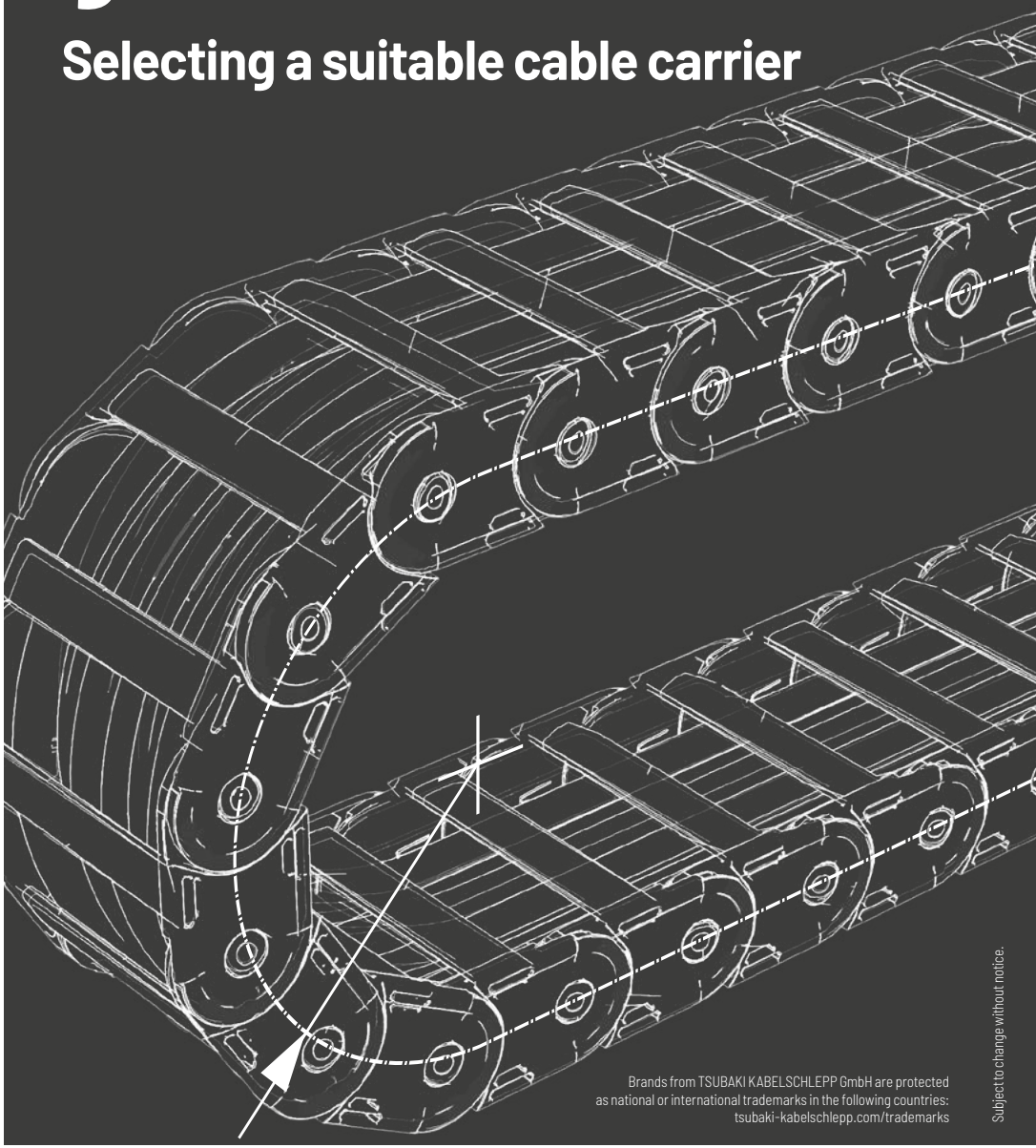
Configuration guidelines

Selecting a suitable cable carrier



Content

01 Selecting a suitable cable carrier

1.1 Required basic data for determination

The cable carrier is selected based on different factors which have to be considered in combination. The following parameters should therefore be already available when starting to select a cable carrier:

» **Installation of cables and hoses**
(Number and diameters of the installed cables and hoses as well as the cable weight including media (kg/m), required minimum bending radius)

» **Dynamic parameters**
(Travel speed, acceleration/deceleration, desired motion cycles)

» **Motion sequence**
(For which type of motion is the cable carrier used?)

» **Installation situation**
(How much space is available? Installation width? Installation height?)

» **Operating temperature**

» **Contamination and degree of contamination**
(Which type of contamination? Which amount?)

» **Application-specific ambient influences**
(e.g. chips, oil, moisture, chemicals)

1.2 Selecting a suitable version

TSUBAKI KABELSCHLEPP offers a variety of cable carriers for all areas of application. The suitable product can be roughly determined with the available basic data.

Selecting the suitable material: side bands made of steel or plastic?

In addition to the environmental conditions, the selection of the suitable material is determined by the dynamic parameters and the load on the cable carrier. Plastic cable carriers have become established in many areas of application over the years. The application should always be examined in detail beforehand, though. The following table shows the operating parameters as a configuration tool for the suitable cable carrier material:

Operating conditions	Plastic	Steel
Travel speed > 2 m/s	+	–*
Travel cycle > 1 million	+	–*
Continuous temperature		
< – 40° C	–**	+
– 40° C to +100° C	+	+
> + 100° C	–**	+
Acidic environment	–	+***
Radioactive radiation	–	+***

Operating conditions	Plastic	Steel
Vacuum	–	+***
Extremely rough operating conditions (e.g. heavy industry, mining, drilling)	•	+
Very high mechanical load	•	+

\+ very suitable
• suitable
– not suitable

* possible as custom version
** special material available
*** stainless steel version available

Our technical support can provide help for critical applications: **technik@kabelschlepp.de**

Selecting the cable protection: open or closed cable carrier?

