail guide systems with maximum rigidity, high bearing loads and vibrations. Also recommended for single-rail systems. Additional common moment loads are absorbed without any significant elastic deformation.

2.1.3 Accuracy

Precision classes

Ewellix offers its LLU roller profile rail guides in four precision classes. These precision classes define the tolerance range of a roller profile rail system in terms of height, width and parallelism (↳ **table 2**). This choice determines the running accuracy of the system within the application.

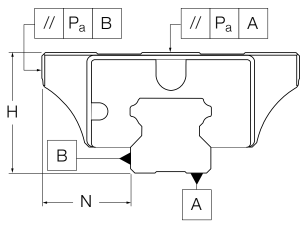
Width and height tolerances

The tolerance of width N determines the maximum deviation of the distance from the carriage to the rail in lateral direction. Both side faces of the rail and the ground part of the carriage's side face can be used as reference sides.

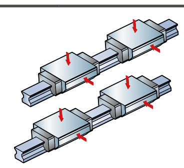
The tolerance of height H is measured between the mounting surface of the carriage and the ground bottom face of the rail. The tolerance values for H and N are arithmetic mean values and refer to the center of the carriage. They are marked on the carriages and also on the marking labels on the product boxes.

NOTE: The reference side face of the carriage is the ground part opposite of the side with the product designation.

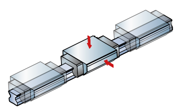
Table 2



Precision class[1)]	Tolerances of H	N	Difference in dimension H and N on one rail ΔH max	ΔH max
–	µm		µm	
P3	±30	±20	15	15
P1	±20	±20	7	7
P01	±10	±7	5	5
P001	±5	±5	3	3



For any combination of carriages and rails



For different carriages on the same rail position

1) Measured at the centre of the carriage.

Parallelism

The values in **diagram 1** show the parallelism P_a for the width and the height as explained in **table 2**. They are depending on the rail length and the precision class. The rail has to be bolted with its ground bottom face to a flat and accurate surface.

NOTE: Precision class P001 can only be ordered as a complete system.

2.1.4 Rigidity

The rigidity of LLU roller profile rail guides, in addition to their load rating, is one of the most important criteria in product selection. Rigidity can be defined as the deflection characteristics of a guiding system under external load. The rigidity of a system depends on the magnitude and direction of the external load, the type of guiding system (size, carriage type, preload) and the mechanical properties of the interface support structure. Usually, this load is indicated, including magnitude and direction, on the point of load application of the mounted guiding system.

Rigidity values, which only take elastic deformation of the rolling elements into consideration, can deviate considerably under realistic conditions due to the elasticity of the support structure, the screw connections and the joints between components. Therefore, the overall rigidity at the bearing point is, as a rule, lower than that of the used guiding system.

The different sizes and types of LLU roller profile rail guides feature significant differences in their deflection behavior. **Diagram 2** represents an example of only the deflection values for a single reference size.

2.1.5 Stiffness curves

The rigidity is one of the most important criteria in product selection of LLU roller profile rail guides.

Diagram 1

Parallelism P_a

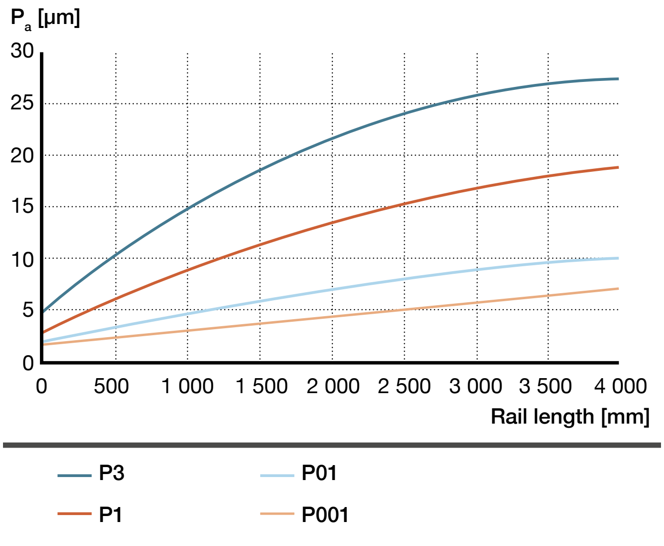
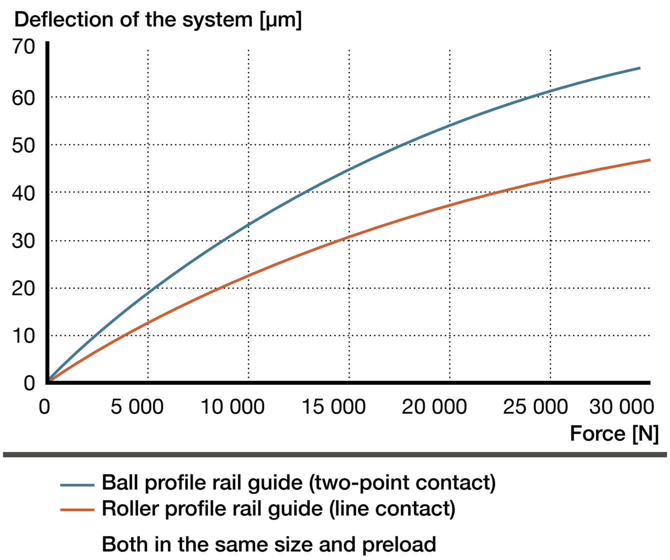


Diagram 2

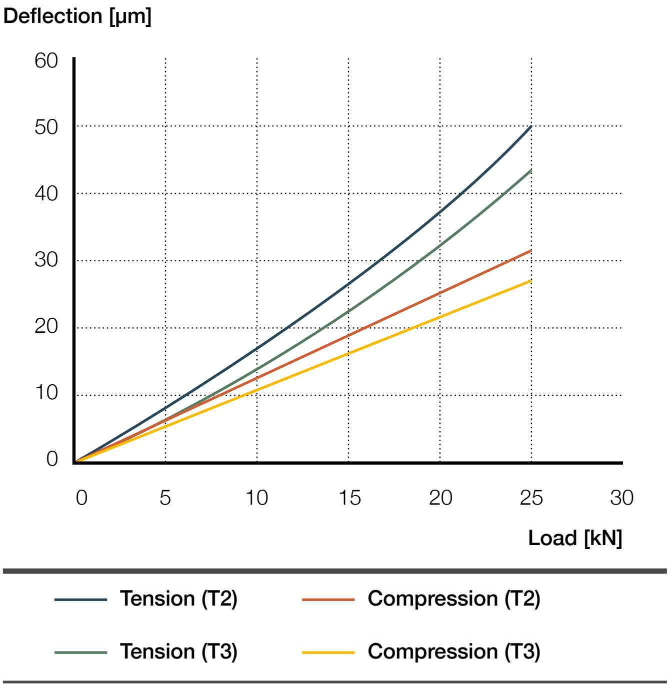
Rigidity comparison between roller and ball guides



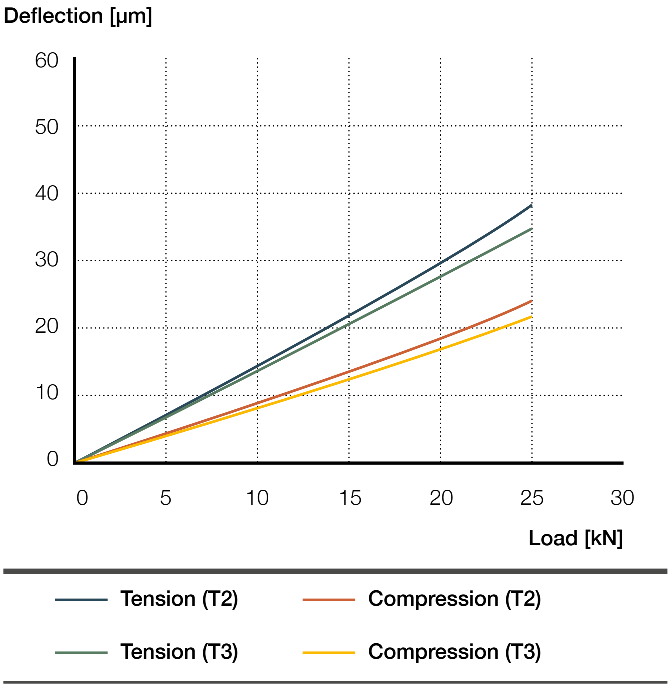
Rigidity is defined as the deformation characteristics of a guidance system under external load. The rigidity of a system depends on the magnitude and direction of the external load, the type of guidance system (size, carriage type, preload) and the mechanical properties of adjacent support structure.

Following diagrams provide the behavior for each LLU carriage type in vertical tension and compression direction depending on their preload classes T2 and T3. Derived from the real application, the known external load with its orientation is to be put on horizontal axis “Load (kN)”. Thus the amount of deflection can be easily read from the vertical coordinate “Deflection (μm)”. The determined value indicates the deformation of the center of associated top datum plane on the carriage. This methodology assumes carefully mounted and adjusted linear guidance systems in appropriately machined surrounding mechanical structures with all attachment screw positions provided by carriage and rail in use. Due to its nature, deflection is a complex phenomenon which might differ from case to case. Therefore values from diagram below can only give an indication of amount of deflection. In reality they can deviate to a certain extent from the information provided herewith.

