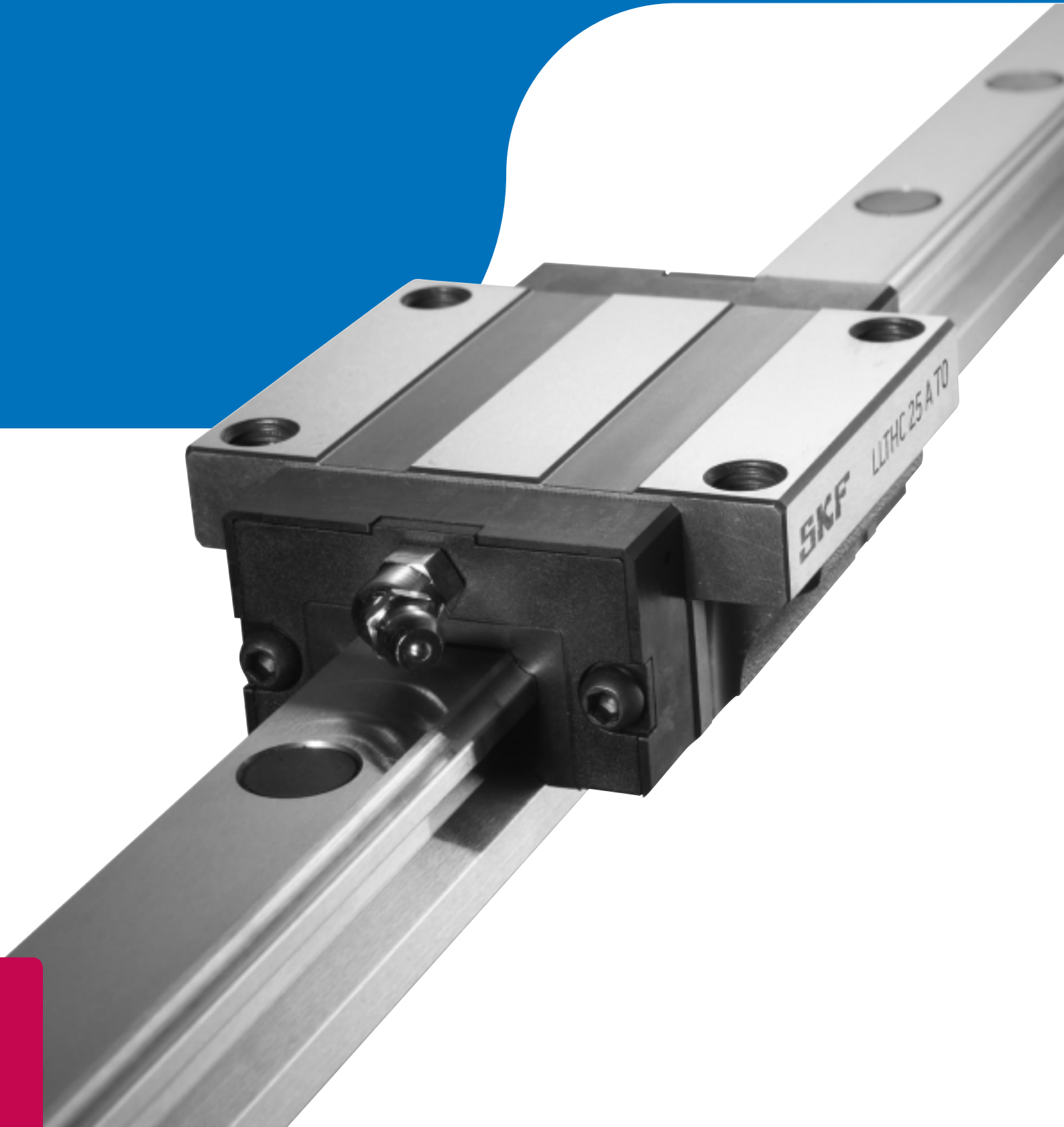# Profile rail guides
LLT

SKF

Contents

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

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

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

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

SKF – the knowledge engineering company

Foreword

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 secure the manufacturer a competitive edge. For this purpose, the linear components have to be as adaptable as possible to precisely meet the application's requirements, ideally with standard components.

The SKF 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 accuracy classes, LLT profile rail guides facilitate the 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 includes 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:

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

SKF

Features and benefits
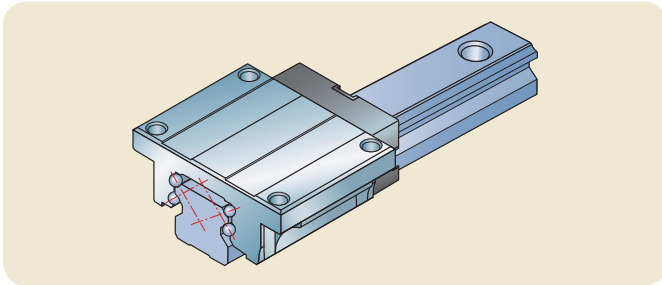
Improved running performance
The LLT profile rail guide has four rows of balls with a 45° contact angle between the rolling elements and raceways. This X-arrangement improves the system's self-aligning capability. Mounting deviations can be accommodated even under preload, resulting in smooth running 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.
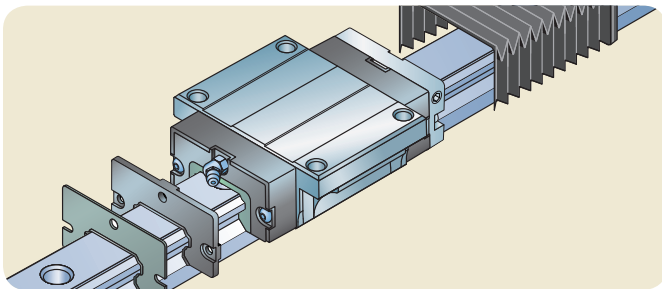
Modular concept for customized solutions
Applications have different speed, precision and environmental requirements. As a result, SKF LLT rail guides use modular components so that cost-effective solutions can be built based on the needs of the application. Various accuracy and preload classes are available to meet different precision and stiffness requirements. Furthermore, a wide range of accessories supports the adaptation to specific environmental needs.
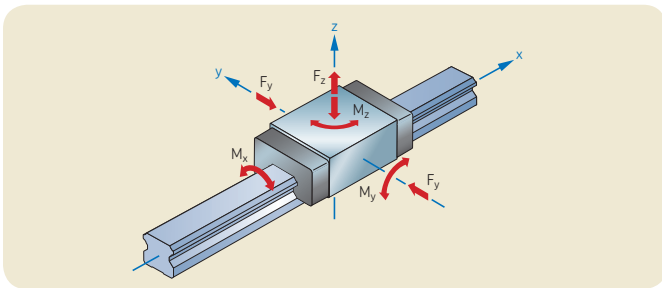
Stiffness, strength and accuracy for improved production processes
The four-row arrangement of balls at a 45° angle optimizes load sharing in all four main load directions and is in accordance with ISO 14728. This feature provides a high degree of design flexibility. The ability to accommodate high loads and moment loads makes these rail guides ideal even for single carriage systems.
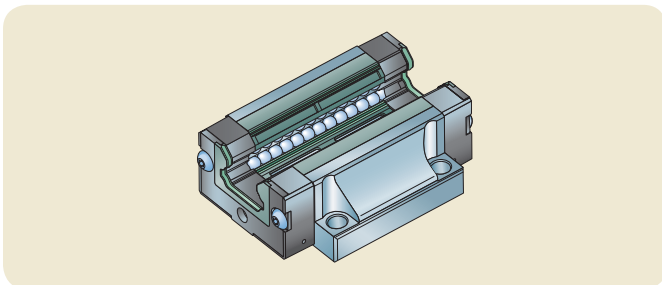
Longer service life and reduced maintenance
SKF profile rail guide carriages are pre-lubricated at the factory.. The integrated lubricant reservoirs, located in the end plates, constantly relubricate the circulating balls. Both ends of the carriage have threaded metal lubrication ports to accommodate an automatic re-lubrication system. As standard, one grease nipple is provided 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.
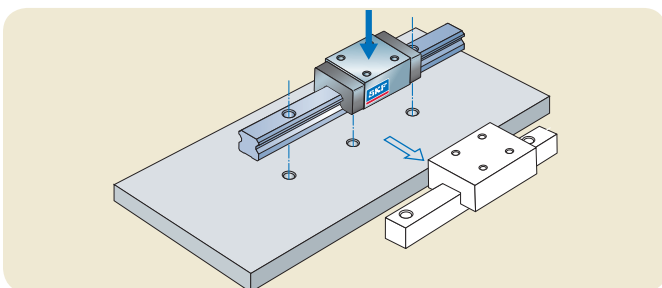
Interchangeability and global availability
The main dimensions of SKF profile rail guides are in accordance with ISO 12090-1. This enables dimensional interchangeability with all ISO-compliant brands. SKF's global sales and distribution network results in availability of replacement parts and serviceability for all systems worldwide.

Basic 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 for when they are subjected to moment loads around the x-axis.

The Profile rail guides from SKF feature an X-arrangement, based on the contact angle of the rolling elements ($\rightarrow$ **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 ($\rightarrow$ **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
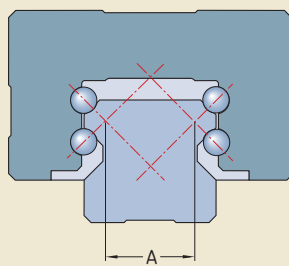
X-arrangement
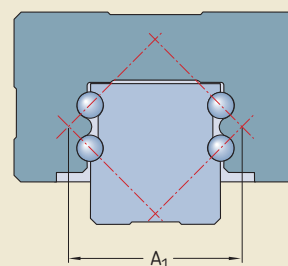
O-arrangement

Fig. 2

Self-aligning capability in comparison

X-arrangement

O-arrangement

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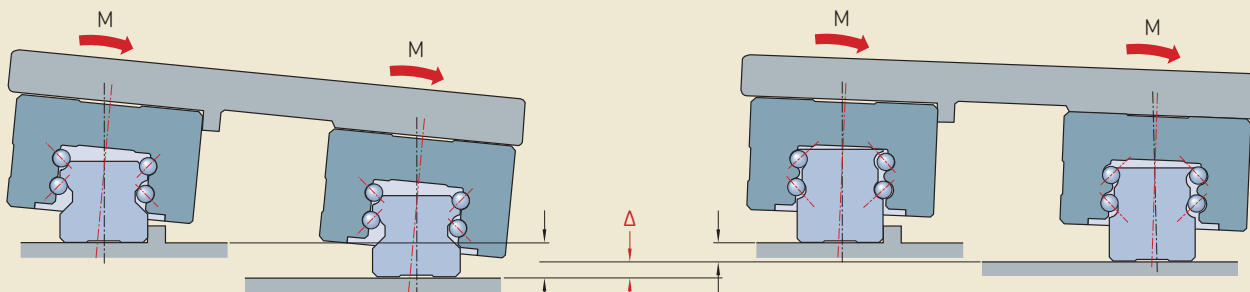
Load rating

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**)

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

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 SKF through internal simulations.

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

In many cases, this SKF 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, are customers 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.

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.

Keep in mind that the 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 regarding 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 1 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 three different carriage types of size 25 with standard length under vertical pushing load in an identical mounting situation.

Deformation behaviour in the three main load directions, symmetrical loading

Deformation [μm]

External load [N]

— LLTHS 25 A T0 lateral load
- - LLTHS 25 A T1 lateral load
— LLTHS 25 A T0 pull load
- - LLTHS 25 A T1 pull load
— LLTHS 25 A T0 push load
- - LLTHS 25 A T1 push load
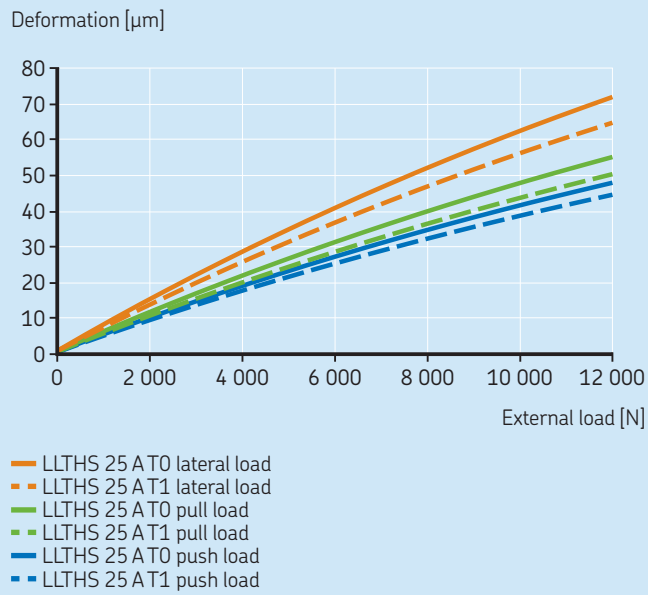
Diagram 1

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

Deformation [μm]

External load [N]

— LLTHS 25 A T0
— LLTHS 25 U T0
— LLTHS 25 R T0

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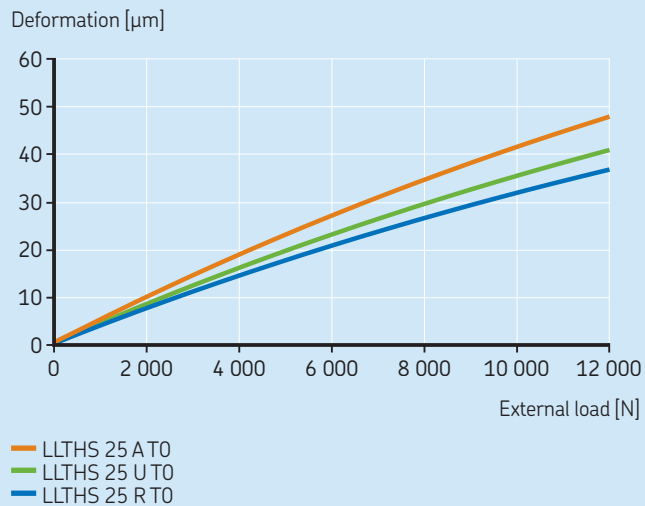
Permissible operating conditions

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 *Calculation bases* (→ **page 14**) are valid only if the operating conditions described in the following are adhered to.

Dynamic

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.

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 bearing load during operation must not exceed 50% of the dynamic load rating. To calculate the dynamic bearing load, **see page 14 ff**.

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 evalution 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.

Standstill

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.

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.

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 low friction S0 shields 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 accuracy 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 $\mu = 0,003$ 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 and can be made available upon request.

Lubrication

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

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

Grease lubrication

Under normal operating condition, 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.

Greases with a metallic soap thickener with a consistency of 2 or 3 on the NLGI scale are particularly suitable for use with SKF 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 tempera-

tures can impede the operation of the linear guidance system.

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

In applications where corrosion protection is a key operational parameter, SKF recommends coated LLT profile rail guides and a grease with a good rust preservative (→ **page 62**).

SKF bearing greases

The assortment of SKF greases has been developed based on the latest information about rolling bearing lubrication and have 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 1 lists those SKF greases that are particularly well suited for LLT profile rail guides. Additional information and special lubricant recommendations are available from SKF upon request.

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

					Table 1
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	200	110	15	130	
Consistency class (acc. to NLGI)	2	2	2	2	
Temperature range / Application range	EP grease	normal	low	food compatible	

Factory pre-lubrication

LLT carriages are supplied pre-lubricated with SKF LGEP 2 grease. The technical data for this grease can be found in **table 1**. 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: 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 SKF 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 2** for appropriate grease quantity and apply it three times.

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

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

Re-lubrication

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 (→ **table 3**). For appropriate grease quantity refer to **table 2**. 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 F_m determination, please use **formula 10** to calculate constant mean load described on **page 16**. Also, consider (**?**) recommended lubrication intervals given in **table 2**.

	Table 2

Size	Grease quantity Carriage type		
	A, U, R	LA, LU, LR	SA, SU
–	cm^3		
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 3

Size	Lubrication intervals[1] Under normal operating conditions, v ≤ 1 m/s Travel under load	
	$F_m \le 0{,}15\ C$	$F_m \le 0{,}3\ C$
–	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

SKF

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 $3 \times 1{,}4$ cm^3 into the left and $3 \times 1{,}4$ cm^3 into the right grease nipple.

NOTICE: 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 possible 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 consistence of 2 or higher on the NGLI scale, contact SKF.

For automatic relubrication systems from SKF, please contact your local SKF representative.

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 15**). The load conditions (→ **page 19**) acting on the guidance 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**.

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

where
C_0 = static load rating [N]
f_d = factor for load conditions
F_{resmax} = 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 4**.
   If, for example, the guidance system is exposed to external vibrations from machinery in close proximity, 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 chapter *Mounting and Maintenance* (→ **page 63**). For overhead installations of LLT profile rail guides, higher safety factors should be applied.

Note: For combined external static bearing loads, the maximum resulting load $F_{res, \, max}$ should be calculated based on an external bearing load F determined according to chapter *Combined static bearing load*, **page 16**.

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 SKF 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 **formula 3** and **5**:

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

$$(4) \quad P = \frac{f_d}{f_i} \, F_{res}$$

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

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]
L_{10h} = basic rating life [h]
L_{10s} = basic rating life [km]
n = stroke frequency [double strokes/min]
P = equivalent dynamic load [N]
s = single stroke length [mm]

Basic rating life at varying speeds

In applications where there are varying speeds, the mean speed must be calculated (**7**). With this value, it is possible to calculate the basic rating life at varying speeds (**6**).

$$(6) \quad L_{10h} = \frac{100 \, L_{10s}}{6 \, v_m}$$

$$(7) \quad v_m = \frac{t_1 \, v_1 + t_2 \, v_2 + \ldots + t_n \, v_n}{100} \quad [m/min]$$

where
L_{10h} = basic rating life [h]
L_{10s} = basic rating life [km]
$t_1, t_2 \ldots t_n$ = time proportions for v_1, v_2 … v_n [%]
v_m = mean speed [m/min]
$v_1, v_2 \ldots v_n$ = speed [m/min]

	Table 4
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	>15

Preload classes

Preload and stiffness

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 stiffness of the carriage under load.

Applying a preload

Preload is determined by the diameter of the balls and increases with their diameter.

SKF LLT profile rail guides are available in different preload classes. For additional information, refer to **table 5**.

For information about what preload classes are typically applied to different applications, see the chapter *Typical application areas* (→ **page 68**).

Depending on the external 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 profile rail guides.

Load case 1
$F \leq 2{,}8\, F_{Pr}$ (F_{Pr} → **table 5**)

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

Load case 2
$F > 2{,}8\, F_{Pr}$ (F_{Pr} → **table 5**)

$$(9) \quad F_{res} = F$$

where
F = external bearing load [N]
F_{Pr} = preload force [N]
F_{res} = resulting load [N]

	Table 5
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 accuracy classes.
T1	**F_{Pr} = 2% * C** For precise profile rail guide systems with low and medium external loads and high degree of stiffness.
T2	**F_{Pr} = 8% * C** For precise profile rail guide systems with high external load and high requirements for overall stiffness. Also recommended for single-rail systems. Additional common moment loads are absorbed without any significant elastic deformation.