The selection of the suitable cable carriers can be further limited with the question whether the guided cables require additional protection (e.g. against foreign bodies) and whether a cable carrier with a cover system is practical.

The following table is a simple guideline; the exact choice should be determined after detailed examination of the specific application. In many cases, closed cable carriers are also used to hide the cables for visual reasons.

For very large accumulations of fine contamination (e.g. dust or sand), especially in combination with moisture, we advise against using the cover systems. This affects the function of the overlapping covers substantially.

Cover systems are available for steel and plastic cable carriers.

Operating conditions	Open cable carriers	Covered cable carriers
Coarse contamination (e.g. chips, metal parts, glass splinters)	•	+
Hot chips/metal spatter	–	+*
Visual protection (hiding the cables)	–	+
Very high incidence of fine contamination (e.g. sand, dust, scale)	•/+	–
Very fine contamination and moisture (e.g. moist dust)	•/+	–

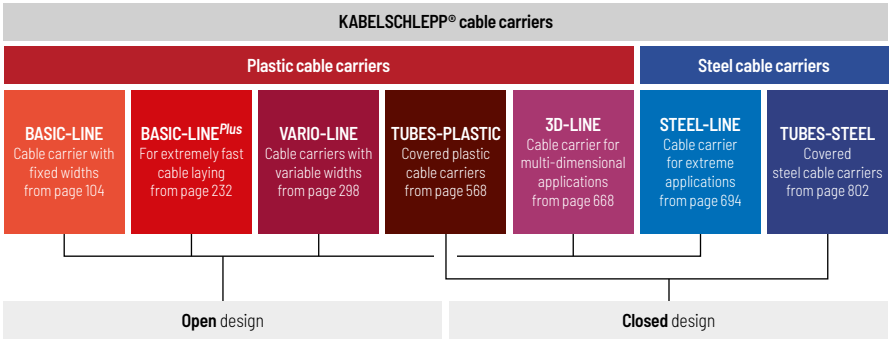
\+ very suitable
• suitable
– not suitable

* Also possible as steel band cover, see page 916
Special materials for covers on plastic cable carriers possible

Example:
Cover system with chips

Negative example:
Cover system with high dust accumulation

According to the specification plastic/steel and open/closed, you can select the suitable cable carriers according to the following diagram in the respective catalog chapter:



1.3 Defining the cable carrier size

The number and diameter of the cables to be installed play a major role here. Very often, the dimensions of the installation space for using a cable carrier are very limited. Both these prerequisites therefore have to be balanced.

The basic data of the cables to be installed are required for the further configuration of the cable carrier:

- Type (cable or hose)
- Outer diameter (d)
- Cable weight incl. media (q_z)
- Minimum bending radius (KR_{min})

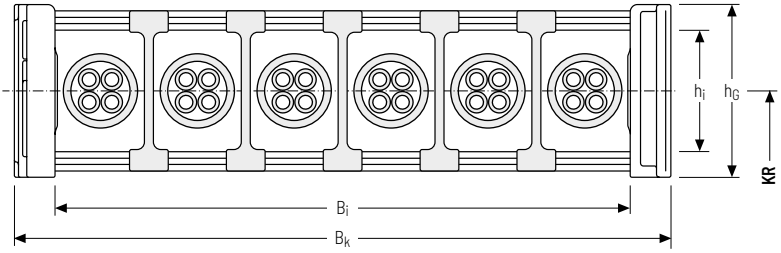
Please select a cable carrier with a sufficient inner height (see page 40). Adequate space on the side for placing the cables should also be planned for the initial configuration. They have to be arranged freely in the cross section of the cable carrier. The following minimum values for the required space apply:

Cables: 1.1 x d (for diameter d < 20 mm, minimum required space: d + 2 mm)

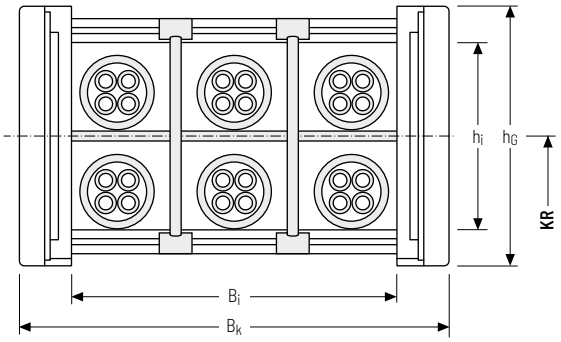
Hoses: 1.2 x d (for diameter d < 20 mm, minimum required space: d + 4 mm)

More information for installing cables can be found in chapter Placement guidelines on page 72.

The first draft for a so-called stay pattern can then look as follows, for example:



It is possible that the cable carrier becomes too wide with regard to the permitted installation dimension. In this case, a larger cable carrier can be used in combination with one of the divider systems. The placement could then look as follows, for example:

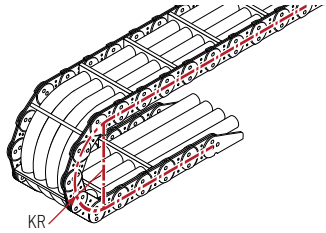


For the installation of cables in the cable carrier, please also take the selected installation variant into account (see page 76) which can have additional implications for loading the cable carrier. The different available stay variants (e.g. hole stay, tube stay) also allow different variations to suit the application.