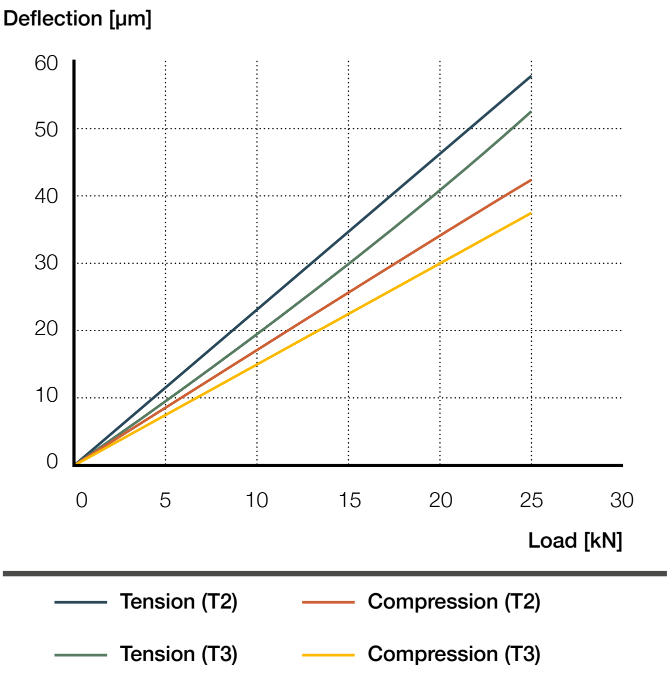
LLUHC 25 A T2 and T3



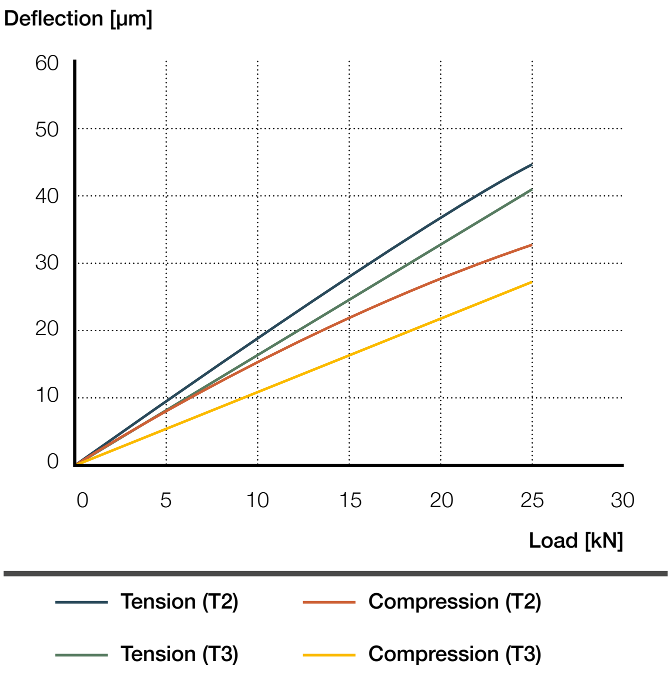
LLUHC 25 LA T2 and T3



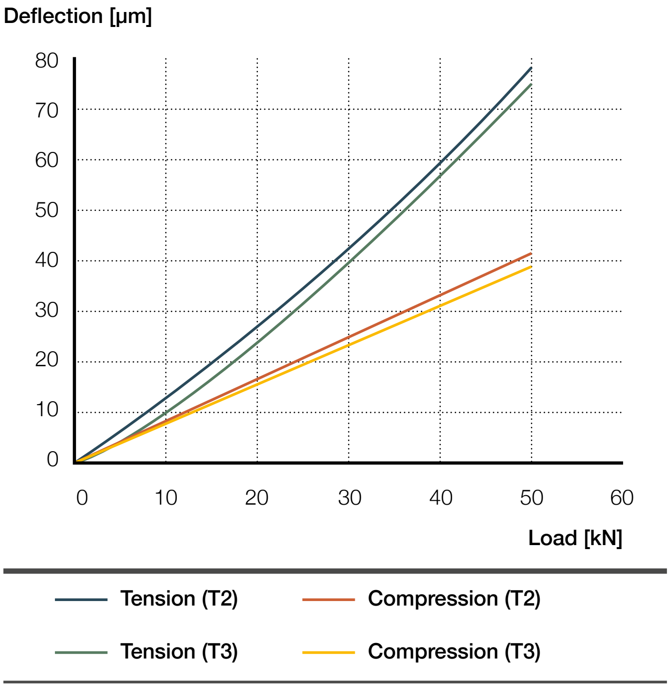
LLUHC 25 R T2 and T3



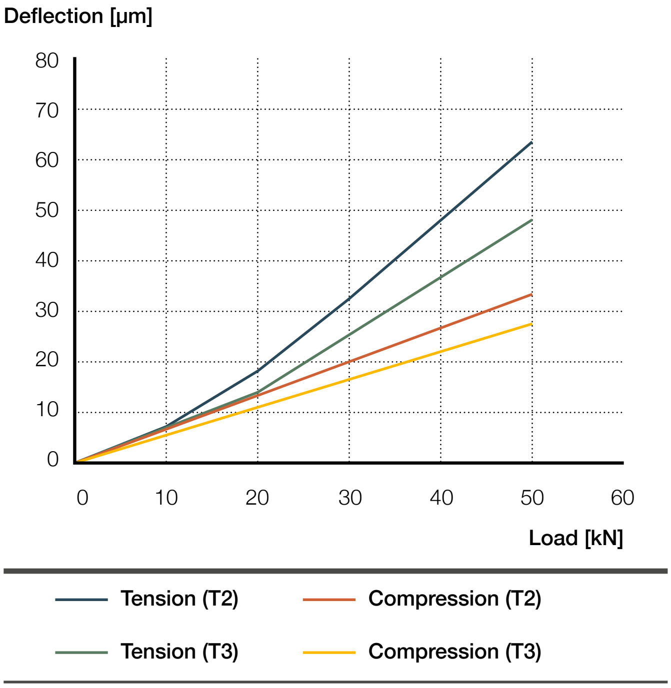
LLUHC 25 LR T2 and T3



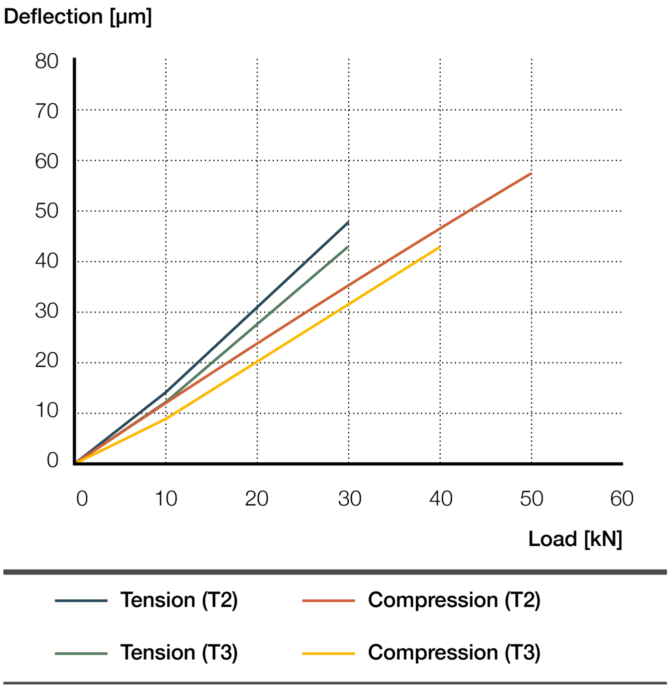
LLUHC 35 A T2 and T3



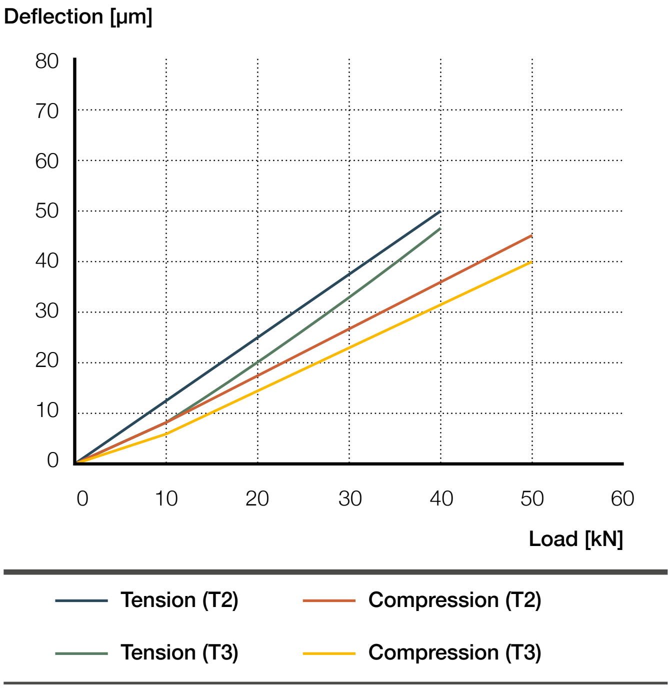
LLUHC 35 LA T2 and T3



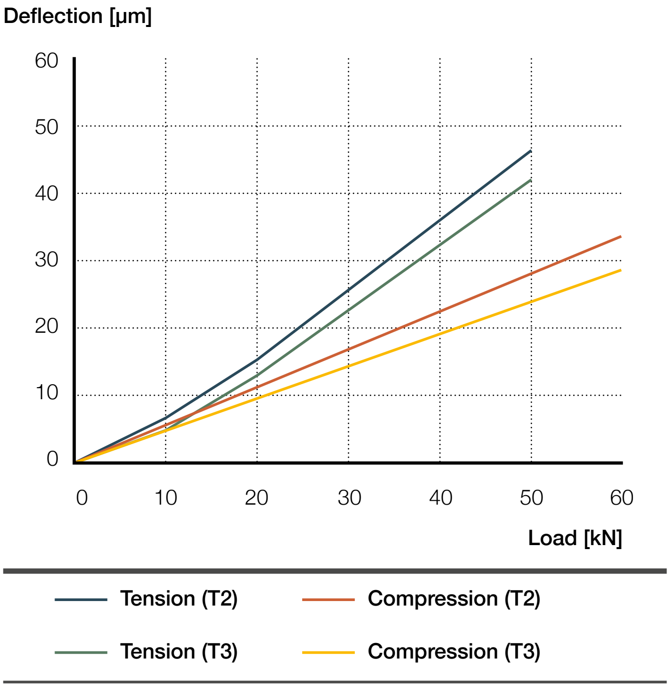
LLUHC 35 R T2 and T3



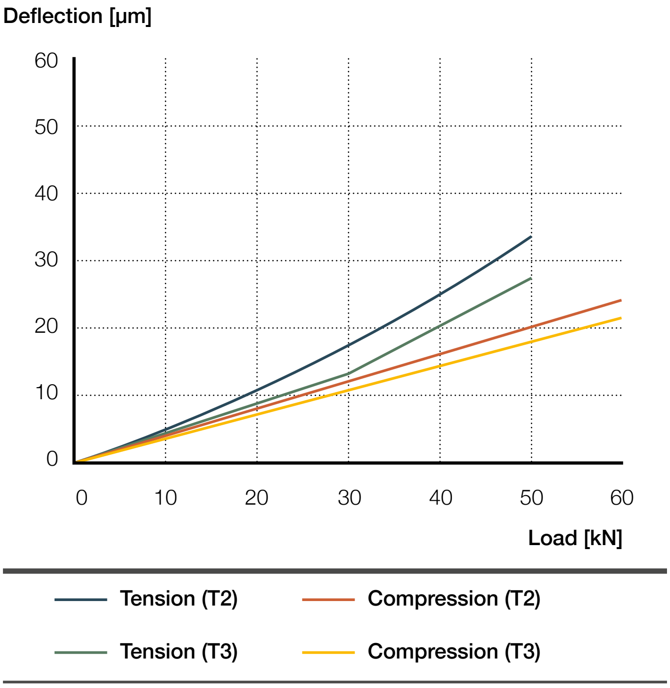
LLUHC 35 LR T2 and T3



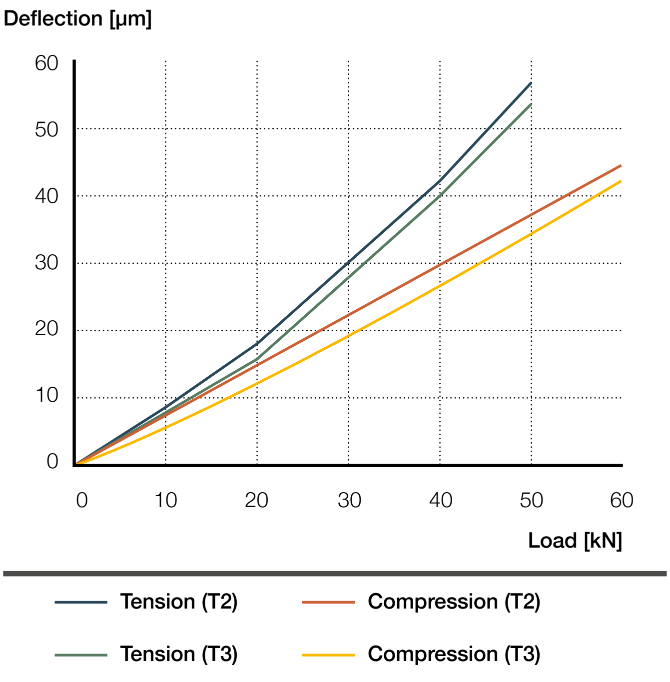
LLUHC 45 A T2 and T3



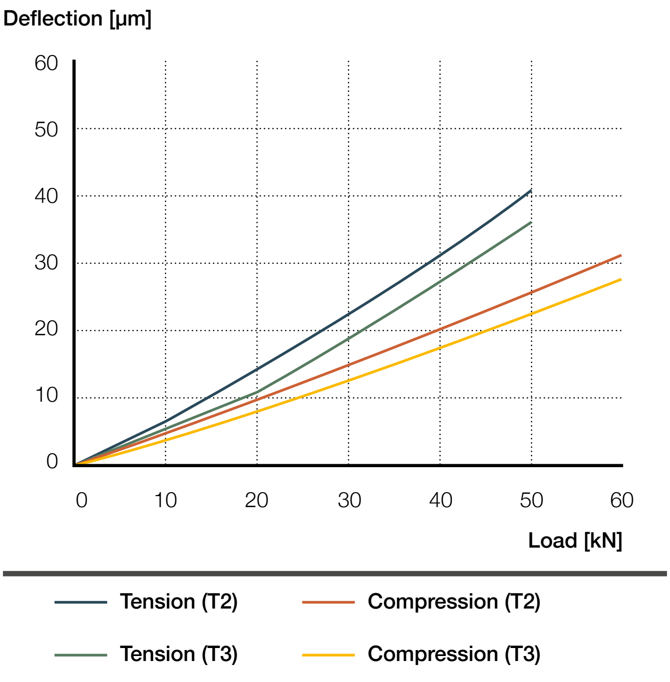
LLUHC 45 LA T2 and T3



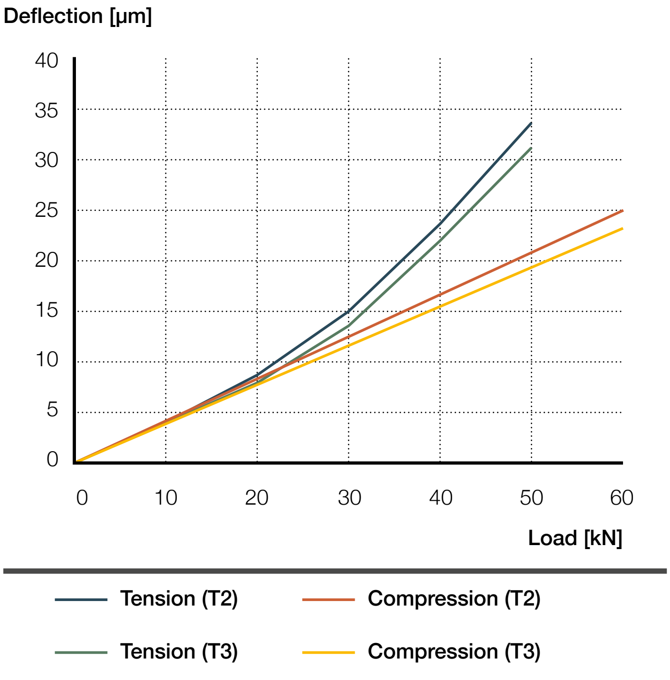
LLUHC 45 R T2 and T3



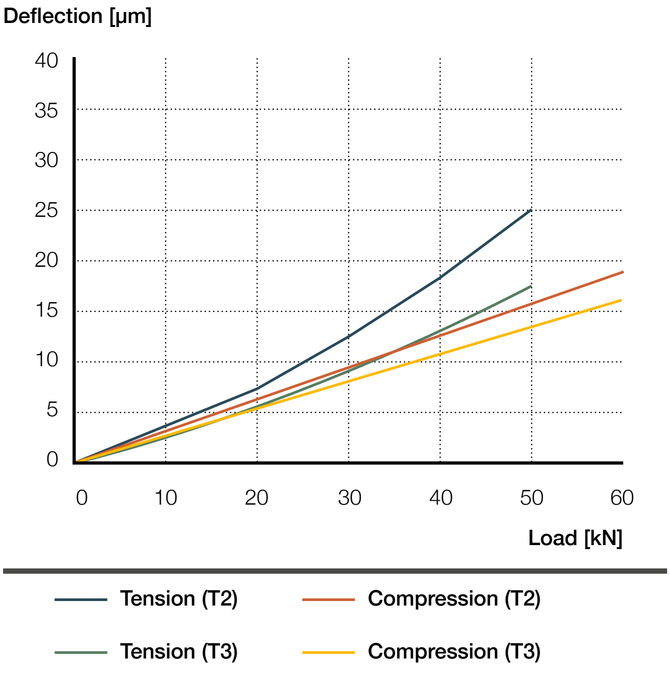
LLUHC 45 LR T2 and T3



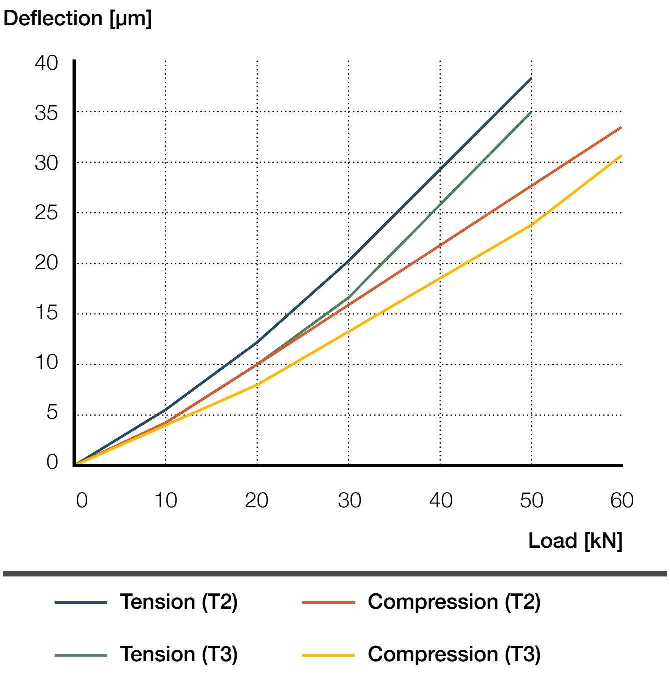
LLUHC 55 A T2 and T3



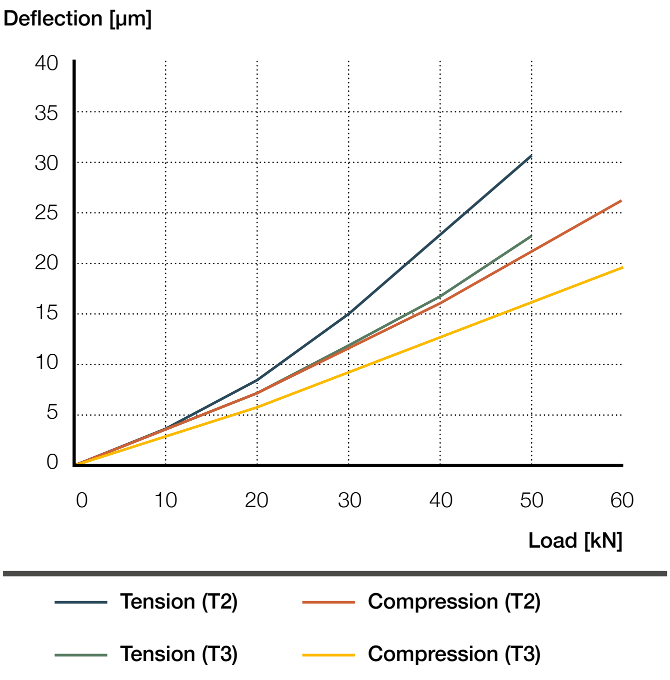
LLUHC 55 LA T2 and T3



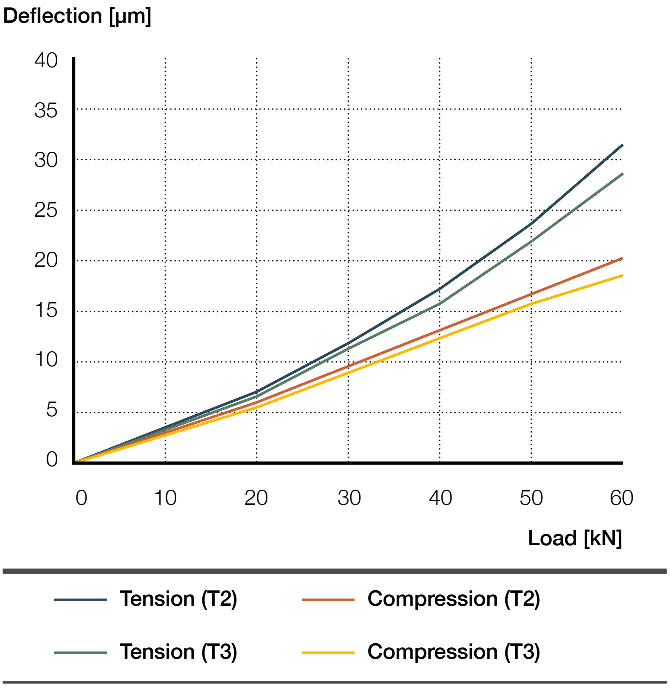
LLUHC 55 R T2 and T3



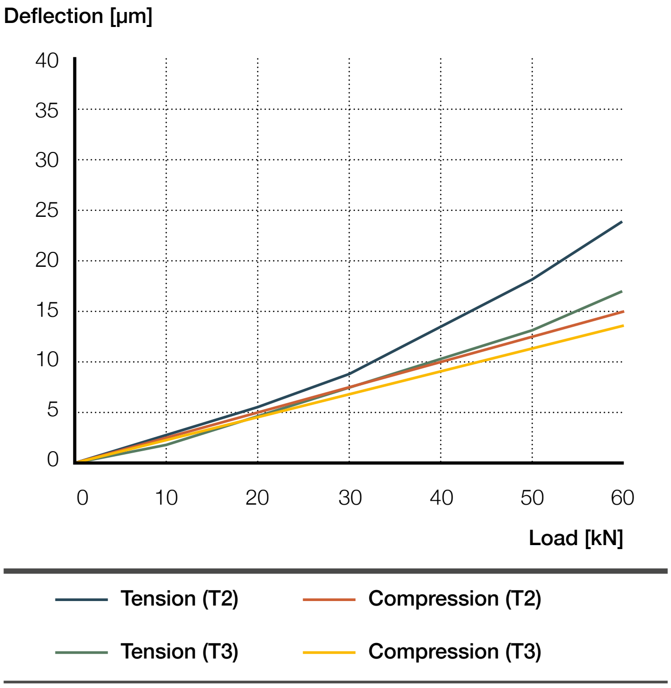
LLUHC 55 LR T2 and T3



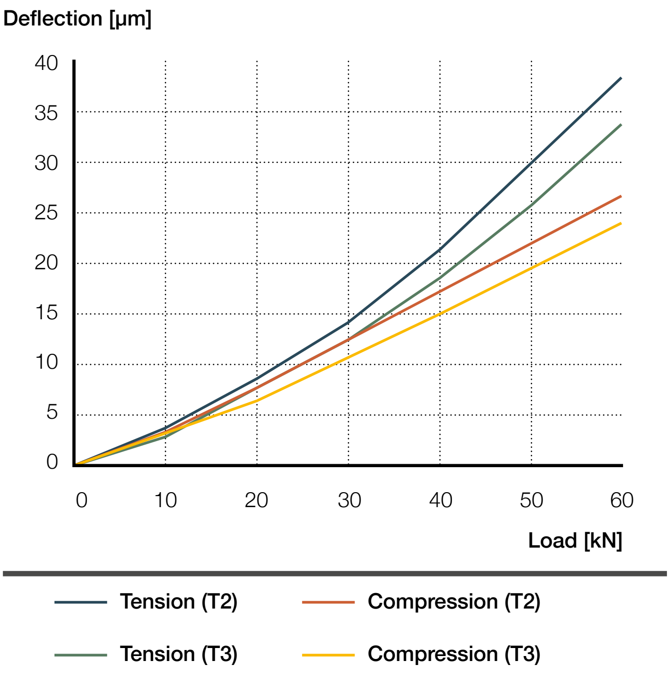
LLUHC 65 A T2 and T3



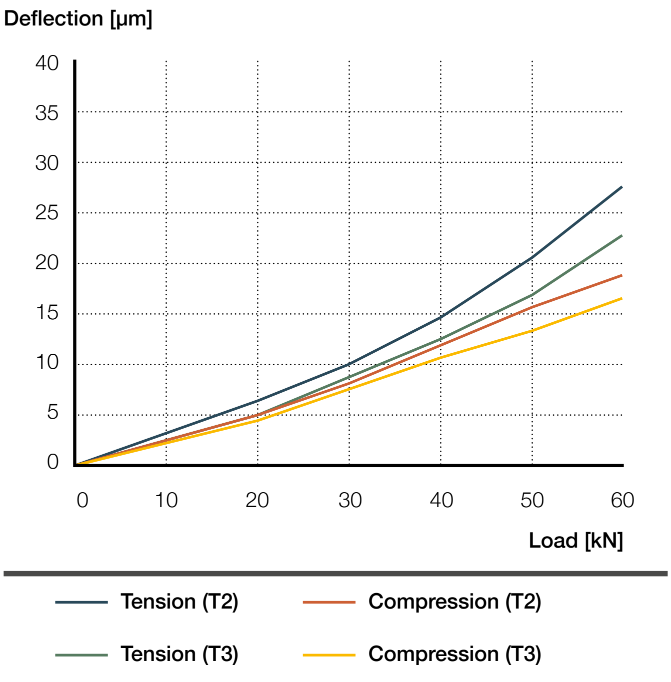
LLUHC 65 LA T2 and T3



LLUHC 65 R T2 and T3



LLUHC 65 LR T2 and T3



2.1.6 Permissible operating conditions

The function of LLU roller profile rail guides can be realized only if there are no deviations from the specified operating conditions. The formulae and life values stated in the chapter calculation bases (↳ **page 24**) are valid only if the operating conditions described in the following are adhered to.