Generation of preload

System without preload   Preloaded system with oversized balls
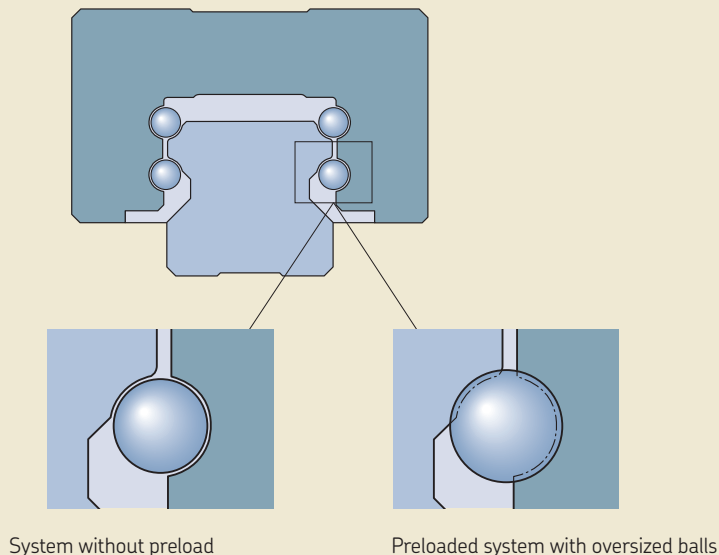
Constant mean load

In operation, it is not uncommon for variable time- or travel-related load conditions to occur. To calculate the basic rating life under these conditions, the constant mean load must be determined.

If the external bearing load is composed of forces of varying magnitudes but constant during the individual stroke lengths, as shown in **fig. 3**, or if a continuously varying load can be replaced approximately by an individual force, the constant mean load F_m can be calculated using **formula 10** and **11**.

$$(10) \quad F_m = \sqrt[3]{\frac{\sum_{i=1}^{n} |F_{res\_i}^3| \, s_i}{s_{tot}}}$$

$$(11) \quad s_{tot} = s_1 + s_2 + \dots + s_n$$

where
F_m = constant mean load [N]
$F_{res1}, F_{res2} \dots F_{resn}$ = resulting load during stroke length s_1, $s_2 \dots s_n$ [N]
s_{tot} = total stroke length [mm]

External bearing load at combined bearing loads

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

If one of the load proportions varies significantly in magnitude over the length of the stroke, a separate load case must be calculated according to the same method. In this case, F_m should be calculated as described.

Note: As for the following four calculation routines, an external 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.

Static bearing load

For external static vertical and horizontal loads, the external bearing load F can be calculated using **formula 12** (→ **fig. 4**).

Formula 12 applies to a system with two rails and four carriages (no torque loads can occur).

$$(12) \quad F = |F_y| + |F_z|$$

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

Combined static bearing load

For combined external static bearing loads – both vertical and horizontal – in combination with static moments, the external bearing load F can be calculated using **formula 13** (→ **fig. 5**).

$$(13) \quad F = |F_y| + |F_z| + C_0 \left(\left| \frac{M_x}{M_{xC_0}} \right| + \left| \frac{M_y}{M_{yC_0}} \right| + \left| \frac{M_z}{M_{zC_0}} \right| \right)$$

where
C_0 = static load rating [N]
F = external bearing load [N]
F_y, F_z = external bearing loads in y- and z-direction [N]
M_x, M_y, M_z = moment loads at respective coordinates [Nm]
$M_{xC_0}, M_{yC_0}, M_{zC_0}$ = permissible static moment loads [Nm]

Formula 13 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 is required for calculating the static safety factor s_0. To this end, all loads must be calculated for the individual stroke lengths. With this figure, the maximum resulting load $F_{res\,max}$ can be calculated and then inserted in the equation for s_0.

Fig. 3

Variable load acting on a carriage

Fig. 4

SKF
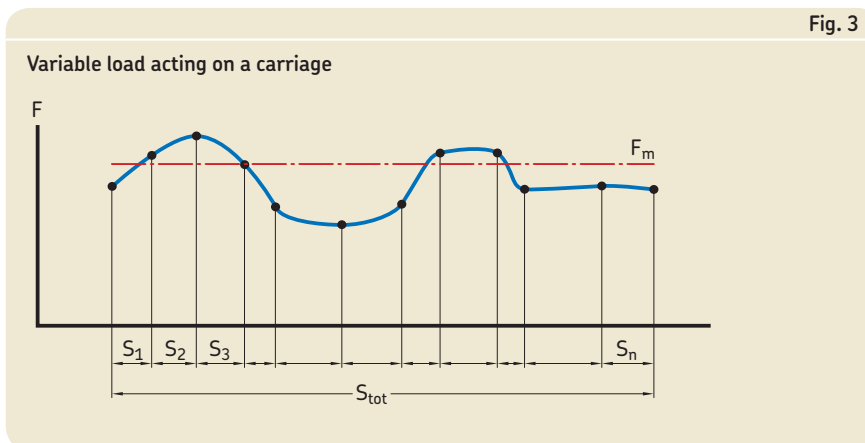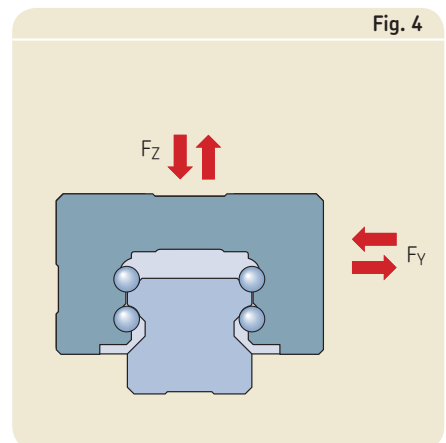
Dynamic bearing load

For external loads – both vertical and horizontal (→ **fig. 4**) – the external bearing load load F is calculated by means of **formula 14**. **Formula 14** applies to a system with two rails and four carriages.

(**14**) $F = |F_y| + |F_z|$

where
F   = external 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 10**.

Combined dynamic bearing load

When combined external dynamic bearing loads and dynamic moments are present, the external bearing load F can be calculated using **formula 15** (**fig. 5**).

(**15**) $F = |F_y| + |F_z| + C\left(\left|\dfrac{M_x}{M_{xC}}\right| + \left|\dfrac{M_y}{M_{yC}}\right| + \left|\dfrac{M_z}{M_{zC}}\right|\right)$

where
C   = dynamic load rating [N]
F   = external bearing load [N]
F_y, F_z = external bearing loads in y- and z-direction [N]
M_x, M_y, M_z = moment loads at respective coordinates [Nm]
M_{xC}, M_{yC}, M_{zC} = permissible dynamic moment loads [Nm]

Formula 15 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. 5
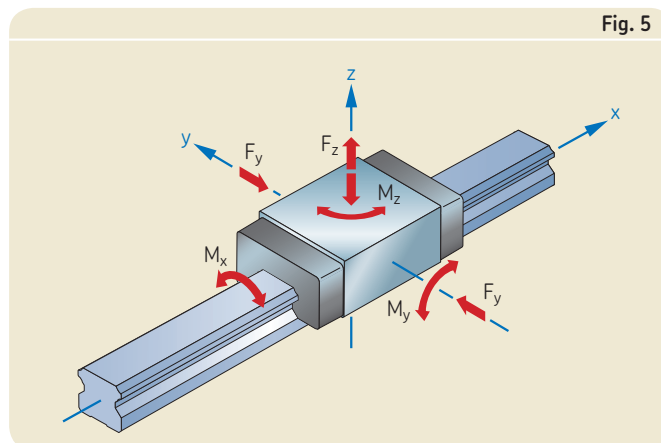
Factors of influence

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 6**).

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 taking into account the kinematic conditions. Assuming a normal level of cleanliness of the profile rail guide as well as effective sealing, then 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 16**).

$$(16) \quad \kappa = \frac{\nu}{\nu_1}$$

where
κ = viscosity ratio
ν = actual kinematic viscosity [mm²/s]
ν_1 = requisite minimum viscosity [mm²/s]

The requisite minimum viscosity ν_1 for LLT guides depends on the mean speed (→ **Diagram 2**).

The value for ν_1 can be put into relation to the actual viscosity ν according to **formula 16** in order to obtain κ. Now c_2 can be taken from the following diagram (→ **Diagram 3**). If the viscosity ratio κ is less than 1, a lubricant with EP additives is recommended. In this case, the higher value for c_2 can be used for calculation.

Table 6

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 2

Determining the requisite minimum viscosity ν_1

ν_1 [mm²/s]
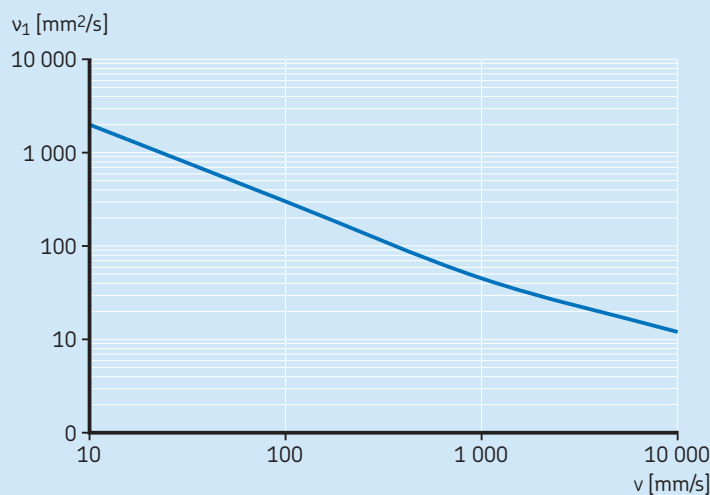
Diagram 3

Determining factor c_2 for operating conditions

$\kappa = \nu/\nu_1$

SKF
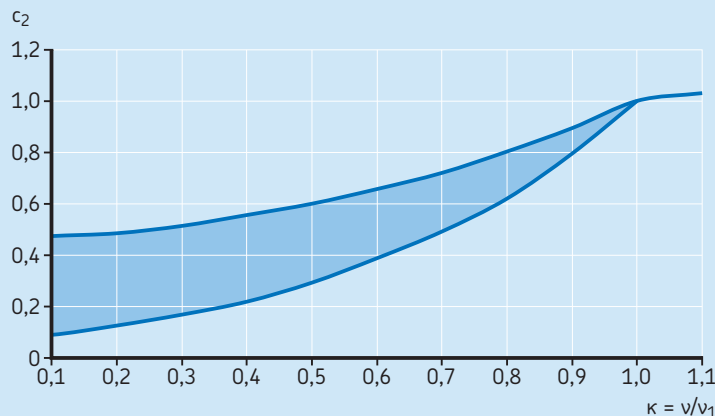
Load conditions

The load acting on an LLT profile rail guide consists of the external force and internal forces 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 impact load, values listed in **table 7** 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 accuracy, 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 ($\rightarrow$ **table 8**).

Impact of stroke length

Strokes that are shorter than the metal body of the carriage (dimension L_2) have a negative impact on the achievable life of a guidance system. Based on the ratio of the stroke length relative to L_2, factor f_s is determined according to **table 9**. If the stroke is longer than the carriage metal body length, the factor is $f_s = 1$.

Modified basic rating life

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

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

In the presence of forces that vary with time, such as those described in chapter *Calculation bases*, **page 14**, **formula 17** is extended as follows to take account of the impact of the operating conditions and loads per interval. This is described in **formula 18**:

$$(18)\ L_{ns} = 100\, c_1\, c_2\, f_s \left[\frac{f_i\, C\, \sqrt[3]{s_{tot}}}{\sqrt[3]{\sum_{i=1}^{n} f_{di}^3 \left| F_{res,i}^3 \right| s_i}} \right]^3 [km]$$

where

C	= dynamic load rating [N]
c_1	= factor for reliability
c_2	= factor for operating conditions
f_d	= factor for load conditions
f_{di}	= load condition factor for load interval i
f_i	= factor for number of carriages per rail
F_{res}	= resulting load [N]
$F_{res,i}$	= resulting load during stroke length [N]
f_s	= factor for stroke length
L_{ns}	= modified basic rating life [km]
s_i	= individual stroke length [mm]
s_{tot}	= total stroke length [mm]

Table 7

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 9

Factor f_s depending on the ratio l_s/L_2

l_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
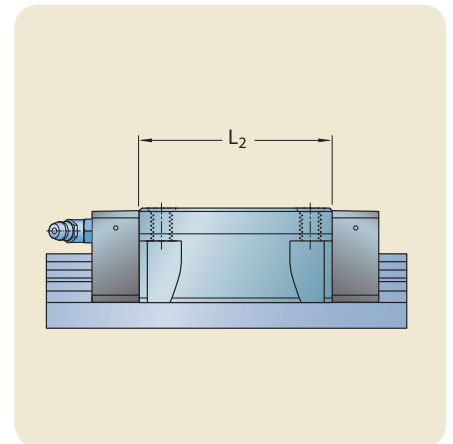
Table 8

Factor f_i for number of carriages per rail

Number of carriages	If X ≥ 1,5*L_2 f_i	If X < 1,5*L_2 f_i
1	1	1
2	1	0,81
3	1	0,72
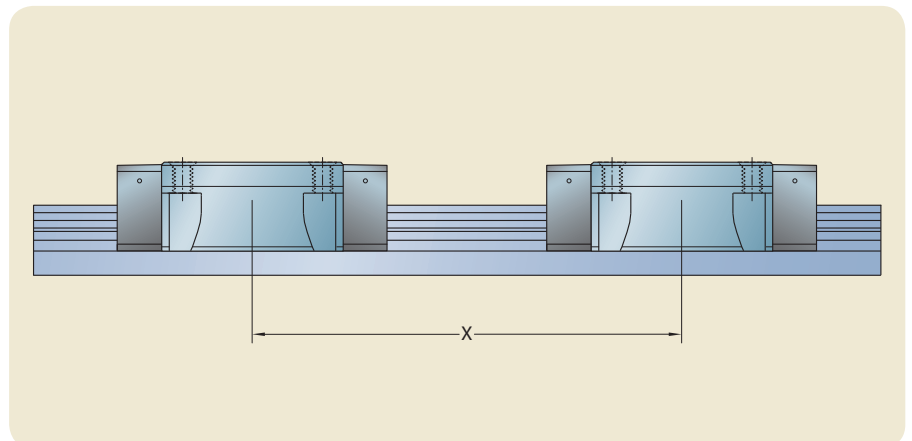
Legend

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_d	factor for load conditions	
$f_{d1}, f_{d2} \dots f_{dn}$	factor for load conditions during stroke length $s_1, s_2 \dots s_n$	
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]
$F_{res\,1}, F_{res\,2} \dots F_{res\,n}$	resulting load during stroke length $s_1, s_2, \dots, s_n$	[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]
$M_{xC0}, M_{yC0}, M_{zC0}$	permissible static moment loads	[Nm]
n	stroke frequency	[double strokes/min]
ν	actual kinematic viscosity	[mm^2/s]
ν_1	requisite minimum viscosity	[mm^2/s]
P	equivalent dynamic load	[N]
P_0	maximum static load	[N]
s	single stroke length	[mm]
s_0	static safety factor	
s_i	individual stroke length	[mm]
s_{tot}	total stroke length	[mm]
$t_1, t_2 \dots t_n$	time proportions for $v_1, v_2 \dots v_n$	[%]
$v_1, v_2 \dots v_n$	speed	[m/min]
v_m	mean speed	[m/min]

SKF

5 [mm]
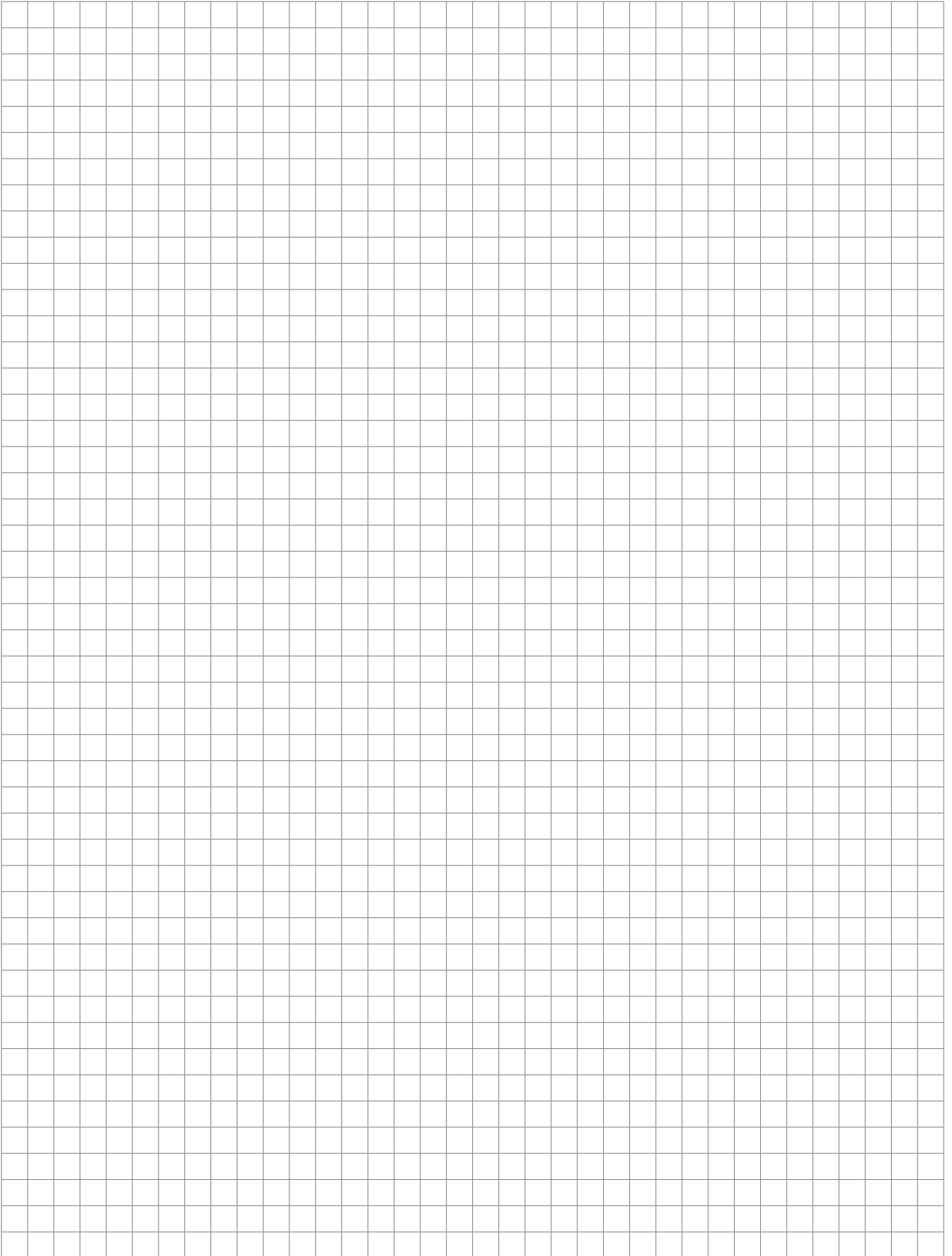
SKF calculation program

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, SKF offers the "linear guide select" calculation program which is available at www.skf.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 task:

- number of load cases
- moved masses as well as operating loads incl. 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
- envisaged 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, SKF recommends using the coordinate system in the program. This facilitates the analysis of all operating loads and 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 from the printout.