This initial draft still has to be verified with regard to the further configuration of the cable carrier in the following (e.g. unsupported use).

Determining the bending radius KR

The chapter for the selected cable carrier contains the sizes of the available bending radii. The selection of the bending radii depends on the cables used. The information from the cable manufacturer regarding the dynamically moving minimum bending radius have to be taken into account for this.



The selected bending radius of the cable carrier has to be equal to or greater than the largest minimum bending radius of the cables to be installed.

We recommend using KABELSCHLEPP® cables which were specially designed for use in cable carriers.

1.4 Determining the cable carrier length L_K for simple linear travel

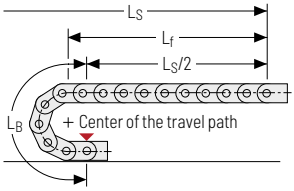
It is practical to place the fixed point connection at the center of the travel path. This provides the shortest connection between fixed and movable driver point and therefore the most economical cable carrier and cable length. Of course your cable carrier can also be installed with a fixed point outside of the center of the travel path. The calculation follows these examples:

For *fixed point at the center* of travel path L_S, the following applies for cable carrier length L_K:

Cable carrier length L_k

$$L_k \approx \frac{L_S}{2} + L_B$$

Cable carrier length L_k rounded to pitch t



The length of carrier in bend L_B is determined according to the selected cable carrier type:

Type	Length of carrier in bend L_B
Plastic cable carriers	$L_B = KR \times \pi + 2 \times t$
LS/LSX series	$L_B = KR \times \pi + 2 \times t$
S/SX series	$L_B = KR \times \pi + 4 \times t$
QUANTUM® series	$L_B = KR \times \pi + 12 \times t$
TKR series	$L_B = KR \times \pi + 2...4 \times t$

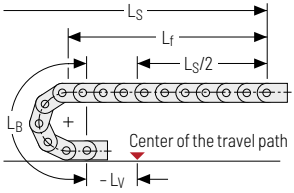
The calculated values can be found in the tables in the respective individual chapters.

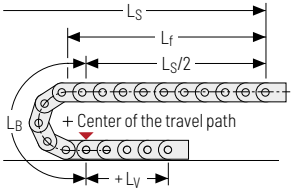
For *fixed point outside of the center* of travel path L_S, the following applies for cable carrier length L_K:

Cable carrier length L_k

$$L_k \approx \frac{L_S}{2} + L_B + |L_V|$$

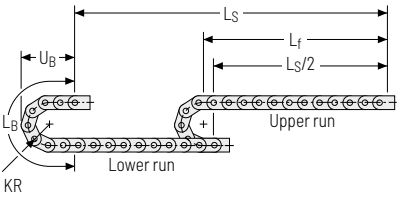
Cable carrier length L_k rounded to pitch t





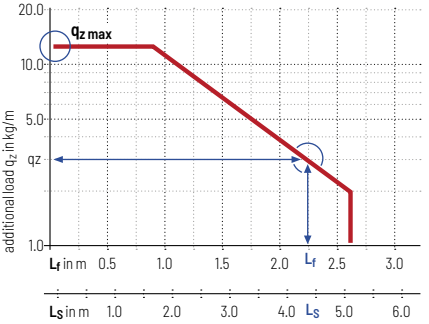
Verification of the load values for unsupported arrangement

The term "unsupported arrangement" describes the condition when the upper run moves parallel to the lower run across the entire horizontal travel length.



The unsupported arrangement is the most common use of cable carriers. The unsupported length L_f resulting from the travel length, and its load on the cable carrier is determined with the cable weight to be guided q_z from the load diagram.

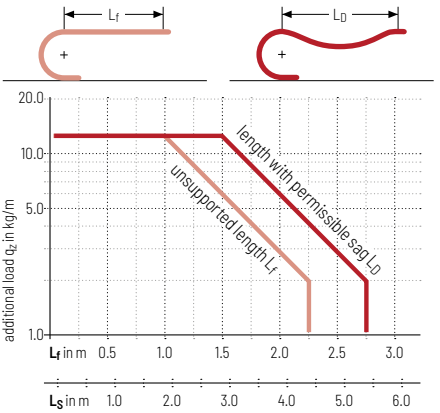
The load diagram therefore marks the area of the unsupported length L_f in which the cable carrier has no appreciable sagging or, in reverse conclusion, the maximum cable weight at which the cable carrier does not yet sag. If the travel length or the cable weight increases above the value stated in the diagram, the cable carrier starts to sag.



The specific load diagrams can be found in the individual chapters. Please note that the diagrams were determined with a specific intrinsic cable carrier weight. This means that the usable additional load can be reduced for large cable carrier widths or for cover systems.

Furthermore, the upper value q_z in the diagram indicates the maximum additional load of the cable carrier.
This value must not be exceeded.

The figure on the left shows an example for a load diagram with the most important parameters for determining the respective cable carrier load.



According to definition, the unsupported length L_f is the length at which the upper run of the cable carrier has no appreciable sag.

For steel cable carriers, sagging is not permitted as a rule. The higher flexibility of the plastic cable carriers allow a slight increase of the additional load or of the unsupported length. As a rule, we advise against this *unsupported arrangement with permitted sag* L_D for reasons of dynamics and appearance.