Dynamic values

LLU roller profile rail guides can reach a maximum speed of v_{max} = 3 m/s.
The maximum acceleration is a_{max} = 50 m/s^2.

Required minimum load

To prevent the rolling elements from sliding in the load zone during operation, a linear guide must be under a minimum load at all times. Because the LLU carriage is always preloaded, this minimum load is provided by its design principle. Thus it does not specifically have to be considered for the application by the user.

Permissible maximum load

When selecting a LLU roller profile rail guide, the dynamic and static load ratings are key factors in this process.

For example, the equivalent dynamic mean load P_m during operation must not exceed 50% of the dynamic load rating. To calculate the dynamic bearing load, see **page 27**.

Exceeding the dynamic load ratings in operation results in a deviation of the usual load distribution and can significantly reduce bearing service life. A statistical evaluation according to the Weibull distribution (continuous probability distribution) is not reliable in these cases. As stated in ISO 14728 Part 2, the maximum load should not exceed 50% of the static load rating C0.

Standstill

When external forces create vibrations in a stationary LLU roller profile rail guide, surface damage due to micro-movements between the cylindrical rollers and raceways may occur. This can increase noise levels during dynamic operation and reduce system service life. To avoid this type of damage, the guides should be isolated from external vibration and mechanically unloaded for transport purposes.

Permissible operating temperatures

The permissible temperature range for LLU roller profile rail guides is:

Continuous operation: –10 to +80 °C

This temperature range is determined by the synthetic materials used for the end plates, recirculations and seals.

The time limit for the permissible maximum temperature is dependent on the actual operating conditions. Low speed (< 0,2 m/s), slightly loaded (P < 15% C) or stationary applications can be exposed to an ambient temperature of < 100 °C for up to one hour. Design measures, such as heat shielding can extend this period.

Be sure to check prior to use that the temperature limits of the lubricant can withstand elevated temperatures.

2.1.7 Friction

In addition to the external operating load, the friction in a guiding system is determined by a number of other factors: the preload class, the speed of travel, the viscosity of the lubricant, etc. should be taken into consideration.

The displacement resistance is determined by the proportions of rolling and sliding friction generated by the rolling elements in the contact zone. Also, the recirculation geometry as well as the lubricant has an influence.

The effect of the lubricant depends on its characteristics, quantity and condition.

A running-in phase provides a better distribution of the lubricant in the carriage, and therefore reduces friction.

The operating temperature of the guiding system also influences friction. Higher temperatures reduce the viscosity of the lubricant.

Another factor is the sliding friction of the front and longitudinal seals in contact with the profile rail guide. The friction generated by the seals will, however, decrease after the running-in phase. Moreover, the mounting accuracy of the rails relative to each other plays an important part, just like the flatness of both the mounting and the base plate.

The coefficient of friction for lubricated roller profile rail guides is typically between μ = 0,004 and 0,006. Lower values should be selected for higher loads, and higher values for lower loads. The friction values of the seals must be added to these values and can be made available upon request.

2.1.8 Joint rail tracks

If the requested rail length exceeds the available delivery length of LLU rails, specially paired and joint rails can be supplied as ready-to-mount sets consisting of two or more rails (per rail track). In this case, the rails are marked on the bottom side (↳ **fig. 2**) in order to avoid mix-up during mounting (↳ **fig. 1**). For specific positions of the joint(s), please add a drawing.

If replacement is required, the complete set should be exchanged to provide full functionality.

For the proper designation, refer to **Ordering key rails** (↳ **page 64**).

Figure 3 shows a tool that simplifies the mounting procedure of joint rails. It consists of a c-clamp and two ground shafts.

Fig. 1

Top side of joint rail

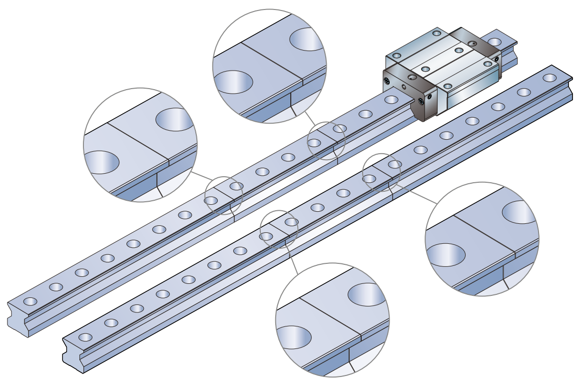


Fig. 2

Bottom side of joint rail

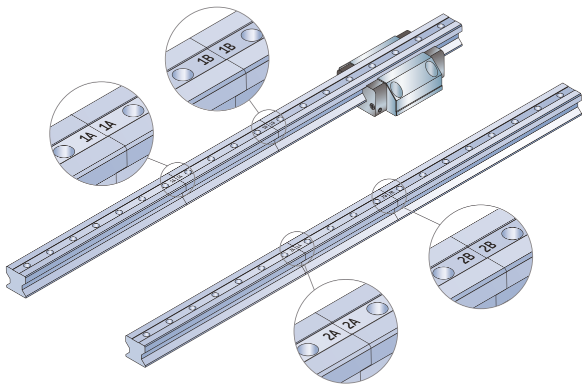
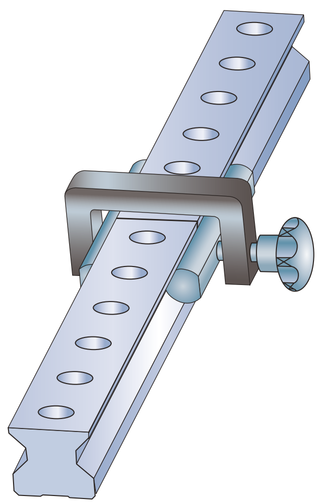


Fig. 3



2.2 Calculation of bearing loads

2.2.1 Calculation bases

The calculation methods described in this chapter must take into account all actual loads and forces acting on the individual carriages.

Static safety factor

The static safety factor is expressed as the relationship between the static load rating and the maximum static bearing load including preload (↳ **page 26**). The load conditions (↳ **page 29**) acting on the guiding system during operation must also be taken into account. The static safety factor indicates the level of safety against permanent plastic deformation of the rolling elements and raceways and is calculated according to **formula 2.**

2)
$$S_0 = \frac{C_0}{P_0} = \frac{C_0}{f_d F_{res\,max}}$$

where

C_0	= static load rating [N]
f_d	= factor for load conditions
$F_{res\,max}$	= maximum resulting load [N]
P_0	= maximum static load [N]
s_0	= static safety factor

Based on practical experience, guideline values have been specified for the static safety factor, which depend on the operating mode and other external factors. See **table 3**.

If, for example, the guiding system is exposed to vibrations from the machining process, higher safety factors should be applied. Moreover, the load transfer paths between a profile rail guide and its support structure should be taken into account. In particular, the bolted connections must be examined for sufficient safety. See also the chapter **Mounting and maintenance** (↳ **page 50**).

For overhead installations of LLU roller profile rail guides, higher safety factors should be applied. In any case, all provided attachment holes in carriage and rail are to be used in the application to make sure that loads applied on the linear guide will safely be taken and transferred.

NOTE: The maximum resulting load $F_{res\,max}$ should be calculated based on the combined static bearing load Fcomb stat determined according to the chapter **Combined static bearing load**, on **page 26**.

NOTE: The general technical rules and standards in the respective industrial sector must also be observed.

Basic rating life L_{10}

Under controlled laboratory conditions, seemingly identical bearings operating under identical conditions have different individual endurance lives. A clearer definition of the term “bearing life” is therefore essential to calculate bearing size as outlined in **Basic rating life at constant speed..**

IMPORTANT: All information presented by Ewellix with regard to load ratings is based on the life that 90% of a sufficiently large group of apparently identical bearings can be expected to attain or exceed.

Basic rating life at constant speed

If the speed is constant, the basic rating life, L_{10s} or L_{10h}, can be calculated using formulae 3 and 5:

3)
$$L_{10} = \left(\frac{C}{P}\right)^{\frac{10}{3}} 100$$

4)
$$P = \frac{f_d}{f_i \sqrt[\frac{10}{3}]{f_s}} F_{res}$$

5)
$$L_{10h} = \frac{5 \times 10^7}{S\,n\,60} \left(\frac{C}{P}\right)^{\frac{10}{3}}$$

where

C = dynamic load rating [N]

f_d = factor for load conditions
f_i = factor for number of carriages per rail
F_{res} = resulting load [N]
L_{10h} = basic rating life [h]
L_{10s} = basic rating life [km]
n = stroke frequency [double strokes/min]
P = equivalent dynamic load [N]
f_s = factor for stroke length
S = single stroke length [mm]

Applying a preload

Depending on the combined bearing load and preload class, the resulting load has to be calculated according to the following methodology to get the impact on the life of LLU roller profile rail guides.

Load case 1

$F_{comb} \leq 2,8\ F_{Pr}$ (F_{Pr} ↳ **table 1, page 14**)

6) $$F_{res} = \left(\frac{F_{comb}}{2,8\ F_{pr}} + 1\right)^{1,5} F_{pr}$$

Load case 2

$F_{comb} > 2,8\ F_{Pr}$ (F_{Pr} ↳ **table 1, page 14**)

7) $F_{res} = F_{comb}$

where

F_{comb} = combined, static or dynamic bearing load [N]
F_{Pr} = preload force [N]
F_{res} = resulting load [N]

Table 3

Static safety factor depending on operating conditions

Operating conditions	s_0
Normal conditions	min. 2
Smooth, vibration-free operation	>2–4
Medium vibrations or impact loads	3–5
High vibrations or impact loads	>5
Overhead installations	The general technical rules and standards in the respective industrial sector must be observed. And if the application poses a risk of serious injury, the user must take appropriate design and safety measures that will prevent the carriage from becoming detached from the rail (e.g. due to loss of rolling elements or failure of screw connections).

2.2.2 Constant mean load

Equivalent dynamic mean load

The rating life calculation formulae are based on the assumption that the load and the speed are constant. In reality the external loads, positions and speeds are changing in most cases and the workflow has to be separated into load phases with constant or approximately constant conditions along their individual strokes (**diagram 3**). All single load phases are summarized to the equivalent dynamic mean load Pm depending on their individual stroke length **formulae 8 and 9**).

(8) $$P_m = \sqrt[\frac{10}{3}]{\frac{\sum\limits_{j=1}^{V} |\, P_j^{\frac{10}{3}} \,|\, S_j}{S_{tot}}}$$

(9) $$s_{tot} = s_1 + s_2 + \ldots + s_n$$

where

P_m = equivalent dynamic mean load [N]
P = equivalent dynamic load[N]
j = counter for load phases
V = amount of load phases
S_j = individual stroke length [mm]
S_{tot} = total stroke length [mm]

Maximum resulting load

The maximum value of F_{res} is required for calculating the static safety factor s . To this end, all loads must be calculated for the individual stroke lengths. With these figures, the maximum resulting load $F_{res\,max}$ can be calculated and then inserted in the equation for s_0.

(10) $$F_{res\,max} = \underset{j=1}{\overset{V}{MAX}} \,|\, F_{res,j} \,|$$

where

$F_{res\,max}$ = maximum resulting load [N]
F_{resj} = resulting load for load phase [N]
j = counter for load phase
V = amount of load phases

Combined bearing loads

The following chapter describes the method to calculate the combined bearing load with possible combinations of forces and moments. All load components must be constant in magnitude to enable their calculation as one load phase.

If one of the load proportions varies significantly in magnitude over the length of the stroke, a separate load phase must be calculated according to the same method.

NOTE: For the following four calculations, a load, acting on the carriage at any angle, must be broken down into the proportions F_y and F_z. These proportions are then inserted into the respective formula.

Combined static bearing load

For static vertical and horizontal loads, the combined static bearing load Fcomb,stat can be calculated using **formula 11** (**↳ fig. 4**).

Formula 11 applies to a system with two rails and four carriages (no torque loads can occur).

(11) $$F_{comb,stat} = |F_y| + |F_z|$$

where

$F_{comb,stat}$ = combined static bearing load [N]
F_y, F_z = external bearing loads in y- and z-direction [N]

For combined static bearing loads – both vertical and horizontal – in combination with static moments, the combined static bearing load $F_{comb,stat}$ can be calculated using **formula 12** (**↳ fig. 4**).

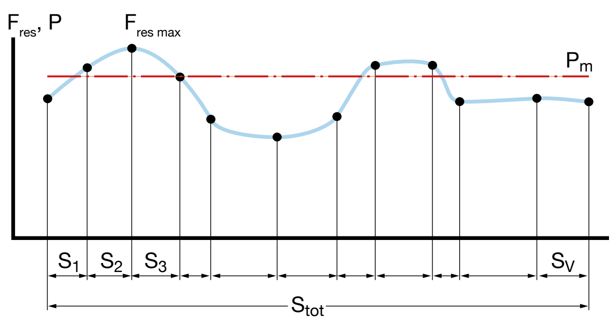
(12) $$F_{comb,stat} = |F_y| + |F_z| + C_0 \left(\left| \frac{M_x}{M_{xC0}} \right| + \left| \frac{M_y}{M_{yC0}} \right| + \left| \frac{M_z}{M_{zC0}} \right| \right)$$

where

C_0 = static load rating [N]
$F_{comb,stat}$ = combined static bearing load [N]
F_y, F_z = external bearing loads in y- and z-diretion [N]
M_x, M_y, M_z = bearing moment loads at respective coordinates [Nm]
M_{xC0}, M_{yC0}, M_{zC0} = permissible static moment loads [Nm]

Diagram 3

Variable load acting on a carriage



Formula 12 can be used for the following systems:

- One rail with one carriage (all types of moment loads can occur)
- Two rails with one carriage each (M_x cannot occur)
- One rail with two carriages (M_y, M_z cannot occur)

NOTE: The maximum value of $F_{comb,stat}$ is required for calculating the static safety factor s_0. To this end, all loads must be calculated for the individual stroke lengths. With these figures, the maximum resulting load $F_{res\ max}$ can be calculated and then inserted in the equation for s_0.

Combined dynamic bearing load

For loads – both vertical and horizontal (↳ **fig. 5**) – the combined dynamic bearing load $F_{comb,dyn}$ is calculated by means of **formula 13.**

Formula 13 applies to a system with two rails and four carriages.

(13) $$F_{comb,dyn} = |F_y| + |F_z|$$

where

$F_{comb,dyn}$ = combined dynamic bearing load [N]

F_y, F_z = bearing loads in y- and z-direction [N]

NOTE: The design of the profile rail guide permits this simplified calculation. If different load stages exist for F_y and F_z, then Fy and Fz must be considered individually in **formula 8**.

When combined dynamic bearing loads and dynamic moments are present, the combined dynamic bearing load $F_{comb,dyn}$ can be calculated using **formula 14** (↳ **fig. 5**).

(14) $$F_{comb,dyn} = |F_y| + |F_z| + C\left(\left|\frac{M_x}{M_{xC}}\right| + \left|\frac{M_y}{M_{yC}}\right| + \left|\frac{M_z}{M_{zC}}\right|\right)$$

where

C = dynamic load rating [N]

$F_{comb,dyn}$ = combined dynamic bearing load [N]

F_y, F_z = bearing loads in y- and z-direction [N]

M_x, M_y, M_z = bearing moment loads at respective coordinates [Nm]

M_{xC}, M_{yC}, M_{zC} = permissible dynamic moment loads [Nm]

Formula 14 can be used for the following systems:

- One rail with one carriage (all types of moment loads can occur)
- Two rails with one carriage each (M_x cannot occur)
- One rail with two carriages (M_y, M_z cannot occur)

2

Fig. 4

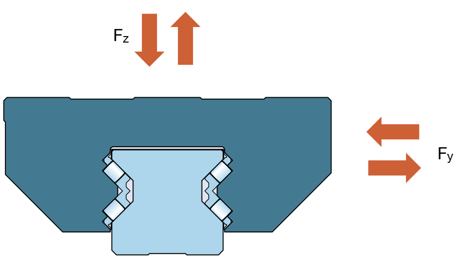
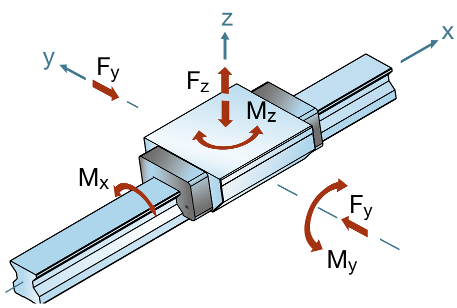


Fig. 5



2.2.3 Factors of influence

Requisite reliability

Factor c_1 is used for lifetime calculations where a reliability higher than 90% is needed. The corresponding values can be found in (↳ **table 4**).

Operating conditions

The lubrication effectiveness is strongly dependent on the degree of separation between the rolling elements and raceway surfaces in the contact zones. A specific minimum viscosity is required for the formation of an effectively separating lubricating film at operating temperature, taking into account the kinematic conditions. Assuming a normal level of cleanliness of the profile rail guide as well as effective sealing, factor c_2 depends on the viscosity ratio κ exclusively. κ designates the ratio between the actual kinematic viscosity and the requisite minimum viscosity (↳ **formula 15**).