SKF
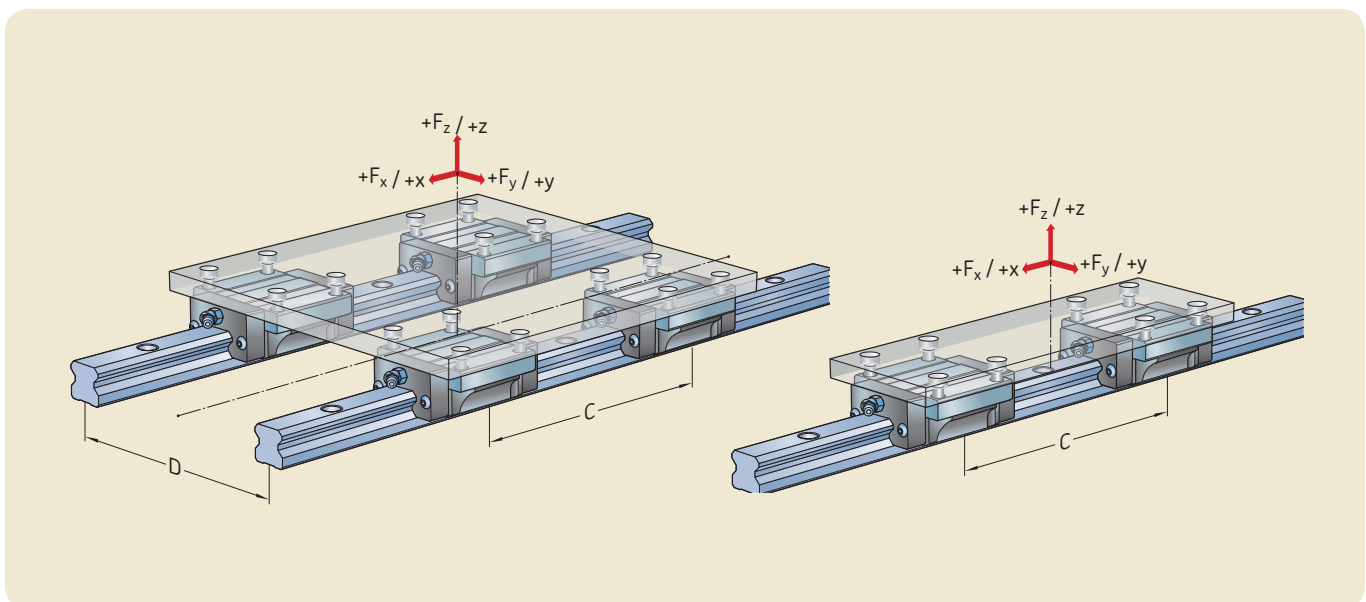
Product overview

LLTHC ... SA
Flanged carriage, short length, standard height
*Further information on **page 32***

LLTHC ... A
Flanged carriage, standard length, standard height
*Further information on **page 34***

LLTHC ... LA
Flanged carriage, extended length, standard height
*Further information on **page 36***

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

LLTHR profile rail with blind holes
*Additional information on **page 50***
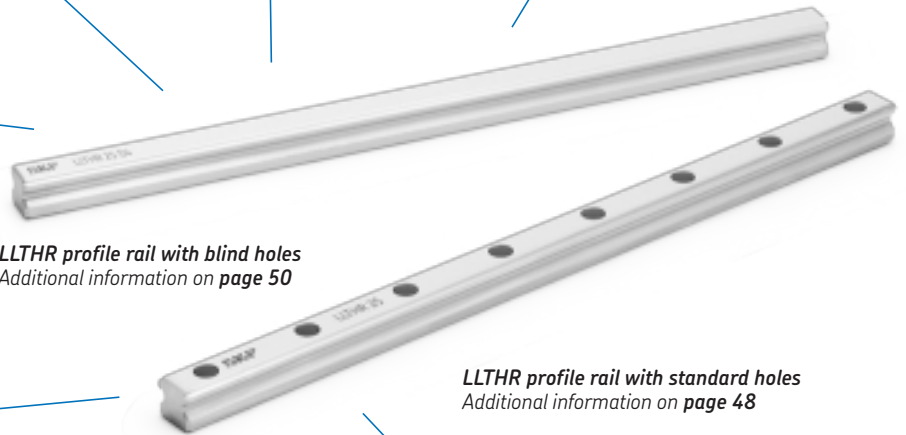
LLTHR profile rail with standard holes
*Additional information on **page 48***

LLTHC ... LR
Slim-line carriage, extended length, extended height
*Further information on **page 46***

LLTHC ... SU
Slim-line carriage, short length, standard height
*Further information on **page 38***

LLTHC ... U
Slim-line carriage, standard length, standard height
*Further information on **page 40***

LLTHC ... LU
Slim-line carriage, extended length, standard height
*Further information on **page 42***

LLT components and material specifications

1 Rail

2 Carriage

3 Steel balls

4 Square nut

5 End plate

6 Lubricant reservoir

7 Front seal

8 Screw

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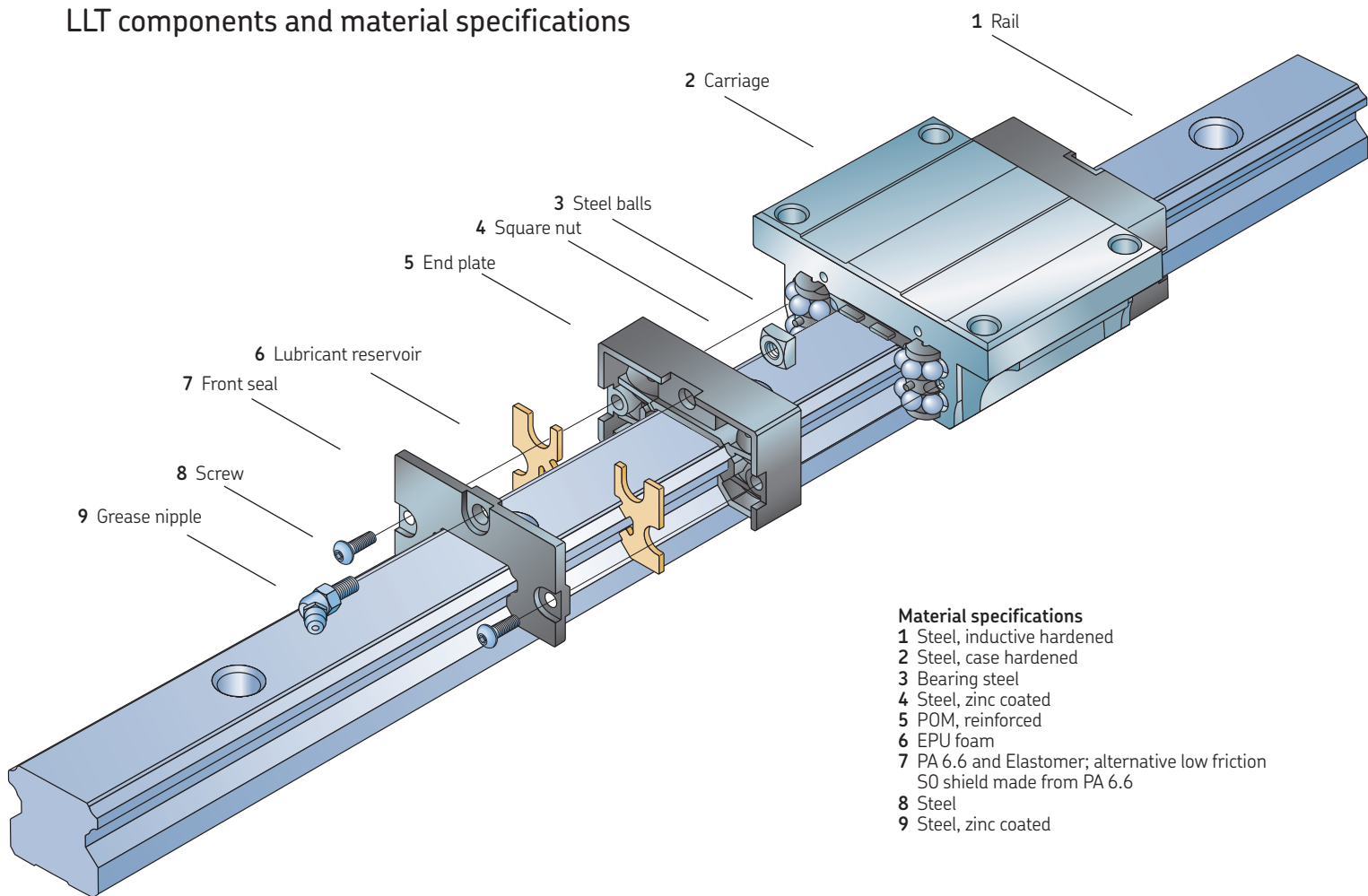
Material specifications
1 Steel, inductive hardened
2 Steel, case hardened
3 Bearing steel
4 Steel, zinc coated
5 POM, reinforced
6 EPU foam
7 PA 6.6 and Elastomer; alternative low friction
   S0 shield made from PA 6.6
8 Steel
9 Steel, zinc coated

SKF

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. SKF LLT profile rail guide carriages are therefore supplied with front, side and inner seals as standard, which can significantly extend service life.

Design version for size 15
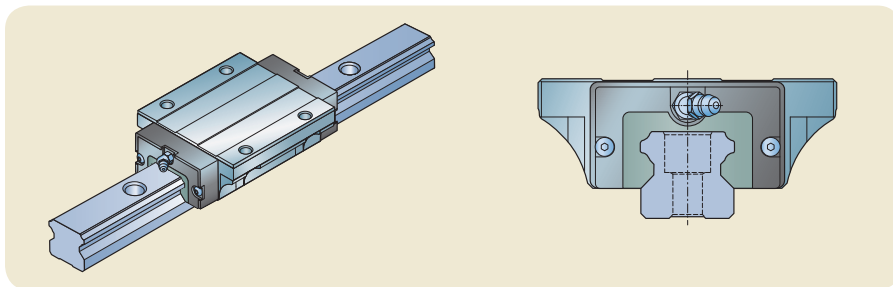
Front seal
Front seals are especially important since they provide protection for the carriage in the direction of movement. They are designed as double-lip seals in order to provide improved wiping properties.
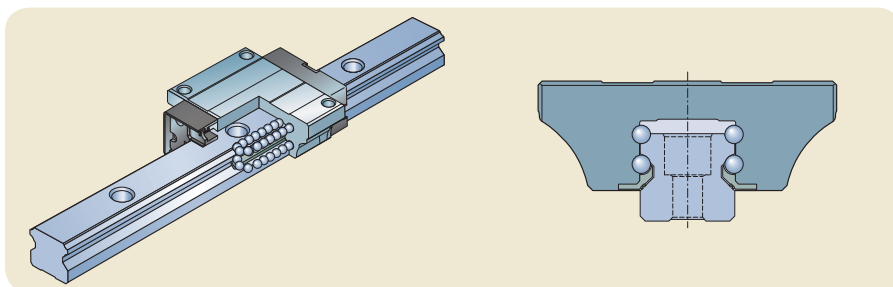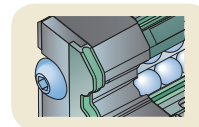
Side seal
Side seals effectively prevent contaminants from working their way into the system from below. Seal design can deviate per size.
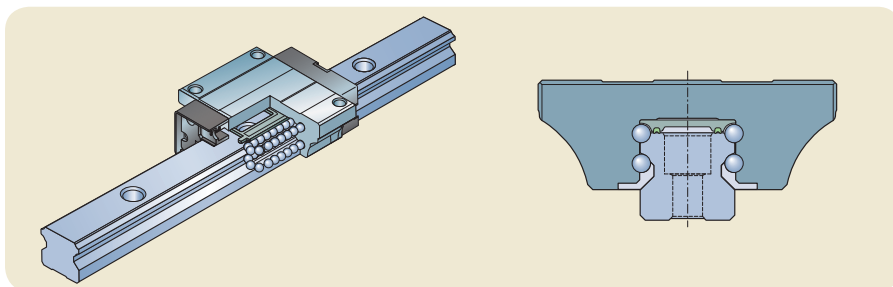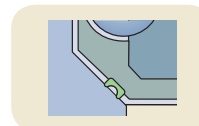
Inner seal
Inner seals are an additional means of protection against lubricant leakage. Seal design can deviate per size.
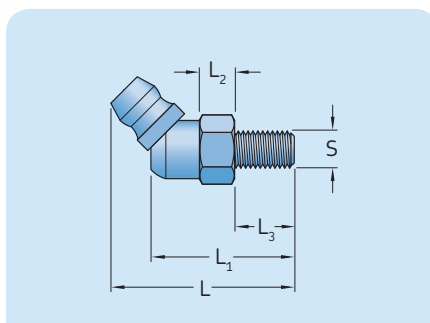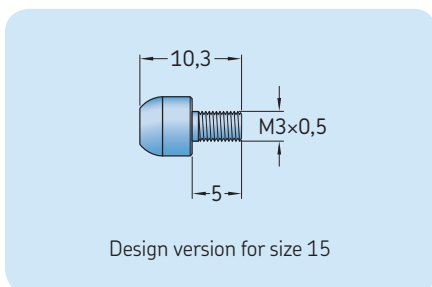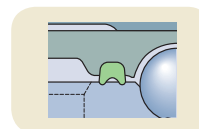
Grease nipple[1]
Two lube ports with metal thread are located on both front sides of each carriage. As standard, one grease nipple for manual relubrication is supplied along with the carriage, while the opposite side is secured by a set screw. The metal thread also enables the easy and reliable mounting of automatic lubricators.

Size	Dimension				
	L	L_1	L_2	L_3	S
–	mm				
20	24,6	19,2	4,72	8	M5
25	24,6	19,2	4,72	10	M5
30–45	28,3	23,2	4,72	12	M6

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

Accuracy classes

Accuracy

SKF manufactures its LLT profile rail guides in three accuracy classes. These accuracy classes define the maximum permissible tolerance range of a profile rail system in terms of height, width and parallelism. This choice determines the positioning accuracy of the system within the application. (→ **table 1** and the chapter *Typical application areas*, **page 70**, for further information).

Width and height accuracy

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

The height accuracy 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 and refer to the centre of the carriage. They are measured at either the same position on the rail for Δ_H or Δ_N.

Parallelism

This refers to the 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 accuracy class (P5/P3) can be combined with each other while maintaining the initial accuracy class. They are fully interchangeable. Mixed accuracy classes are possible.

Note: Accuracy class P1 can only be delivered as a complete system.

Table 1
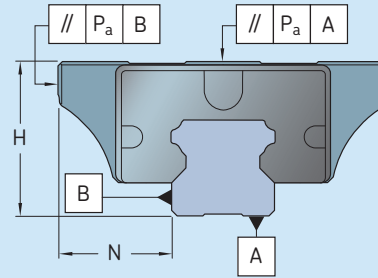
Accuracy class [1]	Tolerances [2]		Differences in dimension H and N on one rail	
	H	N	Δ_H max.	Δ_N max.
–	µm		µm	
P5	±100	±40	30	30
P3	±40	±20	15	15
P1	±20	±10	7	7
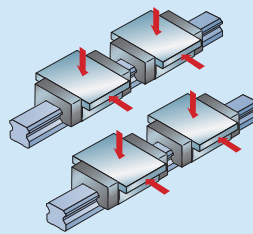
For any combination of carriages and rails
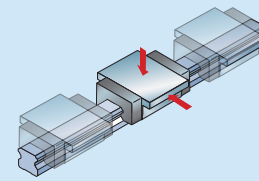
For different carriages on the same rail position

[1] Measured at the centre of the carriage.
[2] Values for one meter rail length.

Diagram 1

Parallelism

P_a Deviation in parallelism [µm] for N and H

P5 = Standard
P3 = Medium
P1 = High

Rail length [mm]

SKF
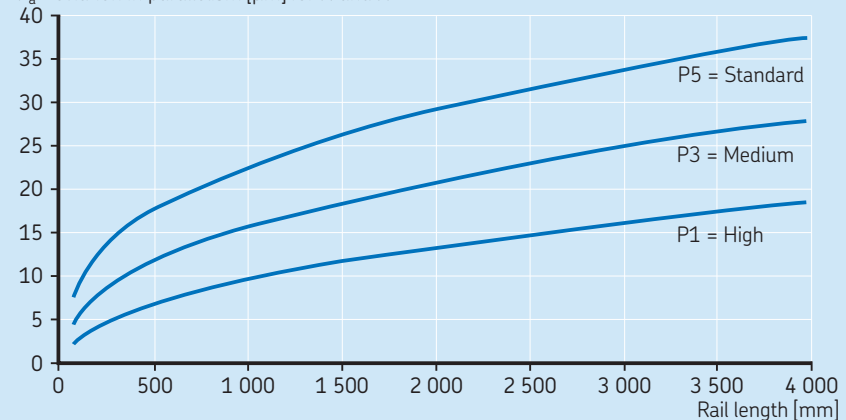
Ordering key system

Designations		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] (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
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

Sealing (no code for standard sealing)
S0   Low friction shield

Jointed rail track [5] (if not selected – no code)
A   Yes

Prepared for bellows
B0   Rails prepared for bellows (for ordering the bellow see ordering key bellows)

Rail
D   Rail, if customized according to drawing number
D4   Rail with blind holes
D6 [6]   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, see page 48

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

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

Additional seals mounted on carriage [7] (if not selected – no code)
M   Yes

[1] Not all combinations of preload / precision class available for each carriage type. Please refer to pages 32–47.
[2] Only available in preload classes T0 and T1 and precision class P5.
[3] 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 isn't coated.
[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] Only possible if the ordered rail length exceeds the maximum standard rail length (defined in dimension tables, pages 33–47).
[6] Available in size 25–45. Mounting tool needs to be ordered separately (see ordering key accessories).
[7] Additional seals can only be mounted on carriage if full system is ordered (Carriage mounted on rail = Yes).

Ordering key carriages

Designations   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] (no code for standard: non coated carriage)
HN   Nickel plated carriage

Sealing (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 32–47.
[2] Only available in preload classes T0 and T1 and precision class P5.
[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..

Ordering key bellows

Designations   LLTH Z 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)

[1] Will be delivered unmounted, but with all needed parts
[2] Available in sizes 15–30
[3] Available in sizes 35–45

SKF

Ordering key rail

Designations	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

Jointed rail track [3]
A   Yes

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

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, see page 49

[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 isn't coated.
[3] Only possible if the ordered rail length exceeds the maximum standard rail length (defined in dimension tables, pages 33–47).
[4] Plastic and metal plugs available as spare parts. Please contact SKF for further information.
[5] Available in sizes 25–45. Mounting tool needs to be ordered separately (see ordering key accessories).

Ordering key accessories (delivered separately)

Designations	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

[1] Available in sizes 15–30 to exchange standard front seal.
[2] Fits for all types of carriages (→ **page 23**), but not in combination with additional seals (S1/S3/S7).
[3] Available in sizes 25–45.