Increased wear of the links also has to be expected. It cannot be ruled out, however, that in individual cases a solution may have to be implemented in this way at low travel speeds. In this case, please request the corresponding values from us.

We will be happy to advise you.

Exceeded the load diagram?

There are several options if the unsupported length of the cable carrier is exceeded:

» Selecting a more sturdy cable carrier with a longer unsupported length and higher additional load

» Using a multi-band carrier for increasing the additional load

» Supporting the upper run after the fixed point:
depending on the dynamic parameters, this arrangement can practically double the travel length. We are happy to help with configuring a suitable support structure.

» For very long travel lengths, the cable carrier has to be configured as gliding or rolling.

More information on these installation variants can be found from page 76.

The overall length of the cable carrier

The cable carrier length L_K does not include the length l_1 of the end connectors. To be able to determine the correct required cable and hose length, the value L_{EF} is required. This is calculated as follows:

Overall length cable carrier L_{EF}

$L_{EF} = L_K + l_1$ Driver connection + l_1 Fixed point connector

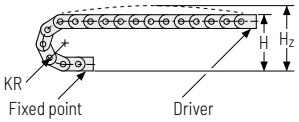
1.5 Connection height, pretension & installation height

Kabelschlepp cable carriers are manufactured with pretension as a standard in order to implement the most extensive unsupported length possible. This produces an elevation of the upper run in the area of the unsupported length and is already considered in the load diagram.

The pretension increases the installation height of the cable carrier to the total value H_z. The connection height H and the installation height H_z are determined for each cable carrier type according to the following guidelines.

Connection height H and installation height H_z for plastic cable carriers

The values for determining the connection height H can be found in the respective individual chapters. They are generally determined as follows:



Installation height H_z is also listed in the respective individual chapters as an allowance for the pretension, specifically for each cable carrier.

Type	Connection height H
Plastic cable carriers*	$H = 2\,KR + h_G$
M1300 series	$H = 2\,KR + 1{,}5\,h_G$
Q040 series	$H_{min} = 2\,KR + 45$ mm
Q060 series	$H_{min} = 2\,KR + 88$ mm
Q080 series	$H_{min} = 2\,KR + 117$ mm
Q100 series	$H_{min} = 2\,KR + 143$ mm
TKR0150 series	$H = 2\,KR + 40$ mm
TKR0200 series	$H = 2\,KR + 72$ mm
TKR0370 series	$H = 2\,KR + 70$ mm
TKR0260 series	$H = 2\,KR + 88$ mm
TKR0280 series	$H = 2\,KR + 102$ mm

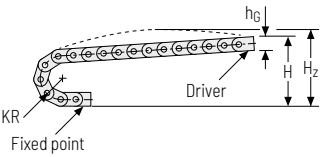
* not for M1300

Installation height H_Z for steel cable carriers

Due to the higher stability of steel cable carriers, the pretension z can already be taken into account on unsupported arrangements by slightly increasing the connection height H. This is based on the following calculation:

Connection height H for systems *without* support (unsupported)

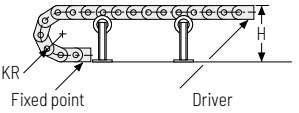
$H = 2\,KR + 1.5\,h_G$



If the unsupported length is increased with support rollers or a continuous support frame, the upper run has to be placed parallel to the support plane.

Connection height H for systems *with* support

$H = 2\,KR + h_G$



To be sure, another verification of the installation height H_Z should be carried out for steel cable carriers depending on the pretension and cable carrier length. The following rule of thumb applies:

Installation height H_Z

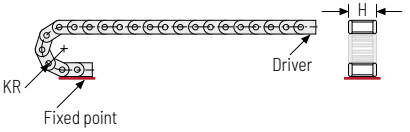
$H_Z = H + z$

Pretension
$z \approx 10$ mm/m cable carrier length

For example, the installation height H_Z for a cable carrier length of $L_k = 5000$ mm increases by 50 mm. Depending on the installation variant, it is still necessary to operate the cable carrier without or with reduced pretension. This is possible on almost all types.

1.6 Consideration of stability

In the tension end position, the stability of the cable carrier must be considered. For extensive unsupported lengths, the remaining small support area at the fixed point can reduce the stability for very narrow cable carriers. Accordingly, the ratio between bending radius KR and outer cable carrier width Bk should always be taken into account for dimensioning of the cable carrier.

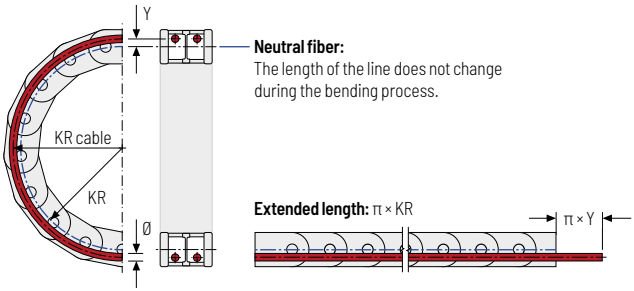


Support area

If the outer cable carrier width on an extensive unsupported length is significantly smaller than the required bending radius, the option of a lateral support should be considered if stability seems at risk. In this case, please contact our technical support.

1.7 Consideration of relative displacement

An arrangement where the cables are placed next to each other and separately should be preferred. This arrangement is recommended to keep the relative displacement of the cables as low as possible.