(15) $$\kappa = \frac{v}{v_1}$$

where

κ = viscosity ratio
v = actual kinematic viscosity [mm²/s]
v_1 = requisite minimum viscosity [mm²/s]

The requisite minimum viscosity v_1 for LLT guides depends on the mean speed (↳ **diagram 4**).

The value for v_1 can be related to the actual viscosity v according to formula 15 in order to obtain κ. Now c_2 can be taken from (↳ **diagram 5**). If the viscosity ratio κ is less than 1, a lubricant with EP additives is recommended. If lubricant with EP additives are used, the higher value for c_2 can be used for calculation.

Table 4

Factor c1 for reliability

Reliability %	L_{ns}	c_1
90	L_{10s}	1
95	L_{5s}	0,62
96	L_{4s}	0,53
97	L_{3s}	0,44
98	L_{2s}	0,33
99	L_{1s}	0,21

Diagram 4

Determining the requisite minimum viscosity v1

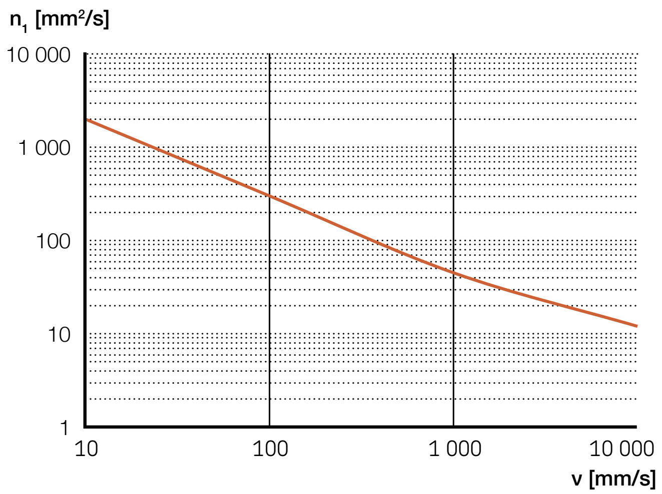
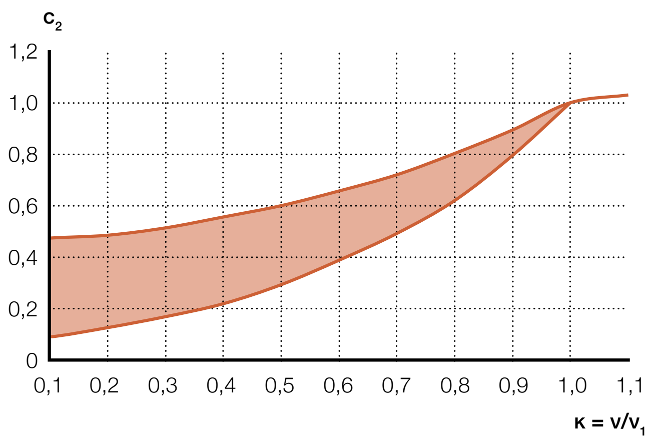


Diagram 5

Determining factor c2 for operating conditions



2.2.4 Load conditions

The load acting on an LLU roller profile rail guide is resulting from acceleration, impact loads and vibration. It is extremely difficult to quantify these additional dynamic forces. To approximate the impact these indeterminate loads will have on the life of the system, the load must be multiplied by factor fd. Depending on the mean speed and strength of the impact load, values listed in **table 5** can be selected for f_d.

Number of carriages per rail

Most profile rail guide configurations feature two or more carriages mounted on one rail. The load distribution on these various carriages is strongly influenced by the mounting precision, the manufacturing quality of the adjacent components, and particularly, the distance between the carriages. Factor fi takes these influences on carriage loading into account based on the number of carriages per rail and their distance relative to each other (↳ **table 6** and **fig. 6**).

Impact of stroke length

Strokes that are shorter than the metal body of the carriage (dimension L_2) have a negative influence on the achievable life of a guiding system. If the stroke is longer than the carriage metal body length, the factor is $f_s = 1$. Sequenced load phases with identical moving direction deliver a sub stroke length (S_s) according to **formula 16** to determine fs. Based on the ratio of the sub stroke lengths (S_s) to the metal body of the carriage L_2, the factor fs is determined according to **table 7**.

(16) $$S_s = \sum_{j=A}^{B} S_j$$

where

S_s = sub stroke length [mm]

S_j = individual stroke length [mm]

j = counter for load phases

A = starting point of movement in one direction

B = next reversal point

2

Table 5

Factor f_d for load conditions		
Load conditions	f_d from	up to
Smooth operation, no or light impact loads Speed ≤ 2 m/s	1,0	1,5
High impact loads Speed > 2 m/s	1,5	3,0

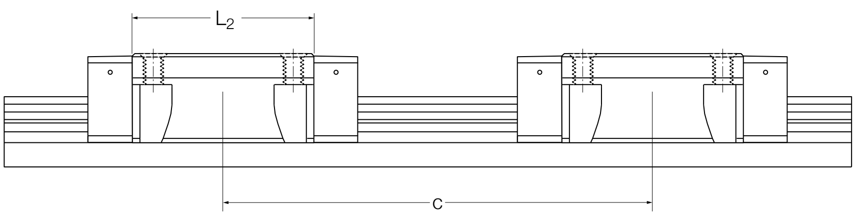
Table 6

Factor f_i for number of carriages per rail		
Number of carriages	If c ≥ 1,5*L_2 f_i	If c < 1,5*L_2 f_i
1	1	1
2	1	0,81
3	1	0,72

Table 7

Factor f_s depending on the ratio S_s/L_2	
S_s/L_2	f_S
1,0	1,0
0,9	0,91
0,8	0,82
0,7	0,73
0,6	0,63
0,5	0,54
0,4	0,44
0,3	0,34
0,2	0,23

Fig. 6



2.2.5 Modified basic rating life

If the load situation is known and the factors have been determined, then the modified basic rating life can be calculated with **formula 17**

$$\text{(17)}\quad L_{ns} = 100\, c_1\, c_2\, f_s \left(\frac{f_i C}{f_d F_{res}}\right)^{\frac{10}{3}}$$

In the presence of varying forces as described in the section **2.2.1 Calculation bases** (↳ **page 24**), **formula 17** is extended to account for the impacts of operating conditions and loads per phase. This is described in **formula 18:**

$$\text{(18)}\quad L_{ns} = 100\, c_1\, c_2 \frac{(f_i C)^{\frac{10}{3}} S_{tot}}{\sum_{j=1}^{V} \left(\left| \frac{f_{d,j} F_{res,j}}{\sqrt[\frac{10}{3}]{f_{s,j}}} \right|^{\frac{10}{3}} S_j \right)}$$

where

C = dynamic load rating [N]
c_1 = factor for reliability
c_2 = factor for operating conditions
f_d = factor for load conditions
f_{dj} = factor for load conditions for load phase j
f_i = factor for number of carriages per rail
F_{res} = resulting load [N]
$F_{res,j}$ = resulting load for load phase j [N]
f_s = factor for stroke length
f_{sj} = factor for stroke length for load phase j
j = counter for load phases
L_{ns} = modified basic rating life [km]
S_i = individual stroke length [mm]
S_{tot} = total stroke length [mm]
V = amount of load phases

2.2.6 Linear guide calculation tools

Ewellix calculation program

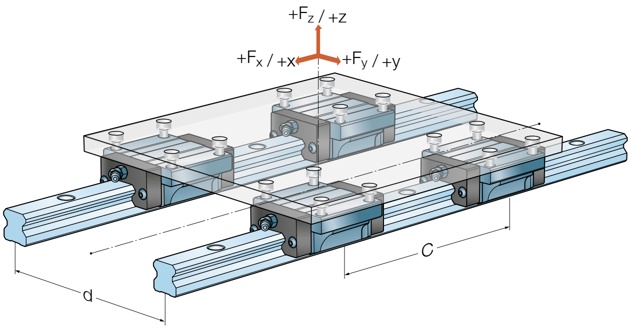
Details pertaining to all the relevant load situations and the specification of the general design conditions are crucial for precisely calculating the life expectancy and static load safety of an LLU profile rail guide system in a specific application. Ultimately, this information determines the size and carriage type of the LLU profile rail guide. This design process can be quite extensive for complex applications.

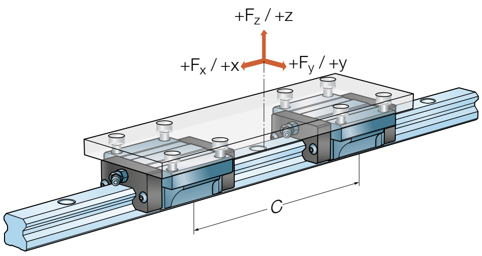
Therefore, Ewellix offers the “Linear guide select” calculation program which is available at www.ewellix.com. This calculation program supports the user and is extremely effective in the design of LLU profile rail guide systems.

The following information must be available prior to starting a calculation:

- number of load cases
- moved masses as well as operating loads including coordinates
- travel proportions of operating loads
- reaction forces accommodated by the drive system (in the direction of travel)
- selection of preload applied to the guide
- layout (number of rails and carriages)
- geometry of linear axis (distance between rails relative to each other and carriages relative to each other)

NOTE: If the user is free to select the application coordinate system, Ewellix recommends using the coordinate system in the program. This facilitates the analysis of all operating loads and the resulting reaction forces in the carriages and prevents transformation errors.





Representation of results

When the calculation routine is complete, the user will receive the following data in a clearly structured form:

- all input data
- load values per carriage in the y- and z-direction and external loads for all conceivable load cases
- calculation of equivalent dynamic load per carriage
- basic rating life of carriages
- static load safety of carriages

Depending on the expected life or static load safety, various carriage sizes can be selected for printout.

2.2.7 Legend

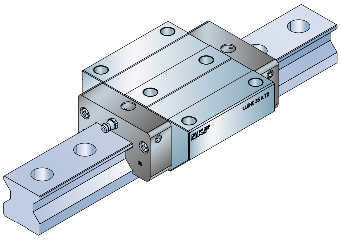
Legend		
A	starting point of movement in one direction	
B	next reversal point	
C	dynamic load rating	[N]
C_0	static load rating	[N]
c_1	factor for reliability	
c_2	factor for operating conditions	
f_d	factor for load conditions	
$f_{d,j}$	factor for load conditions for load phase j	
f_i	factor for number of carriages per rail	
f_s	factor for stroke length	
$f_{s,j}$	factor for stroke length for load phase j	
$f_{d,j}$	factor for load conditions for load phase j	
f_i	factor for number of carriages per rail	
f_s	factor for stroke length	
$f_{s,j}$	factor for stroke length for load phase j	
F_y, F_z	bearing loads in y- and z-direction	[N]
$F_{comb,stat}$	combined static bearing load	[N]
$F_{comb,dyn}$	combined dynamic bearing load	[N]
F_{comb}	combined static or dynamic bearing load	[N]
F_{Pr}	preload force	[N]
F_{res}	resulting load	[N]
$F_{res,j}$	resulting load for load phase j	[N]
$F_{res\ max}$	maximum resulting load	[N]
j	counter for load phases	[N]
κ	viscosity ratio	
L_{10h}	basic rating life	[h]
L_{10s}	basic rating life	[km]
L_{ns}	modified basic rating life	[km]
M_x, M_y, M_z	bearing moment loads at respective coordinates	[Nm]
M_{xC}, M_{yC}, M_{zC}	permissible dynamic moment loads	[Nm]
M_{xC0}, M_{yC0}, M_{zC0}	permissible static moment loads	[Nm]
n	stroke frequency	[double strokes/min]
v	actual kinematic viscosity	[mm²/s]
v_1	requisite minimum viscosity	[mm²/s]
P	equivalent dynamic load	[N]
P_m	equivalent dynamic mean load	[N]
P_0	maximum static load	[N]
s_0	static safety factor	
S_j	individual stroke length	[mm]
S_s	sub stroke length	[mm]
S_{tot}	total stroke length	[mm]
t_1, t_2 … t_n	time proportions for v1, v2 … vn	[%]
v_1, v_2 … v_n	speed	[m/min]
v_m	mean speed	[m/min]
V	amount of load phases	

3

Product range

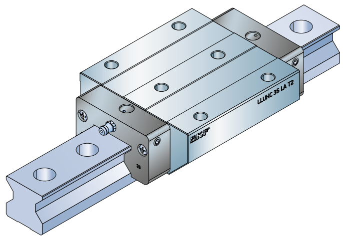
3.1 Carriage data

LLUHC ... A
Flanged carriage, standard length, standard height



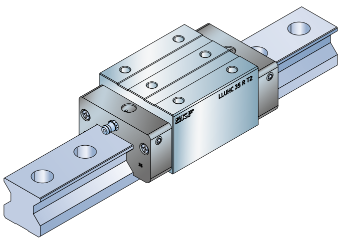
Size[1]	Load ratings	
	C	C_0
–	N	
25	27 000	57 600
35	53 300	99 000
45	95 000	184 000
55	132 600	256 000
65	212 000	414 000

LLUHC ... LA
Flanged carriage, extended length, standard height



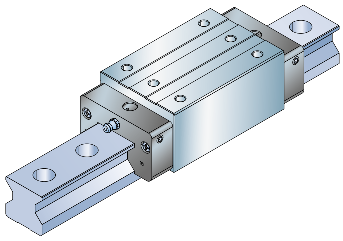
Size[1]	Load ratings	
	C	C_0
–	N	
25	36 500	76 800
35	72 600	136 000
45	119 500	242 200
55	176 000	351 000
65	276 000	579 000

LLUHC ... R
Slim-line carriage, standard length, extended height



Size[1]	Load ratings	
	C	C_0
–	N	
25	27 000	57 600
35	53 300	99 000
45	95 000	184 000
55	132 600	256 000
65	212 000	414 000

LLUHC ... LR
Slim-line carriage, extended length, extended height



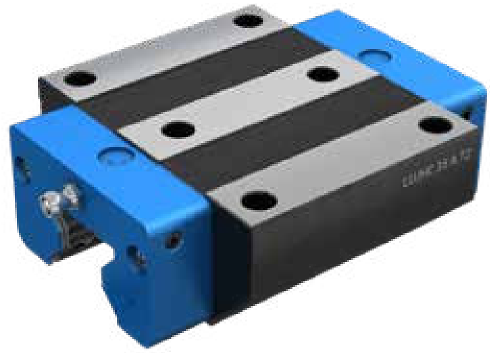
Size[1]	Load ratings	
	C	C_0
–	N	
25	36 500	76 800
35	72 600	136 000
45	119 500	242 200
55	176 000	351 000
65	276 000	579 000

3.1.1 Carriage LLUHC ... A

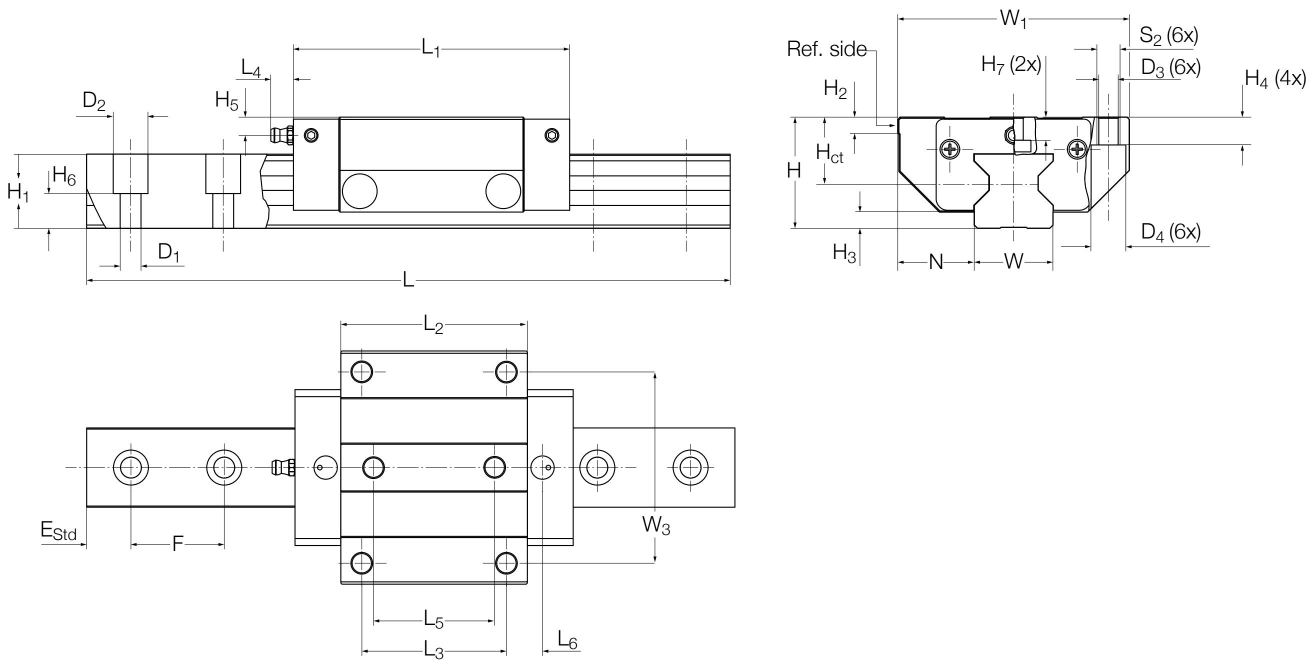
Flanged carriage

Standard length, standard height

For designation, refer to
Ordering key carriages (↳ **page 63**).