Product data

Carriages

Pages 32–47

LLTH ... SA
Flanged carriage, short length, standard height
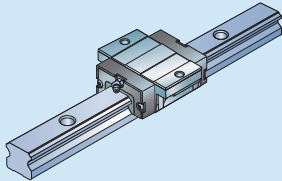
| Size[1] | Load ratings | |
	C	C_0
–	N	
15	5 800	9 000
20	9 240	14 400
25	13 500	19 600
30	19 200	26 600
35	25 500	34 800
45	–	–

LLTHC ... A
Flanged carriage, standard length, standard height
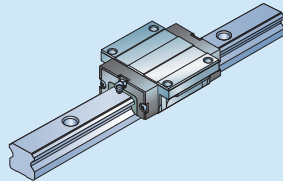
| Size[1] | Load ratings | |
	C	C_0
–	N	
15	8 400	15 400
20	12 400	24 550
25	18 800	30 700
30	26 100	41 900
35	34 700	54 650
45	59 200	91 100

LLTHC ... LA
Flanged carriage, extended length, standard height
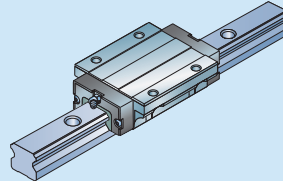
| Size[1] | Load ratings | |
	C	C_0
–	N	
15	–	–
20	15 200	32 700
25	24 400	44 600
30	33 900	60 800
35	45 000	79 400
45	72 400	121 400

LLTHC ... SU
Slim-line carriage, short length, standard height
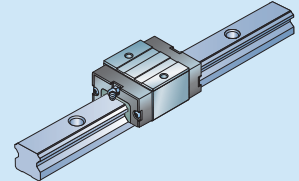
| Size[1] | Load ratings | |
	C	C_0
–	N	
15	5 800	9 000
20	9 240	14 400
25	13 500	19 600
30	19 200	26 600
35	25 500	34 800
45	–	–

LLTHC ... U
Slim-line carriage, standard length, standard height
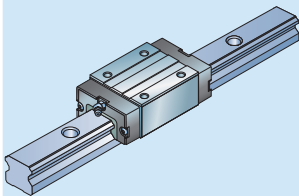
| Size[1] | Load ratings | |
	C	C_0
–	N	
15	8 400	15 400
20	12 400	24 550
25	18 800	30 700
30	26 100	41 900
35	34 700	54 650
45	59 200	91 100

LLTH ... LU
Slim-line carriage, extended length, standard height
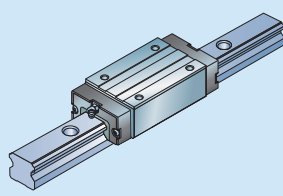
| Size[1] | Load ratings | |
	C	C_0
–	N	
15	–	–
20 [2]	15 200	32 700
25	24 000	44 600
30	33 900	60 800
35	45 000	79 400
45	72 400	121 400

LLTHC ... R
Slim-line carriage, standard length, extended height
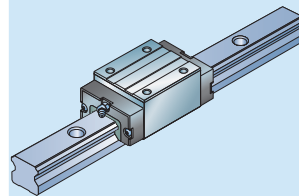
| Size[1] | Load ratings | |
	C	C_0
–	N	
15	8 400	15 400
20	–	–
25	18 800	30 700
30	26 100	41 900
35	34 700	54 650
45	59 200	91 100

LLTHC ... LR
Slim-line carriage, extended length, extended height
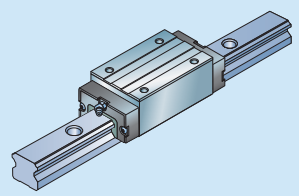
| Size[1] | Load ratings | |
	C	C_0
–	N	
15	–	–
20 [2]	15 200	32 700
25	24 400	44 600
30	33 900	60 800
35	45 000	79 400
45	72 400	121 400

[1] Front seal appearance can slightly deviate per size.
[2] LU20 and LR20 is the same product

SKF

Rails

Pages 48–53

LLTHR rails

For mounting from above, supplied with
protective plastic caps.
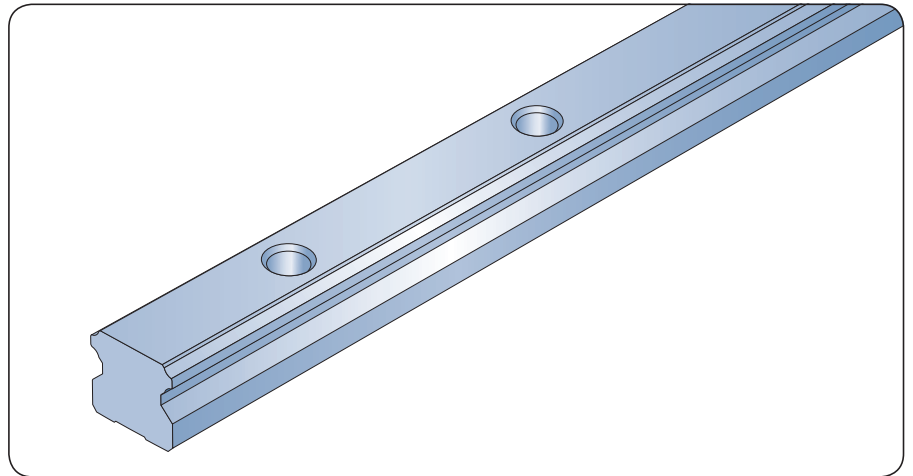
LLTHR ... D4 rails

With blind holes for mounting from below.
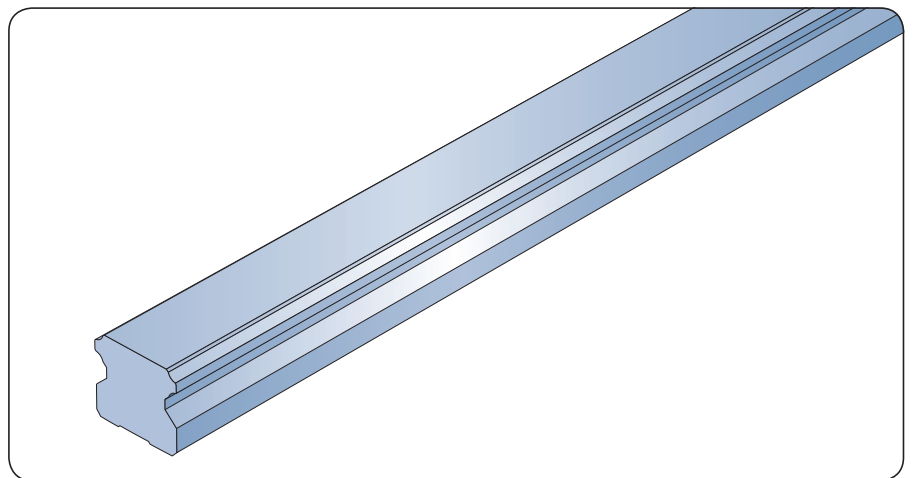
LLTHR ... D6 rails
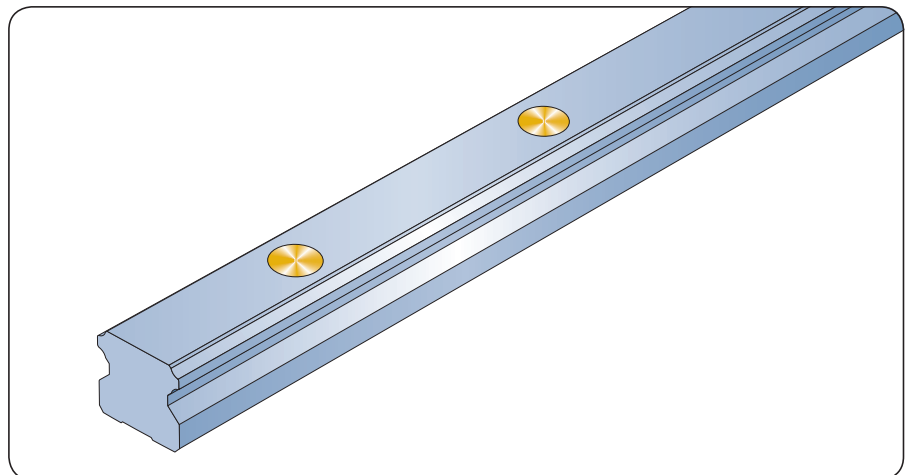
For mounting from above, supplied with
protective metal plugs.

Carriage LLTHC ... SA

Flanged carriage, short length, standard height

Carriages from size 15 to 30 are available with low friction S0 shield. Dimensions are the same as standard version. For designation, refer to *Ordering key carriages* (→ **page 28**).
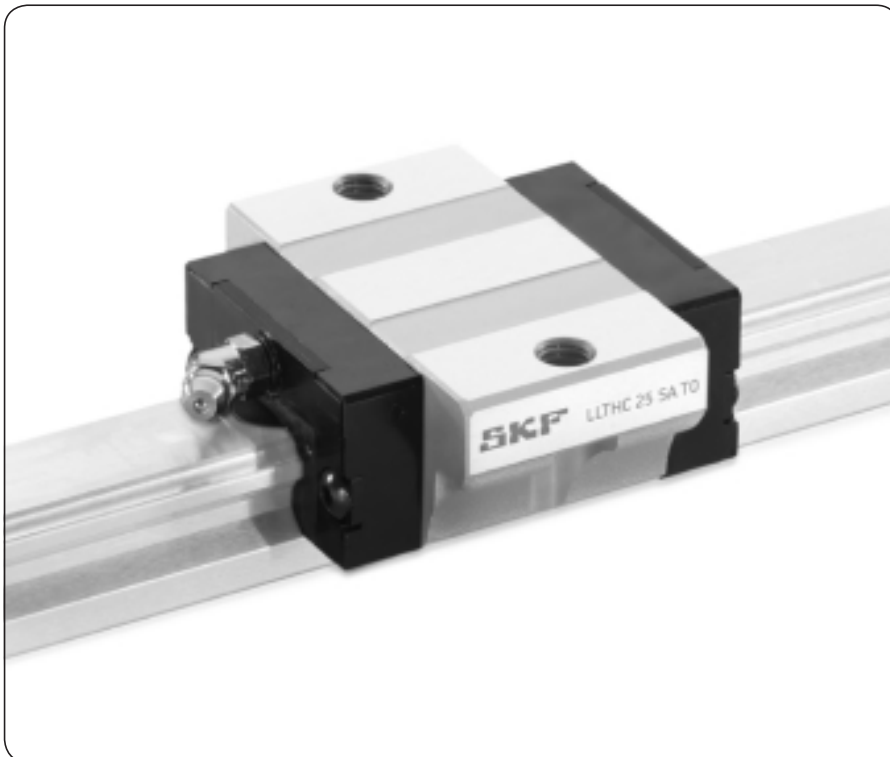
Size	Accuracy class	Designation [1] Preload class T0	T1
		–	–
15	P5	LLTHC 15 SA T0 P5	LLTHC 15 SA T1 P5
	P3	LLTHC 15 SA T0 P3	LLTHC 15 SA T1 P3
	P1		LLTHC 15 SA T1 P1
20	P5	LLTHC 20 SA T0 P5	LLTHC 20 SA T1 P5
	P3	LLTHC 20 SA T0 P3	LLTHC 20 SA T1 P3
	P1		LLTHC 20 SA T1 P1
25	P5	LLTHC 25 SA T0 P5	LLTHC 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 T0 P5
	P3	LLTHC 35 SA T0 P3	LLTHC 35 SA T0 P3
	P1		LLTHC 35 SA T0 P1

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

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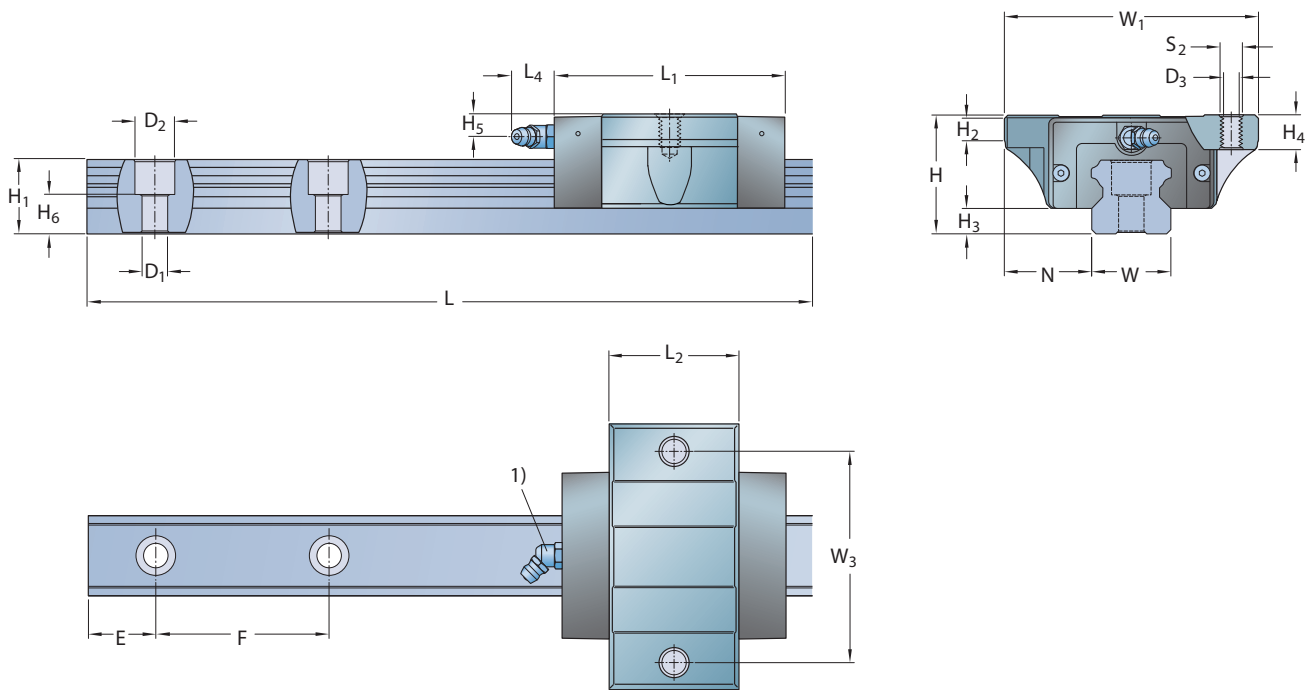
Size	Assembly dimensions					Carriage dimensions							
	W_1	N	H	H_2	H_3	L_1	L_2	L_4	W_3	H_4	H_5	D_3	S_2
–	mm												–
15	47	16	24	5,9	4,6	48,9	25,6	4,3	38	8	4,3	4,3	M5
20	63	21,5	30	6,9	5	55,4	32,1	15	53	9	5,7	5,2	M6
25	70	23,5	36	11	7	66,2	38,8	16,6	57	12	6,5	6,7	M8
30	90	31	42	9	9	78	45	14,6	72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

Size	Rail dimensions									Weight		Load ratings [2]		Moments [2]			
										carriage	rail	dynamic C	static C_0	dynamic M_x	static M_{x0}	dynamic $M_{y/z}$	static $M_{y0/z0}$
	W	H_1	H_6	F	D_1	D_2	E_{min}	E_{max}	L_{max}								
							−0,75	−0,75	−1,5								
–	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 25**.
[2] Dynamic load capacities and moments are based on a travel life of 100 km. Please refer to **page 7** for further details.

Carriage LLTHC ... A

Flanged carriage, standard length,
standard height

Carriages from size 15 to 30 are available
with low friction S0 shield. Dimensions are
the same as standard version. For designa-
tion, refer to *Ordering key carriages*
(→ **page 28**).

Size	Accuracy 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.

SKF

B

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	5,9	4,6	63,3	40	30	4,3	38	8	4,3	4,3	M5
20	63	21,5	30	6,9	5	73,3	50	40	15	53	9	5,7	5,2	M6
25	70	23,5	36	11	7	84,4	57	45	16,6	57	12	6,5	6,7	M8
30	90	31	42	9	9	100,4	67,4	52	14,6	72	11,5	8	8,5	M10
35	100	33	48	12,3	9,5	114,4	77	62	14,6	82	13	8	8,5	M10
45	120	37,5	60	12,3	14	136,5	96	80	14,6	100	15	8,5	10,4	M12

Size	Rail dimensions									Weight		Load ratings [2]		Moments			
	W	H_1	H_6	F	D_1	D_2	E_{min} −0,75	E_{max} −0,75	L_{max} −1,5	carriage	rail	dynamic C	static C_0	dynamic M_x	static M_{x0}	dynamic $M_{y/z}$	static $M_{y0/z0}$
–	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	1270

[1] For detailed information on grease nipples please refer to **page 25**.
[2] Dynamic load capacities and moments are based on a travel life of 100 km. Please refer to **page 7** for further details.

Carriage LLTHC ... LA

Flanged carriage, extended length,
standard height

Carriages from size 20 to 30 are available
with low friction S0 shield. Dimensions are
the same as standard version. For designa-
tion, refer to *Ordering key carriages*
(→ **page 28**).
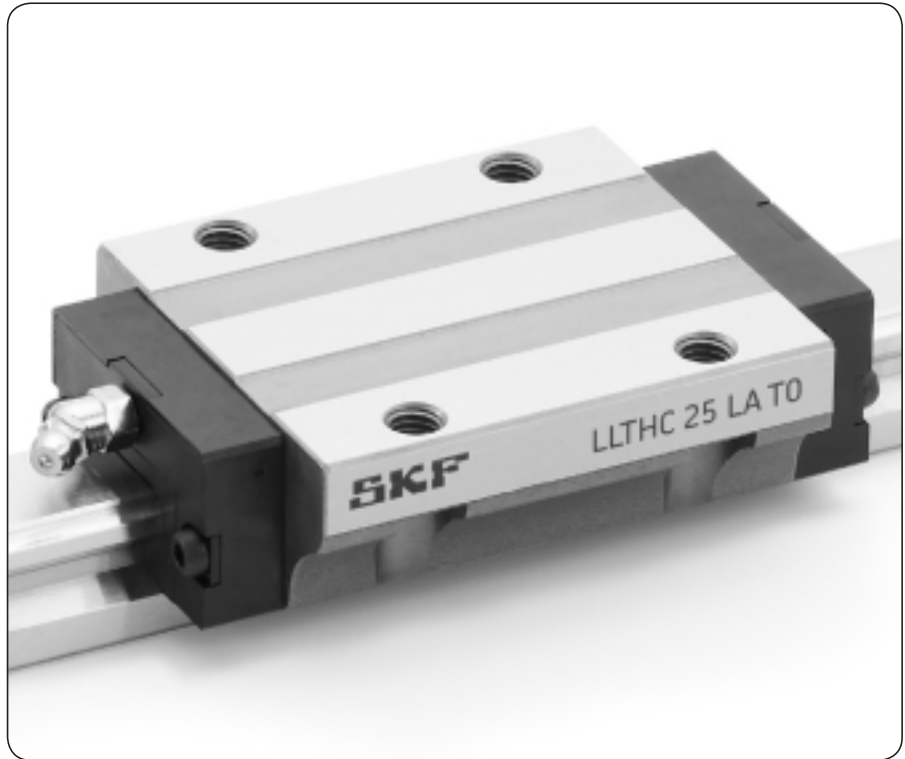
Size	Accuracy class	Designation [1] Preload class		
		T0	T1	T2
–	–			
20	P5	LLTHC 20 LA T0 P5	LLTHC 20 LA T1 P5	LLTHC 20 LA T2 P5
	P3	LLTHC 20 LA T0 P3	LLTHC 20 LA T1 P3	LLTHC 20 LA T2 P3
	P1		LLTHC 20 LA T1 P1	LLTHC 20 LA T2 P1
25	P5	LLTHC 25 LA T0 P5	LLTHC 25 LA T1 P5	LLTHC 25 LA T2 P5
	P3	LLTHC 25 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.