Length of neutral fiber

$L = \pi \times KR$

Length of relat. displacement

$\Delta L = \pi \times Y$

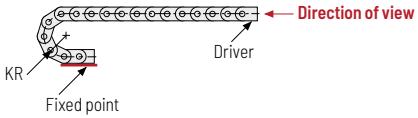
Due to the off-center placement, the cables move in the cable carrier by the value of the relative displacement. This can cause increased cable wear on the stays.

02 Placement guidelines for cables and hoses

Cable carriers are designed to protect moving energy lines and data lines which can be guided together in a variety of combinations. The following chapters list the guidelines which ensure configuration of the cable carrier system for maximum service life.

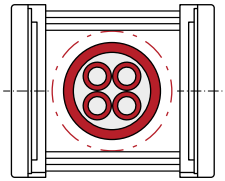
2.1 General guidelines

A "direction of view" is defined to allow a clear definition of the position of the cables in the cable carrier. For Kabelschlepp cable carriers, the view is always into the driver.



Only cables which are suitable for use in cable carriers should be used, e.g. TRAXLINE® cables.

Cables and hoses have to be able to move freely in the cable carrier. They must not be attached or tied together.



The following guide values apply for dimensioning the required clearance:

» **For round cables:**
10 % of the diameter*

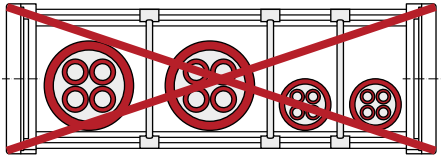
» **For flat cables:**
10 % of the cable width/thickness each

» **For hoses:**
20 % of the diameter for pressure hoses**
10 % - 20 % for unpressured/low-pressure hoses*

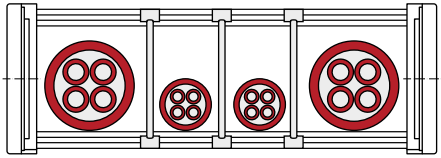
* For diameter d < 20 mm, min. space requirement: d + 2 mm
** For diameter d < 20 mm, min. space requirement: d + 4 mm

Weight distribution for installation

For the installation of cables and hoses, please ensure that the cable weight is symmetrically distributed across the width of the cable carrier. Even loading can help the cable carrier to achieve its maximum service life.



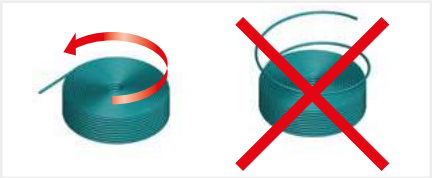
Poor weight distribution



Good weight distribution

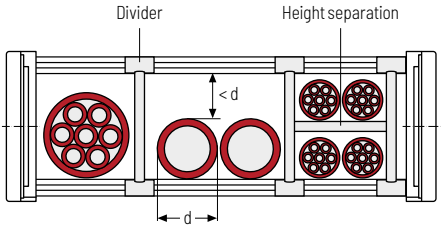
No cable loops

When cutting the cables for installation in the cable carrier, remove the cable from the coil tangentially and not in loops.



Do not twist cables

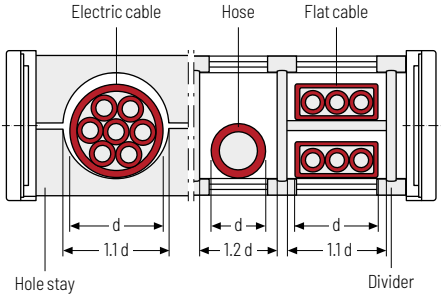
When cutting the cables for installation in the cable carrier, unwind the cable from the drum without twisting it.



Separating multiple cables

Adjacent cables with strongly differing diameters should be separated by dividers. Directly adjacent placement of cables with strongly differing diameters has to be avoided.

If this is unavoidable, ensure that the remaining clearance height is smaller than the smallest cable diameter. This is the only way to prevent the cables from becoming tangled.

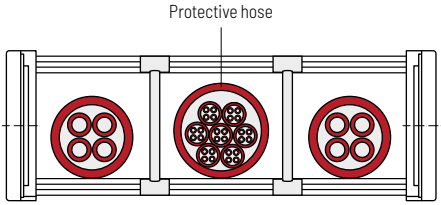


Multiple layers

When placing cables in multiple layers, we recommend installing a height separation between the individual layers for electric cables.

Individually manufactured hole stays or partitions through dividers prevent adjacent cables from rubbing against each other. In many cases, it is beneficial to place each cable in a separate chamber.

A height separation always has to be installed between multiple layers of flat cables.



Collating in protective hoses

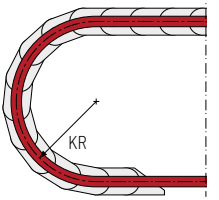
Thin hi-flex cables with low bending strength have to be loosely bundled and sorted in a protective hose. The cross section of the protective hose has to be significantly larger than the sum of the individual cable cross sections.

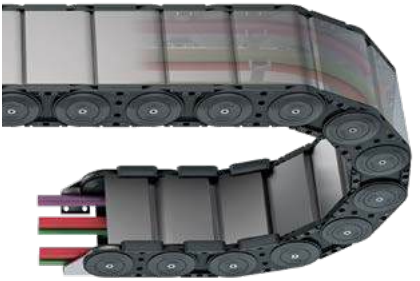
As a guideline for determining the cross section: each cable takes up approx. 10 % of its diameter as a clearance all around.

It always has to be ensured that the cables can run through the bending radius KR without any tensions or force.