Dimensional drawing



Size	Assembly dimensions						Carriage dimensions												
	W_1	N	H	H_2	H_3	H_{ct}	L_1	L_2	L_3	L_4	L_5	L_6 [1)]	W_3	H_4	H_5	H_7	D_3	D_4	S_2
–	mm																		
25	70	23,5	36	7,5	6,5	21	90,2	62	45	9,8	40	14	57	9	5,5	6,5	6,8	11	M8
35	100	33	48	8	7	28.5	119,3	80	62	9,8	52	15,5	82	12	7,9	10	8,5	15	M10
45	120	37,5	60	10	10	35.5	147,3	101,3	80	9,8	60	17,65	100	15	8	12	10,5	18	M12
55	140	43,5	70	12	13	40.5	173	120	95	9,8	70	21,5	116	18	9,5	13,5	12,5	20	M14
65	170	53,5	90	15,5	12	58	221,8	159,8	110	9,8	82	31,8	142	22	15	19,5	14,5	23	M16

Size	Rail dimensions							Weight		Load ratings		Moments			
								carriage	rail	dynamic	static	dynamic	static	dynamic	static
	W	H_1	H_6	F	D_1	D_2	E_{Std}			C	C_0	M_{xC}	M_{xC_0}	$M_{yC} = M_{zC}$	$M_{yC_0} = M_{zC_0}$
–	mm							kg	kg/m	kN		Nm			
25	23	24,35	12,85	30	7	11	12,5	0,7	3,4	27,0	57,6	431	863	285	570
35	34	32	15	40	9	15	17,5	1,7	6,5	53,3	99,0	1 179	2 192	674	1 253
45	45	39,85	20,85	52,5	14	20	23,75	3,3	10,7	95,0	184,0	2 617	5 070	1 538	2 979
55	53	47,8	25,8	60	16	24	27,5	5,1	15,2	132,6	256,0	4 503	8 707	2 576	4 981
65	63	55	29	75	18	26	35	9,3	22,5	212,0	414,0	8 100	15 780	5 210	10 140

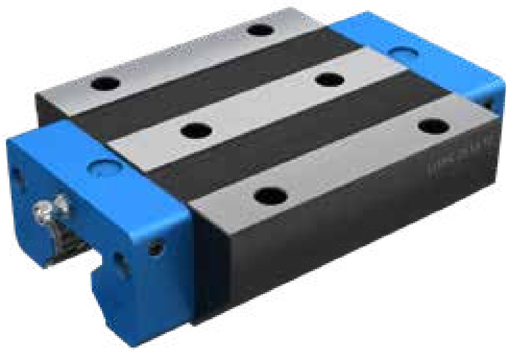
[1)] For size 65, L_6 in the table is valid only with top lubrication adaptor mounted, which is not shown on the drawing.

3.1.2 Carriage LLUHC ... LA

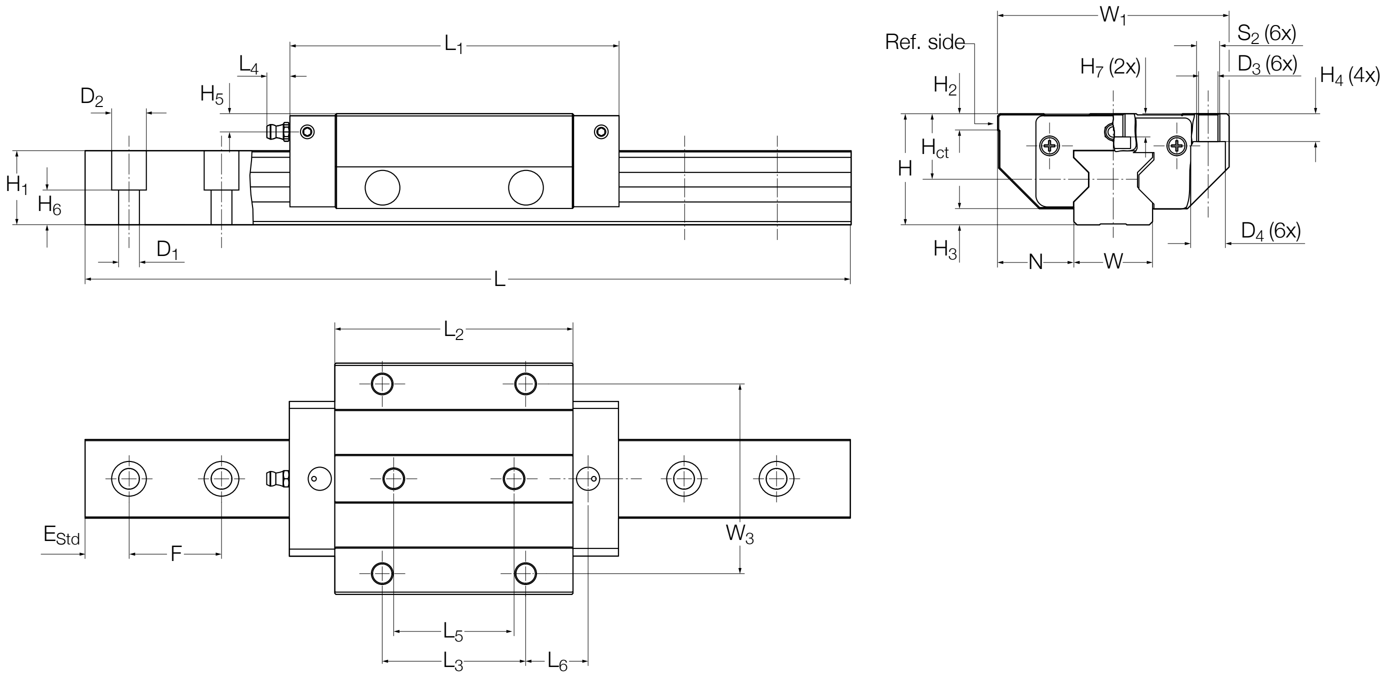
Flanged carriage

Extended length, standard height

For designation, refer to
Ordering key carriages (↳ **page 63**).



Dimensional drawing



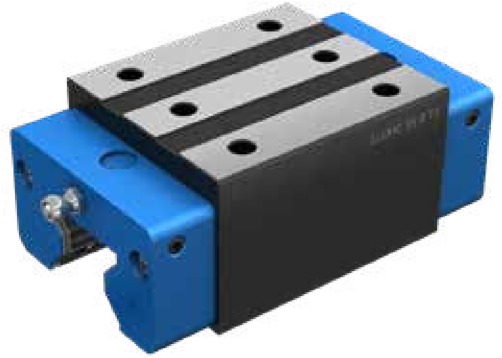
Size	Assembly dimensions						Carriage dimensions												
	W_1	N	H	H_2	H_3	H_{ct}	L_1	L_2	L_3	L_4	L_5	L_6[1)]	W_3	H_4	H_5	H_7	D_3	D_4	S_2
–	mm																		
25	70	23,5	36	7,5	6,5	21	109,7	81,5	45	9,8	40	23,75	57	9	5,5	6,5	6,8	11	M8
35	100	33	48	8	7	28.5	142,3	103	62	9,8	52	27	82	12	7,9	10	8,5	15	M10
45	120	37,5	60	10	10	35.5	179,8	133,8	80	9,8	60	33,9	100	15	8	12	10,5	18	M12
55	140	43,5	70	12	13	40.5	215	162	95	9,8	70	42,5	116	18	9,5	13,5	12,5	20	M14
65	170	53,5	90	15,5	12	58	272,3	210,3	110	9,8	82	57,1	142	22	15	19,5	14,5	23	M16

Size	Rail dimensions							Weight		Load ratings		Moments			
								carriage	rail	dynamic	static	dynamic	static	dynamic	static
	W	H_1	H_6	F	D_1	D_2	E_{Std}			C	C_0	M_{xC}	M_{xC_0}	$M_{yC} = M_{zC}$	$M_{yC_0} = M_{zC_0}$
–	mm							kg	kg/m	kN		Nm			
25	23	24,35	12,85	30	7	11	12,5	0,9	3,4	36,5	76,8	583	1 150	491	970
35	34	32	15	40	9	15	17,5	2,2	6,5	72,6	136,0	1 595	3 014	1 187	2 243
45	45	39,85	20,85	52,5	14	20	23,75	4,3	10,7	119,5	242,2	3 293	6 672	2 444	4 951
55	53	47,8	25,8	60	16	24	27,5	7,0	15,2	176,0	351,0	5 977	11 915	4 470	8 910
65	63	55	29	75	18	26	35	13,5	22,5	276,0	579,0	10 530	22 100	8 980	11 840

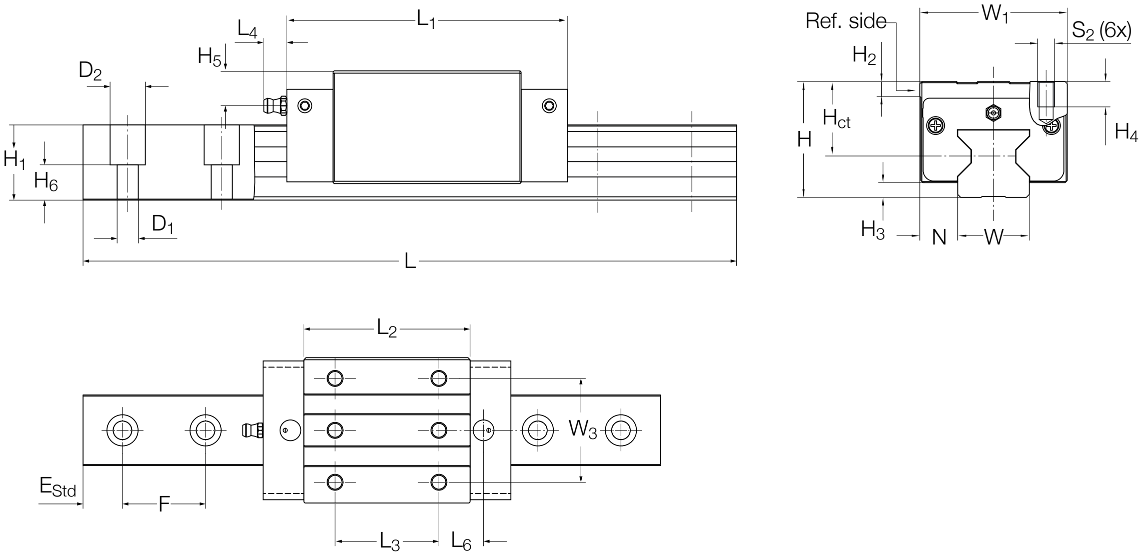
[1)] For size 65, L_6 in the table is valid only with top lubrication adaptor mounted, which is not shown on the drawing.

3.1.3 Carriage LLUHC ... R

Slim-line carriage
Standard length, extended height
For designation, refer to
Ordering key carriages (↳ **page 63**).



Dimensional drawing



Size	Assembly dimensions						Carriage dimensions								
	W_1	N	H	H_2	H_3	H_{ct}	L_1	L_2	L_3	L_4	L_6 1)	W_3	H_4	H_5	S_2
–	mm														
25	48	12,5	40	7,5	6,5	25	90,2	62	35	9,8	19	35	9	9,5	M6
35	70	18	55	8	7	35.5	119,3	80	50	9,8	21,5	50	12	14,9	M8
45	86	20,5	70	10	10	45.5	147,3	101,3	60	9,8	27,65	60	18	18	M10
55	100	23,5	80	12	13	50.5	173	120	75	9,8	31,5	75	19	19.5	M12
65	126	31,5	90	15,5	12	58	221,8	159,8	70	9,8	51,8	76	22	15	M16

Size	Rail dimensions							Weight		Load ratings		Moments			
								carriage	rail	dynamic	static	dynamic	static	dynamic	static
	W	H_1	H_6	F	D_1	D_2	E_{Std}			C	C_0	M_{xC}	M_{xC_0}	$M_{yC} = M_{zC}$	$M_{yC_0} = M_{zC_0}$
–	mm							kg	kg/m	kN		Nm			
25	23	24,35	12,85	30	7	11	12,5	0,6	3,4	27,0	57,6	431	863	285	570
35	34	32	15	40	9	15	17,5	1,6	6,5	53,3	99,0	1 179	2 192	674	1 253
45	45	39,85	20,85	52,5	14	20	23,75	3,1	10,7	95,0	184,0	2 617	5 070	1 538	2 979
55	53	47,8	25,8	60	16	24	27,5	4,7	15,2	132,6	256,0	4 503	8 707	2 576	4 981
65	63	55	29	75	18	26	35	8,5	22,5	212,0	414,0	8 100	15 780	5 210	10 140

1) For size 65, L_6 in the table is valid only with top lubrication adaptor mounted, which is not shown on the drawing.

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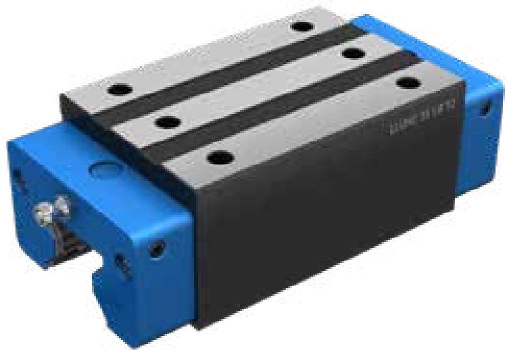
3.1.4 Carriage LLUHC ... LR

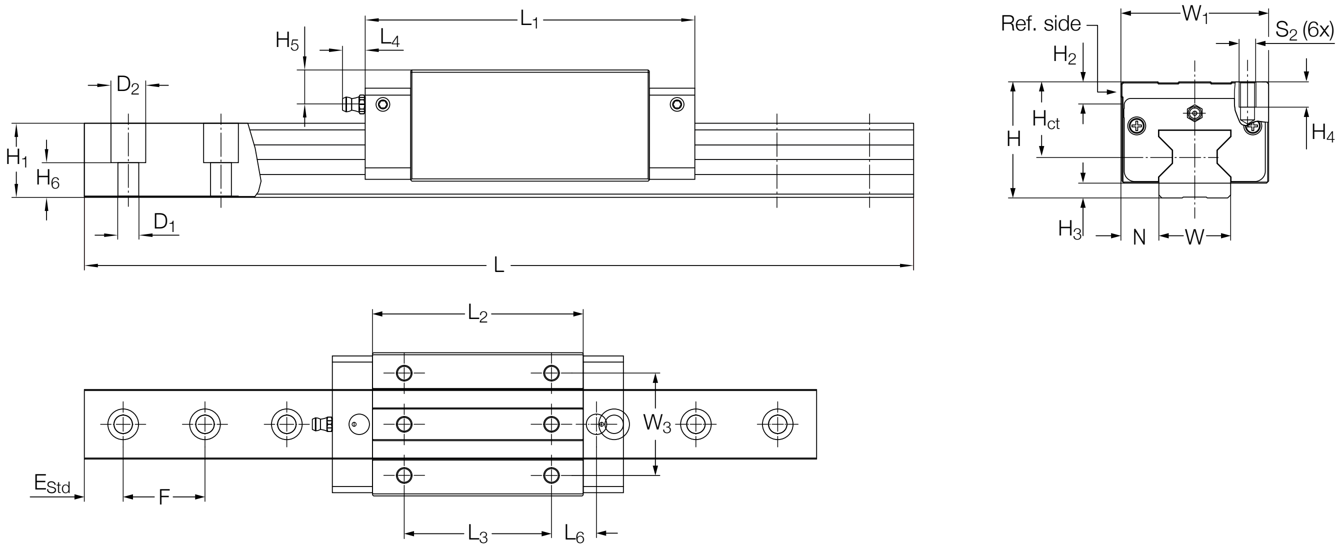
Slim-line carriage

Extended length, extended height

For designation, refer to
Ordering key carriages (↳ **page 63**).



Dimensional drawing



Size	Assembly dimensions						Carriage dimensions								
	W_1	N	H	H_2	H_3	H_{ct}	L_1	L_2	L_3	L_4	L_6 [1]	W_3	H_4	H_5	S_2
–	mm														
25	48	12,5	40	7,5	6,5	25	109,7	81,5	50	9,8	21,25	35	9	9,5	M6
35	70	18	55	8	7	35.5	142,3	103	72	9,8	22	50	12	14,9	M8
45	86	20,5	70	10	10	45.5	179,8	133,8	80	9,8	33,9	60	18	18	M10
55	100	23,5	80	12	13	50.5	215	162	95	9,8	42,5	75	19	19.5	M12
65	126	31,5	90	15,5	12	58	272,3	210,3	120	9,8	52,05	76	22	15	M16

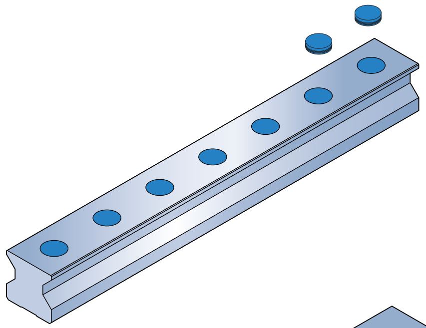
Size	Rail dimensions							Weight		Load ratings		Moments			
								carriage	rail	dynamic	static	dynamic	static	dynamic	static
	W	H_1	H_6	F	D_1	D_2	E_{Std}			C	C_0	M_{xC}	M_{xC_0}	$M_{yC} = M_{zC}$	$M_{yC_0} = M_{zC_0}$
–	mm							kg	kg/m	kN		Nm			
25	23	24,35	12,85	30	7	11	12,5	0,8	3,4	36,5	76,8	583	1 150	491	970
35	34	32	15	40	9	15	17,5	2,0	6,5	72,6	136,0	1 595	3 014	1 187	2 243
45	45	39,85	20,85	52,5	14	20	23,75	4,1	10,7	119,5	242,2	3 293	6 672	2 444	4 951
55	53	47,8	25,8	60	16	24	27,5	6,2	15,2	176,0	351,0	5 977	11 915	4 470	8 910
65	63	55	29	75	18	26	35	12,7	22,5	276,0	579,0	10 530	22 100	8 980	11 840

[1] For size 65, L_6 in the table is valid only with top lubrication adaptor mounted, which is not shown on the drawing.