SKF

1) For detailed information on grease nipples please refer to **page 25**.

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	6,9	5	89,5	66,2	40	15	53	9	5,7	5,2	M6
25	70	23,5	36	11	7	106,5	79,1	45	16,6	57	12	6,5	6,7	M8
30	90	31	42	9	9	125,4	92,4	52	14,6	72	11,5	8	8,5	M10
35	100	33	48	12,3	9,5	142,9	105,5	62	14,6	82	13	8	8,5	M10
45	120	37,5	60	12,3	14	168,5	128	80	14,6	100	15	8,5	10,4	M12

Size	Rail dimensions									Weight		Load ratings [2]		Moments			
	W	H_1	H_6	F	D_1	D_2	E_{min} −0,75	E_{max} −0,75	L_{max} −1,5	carriage	rail	dynamic C	static C_0	dynamic M_x	static M_{x0}	dynamic $M_{y/z}$	static $M_{y0/z0}$
–	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 25**.
2) Dynamic load capacities and moments are based on a travel life of 100 km. Please refer to **page 7** for further details.
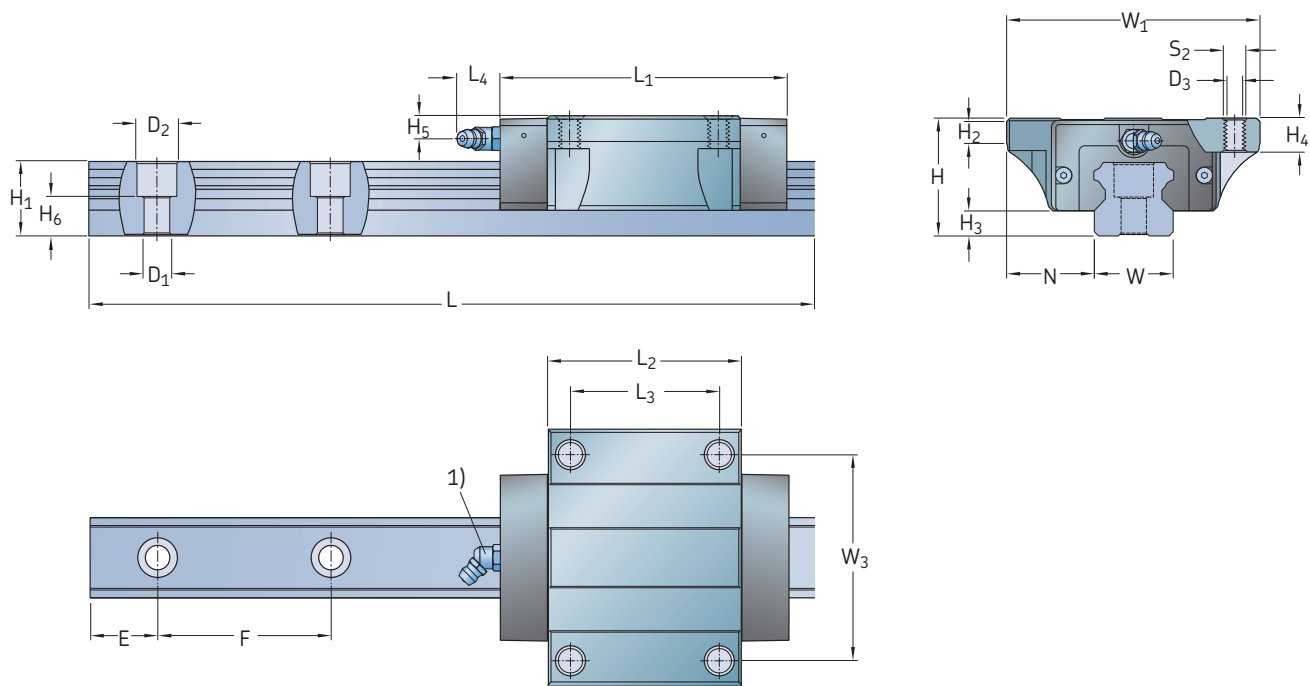
Carriage LLTHC ... SU

Slim-line carriage, short length,
standard height

Carriages from size 15 to 30 are available
with low friction S0 shield. Dimensions are
the same as standard version. For designa-
tion, refer to *Ordering key carriages*
(→ **page 28**).

Size	Accuracy 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.

SKF

1)

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	4,2	4,6	48,9	25,6	4,3	26	4	4,3	M4
20	44	12	30	8,3	5	55,4	32,1	15	32	6,5	5,7	M5
25	48	12,5	36	8,2	7	66,2	38,8	16,6	35	6,5	6,5	M6
30	60	16	42	11,3	9	78	45	14,6	40	8,5	8	M8
35	70	18	48	11	9,5	88,8	51,4	14,6	50	10	8	M8

| Size	Rail dimensions									Weight		Load ratings [2]		Moments [2]			
	W	H_1	F	D_1	D_2	H_6	E_{min} −0,75	E_{max} −0,75	L_{max} −1,5	carriage	rail	dynamic C	static C_0	dynamic M_x	static M_{x0}	dynamic $M_{y/z}$	static $M_{y0/z0}$
–	mm									kg	kg/m	N		Nm			
15	15	14	60	4,5	7,5	8,5	10	50	3 920	0,1	1,4	5 800	9 000	39	60	21	32
20	20	18	60	6	9,5	9,3	10	50	3 920	0,17	2,3	9 240	14 400	83	130	41	64
25	23	22	60	7	11	12,3	10	50	3 920	0,21	3,3	13 500	19 600	139	202	73	106
30	28	26	80	9	14	13,8	12	70	3 944	0,48	4,8	19 200	26 600	242	335	120	166
35	34	29	80	9	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 25.**
[2] Dynamic load capacities and moments are based on a travel life of 100 km. Please refer to **page 7** for further details.
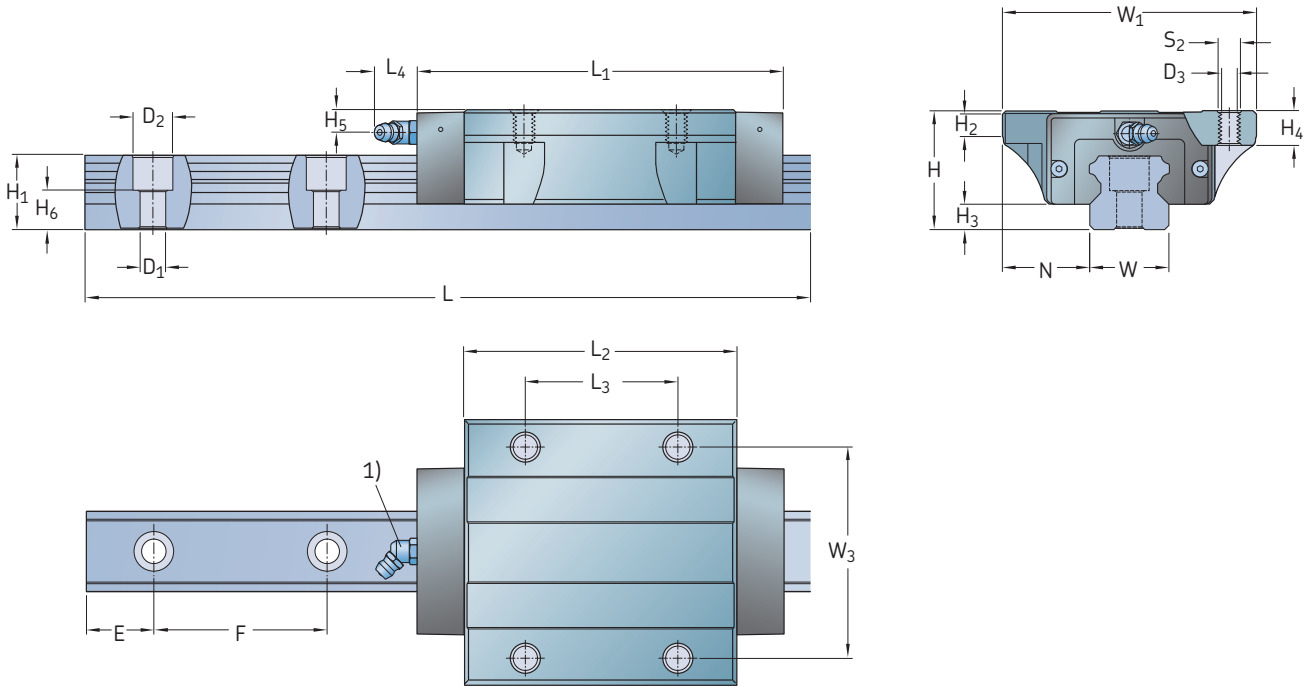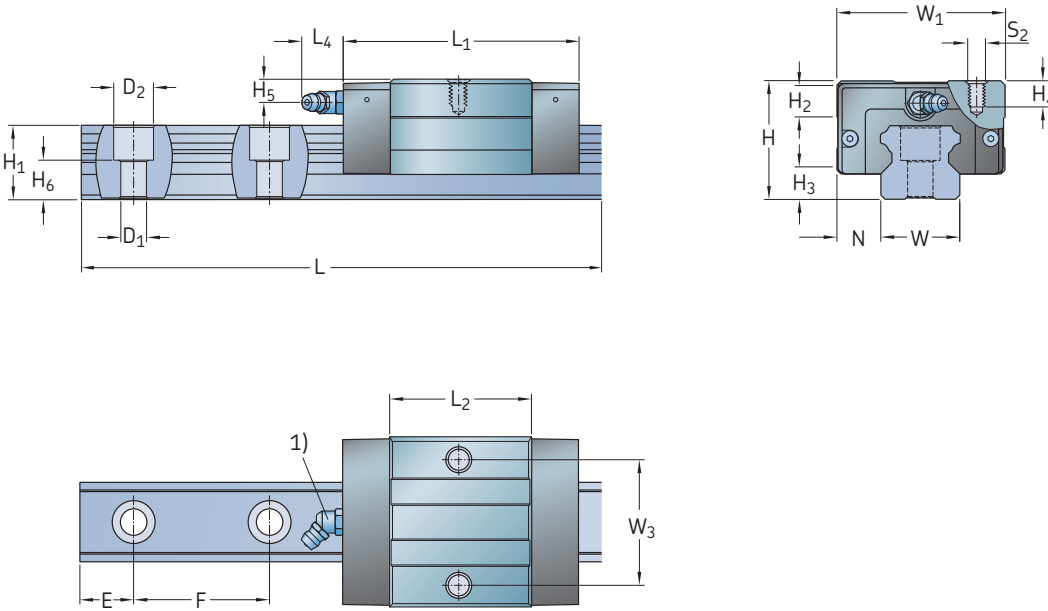
Carriage LLTHC ... U

Slim-line carriage, standard length, standard height

Carriages from size 15 to 30 are available with low friction S0 shield. Dimensions are the same as standard version. For designation, refer to *Ordering key carriages* (→ **page 28**).
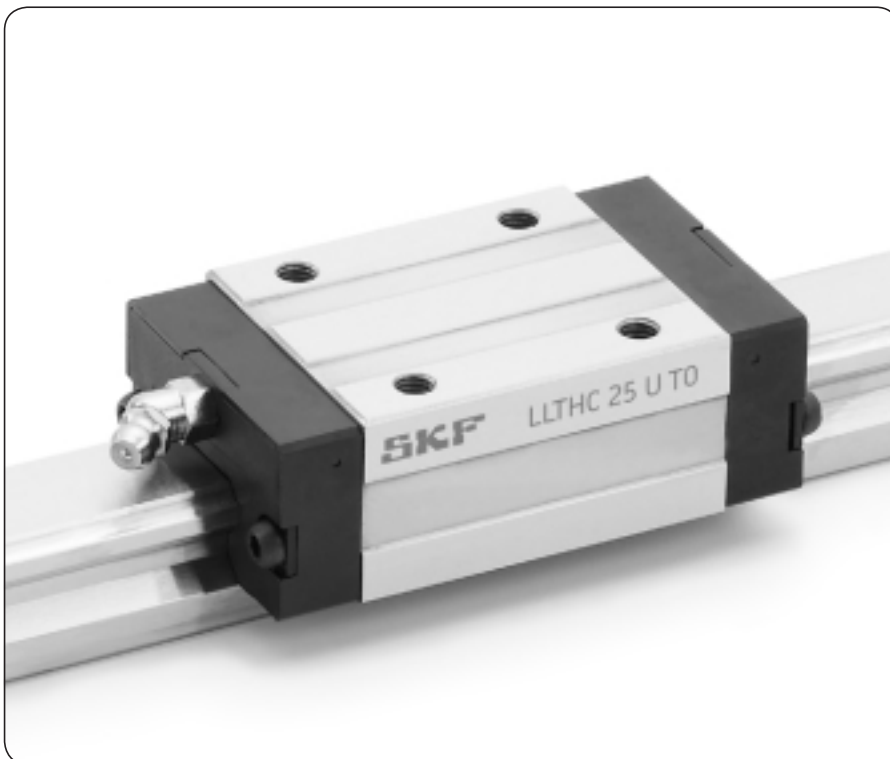
Size	Accuracy class	Designation [1] preload class		
		T0	**T1**	**T2**
–	–			
15	P5	**LLTHC 15 U T0 P5**	**LLTHC 15 U T1 P5**	**LLTHC 15 U T2 P5**
	P3	**LLTHC 15 U T0 P3**	**LLTHC 15 U T1 P3**	LLTHC 15 U T2 P3
	P1		LLTHC 15 U T1 P1	LLTHC 15 U T2 P1
20	P5	**LLTHC 20 U T0 P5**	**LLTHC 20 U T1 P5**	**LLTHC 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.

B

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	4,2	4,6	63,3	40	26	4,3	26	4	4,3	M4
20	44	12	30	8,3	5	73,3	50	36	15	32	6,5	5,7	M5
25	48	12,5	36	8,2	7	84,4	57	35	16,6	35	6,5	6,5	M6
30	60	16	42	11,3	9	100,4	67,4	40	14,6	40	8,5	8	M8
35	70	18	48	11	9,5	114,4	77	50	14,6	50	10	8	M8
45	86	20,5	60	10,9	14	136,5	96	60	14,6	60	12	8,5	M10

| Size	Rail dimensions									Weight		Load ratings [2]		Moments [2]			
	W	H_1	H_6	F	D_1	D_2	E_{min}	E_{max}	L_{max}	carriage	rail	dynamic C	static C_0	dynamic M_x	static M_{x0}	dynamic $M_{y/z}$	static $M_{y0/z0}$
							−0,75	−0,75	−1,5								
–	mm			Ø			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 25.**
[2] Dynamic load capacities and moments are based on a travel life of 100 km. Please refer to **page 7** for further details.
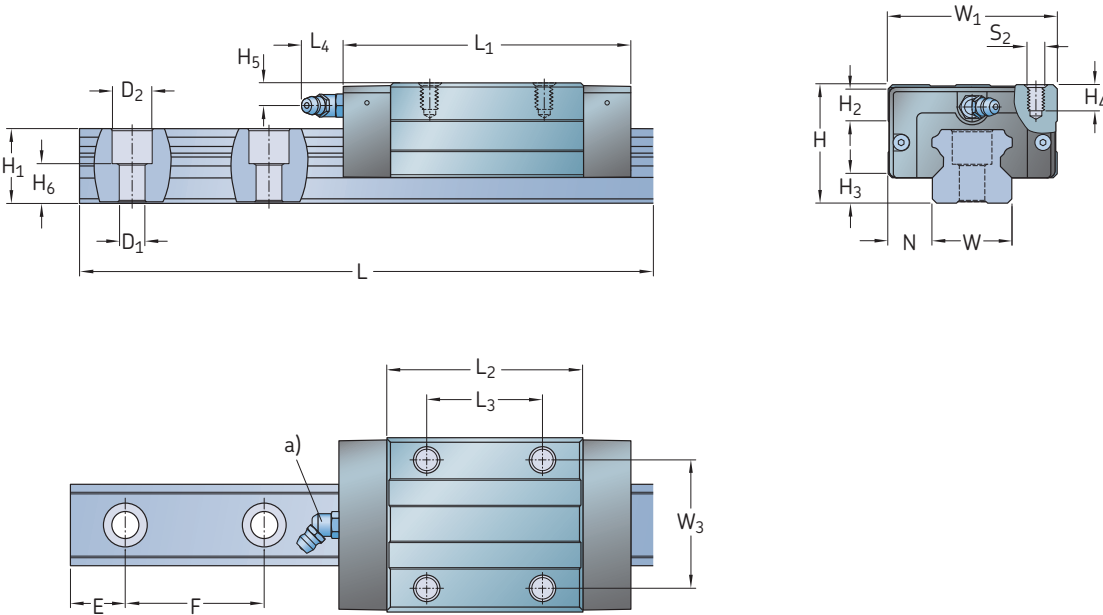
Carriage LLTHC ... LU

Slim-line carriage, extended length, standard height

Carriages from size 25 to 30 are available with low friction S0 shield. Dimensions are the same as standard version. For designation, refer to *Ordering key carriages* (**→ page 28**).
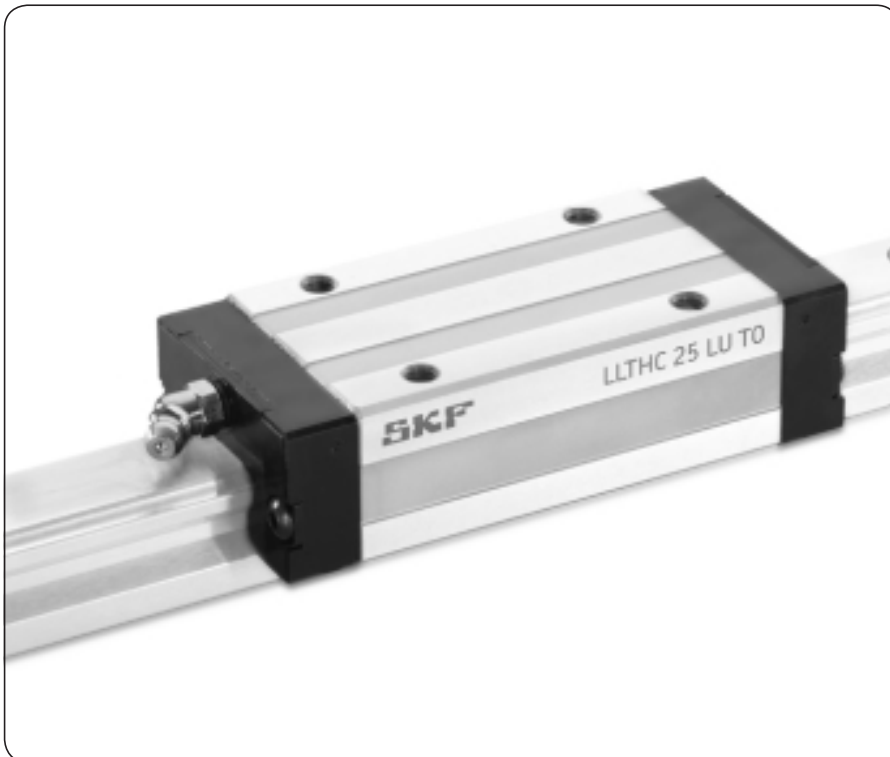
Size	Accuracy class	Designation [1] Preload class		
		T0	T1	T2
–		–		
25	P5	LLTHC 25 LU T0 P5	LLTHC 25 LU T1 P5	LLTHC 25 LU T2 P5
	P3	LLTHC 25 LU T0 P3	LLTHC 25 LU T1 P3	LLTHC 25 LU T2 P3
	P1		LLTHC 25 LU T1 P1	LLTHC 25 LU T2 P1
30	P5	LLTHC 30 LU T0 P5	LLTHC 30 LU T1 P5	LLTHC 30 LU T2 P5
	P3	LLTHC 30 LU T0 P3	LLTHC 30 LU T1 P3	LLTHC 30 LU T2 P5
	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.