They have to move freely lengthwise and must not exert any towing forces on the cable carrier in the bend.

For multiple layer, the cables have to be placed in such a way that they also have enough clearance between them in the cable carrier bend.



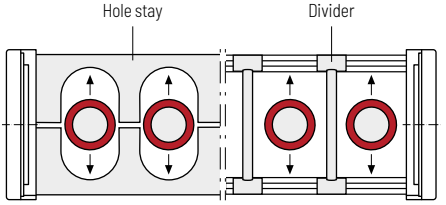


Installing cables and hoses in closed cable carriers

For large numbers of electric cables in covered cable carriers or in energy conduits, the current carrying capacity of the cables has to be configured according to the applicable standards, regulations and recommendations so that the maximum permissible temperatures for the corresponding cable materials and the cable carrier material are not exceeded.

For your configuration, please note that this is a closed system.

2.2 Placement of pressure hoses

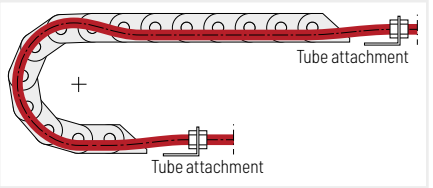


The following applies regardless of the partitioning type of the stay cross section:
Pressure hoses have to be able to move freely because they expand or contract during pressure changes!

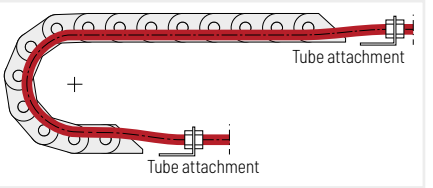
Expansion or contraction can be compensated in the bending radius area. The required clearance can be calculated depending on the proportional change (manufacturer's information).

If technically possible, we recommend placing each pressure hose in a separate chamber.

Pressure hoses are often attached to a tube directly before the driver and fixed point connection. Length differences, which result from the pressure change but also from manufacturing tolerances during installation of the hoses, can result in increased wear in the area of the bending radius.



Hose too long



Hose too short

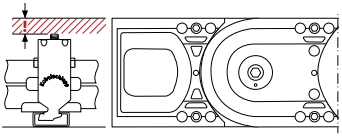
For your configuration, please take into account a suitable length compensation for the hoses so they can run through the bending radius without tensions or force. It is often sufficient to provide a loop before the fixed point to compensate for the hose length.

2.3 Strain relief

The strain relief for the cables depends on cable type, length of the cable carrier and installation variant. Generally, it has to be ensured that the retention force is applied on the largest possible area of the outer jacket so that the cables are not crushed while also preventing displacement of the cables.

» Within the **unsupported area** of the cable carrier, electric cables should preferably be equipped with a strain relief on the driver and on the fixed point. For short travel lengths and smaller cable diameters, we recommend the use of strain relief combs and cable ties for this application. LineFix clamps can also be used for larger cable carriers which use a C-rail.

» **Longer travel lengths**, which require gliding operation of the cable carrier, should also be equipped with strain relief on the driver and on the fixed point. Secure strain relief, e.g. with LineFix clamps, has to be provided especially at the driver connection where push and pull forces are present. When using the strain relief at the fixed point of a gliding cable carrier, it primarily has to be ensured that the installed height of the strain relief is significantly smaller than the chain link height h_G in order to prevent a collision. For slow travel speeds, it is often sufficient to provide fixation with a strain relief comb and cable ties on the fixed point of gliding cable carriers.



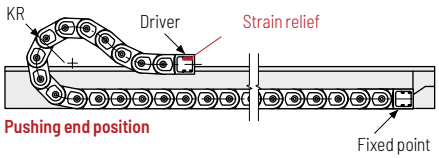
» For vertically operating cable carriers, the cables also have to be provided with a strain relief on the driver and on the fixed point. For hanging cable carriers with very long travel lengths and high cable weights, it can be practical to install a double strain relief arrangement on both sides.

» Pressure hoses which will not be bolted on in direct proximity to the driver or fixed point also have to be provided with a strain relief, in the same way as the cables. We recommend the robust block clamps for this case.

2.3.1 Strain relief for gliding cable carriers

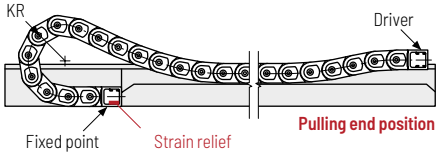
Strain relief on the driver cable carrier end

After moving the cable carrier driver (moving cable carrier end) to the **pushing end position**, the cables are provided with a strain relief at the moving cable carrier end.



Correct cable length in the cable carrier

After moving the cable carrier driver (moving cable carrier end) to the **pulling end position** of the cable carrier, the cables are checked for tension-free length in the bend and, if necessary, "fed further into the cable carrier".



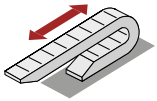
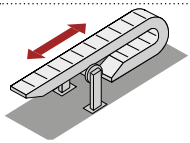
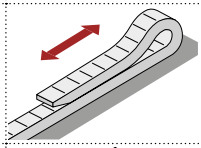
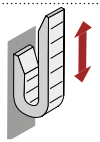
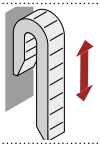
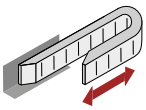
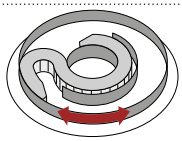
Strain relief on the fixed point cable carrier end

With this tension-free "inserted length", the cables are finally provided with a strain relief at the fixed point cable carrier end.