3.2 Rail data

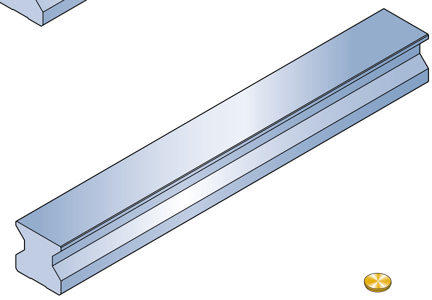
LLUHR rails

Standard rail, always supplied with protective plastic caps for mounting from above.



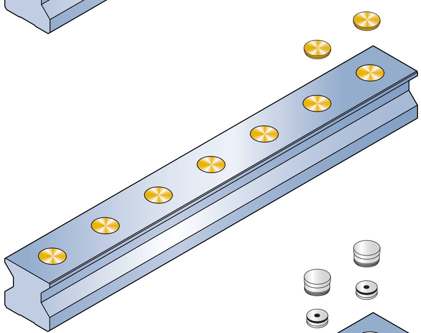
LLUHR ... D4 rails

With blind holes for mounting from below.



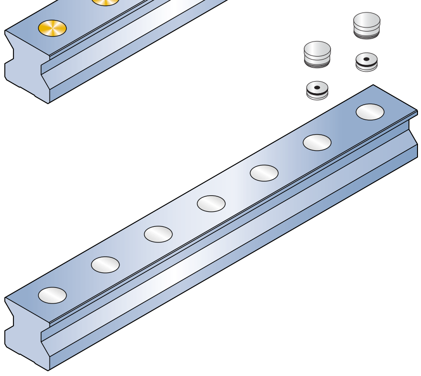
LLUHR ... D6 rails

Standard rail supplied with protective brass plugs for mounting from above.



LLUHR ... D8 rails

Standard rail supplied with protective steel plugs for mounting from above.

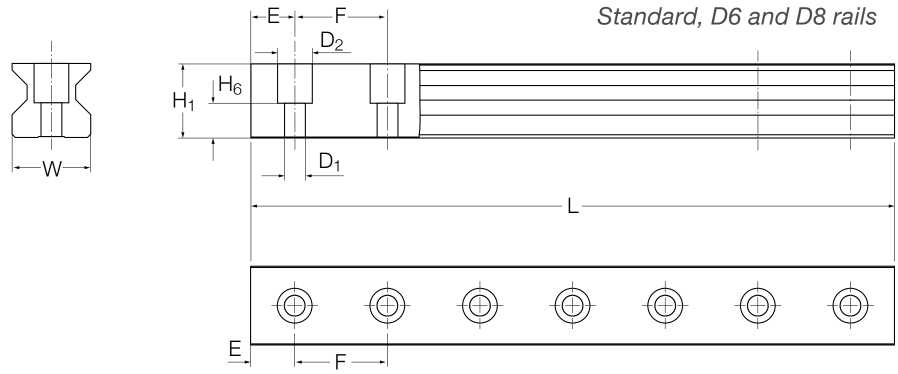


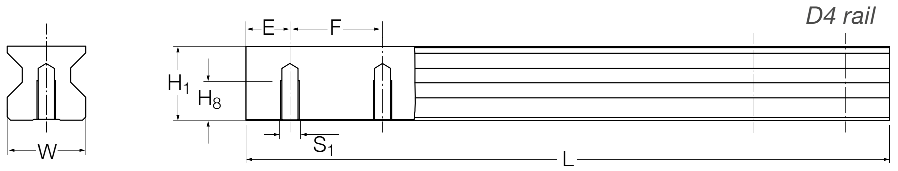
Protective metal plugs ensure that no residues of dirt, swarf, cooling water and other contaminants remain in the area of the attachment holes . After insertion, these plugs align flush with the surface of the profile rail guide to provide effective wiping. The use of additional scraper plates in combination with these protective metal plugs is an option which will further enhance protection.

Size-specific mounting tools for installing the protective brass and steel plugs are available from Ewellix. Please refer to **page 65** to order the mounting tool.

NOTE: If a rail length is required that exceeds the maximum length available, joint rails can be ordered. These rails are manufactured to match seamlessly with each other.

To determine the rail length and calculate specific equidistant E values see formulae on the following page (↳ **page 41**).





Size	Rail dimensions											
	W	H_1	H_6	F	D_1	D_2	H_8	S_1	E_{Std} –0.75	E_{min} –0.75	E_{max} –0.75	L_{max} [1)] –1.5
–	mm											
25	23	24,35	12,85	30	7	11	12	M6	12,5	10	22	3 985
35	34	32	15	40	9	15	15	M8	17,5	12	30	3 995
45	45	39,85	20,85	52,5	14	20	19	M12	23,75	15	40	3 985
55	53	47,8	25,8	60	16	24	22	M14	27,5	17	46	3 955
65	63	55	29	75	18	26	25	M16	35	18	60	3 970

[1)] Calculated by using E_{Std}
For the designation of the different rails refer to Ordering key rails (↳ **page 64**) .

The "E" dimension designates the distance between the end face and the center of the first mounting hole of the rail.
With suffix "ES" in the ordering key, the holes at both rail ends will be positioned equidistantly from either end of the rail using the E_{Std} dimension. This results in predefined rail lengths that should be preferred when ordering:

$L = nF + 2\,E_{Std}$

With suffix "E0", the rail is produced with the shortest possible symmetrical "E" dimension on both rail ends.

With suffix "Exx", the "E" dimension has to be specified.

To calculate specific equidistant "E" dimensions, following formulae are used:

Calculation of number of attachment holes in rail guide

(1) $n_{real} = \frac{L}{F}$

(2) Round down of n_{real} to n

(3) n + 1 = z

F = Distance of attachmentholes
L = Rail length
n_{real} = Real calculation value for number of hole distances
z = Number of attachment holes in rail

Determination of E dimension based on z

(4) $E_{real} = \frac{L - F\,(z - 1)}{2}$

E_{real} = Real calculation value for E-dimension

E_{min} = Minimum E-dimension according to catalogue

E_{Std} = Standard value for E-Dimension

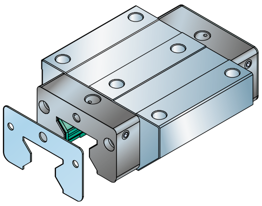
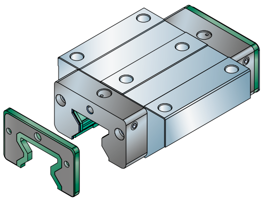
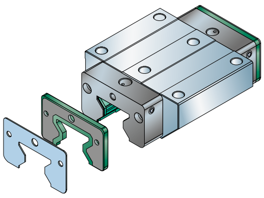
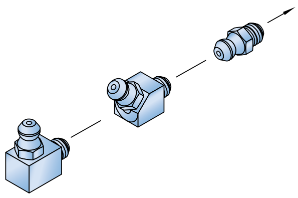
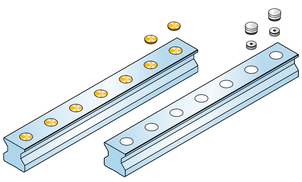
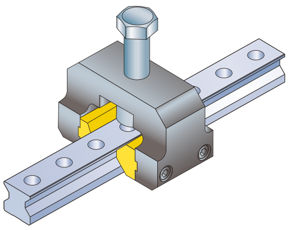
Comparison with catalogue value of E_{min}

(4.1) If $E_{real} \geq E_{min}$
Usage of E_{real} from **formula 4**

(4.2) If $E_{real} < E_{min}$
Calculation of E_{real} according to **formula 5**

(5) $E_{real} = \frac{L - F\,(z - 2)}{2}$

3.3 Accessories

Accessories Item name	Illustration[1]	Purpose
Scraper plate **LLTHZ ... S1**		Scraper plates are spring-steel, non-contact components. They protect the front seal from coarse contaminants or hot metal chips. Lubrication adaptors can be used without modifications. Longer mounting screws are supplied with the scraper plate
Additional front seal **LLTHZ ... S7**		Additional front seals are contact seals that can be attached to the carriage end faces. They are single-lip seals consisting of special heavy-duty material with rubber (NBR) seal lips (S7) or fluoroelastomere (FKM) seal lips (S4). Both offer additional protection against liquids and smaller contaminants. The FKM seal has a better chemical resistance, e.g. against agressive coolants. One lubrication connector and longer screws are supplied with the seal.
Seal kit **LLTHZ ... S3** **LLTHZ ... S8**		The seal kit consists of a metal scraper and an additional front seal. It is intended for applications involving exposure to coarse and fine dirt as well as liquids. One lubrication connector and longer screws are supplied with the seal kit.
Lubrication adaptors **LLUHZ VN ...**		To connect different lubrication devices to the carriage, several lubrication adaptors are available.
Protective metal plugs from brass or steel **LLUHZ ... TD6 / TD8**		Metal plugs protect carriage and rail from damages caused by high thermal and mechanical exposure, e.g. chip formation.
Assembly tool for metal plugs **LLUHZ ... D6**		Rail size specific assembly tools are available for proper installation of protective metal plugs. There are two sizes available, one covering the range of size 25-45 and one covering size 45-65.

[1] Appearance can vary slightly depending on the size

3.3.1 Scraper plate

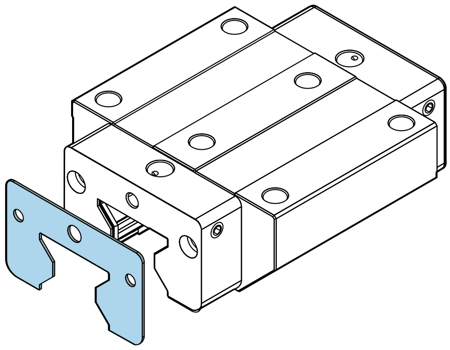
LLUHZ ... S1

- Material: Spring steel according to DIN EN 10088
- Appearance: Steel grey
- Designed with a specified maximum gap of ~ 50 µm

Mounting

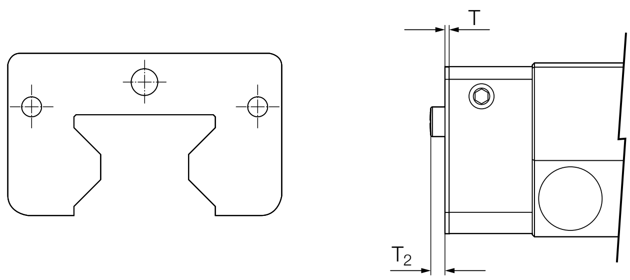
The standard grease nipple still fits. Longer mounting screws are supplied with the scraper plate. When mounting, be sure there is an even space between the rail and scraper plate.

NOTE: Can be ordered in combination with an additional front seal as a kit, designation S3 or S8.



Appearance can vary slightly depending on the size.

Dimensional drawing



Carriage size –	T mm	T_2
25	1	2,6
35	1	3,3
45	1,5	4
55	1,5	4,8
65	2	8

3.3.2 Additional front seal

LLUHZ ... S7

- Material: Elastomer (NBR) on steel carrier
- Design: Single-lip seal

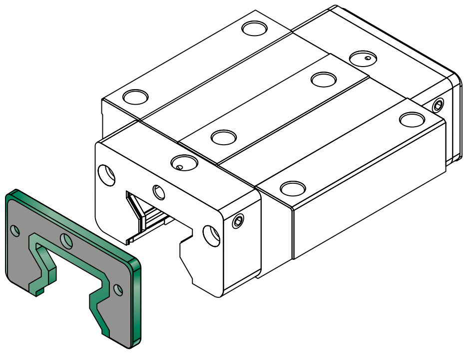
LLUHZ ... S4

- Material: Fluoroelastomer (FKM) on steel carrier
- Good chemical resistance e.g. against agressive coolants
- Design: Single-lip seal

Mounting

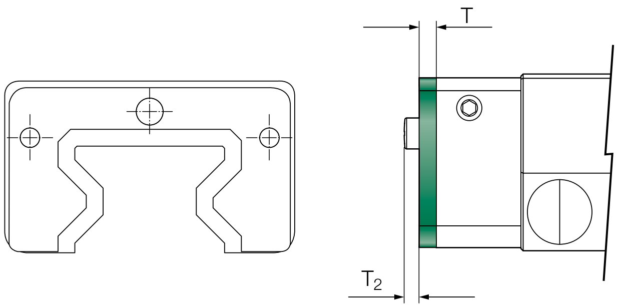
One lubrication connector and longer mounting screws are supplied with the seal. For dimensions of the lubrication connector please refer to **table 1** (↳ **page 47**)

NOTE: Can be ordered in combination with an additional scraper plate as a kit, designation S3 or S8.



Appearance can vary slightly depending on the size.

Dimensional drawing



Carriage size –	T mm	T_2
25	6	2,6
35	6	3,3
45	6	4
55	6	4,8
65	7	8

3.3.3 Seal kit

LLUHZ ... S3

The seal kit consists of the following components:

- Scraper plate
- Additional front seal S7 (NBR)

LLUHZ ... S8

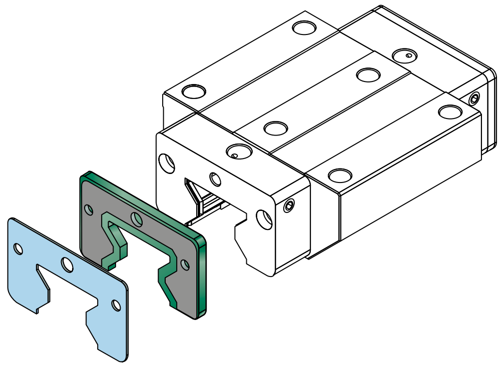
The seal kit consists of the following components:

- Scraper plate
- Additional front seal S4 (FKM)

Mounting

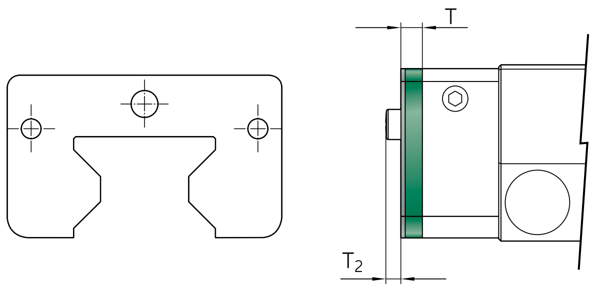
One lubrication connector and longer mounting screws are supplied with the seal kit. For dimensions of the lubrication connector please refer to **table 1** (↳ **page 47**).

When mounting, be sure there is an even space between the rail and scraper plate.



Appearance can vary slightly depending on the size.

Dimensional drawing



Carriage size –	T mm	T_2
25	7	2,6
35	7	3,3
45	7,5	4
55	7,5	4,8
65	9	8

3.3.4 Lubrication adaptors

All lubrication adaptors are standardized with a M6 thread for secure attachment to the carriages of all sizes. For our range of grease nipples, couplings and fittings, please refer to **table 1.**

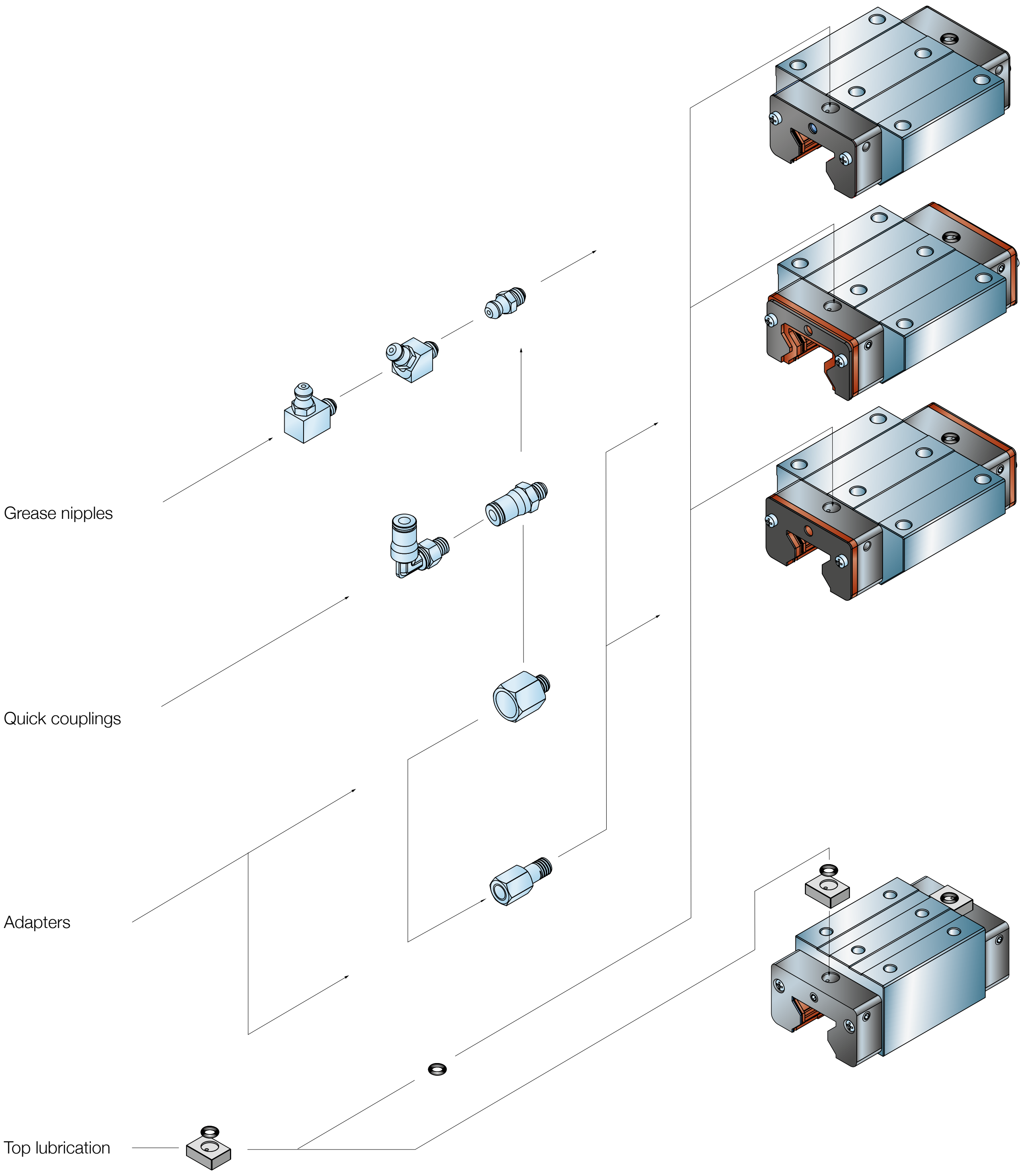
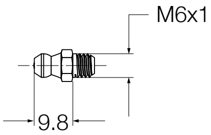
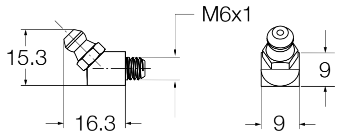
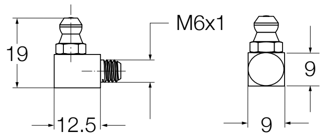
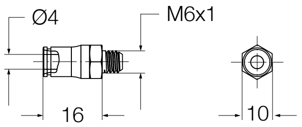
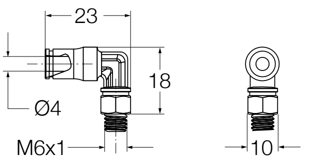
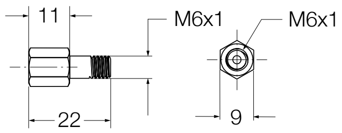
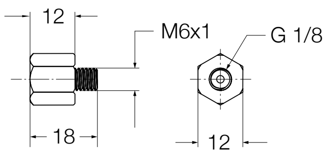
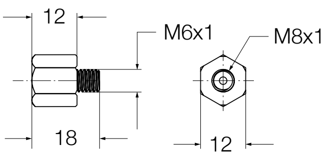
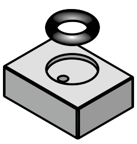