SKF

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	8,2	7	106,5	79,1	50	16,6	35	6,5	6,5	M6
30	60	16	42	11,3	9	125,4	92,4	60	14,6	40	8,5	8	M8
35	70	18	48	11	9,5	142,9	105,5	72	14,6	50	10	8	M8
45	86	20,5	60	10,9	14	168,5	128	80	14,6	60	12	8,5	M10

| 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}	E_{max}	L_{max}			C	C_0	M_x	M_{x0}	$M_{y/z}$	$M_{y0/z0}$
							$-0,75$	$-0,75$	$-1,5$								
–	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 25**.
[2] Dynamic load capacities and moments are based on a travel life of 100 km. Please refer to **page 7** for further details.
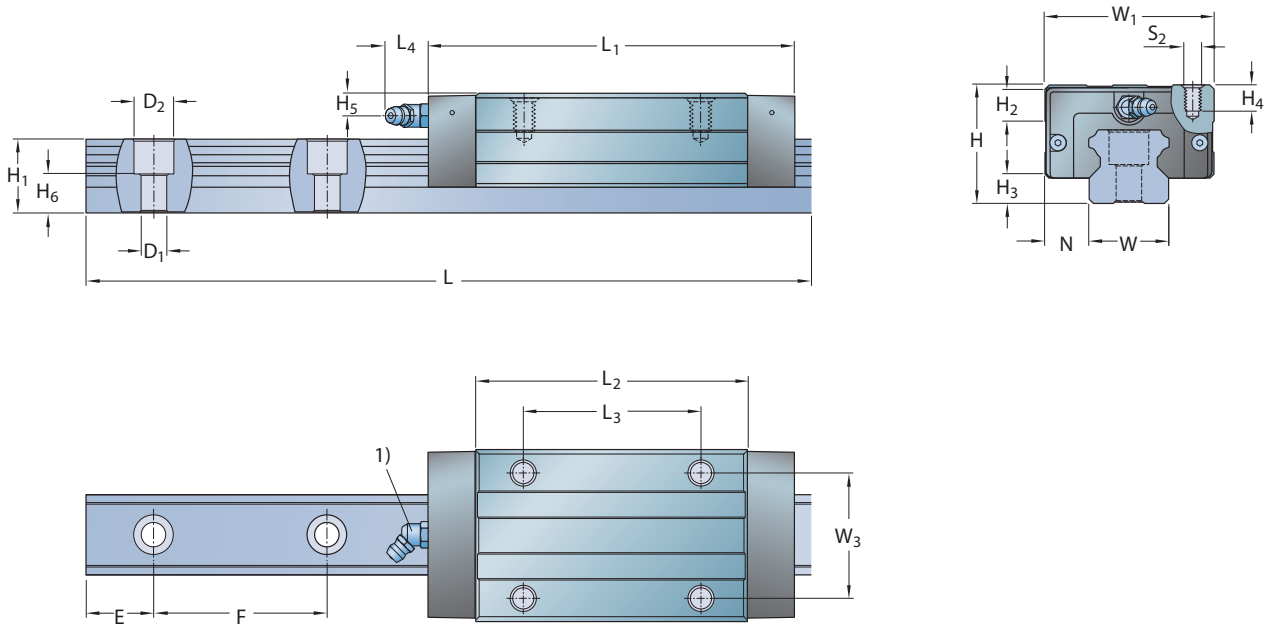
Carriage LLTHC ... R

Slim-line carriage, standard length,
extended height

Carriages from size 15 to 30 are available
with low friction S0 shield. Dimensions are
the same as standard version. For designa-
tion, refer to *Ordering key carriages*
(→ **page 28**).

Size	Accuracy 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.

SKF

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	28	7,8	4,6	63,3	40	26	15	26	7,5	8,3	M4
25	48	12,5	40	12,2	7	84,4	57	35	16,6	35	10	10,5	M6
30	60	16	45	14,3	9	100,4	67,4	40	14,6	40	11,2	11	M8
35	70	18	55	18	9,5	114,4	77	50	14,6	50	17	15	M8
45	86	20,5	70	20,9	14	136,5	96	60	14,6	60	20,5	18,5	M10

Size	Rail dimensions									Weight		Load ratings [2]		Moments [2]			
										carriage	rail	dynamic C	static C_0	dynamic M_x	static M_{x0}	dynamic $M_{y/z}$	static $M_{y0/z0}$
	W	H_1	H_6	F	D_1	D_2	E_{min} −0,75	E_{max} −0,75	L_{max} −1,5								
–	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 25**.
[2] Dynamic load capacities and moments are based on a travel life of 100 km. Please refer to **page 7** for further details.
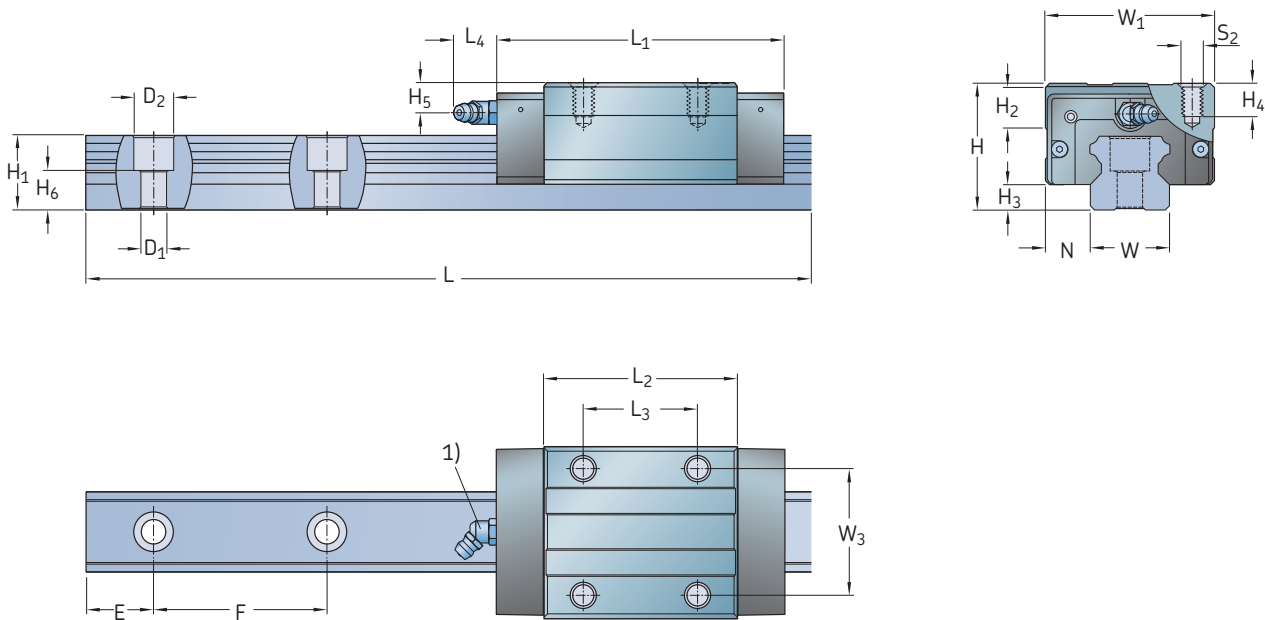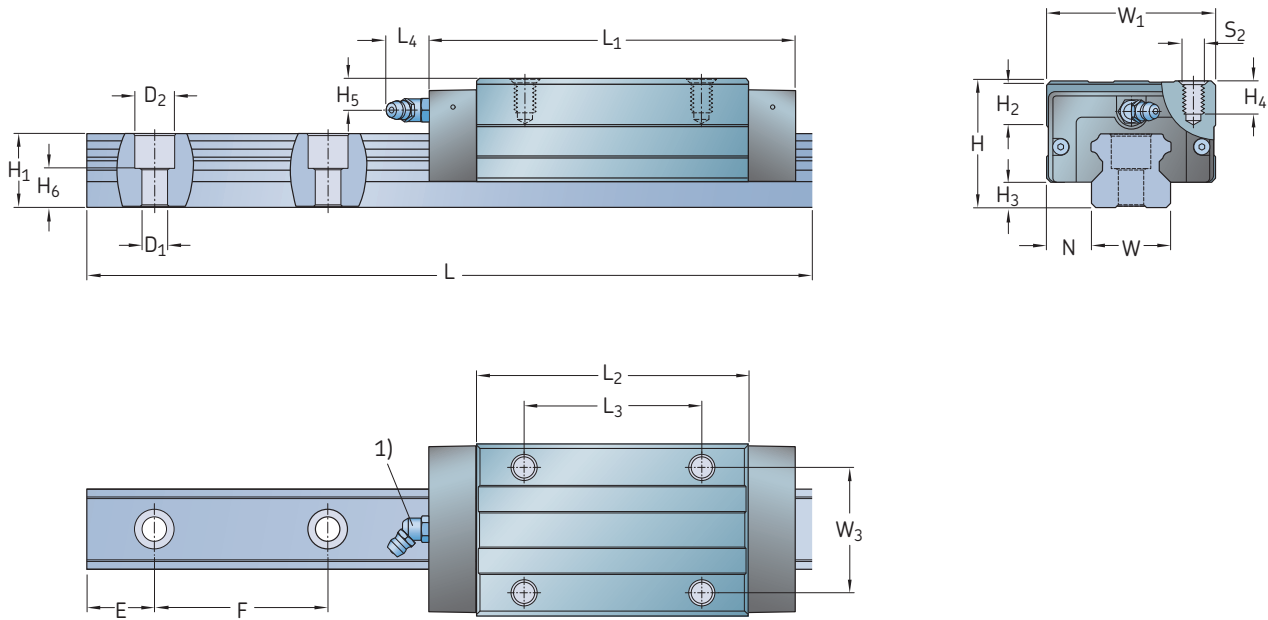
Carriage LLTHC ... LR

Slim-line carriage, extended length, extended height

Carriages from size 20 to 30 are available with low friction S0 shield. Dimensions are the same as standard version. For designation, refer to *Ordering key carriages* (→ **page 28**).

Size	Accuracy 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.

SKF

B

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	8,3	5	89,5	66,2	50	15	32	6,5	5,7	M5
25	48	12,5	40	12,2	7	106,5	79,1	50	16,6	35	10	10,5	M6
30	60	16	45	14,3	9	125,4	92,4	60	14,6	40	11,2	11	M8
35	70	18	55	18	9,5	142,9	105,5	72	14,6	50	17	15	M8
45	86	20,5	70	20,9	14	168,5	128	80	14,6	60	20,5	18,5	M10

Size	Rail dimensions									Weight		Load ratings [2]		Moments [2]			
	W	H_1	H_6	F	D_1	D_2	E_{min}	E_{max}	L_{max}	carriage	rail	dynamic C	static C_0	dynamic M_x	static M_{x0}	dynamic $M_{y/z}$	static $M_{y0/z0}$
							−0,75	−0,75	−1,5								
–	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 25.**
[2] Dynamic load capacities and moments are based on a travel life of 100 km. Please refer to **page 7** for further details.
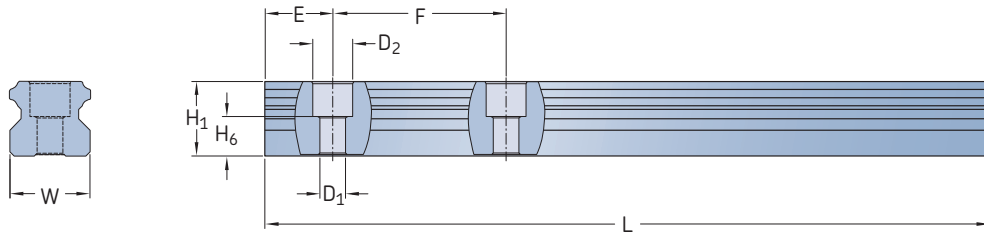
LLTHR rails

For mounting from above, rails are supplied with protective plastic caps. For designation, refer to *Ordering key rails* (→ **page 29**).

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

Standard rail size	Accuracy class	Designations [1] One-piece rail	Multi-piece rail	Pitch 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.
replace "..." by rail length in mm, e. g. LLTHR 15 - 1000 P5

SKF

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 railguide

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

(**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**) $E_{real} = \dfrac{L - F(z - 1)}{2}$

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**

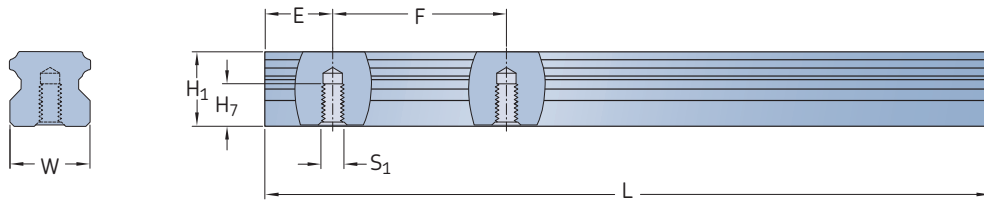(**5**) $E_{real} = \dfrac{L - F(z - 2)}{2}$

LLTHR ... D4 rails

For mounting from below. For designation, refer to *Ordering key rails* (→ **page 29**).

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

Standard rail size	Accuracy class	Designations [1] One-piece rail	Multi–piece rail	Pitch F
–	–	–		mm
15	P5 D4	LLTHR 15 - ... P5 D4	LLTHR 15 - ... P5 A D4	60
	P3 D4	LLTHR 15 - ... P3 D4	LLTHR 15 - ... P3 A D4	
	P1 D4	LLTHR 15 - ... P1 D4	LLTHR 15 - ... P1 A D4	
20	P5 D4	LLTHR 20 - ... P5 D4	LLTHR 20 - ... P5 A D4	60
	P3 D4	LLTHR 20 - ... P3 D4	LLTHR 20 - ... P3 A D4	
	P1 D4	LLTHR 20 - ... P1 D4	LLTHR 20 - ... P1 A D4	
25	P5 D4	LLTHR 25 - ... P5 D4	LLTHR 25 - ... P5 A D4	60
	P3 D4	LLTHR 25 - ... P3 D4	LLTHR 25 - ... P3 A D4	
	P1 D4	LLTHR 25 - ... P1 D4	LLTHR 25 - ... P1 A D4	
30	P5 D4	LLTHR 30 - ... P5 D4	LLTHR 30 - ... P5 A D4	80
	P3 D4	LLTHR 30 - ... P3 D4	LLTHR 30 - ... P3 A D4	
	P1 D4	LLTHR 30 - ... P1 D4	LLTHR 30 - ... P1 A D4	
35	P5 D4	LLTHR 35 - ... P5 D4	LLTHR 35 - ... P5 A D4	80
	P3 D4	LLTHR 35 - ... P3 D4	LLTHR 35 - ... P3 A D4	
	P1 D4	LLTHR 35 - ... P1 D4	LLTHR 35 - ... P1 A D4	
45	P5 D4	LLTHR 45 - ... P5 D4	LLTHR 45 - ... P5 A D4	105
	P3 D4	LLTHR 45 - ... P3 D4	LLTHR 45 - ... P3 A D4	
	P1 D4	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

SKF

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 railguide

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

(**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**) $E_{real} = \dfrac{L - F(z - 1)}{2}$

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**) $E_{real} = \dfrac{L - F(z - 2)}{2}$

LLTHR ... D6 rails

For mounting from above, rails are supplied with protective metal plugs. For designation, refer to *Ordering key rails* (→ **page 29**).

Protective metal plugs ensure that no residues of dirt, swarf, cooling water and other contaminants remain in the area of the attachment holes. After pressing in, 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 protective metal plugs is an option to further enhance protection (→ **page 57**).

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

Size-specific mounting tools from SKF are needed for installing the protective metal plugs. Please refer to **page 29** for ordering the mounting tool.
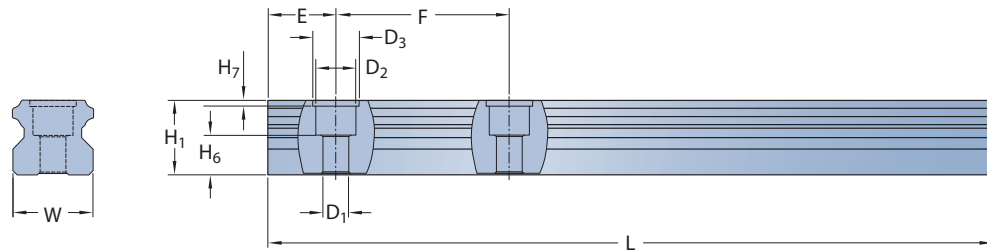

Mounting tool for installing protective metal plugs

Standard rail size	Accuracy class	Designations [1] One-piece rail	Multi–piece rail	Pitch 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 D6

SKF

Size	Dimensions											Weight
	W	H_1	H_6	H_7	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 railguide

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

(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

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

E_{real} = Real calculation value for E-dimension
E_{min} = Minimum E-dimension according to catalogue

Comparison with catalogue value of E_{min}

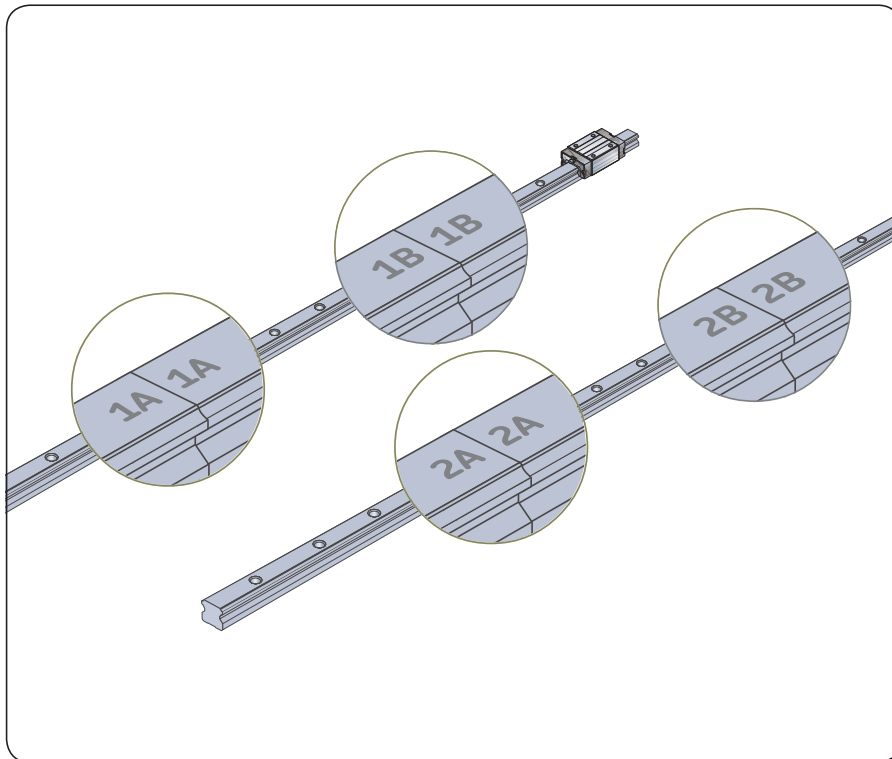(4.1) If $E_{real} \geq E_{min}$
→ Usage of E_{real} from **formula 4**