Test operation of the cable carrier: After an initial test run, check the tension-free cable routing and, if necessary, adjust the strain relief at the fixed point.

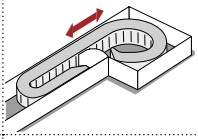
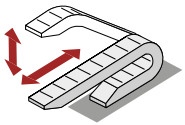
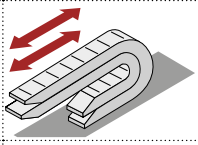
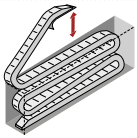
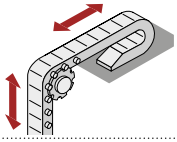
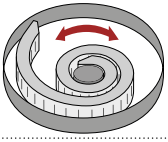
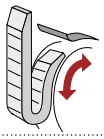
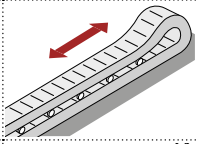
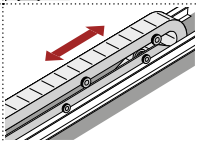
03 Installation variants

Overview of installation variants

Code	Symbol	Designation	Plastic cable carriers	Plastic tubes	Steel cable carriers	Steel tubes	Page
INV 1		Horizontal arrangement, unsupported	•	•	•	•	78
INV 2		Horizontal arrangement, with support	° / –	° / –	•	•	79
INV 3		Horizontal arrangement, gliding in guide channel	•	•	•	•	80
INV 4		Vertical arrangement, hanging	•	•	•	•	81
INV 5		Vertical arrangement, standing	•	•	•	•	82
INV 6		Horizontal arrangement, rotated 90° (straight)	•	•	°	°	83
INV 7		Horizontal arrangement, rotated 90° (circular)	°	–	°	–	85

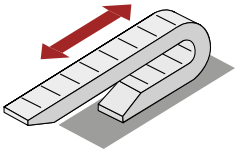
• Standard version
° Customized
– Not possible

Configuration guidelines | Installation variants

Code	Symbol	Designation	Plastic cable carriers	Plastic tubes	Steel cable carriers	Steel tubes	Page
INV 8		Horizontal arrangement, rotated 90° (rolled)	•	•	○	○	87
INV 9		Horizontal-vertical combined arrangement	•	•	•	•	87
INV 10		Unsupported arrangement, nested	•	•	•	•	87
INV 11		Zig-zag arrangement	○	○	○	○	88
INV 12		Vertical arrangement, hanging with support bolt	–	–	○	○ / –	88
INV 13		Horizontal arrangement, curled	•	•	○	○ / –	89
INV 14		Vertically rotating arrangement, hanging	○	–	○	–	89
INV 15		Roller chain	•	○	–	–	89
INV 16		Arrangement with continuous support structure	○	○	○	○	90

INV 1

Horizontal arrangement, unsupported



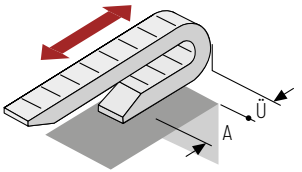
For unsupported arrangement, the driver connection of the cable carrier is attached to the movable system part and moves with it in the horizontal direction.

The upper run of the cable carrier is free, i.e. without support and without sag, parallel above the fully supported lower run.

The formulas and configuration information for this installation variant can be found in the chapter "Determining the cable carrier length L_k for simple linear travel" on page 67.

Special case

Horizontal arrangement, unsupported with overhang



The lower run of the cable carrier is not supported across the entire length. We are happy to calculate the required dimensions A + Ü for your individual application.

Please contact us for individual project planning for your specific application. We will be happy to help.

Rule of thumb

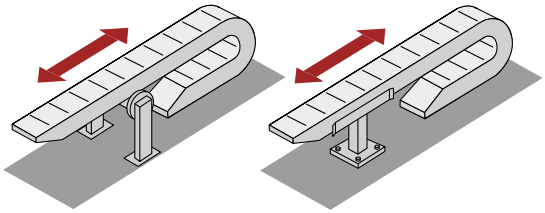
$\ddot{U}_{max} \leq \frac{L_f}{4}$

TSUBAKI KABELSCHLEPP technical support

If you have any questions about cable carriers or technical details please contact our technical support service at technik@kabelschlepp.de. We will be happy to help you.

INV 2

Horizontal arrangement with support



If the unsupported length of the cable carrier is exceeded, the upper run can be supported.

We recommend using the next larger type instead of a cable carrier with support(s), if the installation situation allows this.

Support for the upper run is generally possible for almost all cable carriers. The support stand used for plastic cable carriers always has to be equipped with start-up bevels. The upper run should be supported as far as possible.

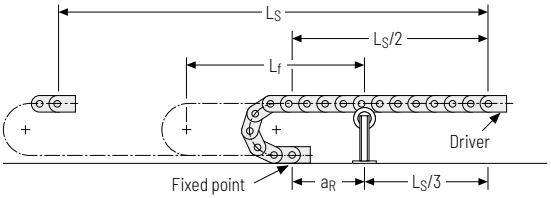
Arrangement of the support

Due to the flexible material and the potential sag, however, there are limitations on the use of supports for plastic cable carriers. The following section therefore examines the arrangement of the support for **steel cable carriers with support rollers**:

Arrangement with one support roller:

for $L_S < 3\,L_f$ $\quad a_R = \frac{L_S}{6}$

The distance of the support from the fixed point is approx. 1/6 of the travel length!