Table 1

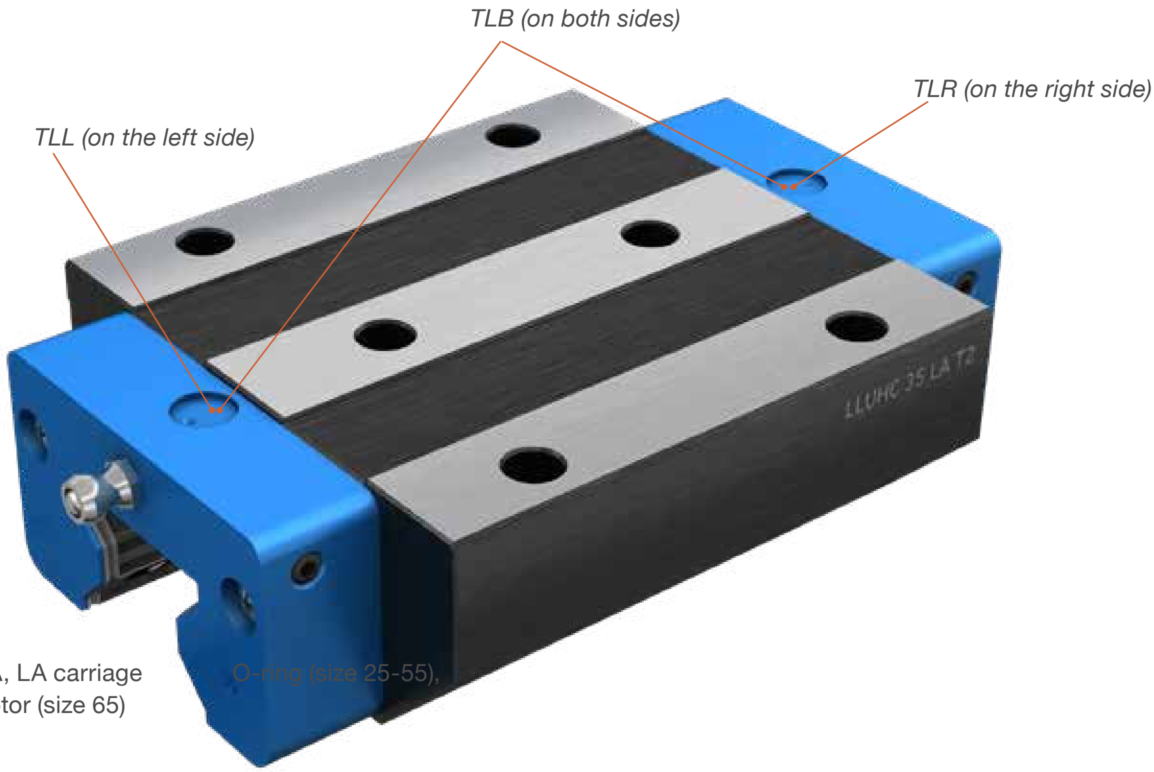
	Item name Ordering key	Size	Description
	Grease nipple straight LLUHZ VN-M6	Steel, coated	Is supplied with the carriage as standard.
	Grease nipple 45° LLUHZ VN-M6-45	Steel, coated	
	Grease nipple 90° LLUHZ VN-M6-90	Steel, coated	
	Quick coupling straight LLUHZ VN SC	Steel, coated	To connect 4 mm outer diameter plastic pipe. Max. operating pressure: 30 bar
	Quick coupling 90°, adjustable LLUHZ VN AC	Steel, coated	Coupling can be rotated 360°. To connect 4 mm outer diameter plastic pipe. Max. operating pressure: 30 bar
	Lubrication connector LLUHZ VN UA	Stainless steel	Needed when using seal kit S3, S8 and seal S7, S4.
	Reduction fitting LLUHZ VN UB	Stainless steel	Reduction from G1/8 to M6 when connection to a pipe system is needed.
	Reduction fitting LLUHZ VN UC	Stainless steel	Reduction from M8x1 to M6.
	Adaptor for top lubrication LLUHZ VN TL	Aluminium and O-rings	Supplied with top lubrication option. Separately only if needed as a spare part.

3.3.5 Adaptor for top lubrication

The lube port for top lubrication in the end plate is usually closed. If needed, it is to be ordered separately. In this case the carriage will be delivered with an opened port and the necessary top lubrication adaptor. Reconditioning of delivered carriages to accommodate top lubrication is not possible.

When ordering a system or a single carriage with top lubrication, be sure to specify on which side of the carriage the lubrication port is needed.

When ordering an adaptor for top lubrication as a spare part, be sure to specify which carriage type it is needed for.



TL1	for A, LA carriage	O-ring (size 25-55), O-ring + adaptor (size 65)
TL2	for R, LR carriage	O-ring + adaptor

4

Mounting instruction and maintenance

4.1 Design rules

The following mounting instructions are applicable to all carriage types. To maintain the high precision of Ewellix roller profile rail guides LLU, the carriages must be handled carefully during transport and assembly. To provide protection during transport, storage and assembly, LLU rails and carriages are supplied with a corrosion preservative. This preservative does not need to be removed if the recommended lubricants are used.

NOTE: When carriages are shipped without a rail, they are equipped with a transportation sleeve to keep the rollers in place. This transportation sleeve should never be removed without pushing the carriage onto a rail. Also, the carriages should never be removed from a rail without using a transportation sleeve to keep the rollers in place. Failure to follow these directions may result in the rollers falling out of place. If this happens, the carriages cannot be used anymore.

Fig. 1

Mounting with laterally fixed rails

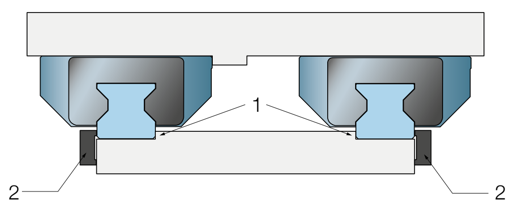
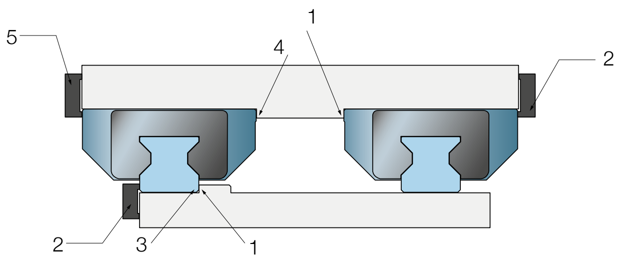


Fig. 2

Mounting with laterally fixed rail and carriages



4.1.1 Typical mounting examples

Rails

Each rail has ground reference edges on both sides.

Options for securing the rails laterally (↳ figs. 1 and 2)

4.2.1. Stop edges
4.2.2. Retaining strips
4.2.3. Reference edges

NOTE: Rail ends must be chamfered to prevent seal damage during installation. However, if two rails are to be joined, do not chamfer either of the mating ends.

Rails that are not laterally fixed must be installed straight and parallel. Ewellix recommends using a support strip to maintain the rail's position during installation.

Guideline values for the permissible lateral loads for guidings that are not laterally supported are listed in **table 11.**

Carriage

Each carriage has one reference side (please refer to dimension H_2 in the drawings of the carriages) (↳ **pages 36 and following**).

Options for securing the carriages laterally (↳ fig. 2)

4.2.4. Stop edges
4.2.5. Retaining strips

NOTE: If mounted correctly, the carriage should move easily on the rail when pushed (moving force depending on preload). During assembly, secure the carriage to prevent it from falling.

4

4.1.2 Interface design, screw sizes and tightening torques

- The flange-type carriages can be fastened from above (↳ **fig. 4**) and below (↳ **fig. 5**). For fixation from below, use the attachment holes as pass-through holes for a screw in the next smaller size. For the two inner attachment holes (O_3), special screws with low head height according to **DIN 6912** must be used.
- The slim-type carriages can be fastened only from above (↳ **fig. 6**).
- Rails can be fastened from both above (↳ **fig. 5** and **6**) or below (↳ **fig. 4**).

All screw dimensions and recommended lengths are shown in **table 1**. The correct tightening torque is critical to the proper function of the guide system. It is to be considered according to **table 2**. If no stop edge is provided in the adjacent structure, then the permissible maximum lateral load per carriage should be considered. Values can be found in **table 3**.

Fig. 3

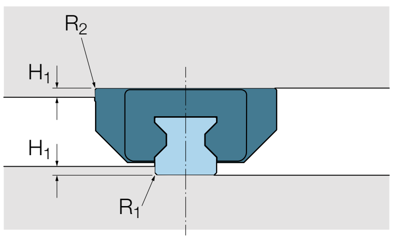


Fig. 4

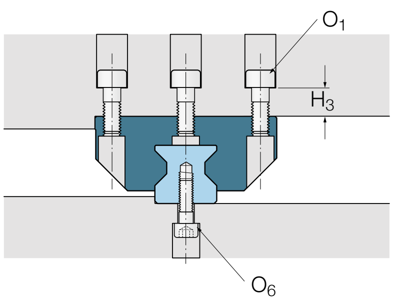


Fig. 5

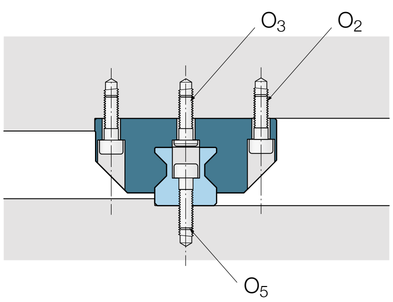


Fig. 6

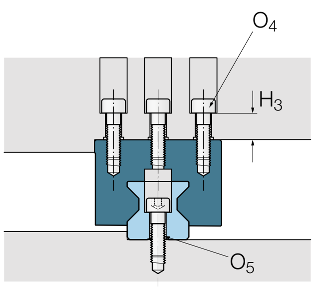


Table 1

Stop edges, corner radii, screw types and sizes per carriage type and fastening direction

Size	Dimensions				Screw					
	H1	R1 max	R2 max	H3	O1[1]	O2[2]	O3[3]	O4[4]	O5	O6[5]
–	mm				ISO 4762	ISO 4762	DIN 6912	ISO 4762		
25	5	0,8	0,8	10	M8x20	M6x20	M6x16	M6x18	M6x30	M6x20
35	6	0,8	0,8	13	M10x25	M8x25	M8x20	M8x25	M8x35	M8x25
45	8	0,8	0,8	14	M12x30	M10x30	M10x25	M10x30	M12x45	M12x30
55	10	1,0	1,2	20	M14x40	M12x40	M12x30	M12x35	M14x50	M14x40
65	10	1,5	1,5	25	M16x45	M14x45	M14x35	M16x40	M16x60	M16x45

[1] A, LA type, bolted from above
[2] A, LA type, bolted from below 4 outer screws
[3] A, LA type bolted from below 2 inner screws
[4] R, LR type bolted from above
[5] Please respect the general recommendations for minimum thread engagement lengths

Table 2

Recommended tightening torques of mounting screws

Screw strength class	Screw					
	M6	M8	M10	M12	M14	M16
–	Nm					
8.8	10	24	48	83	130	200
12.9	15	40	81	135	215	265

Table 3

Maximum lateral load per carriage

Screw strength class	Screws used for mounting in line				
	Carriage			Rail	
	O1	O2+O3	O4	O5	O6
8.8	19% C	14% C	14% C	6% C	6% C
12.9	29% C	22% C	22% C	10% C	10% C

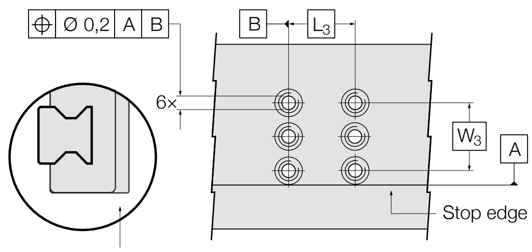
4

4.1.3 Position tolerances of attachment holes

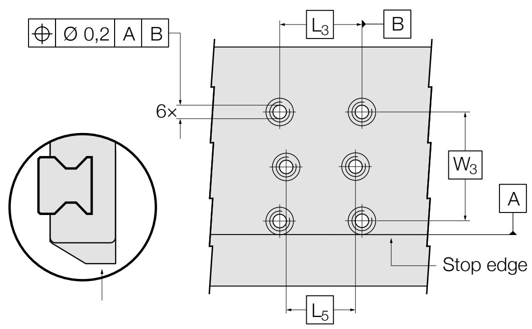
To ensure the interchangeability between the machine bed and the profile rail guides, it is necessary to match the positions of the corresponding attachment holes of all components to be mounted. When observing the tolerances given in the following drawings, it is not necessary to remachine the machine bed, in particular with long profile rail guides.

Fig. 7

Attachment structure for carriages



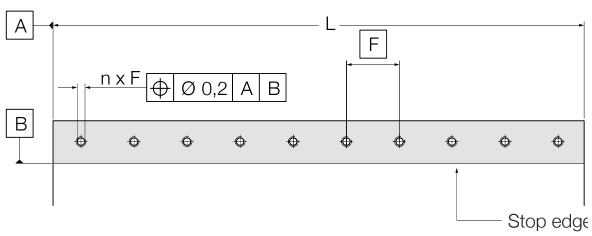
Ref. side
R / LR - carriage



Ref. side
A / LA - carriage

Fig. 8

Attachment structure for rails



4.1.4 Permissible height deviation

The values for height deviation are applicable for all carriage types. If the values for height deviation S_1 and S_2 are within the specified range, the service life of the rail guide system will not be influenced.

Permissible height deviation in lateral direction (↳ table 12)

$S_1 = d\ Y$

where

s_1 = Permissible height deviation [mm]

d = Distance between the rails [mm]

Y = Calculation factor lateral direction

NOTE: The height tolerance H for the carriages has to be taken into account. Please refer to **table 2** on **page 14**. If the difference S_1–2 x tolerance H < 0, a new product selection is necessary (other preload, precision).

Permissible height deviation in longitudinal direction (↳ table 5)

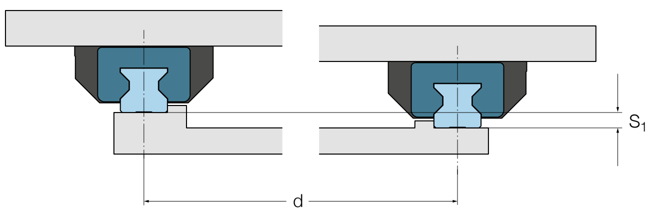
$S_2 = c\ X$

where

S_2 = Permissible height deviation [mm]

Table 4

Permissible height deviation in lateral direction



Calculation factor	Preload	
	T2 (8% C)	T3 (13% C)
Y	1,7 × 10−4	1,2 × 10−4

c = Distance between the carriages [mm]

X = Calculation factor longitudinal direction

NOTE: The maximum difference ΔH for the carriages has to be taken into account. Please refer to **table 2** on **page 14**. If the difference $S_2 - \Delta H < 0$, a new product selection is necessary (other preload, precision).

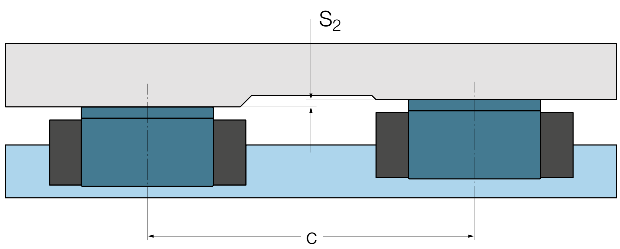
4.1.5 Parallelism

The parallelism of mounted rails is measured on the rails and the carriages.

The values for deviation in parallelism P_a are applicable to all carriage types. Deviation in parallelism Pa increases the internal load. If the values are within the specified range in **table 6**, the service life of the profile rail guide system will not be influenced. With standard mounting, the adjacent structure is slightly resilient. However, a rigid, high-precision adjacent structure is required for precision mounting. In this case, the values in **table 6** must be halved.