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

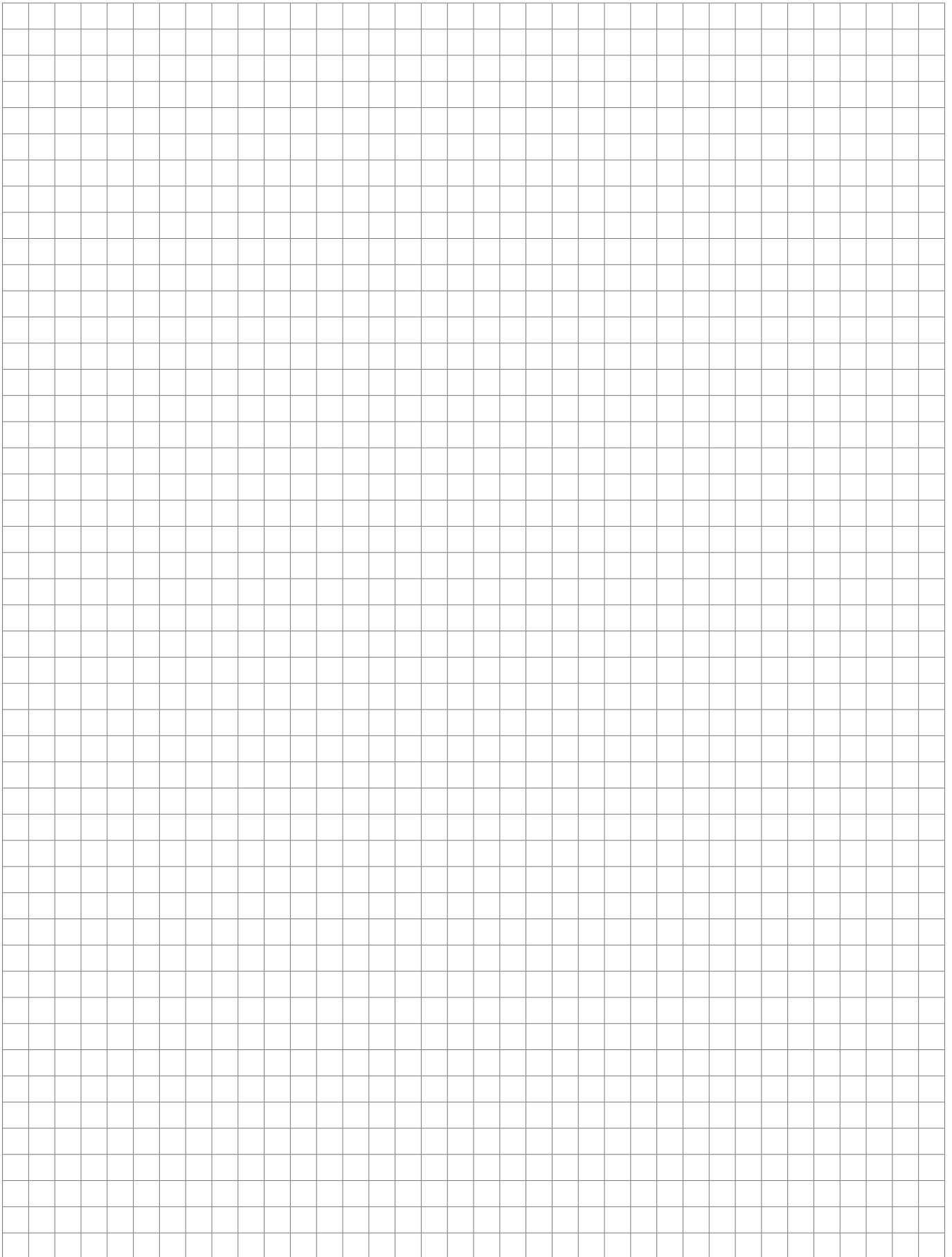$$(5)\quad E_{real} = \frac{L - F\,(z - 2)}{2}$$

Jointed rail tracks

If the requested rail length exceeds the available delivery length of LLT rails, special–ly 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 maxi–mum length for a deliverable rail track is 50 m. Please contact SKF to inquire about longer individual rail tracks. If replacement is required, the complete set should be exchanged to provide full functionality.

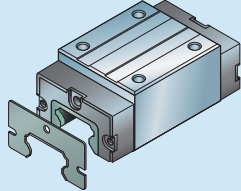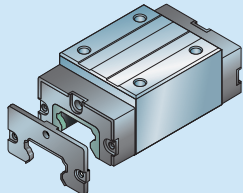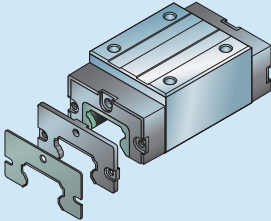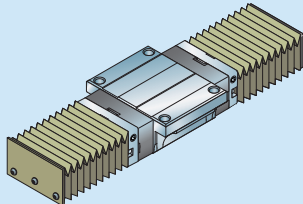For designation, refer to *Ordering key rails* (→ **page 29**).
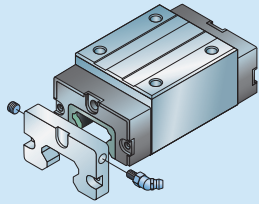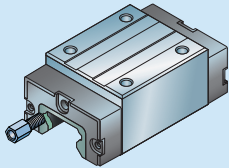
Accessories

Accessories

Item name	Illustration[1]	Purpose
Scraper plate		Scraper plates are spring-steel, non-contact components. They protect the front seal from, coarse contaminants or hot metal chips.
Additional front seal		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 low friction S0 shield, result in a sealed system with lower friction.
Seal kit		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.
Bellows		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.
Adapter plate		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		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).

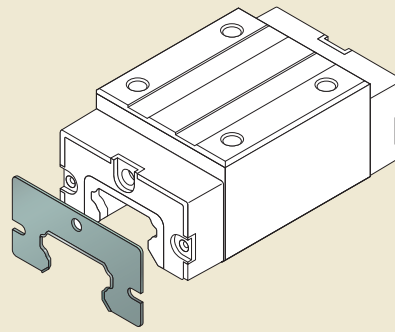[1] Appearance can vary slightly depending on the size.

SKF

Scraper plate

- 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.
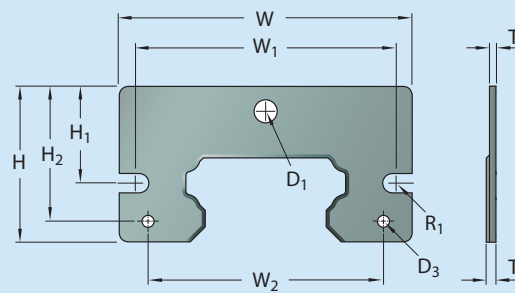
Note: Can be ordered in combination with an additional front seal as a kit. For designation, refer to *Ordering key accessories* (→ **page 29**).

Scraper plate

Appearance can vary slightly depending on the size.

Scraper plate

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

Additional front seal

- 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 29**).
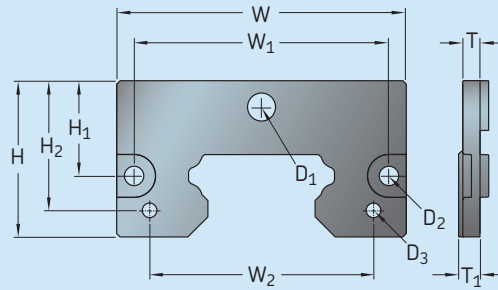
An additional front seal in combination with carriages equipped with low friction S0 shield, results in a sealed system with lower friction.

Front seal
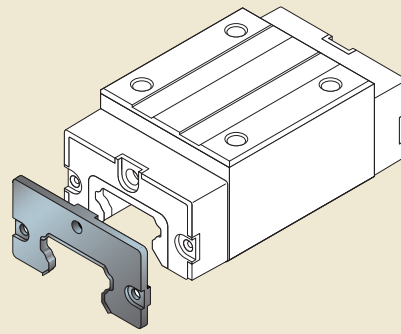
Appearance can vary slightly depending on the size.

Additional front seal

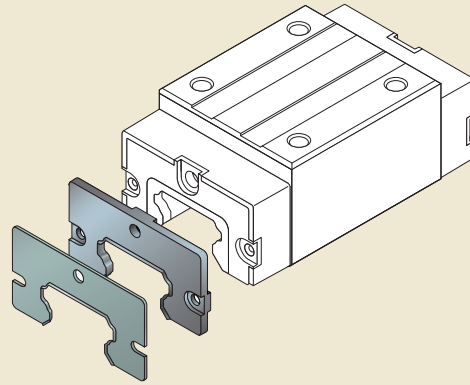| Size	Part designation	Dimensions										
		D_1	D_2	D_3	W	W_1	W_2	H	H_1	H_2	T	T_1
–	–	mm										
15	LLTHZ 15 S7	3,6	3,4	–	31,6	25,8	–	18,5	12	–	3	4
20	LLTHZ 20 S7	5,5	3,4	–	42,6	35	–	24,2	14,8	–	3	4
25	LLTHZ 25 S7	5,5	4,5	–	46,6	39,6	–	27,7	16,8	–	3	4
30	LLTHZ 30 S7	6,5	3,4	–	57,9	50	–	31,5	19.3	–	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

SKF

Seal kit

The seal kit consists of the following components:

• Scraper plate
• Additional front seal

Mounting screws and grease nipple are included. For designation, refer to *Ordering key accessories* (→ **page 29**).
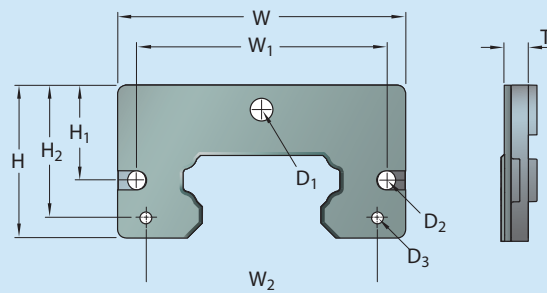
Seal kit

Appearance can vary slightly depending on the size.

Seal kit

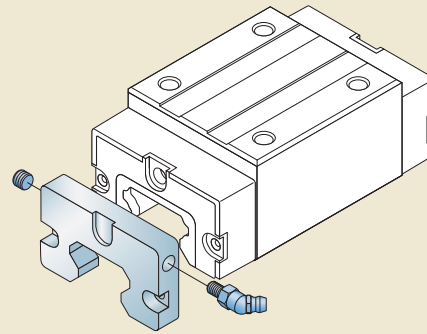| Size	Part designation	Dimensions									
		D_1	D_2	D_3	W	W_1	W_2	H	H_1	H_2	T
–	–	mm									
15	LLTHZ 15 S3	3,6	3,4	–	31,6	25,8	–	18,5	12	–	4
20	LLTHZ 20 S3	5,5	3,4	–	42,6	35	–	24,2	14,8	–	4
25	LLTHZ 25 S3	5,5	4,5	–	46,6	39,6	–	27,7	16,8	–	4
30	LLTHZ 30 S3	6,5	3,4	–	57,9	50	–	31,5	19,3	–	5
35	LLTHZ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

Adapter plate

- Material: Aluminium
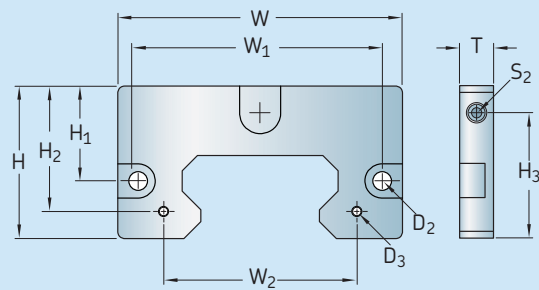- Design: Natural aluminium, no anodizing

Mounting

Mounting screws and grease nipple are included. For designation, refer to *Ordering key accessories* (→ **page 29**).

Adapter plate

Appearance can vary slightly depending on the size.

Adapter plate

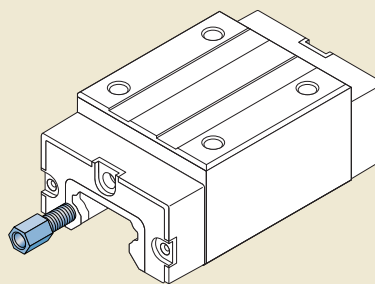| Size	Part designation	Dimensions										
		S_2	D_2	D_3	W	W_1	W_2	H	H_1	H_2	H_3	T
–	–	mm										
15	LLTHZ 15 PL	M5	3,4	M2	32	25,8	20	18,9	12,2	16,4	13,7	10
20	LLTHZ 20 PL	M5	3,4	M3	43	35	28	24,5	15	20	17,5	10
25	LLTHZ 25 PL	M5	4,5	M3	47	39,6	32	28	17	23	22,5	10
30	LLTHZ 30 PL	M6	3,5	M3	58,5	50	38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

SKF

Lubrication connector

- Material: Steel, alternative brass
- Appearance: Hard chromed

Mounting

To be used with central lubrication systems, see SKF Lubrication. For designation, refer to *Ordering key accessories* (**→ page 29**).
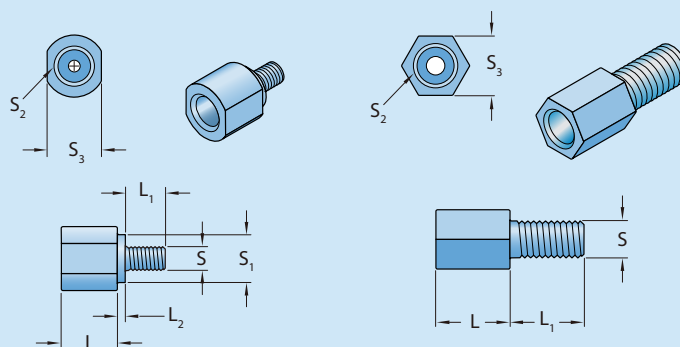
Note: The lubrication connector cannot be used in combination with additional seals (scraper plate, additional front seal, seal kit).

Lubrication connector

Appearance can vary slightly depending on the size.

Lubrication connector

Size	Part designation	Dimensions						
		L	L_1	L_2	S	S_1	S_2	S_3
–	–	mm						
15	LLTHZ 15 VN UA	7	5	1	M3	6	M5 × 5L	7
20	LLTHZ 20 VN UA	10	8	–	M5	–	M6 × 7L	8
25	LLTHZ 25 VN UA	10	10	–	M5	–	M6 × 7L	8
30	LLTHZ 30 VN UA	10,5	12	–	M6	–	M6 × 8L	8
35	LLTHZ 35 VN UA	10,5	12	–	M6	–	M6 × 8L	8
45	LLTHZ 45 VN UA	10,5	12	–	M6	–	M6 × 8L	8

Bellows

Temperature resistance

t_{max} = 90 °C.
During continuous operation the permissible operating termperature 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.
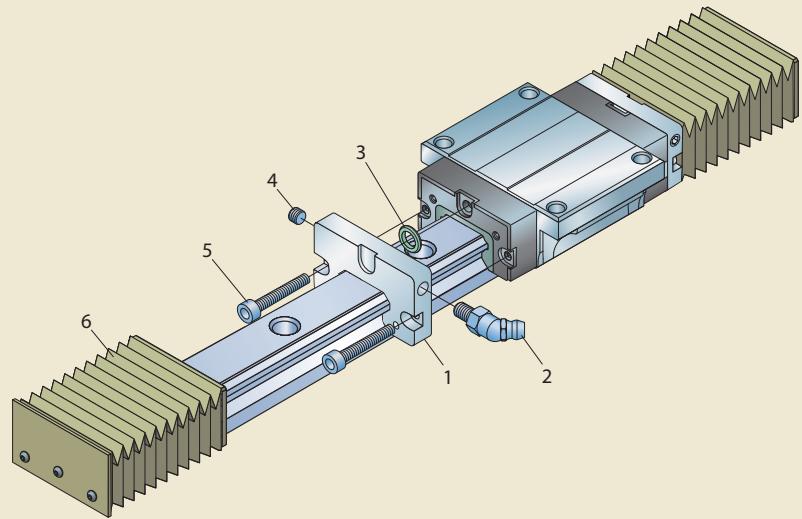
For all application please note the maximum temperature range for LLT systems (→ **page 9**).

Material

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

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.

Fig. 1

Delivery scope

Table 1

Bellows designations[1]

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

[1] Replace ".." by number of folds per bellow.

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.

Calculation of the bellows type 2[1]

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

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 < 1000 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} = Bellows stretched
L_{min} = Bellow pushed together
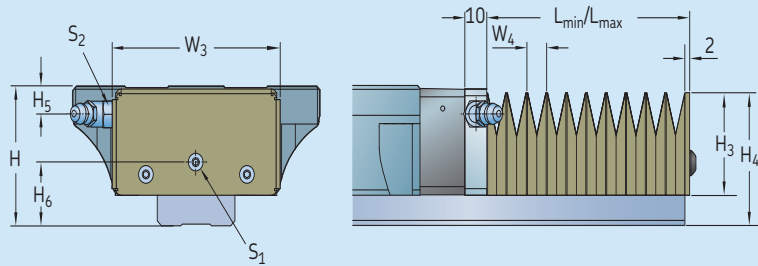n = total number of folds per carriage side
S_F = Stroke per fold
S_F = $W_{4\,max} - W_{4\,min}$ [mm]
Stroke = Stroke [mm]
W_4 = maximum and minimum extension per fold

Table 2

Dimensions of the bellows

Size	Dimensions									STD	LAS	WEL	
	W_3	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]
–	mm												
15	32	24	28	18,9	23,5	3,8	8,8	M4	M5	2,5	3	–	9,6
20	43	30	30	24,5	29,5	5,2	12	M4	M5	2,5	3	–	12
25	47	36	40	28	35	5,5	15,5	M4	M5	2,5	3	–	12
30	58	42	45	32	41	7	19	M4	M6	2,5	3	–	16,9
35	68	48	55	37	47	6,5	21,5	M4	M6	2,5	–	4	21
45	84	60	70	45	59	7,5	28,5	M4	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)
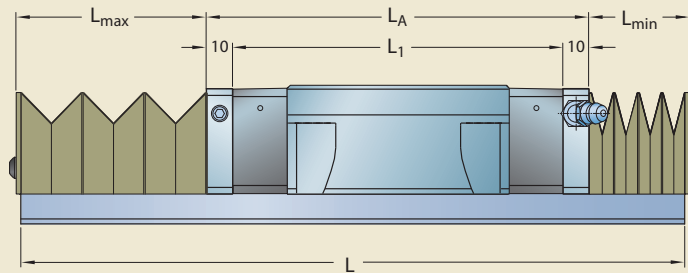
[1] Calculation for maximum possible stroke. Calculation of bellow type 4 on request, specifications on stroke length required.

Applications in corrosive environments

To ensure that LLT profile rail guides operate reliably even 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.

SKF protects components with the following coatings:

LLTHR rails: TDC (Thin Dense Chrome) coating

LLTHC carriages: Nickel layer

Rail: The rail features a very thin TDC layer that provides effective corrosion protection, but does not affect the load rating of the system. For technical data regarding both types of coatings, please refer to **table 1**.

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 increase 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 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
- Completely coated rails: maximum length approximately 4 000 mm
- Cut-to-length rail: standard – cut edges not coated
- Cut-to-length rail: possible – cut edges TDC coated

Note: Where coated LLT rails are used, glossy areas may appear on the raceways after running-in. The corrosion protection properties are not compromised.
All components are delivered with preservative ex works. The nickel-plated carriages are delivered unlubricated and must to be greased by the customer prior to use.

Note: The carriages of size 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 58**).

		Table 1
Technical data and ordering designations of coated components		
Properties	**Rail**	**Carriage**
Designation	LLTHR .../ HD (Europe) LLTHR .../HA (USA/CAN)	LLTHC .../ HN
Coating	TDC	Nickel
Colour	matt grey	glossy silver
Layer hardness	900 HV – 1300 HV	800 HV
Corrosion protection	72 h (salt spray test DIN EN ISO 9227)	100 h (salt spray test DIN EN ISO 9227)
RoHS compliant	yes	yes

Mounting and maintenance

General instructions

The following mounting instructions[1] are applicable to all carriage types.

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

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

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

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.

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

Guideline values for the permissible lateral loads for unfixed rails are listed in **table 3** on **page 66**.

Mounting with laterally fixed rails and carriages

Mounting without lateral rail fixation
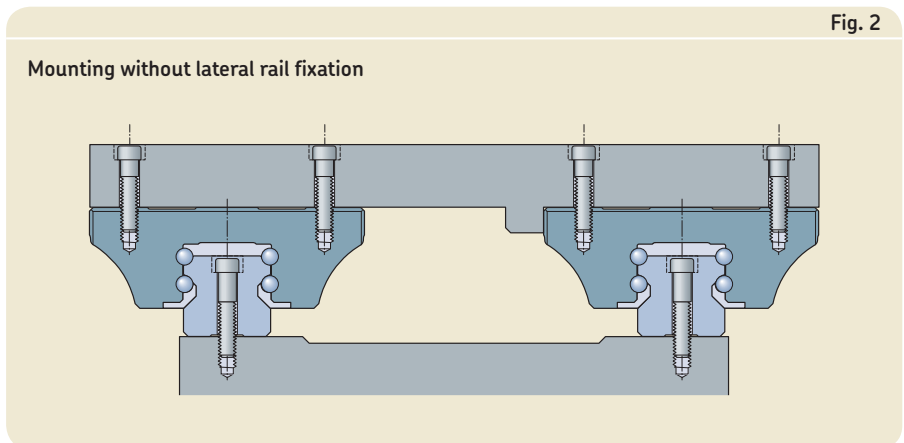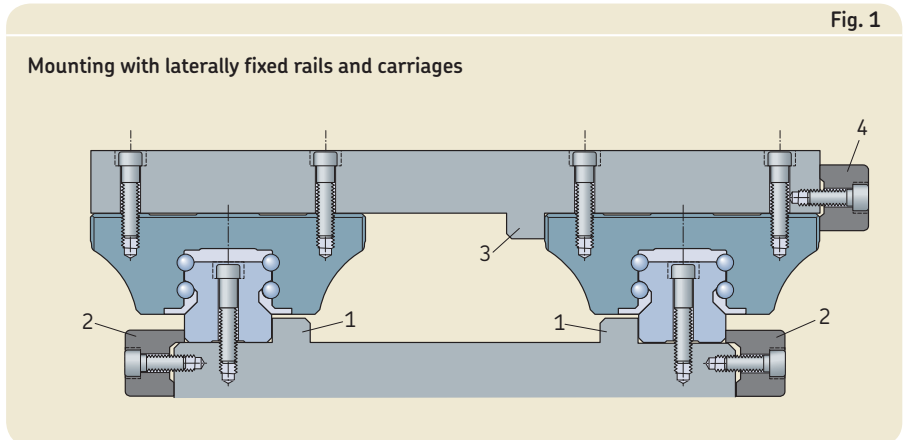
Carriage

Each carriage has one ground reference side (please refer to dimension H_2 in the drawings of the carriages (→ **pages 32 ff.**).

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.

---

[1] For detailed information please download "Mounting Instruction Profile rail guides LLT" at www.skf.com.

Interface design, screw sizes and tightening torques

- The flange-type carriages can be fas-tened from above (→ **fig. 3**) and below (→ **fig. 4**)
- The slim-type carriages can be fastened from above (→ **fig. 5**)

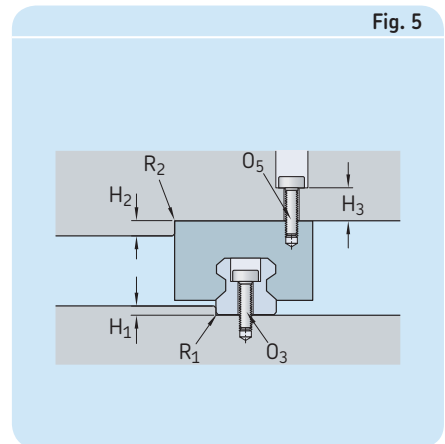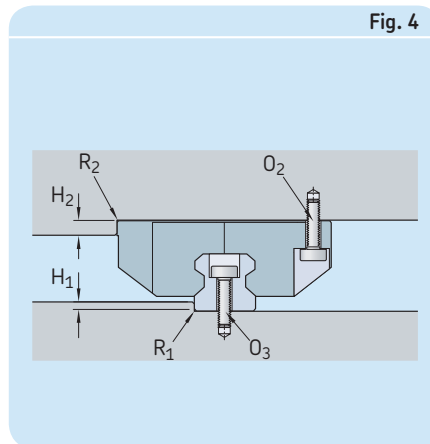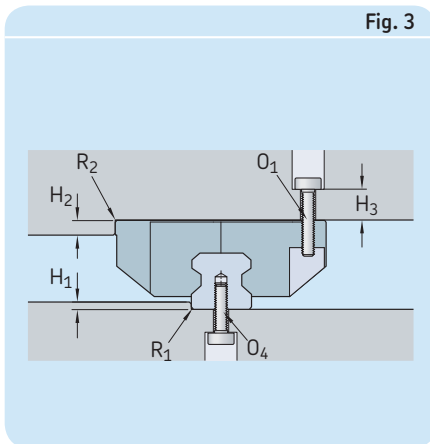- Rails can be fastened from both above (→ **fig. 4** and **5**) and below (→ **fig. 3**, rail type **LLTHR ... D4**).

Fig. 3

Fig. 4

Fig. 5

Table 1

Stop edges, corner radii and screw sizes

Size	Dimensions H_1 min	H_1 max	R_1 max	H_2	R_2 max	H_3[1]	Screw O_1 ISO 4762	O_2	O_3[1]	O_4[1]	O_5[2]
–	mm						4 Piece		Rail		
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 of 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	Rails 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

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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 elements 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.

Attachment structure for carriages
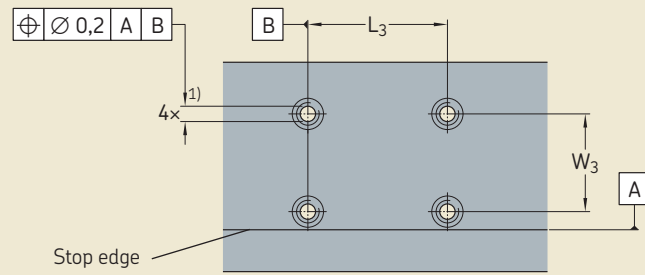
Attachment structure for profile rail guides
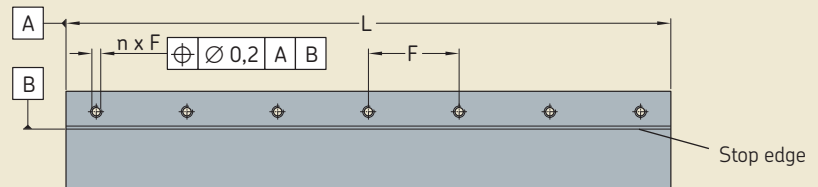
[1] in case of carriage types SA, SU: 2x

Permissible height deviation

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

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

Permissible height deviation in lateral direction ($\rightarrow$ table 4)

$$S_1 = a\,Y$$

where
S_1 = Permissible height deviation [mm]
a = 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. Please refer to **table 3** on **page 64**. If the difference S_{1-2x} tolerance H < 0, a new product selection is necessary (other preload, precision).

Permissible height deviation in longitudinal direction ($\rightarrow$ table 5)

$$S_2 = b\,X$$

where
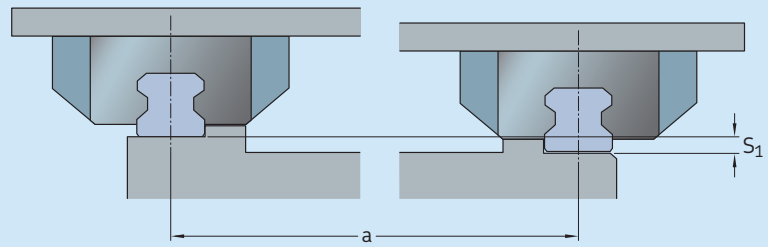S_2 = Permissible height deviation [mm]
b = Distance between the carriages [mm]
X = Calculation factor longitudinal direction

Note: The maximum difference Δ_H for the carriages has to be taken into account. Please refer to **table 3** on **page 64**. If the difference $S_2 - \Delta_H < 0$, a new product selection is necessary (other preload, precision).

Table 4

Permissible height deviation in lateral direction

Calculation factor Y for carriages

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 (carriage type SA + SU)	$6{,}2 \times 10^{-4}$	$4{,}1 \times 10^{-4}$	–

Table 5

Permissible height deviation in longitudinal direction
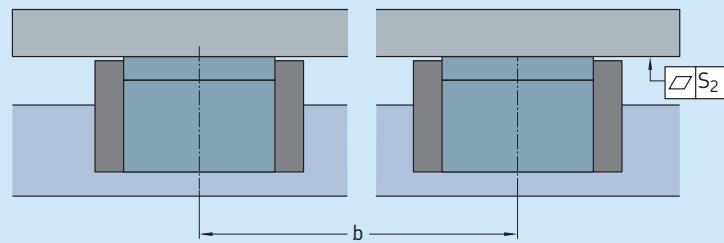
Calculation factor X for carriages

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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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.

With standard mounting, the adjacent structure is slightly resilient. However, a rigid, high-precision adjacent structure is required for precision mounting. In these case, the values in the table must be halved.

Maintenance

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

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

Table 6

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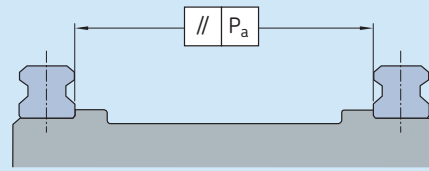
Size	Tolerance class T0	T1 (2% C)	T2 (8% C)
–	–	–	–
15	0,030	0,018	0,010
20	0,036	0,022	0,012
25	0,038	0,024	0,014
30	0,042	0,028	0,018
35	0,046	0,030	0,020
45	0,056	0,038	0,024
Carriage type SA + SU			
15	0,036	0,022	–
20	0,044	0,026	–
25	0,046	0,028	–
30	0,050	0,034	–
35	0,056	0,036	–

C

Typical application areas

Typical application areas								
Applications	**Accuracy 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	+	+		+	+	+	+	

Symbols: + Suitable

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Specification sheet
Please complete form and send to your SKF representative or authorized distributor.

Selection of profile rail guide slides

Date
_____

1a Customer

Company
_____

Address 1
_____

Address 2
_____

City | Post code
_____ | _____

Country
_____

Phone | Fax
_____ | _____

2 SKF contact

Company
_____

Address 1
_____

Address 2
_____

City | Post code
_____ | _____

Country
_____

Phone | Fax
_____ | _____

1b Contact

Name	telephone	mobile
Job title	Department	e-mail
Name	telephone	mobile
Job title	Department	e-mail
Name	telephone	mobile
Job title	Department	e-mail

3 Reason for request

Currently used product

☐ Replacement ☐ New design ☐ Other:

4 Application / Industry

5 Application description

6 Number of carriages per rail

Please specify other

☐ 1   ☐ 2   ☐ 3   ☐ Other:

7 Number of rails used in parallel

Please specify other

☐ 1   ☐ 2   ☐ Other:

8 Stroke

mm

9 Rail length

mm

10 Distance between carriages

mm

11 Distance between rails

mm

12 Loads per axis

Additional moving load	Additional force
kg	N
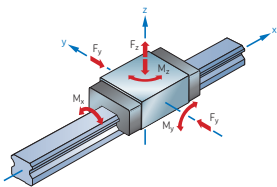
Force		N
Moment		Nm
Eccentricity		mm

X	Y	Z

13 Speed

Maximum

m/s

14 Acceleration

Maximum

m/s^2

15 Mode of operation

Duty cycle	Length of one operation cycle
%	s

16 Specification life

Operating hours per day	requisite life
h	h

17 Dynamic diagram

S [mm]

t [s]

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18 Accuracy class

(Details can be found in the LLT product catalog on **page 25**)

☐ P5 (standard)   ☐ P3 (medium)   ☐ P1 (high)

19 Preload class

(Details can be found in the LLT product catalog on **page 15**)

☐ T0 (Zero preload)   ☐ T1 (Light preload 2% C)   ☐ T2 (Medium preload 8% C)

20 Mounting

Carriages	☐ Flange type, mounted from above	☐ Flange type, mounted from below	☐ Slim type, mounted from above
Rails	☐ Mounted from above with plastic caps	☐ Mounted from above with metal plugs	
	☐ Mounted from below	☐ Other	

Customer interface

21 Environmental conditions

22 Remarks / Special request / Sketch

SKF – the knowledge engineering company

From the company that invented the self-aligning ball bearing more than 100 years ago, SKF has evolved into a knowledge engineering company that is able to draw on five technology platforms to create unique solutions for its customers. These platforms include bearings, bearing units and seals, of course, but extend to other areas including: lubricants and lubrication systems, critical for long bearing life in many applications; mechatronics that combine mechanical and electronics knowledge into systems for more effective linear motion and sensorized solutions; and a full range of services, from design and logistics support to condition monitoring and reliability systems.

Though the scope has broadened, SKF continues to maintain the world's leadership in the design, manufacture and marketing of rolling bearings, as well as complementary products such as radial seals. SKF also holds an increasingly important position in the market for linear motion products, high-precision aerospace bearings, machine tool spindles and plant maintenance services.

The SKF Group is globally certified to ISO 14001, the international standard for environmental management, as well as OHSAS 18001, the health and safety management standard. Individual divisions have been approved for quality certification in accordance with ISO 9001 and other customer specific requirements.

With over 120 manufacturing sites worldwide and sales companies in 70 countries, SKF is a truly international corporation. In addition, our distributors and dealers in some 15 000 locations around the world, an e-business marketplace and a global distribution system put SKF close to customers for the supply of both products and services. In essence, SKF solutions are available wherever and whenever customers need them. Overall, the SKF brand and the corporation are stronger than ever. As the knowledge engineering company, we stand ready to serve you with world-class product competencies, intellectual resources, and the vision to help you succeed.


© Airbus – photo: eXm company, H. Goussé

Evolving by-wire technology
SKF has a unique expertise in the fast-growing by-wire technology, from fly-by-wire, to drive-by-wire, to work-by-wire. SKF pioneered practical fly-by-wire technology and is a close working partner with all aerospace industry leaders. As an example, virtually all aircraft of the Airbus design use SKF by-wire systems for cockpit flight control.

SKF is also a leader in automotive by-wire technology, and has partnered with automotive engineers to develop two concept cars, which employ SKF mechatronics for steering and braking. Further by-wire development has led SKF to produce an all-electric forklift truck, which uses mechatronics rather than hydraulics for all controls.

SKF
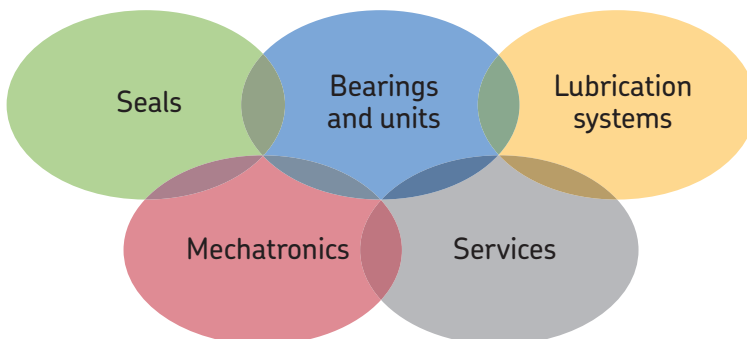
Harnessing wind power

The growing industry of wind-generated electric power provides a source of clean, green electricity. SKF is working closely with global industry leaders to develop efficient and trouble-free turbines, providing a wide range of large, highly specialized bearings and condition monitoring systems to extend equipment life of wind farms located in even the most remote and inhospitable environments.

Working in extreme environments

In frigid winters, especially in northern countries, extreme sub-zero temperatures can cause bearings in railway axleboxes to seize due to lubrication starvation. SKF created a new family of synthetic lubricants formulated to retain their lubrication viscosity even at these extreme temperatures. SKF knowledge enables manufacturers and end user customers to overcome the performance issues resulting from extreme temperatures, whether hot or cold. For example, SKF products are at work in diverse environments such as baking ovens and instant freezing in food processing plants.

Developing a cleaner cleaner

The electric motor and its bearings are the heart of many household appliances. SKF works closely with appliance manufacturers to improve their products' performance, cut costs, reduce weight, and reduce energy consumption. A recent example of this cooperation is a new generation of vacuum cleaners with substantially more suction. SKF knowledge in the area of small bearing technology is also applied to manufacturers of power tools and office equipment.

Maintaining a 350 km/h R&D lab

In addition to SKF's renowned research and development facilities in Europe and the United States, Formula One car racing provides a unique environment for SKF to push the limits of bearing technology. For over 60 years, SKF products, engineering and knowledge have helped make Scuderia Ferrari a formidable force in F1 racing. (The average racing Ferrari utilizes around 150 SKF components.) Lessons learned here are applied to the products we provide to automakers and the aftermarket worldwide.

Delivering Asset Efficiency Optimization

Through SKF Reliability Systems, SKF provides a comprehensive range of asset efficiency products and services, from condition monitoring hardware and software to maintenance strategies, engineering assistance and machine reliability programmes. To optimize efficiency and boost productivity, some industrial facilities opt for an Integrated Maintenance Solution, in which SKF delivers all services under one fixed-fee, performance-based contract.

Planning for sustainable growth

By their very nature, bearings make a positive contribution to the natural environment, enabling machinery to operate more efficiently, consume less power, and require less lubrication. By raising the performance bar for our own products, SKF is enabling a new generation of high-efficiency products and equipment. With an eye to the future and the world we will leave to our children, the SKF Group policy on environment, health and safety, as well as the manufacturing techniques, are planned and implemented to help protect and preserve the earth's limited natural resources. We remain committed to sustainable, environmentally responsible growth.

SKF

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