Table 5

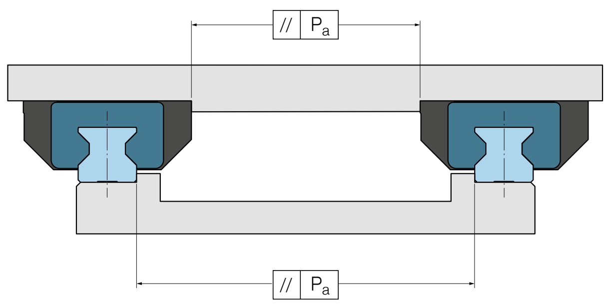
Permissible height deviation in longitudinal direction on one rail



Calculation factor X for carriages Calculation factor		
	Standard length	Extended length
X	4,5 × 10–5	3,5 × 10–5

Table 6

Deviation in parallelism Pa



Size	P_a in relation to preload class [mm]	
	T2 (8% C)	T3 (13% C)
25	0,008	0,005
35	0,012	0,008
45	0,014	0,009
55	0,017	0,011
65	0,018	0,011

4.2 Maintenance and repairs

4.2.1 Preventive maintenance

To avoid dirt from adhering to and being embedded into the rails, the rails should be cleaned regularly with a “cleaning stroke”. Ewellix recommends a cleaning stroke over the entire length of the rails twice a day or at least every eight hours.

Perform a cleaning stroke whenever switching the machine on or off.

4.2.2 Lubrication

The appropriate type and amount of lubricant is required for rolling bearings to function reliably. To reduce wear, the lubricant prevents direct metal-to-metal contact between the rolling elements and the raceways. In addition, the lubricant protects the carriage from corrosion.

The guiding system can only realize its optimum operating temperature when a suitable amount of lubricant to reliably lubricate the roller profile rail guide is applied.

Basically, two different lubrication methods are available for LLU: grease and oil lubrication.

Delivery condition from factory

LLU roller carriages and rails are protected with high-quality anti-corrosion preservation oil for transport, storage and mounting. This special oil supports initial installation of LLU and can remain in the product if the Ewellix recommended lubricants are used.

Each carriage is delivered with one straight grease nipple and has to be initially lubricated before usage as described on the next pages.

Lubrication ports

Both end plates of the carriage feature three lube ports with M6 thread, one in longitudinal and two in 90° orientation to moving direction (↳**fig. 9**). At delivery these ports are closed by grub screws. As standard, one straight grease nipple for manual lubrication is supplied with the carriage. If needed, the carriage can be adapted for top lubrication.

The lube port for top lubrication is usually closed and has to be ordered separately if required (see ordering key system). In this case the carriage will be delivered with an opened port and the necessary adaptor. Reconditioning of delivered carriages to accommodate top lubrication is not possible. For additional lubrication adaptors please refer to **table 8** on **page 47**.

Grease lubrication

Under normal operating conditions, LLU roller profile rail guides should be lubricated with grease. The advantage of grease is that it is more easily retained in the bearing, which is particularly important when the axis of travel is inclined or vertical. Moreover, it contributes to sealing the bearing against the ingress of liquid contaminants or humidity.

Base oil viscosity

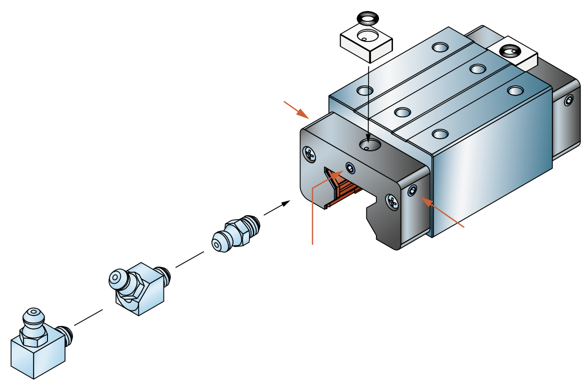
The viscosity of the lubricating oil in grease is key to the formation of the hydrodynamic film that separates the rolling elements from the raceways.

In general, the viscosity of lubricating oils is based on the flow rate at 40 °C. These values also apply to the mineral base oils contained in lubricating greases.

The base oils of commercially available rolling bearing greases have viscosity values between 15 and 500 mm2/s

Fig. 9

Permissible Lubrication ports



(at 40 °C). Greases with higher base oil viscosities often release the oil too slowly to sufficiently lubricate bearings.

Consistency class

Lubricating greases are divided into various consistency classes according to a scale by the National Institute of Grease Lubrication (NLGI). These are also reflected in DIN 51 818 and DIN 51 825.

Greases with a metallic soap thickener with a consistency of 2 or 3 on the NLGI scale are particularly suitable for use with LLU roller profile rail guides. The grease consistency should not vary too much with changing operating temperatures or stress levels. Greases that soften at higher temperatures can leak from the bearing position, while greases that stiffen at lower temperatures can impede the operation of the linear guiding system.

Specific requirements are placed on the lubricating grease's purity, composition and compatibility if the grease is to be used in special applications.

Temperature range

The temperature range over which a grease can be used depends largely on the type of base oil and thickener as well as the additives.

The low temperature limit, the lowest temperature at which the grease enables the bearing to be started up without difficulty, is largely determined by the type of base oil and its viscosity. The high temperature limit is determined by the type of thickener and its dropping point. The dropping point is the temperature at which grease changes its consistency and becomes a fluid.

NOTE: that grease will age with increasing rapidity at higher operating temperatures. The resulting by-products have a detrimental effect on the grease's lubrication properties and conditions in the rolling contact zone.

Lubricating greases with synthetic base oils can be used both at higher and lower temperatures than lubricants with a mineral oil base.

Corrosion-inhibiting additives in lubricants

Lubricants typically contain additives to inhibit corrosion. In addition, the type of thickener is crucially important in this regard.

Lithium-base and calcium-soap greases provide excellent corrosion protection properties. They are also resistant to water wash-out.

SKF bearing greases

The assortment of SKF greases has been developed based on the latest information about rolling bearing lubrication and has undergone extensive testing both in the laboratory and under field conditions. SKF continuously monitors the quality of its greases prior to use or sale.

Table 7 lists those SKF greases that are particularly well-suited for LLU roller profile rail guides. Additional information and special lubricant recommendations are available from Ewellix upon request.

Initial grease lubrication

LLU roller profile rail guides must be initially lubricated immediately after installation with lubricant quantities specified in **table 8**. During lubrication, the carriage should be moved at least three times' its length for better lubricant distribution within the carriage.

Grease relubrication

The lubrication intervals for LLU roller profile rail guides depend primarily on the average running speed, operating temperature and grease quality. The intervals recommended for fixed operating conditions are listed in **table 9.** For appropriate grease quantity, refer to **table 10**. Where contamination, use of coolants, vibration, shock loads, etc. are part of the environmental conditions, it is advisable to reduce relubrication intervals accordingly.

Oil lubrication

When a LLU roller profile rail guide is used under particular operating conditions, such as unfavorable load scenarios or limited access for relubrication, oil lubrication is advisable.

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Table 7

A selection of SKF rolling bearing greases

Properties	**Lubricant (designation)** LGEP 2	LGMT 2	LGLT 2	LGFP 2
Thickener	Li	Li	Li	Al complex soap
Base oil	Mineral oil	Mineral oil	Di-ester oil	Medical white oil
Operating temperature, °C (steady state)	–20 up to +100	–30 up to +120	–55 up to +110	–20 up to +110
Kinematic viscosity of base oil	200	110	15	130
Consistency class (acc. to NLGI)	2	2	2	2
Temperature range /Application range	EP grease	normal	low	food compatible

For small sizes of roller profile rail guides under heavy load conditions oil lubrication might be advantageous to extend the service life in the application.

Oil lubrication can also be advantageous when a centralized lubrication system is installed or where there is a need to unify the lubrication management with other machine parts, e g drive train or secondary lubrication points In this case, Ewellix recommends oil types according to DIN 51517, type CLP or DIN 51524, type HLP The viscosity range should cover ISO VG 68 to ISO VG 220.

Initial oil lubrication

Immediately after installation, the carriages should be lubricated with the oil quantities specified in **table 11**. The quantities are valid for all carriage types and vary only with the size. During the filling, the carriage should be moved at least three times' its length for better oil distribution within the carriage.

Table 8

Initial grease lubrication quantities

Quantity/carriage –	LLUHC 25 cm3	LLUHC 35	LLUHC 45	LLUHC 55	LLUHC 65
A, R	1,9	2,9	5,3	8,4	15
LA, LR	2,2	3,7	6,6	10,6	18,9

Table 9

Relubrication interval according to applied carriage load

Load ratio C/Fm ≥	 <	LLUHC 25 travel interval in km	LLUHC 35	LLUHC 45	LLUHC 55	LLUHC 65
8	–	800	500	300	200	100
5	8	500	300	150	100	50
3	5	200	150	80	50	25
2	3	120	80	40	25	15

Table 10

Grease relubrication quantities

Quantity/carriage –	LLUHC 25 cm3	LLUHC 35	LLUHC 45	LLUHC 55	LLUHC 65
A, R	0,5	1,2	2,2	3,2	5,9
LA, LR	0,6	1,4	2,6	4	7,4

Oil relubrication

The oil relubrication intervals for LLU roller profile rail guides depend primarily on the average running speed, operating temperature and oil quality. The intervals recommended for fixed operating conditions are the same as for grease lubrication and are listed in **table 9**. The appropriate oil quantity is the same as for initial lubrication according to **table 11**. Where contamination, use of coolants, vibration, shock loads, etc. are part of the environmental conditions, it is advisable to reduce relubrication intervals accordingly.

In case of impulse oil lubrication, the minimum quantity per impulse should be 15% of the values from **table 11**.

Temperature range

Note that oil will age with increasing rapidity at higher operating temperatures. The resulting by-products have a detrimental effect on the oil's lubrication properties and conditions in the rolling contact zone.

Short stroke applications

If the stroke is less than twice the carriage length, lube ports on both carriage end plates must be used, each filled equally with the grease or oil quantity stated for initial lubrication or relubrication.

Example

- Short stroke application
- Carriage type A
- Size LLUHC 25
- Grease lubrication

Apply 1,9 cm^3 into the left and 1,9 cm^3 into the right grease nipple for initial lubrication.

IMPORTANT: To avoid serious damage to the rail guides, it is important to consider the miscibility of greases or oils when changing from one lubricant to another.

Moreover, you must also consider the possibility of reduced relubrication intervals and reduced load ratings as well as the possibility of chemical interaction with synthetic materials, lubricants and preservatives. Please refer to the grease and oil manufacturer's instructions. In case of incompatibility between lubricants employed, the carriages should be thoroughly cleaned before regreasing.

Centralized lubrication systems

If the application features a centralized lubrication system using greases with a consistency of 2 or higher on the NLGI scale, contact Ewellix.

For automatic relubrication systems from Ewellix, please contact your local Ewellix representative.

Table 11

Initial oil lubrication quantities

Quantity/carriage –	LLUHC 25 cm3	LLUHC 35	LLUHC 45	LLUHC 55	LLUHC 65
	0,8	1,0	1,4	1,8	3,6

4.2.3 Replacement

If the LLU roller profile rail guide system has reached the end of its service life and has to be replaced, Ewellix recommends replacing the whole system. Please locate the name of the ordering key written on the carriage and measure the rail length and the E-dimension (the distance from the rail end to the first hole) for re-ordering.

4.2.4 Stationary conditions, shipping and storage

If a LLU roller profile rail guide is stationary for long periods and subjected to vibration from external sources, micro movement in the contact zone between rollers and raceways will lead to damage of those surfaces. This damage can result in a significant increase in running noise and premature failure due to material fatigue. Damage of this kind should be avoided at all costs, for instance by isolating the bearings from external vibration and by taking suitable precautions during transport.

4.3 Ordering key

The ordering key on the following tables supports the selecting of complete systems, carriages, rails and accessories.

NOTE: Carriage and rail types marked in **RED** represent the preferred range, meaning they are usually available from stock for prompt delivery. Accessories although not being marked in RED are usually available for prompt deliveries as well.

4.3.1 Ordering key LLU system

LLUH	S	35	R	2	T2	1000	P01	A	D4	E0	M	S1	C	TLL	M

LLU roller profile rail guide

Type code

C	Carriage (carriage only)[1]
R	Rail (rail only)[1]
S	System[2]
Z	Accessories (if ordered separately)[1]

Size

25, **35**, **45**, 55, 65

Carriage type

A	Flanged carriage, standard length, standard height
LA	Flanged carriage, extended length, standard height
R	Slim-line carriage, standard length, extended height
LR	Slim-line carriage, extended length, extended height

Number of carriages per rail

1, 2, 4, 6, …

Preload class

T2	Medium preload, 8% C
T3	Heavy preload, 13% C

Rail length

Maximum rail length without joint: 4 000 mm; in 1 mm increments[3]

Precision class

P3	Medium
P1	High
P01	Super
P001	Ultra

Joint rails

–	If not selected, no code
A	Yes

Rail

–	Standard rail with plastic caps, no code
D	Rail, if customized according to drawing number
D4	Rail with blind holes
D6	Rail with brass plugs
D8	Rail with steel plugs

Distance between end face and first mounting hole of the rail [3]

ES	The holes at both rail ends will be positioned equidistantly from either end of the rail using the EStd dimension. This results in predefined rail lengths, details see **page 41**.
E0	The holes at both rail ends will be positioned equidistantly from either end of the rail with the shortest possible “E” dimension.
Exx	“E” dimension to be specified

LLUH	S	35	R	2	T2	1000	P01	A	D4	E0	M	S1	C	TLL	M

System (Carriage mounted on rail)

–	If not selected, no code
M	Yes

Additional sealing, as part of the system (for separate parts see Ordering Key Accessories)

S1	Scraper plate
S3	Seal kit, additional front seal NBR with scraper plate
S4	Additional front seal FKM
S7	Additional front seal NBR
S8	Seal kit, additional front seal FKM with scraper plate

Number of additional seals

C	Two additional seals per carriage
S	Two additional seals per system, only outer sides of carriages are additionally sealed

Top lubrication (details and definition see page 48)

–	If not selected, no code
TLL	Left end plate modified plus adaptor for lubrication from top
TLR	Right end plate modified plus adaptor for lubrication from top
TLB	Both end plates modified plus two adaptors for lubrication from top

Mounting of accessories[4]

–	Not mounted, no code
M	Accessories mounted on the carriages

Preferred range

[1] When ordered separately (not in a system)

[2] System can consist of one rail, one or more carriages and accessories

[3] For details and more information please refer to **page 41**

[4] Can only be selected when option "Carriage mounted on rail" is ordered

4

4.3.2 Ordering key LLU carriages

LLUH	C	35	R	T2	P01	TLL

Carriage size

25, **35**, **45**, 55, 65

Carriage type

A	Flanged carriage, standard length, standard height
LA	Flanged carriage, extended length, standard height
R	Slim-line carriage, standard length, extended height
LR	Slim-line carriage, extended length, extended height

Preload class

T2	Medium preload, 8% C
T3	Heavy preload, 13% C

Precision class

P3	Medium
P1	High
P01	Super
P001	Ultra[1]

Top lubrication (details and definition see page 48)

–	If not selected, no code
TLL	Left end plate modified plus adaptor for lubrication from top
TLR	Right end plate modified plus adaptor for lubrication from top
TLB	Both end plates modified plus adaptor for lubrication from top

Preferred range

[1] Can only be ordered as a complete system

4.3.3 Ordering key LLU rails

LLUH	R	35	1000	P01	A	D4	E0

Rail size
25, **35**, **45**, 55, 65

Rail length
Maximum rail length without joint: 4000 mm; in 1 mm increments[1]

Precision class

P3	Medium
P1	High
P01	Super
P001	Ultra[5]

Joint rails[2]

–	If not selected, no code
A	Yes

Rail[3]

–	Standard rail with plastic caps, no code
D4	Rail with blind holes
D6	Rail with brass plugs[4]
D8	Rail with steel plugs[4]
D	Rail, if customized according to drawing number

Distance between end face and the center of the first mounting hole of the rail[1]

ES	The holes at both rail ends will be positioned equidistantly from either end of the rail using the EStd dimension. This results in predefined rail lengths, details see **page 41**.
E0	The holes at both rail ends will be positioned equidistantly from either end of the rail with the shortest possible “E” dimension.
Exx	“E” dimension to be specified.

[1] For details and more information please refer to **page 41**
[2] Only if required rail length exceeds the maximum available rail length
[3] Plastic and metal plugs are available as spare parts, please see **Ordering Key Accessories**
[4] Mounting Tools are separately available, please see **Ordering Key Accessories**
[5] Can only be ordered as a complete system

Preferred range

4.3.4 Ordering key LLU accessories

LLUH	Z	35	S1

Size
25, 35, 45, 55, 65

Accessories:
Additional sealing options

S1	Scraper plate
S3	Seal kit, additional front seal NBR with scraper plate
S4	Additional front seal FKM
S7	Additional front seal NBR
S8	Seal kit, additional front seal FKM with scraper plate

Assembly tools for metal plugs

25-45 D6	Assembly tool for sizes 25, 35 and 45
45-65 D6	Assembly tool for sizes 45, 55 and 65

Caps and plugs as spare parts

VP	Set of 40 plastic caps
TD6	Set of 40 brass plugs
TD8	Set of 40 steel plugs

Grease nipples[1)]

25-65 VN-M6	Standard grease nipple, straight
25-65 VN-M6-45	Grease nipple, 45 degrees
25-65 VN-M6-90	Grease nipple, 90 degrees

Adaptors[1)]

25-65 VN UA	Lubrication connector, extension M6 to M6
25-65 VN UB	Reduction fitting, from G1/8 to M6
25-65 VN UC	Reduction fitting, from M8x1 to M6

Quick lubrication couplings[1)]

25-65 VN SC	Lubrication coupling, straight
25-65 VN AC	Adjustable coupling, 90 degrees

Adaptors for top lubrication (as spare part)

VN TL1	for A, LA carriage, O-ring (size 25 - 55), O-ring + adaptor (size 65)
VN TL2	for R, LR carriage, O-ring + adapter

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