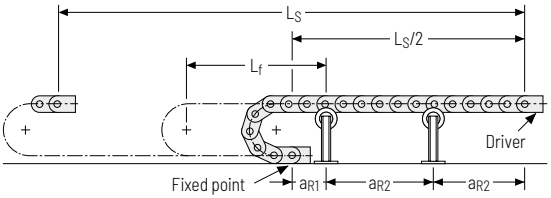


Arrangement with two support rollers:

for $L_S < 4\,L_f$ $\quad a_{R1} = 300$ mm

$a_{R2} = \frac{L_S}{4} - 150$ mm

First support 300 mm behind the fixed point, second support at the center of the remaining unsupported length!



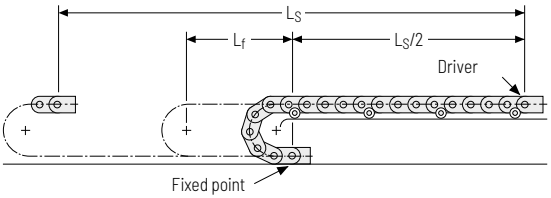
A travel speed of 1 m/s should not be exceeded. When using support rollers, the length Lf should only be 80 % of the value resulting from the load diagram, if possible.

Special version with lateral rollers:

for $L_S < 4\,L_f$

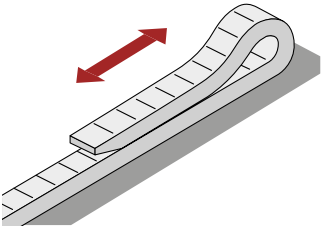
To utilize the maximum possible travel length in an unsupported arrangement with stationary support structure.

The lateral track rollers are mounted on the chain links. An even running surface has to be ensured, with a support tray provided if necessary.



INV 3

Horizontal arrangement, gliding in the guide channel



The upper run of the cable carrier **glides** on the lower run or on a gliding surface of the associated guide channel.

Application: For long travel lengths which cannot be implemented as unsupported arrangements.

Condition: The cable carrier must be guided in a channel, though!

Different cable carrier types provide the option of using glide shoes on the inner radius. These are manufactured from a special sliding and wear-resistant plastic. This allows the sliding friction factor to be reduced to a value of $\mu < 0.2$.

For steel cable carriers, the use of these elements is mandatory to prevent gliding of "steel on steel". The travel speed, however, should not exceed 1 m/s for gliding steel cable carriers. For steel cable carriers, the glide shoes are bolted onto the side band.

For plastic cable carriers, the glide shoes are simply clipped on the inner radius and can therefore easily be replaced if necessary.

To reduce wear and increase the service life, we recommend using the abrasion resistant glide shoes for gliding applications. For travel speeds > 2.5 m/s, however, glide shoes should always be used.

Arrangement of the cable carrier

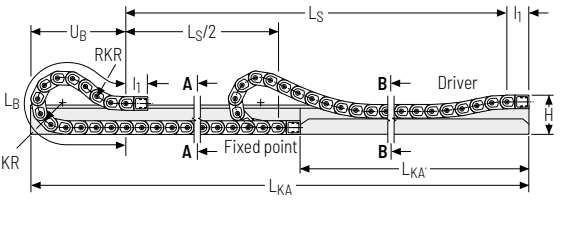
Single-sided arrangement with lowered driver connection and reverse bending radius (standard)

The cable carrier length is always calculated with the same formula as for the unsupported arrangement:

Cable carrier length L_k

$$L_k \approx \frac{L_S}{2} + L_B$$

Cable carrier length L_k rounded to pitch t



For the standard arrangement of the cable carrier, the driver connection is reduced for load reasons:

Connection height H

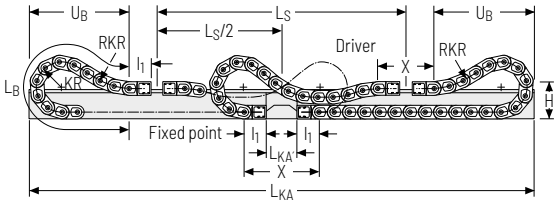
$H = 3\ h_G$

The length of carrier in bend L_B is increased by the lower driver connection and the resulting cable carrier extension. To keep this elevation of the length of carrier in bend as small as possible, chain links with reverse bending radius (RKR) are used on the driver connection as a standard. This results in a slight S-shape for the bend in the thrust end position.
The respective values for LB can be found in the respective individual chapters for the cable carriers.

For the configuration of this installation variant we recommend the simple way of determining the cable carrier length using our Configurator at online-engineer.de or requesting support from our support team.

Opposite arrangement with lowered driver connection and reverse bending radius

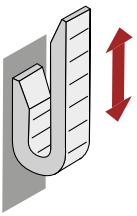
If the cable carrier is wider than the available space due to a very large number of cables, a second cable carrier can be used, running in the opposite direction. This almost halves the total width because the cables can be distributed among both cable carriers.



The cable carrier length is then determined in the same way as for single-sided arrangements. For only one moving consuming unit and a joint travel path, both cable carrier lengths have to be the same. As both cable carriers run in a guide channel, it must be ensured that they have the same outer width. More information and the details for dimensioning the guide channel can be found in chapter Support trays and guide channels on page 844.

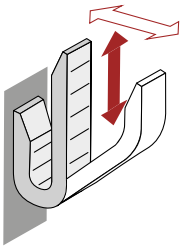
INV 4

Vertical arrangement, hanging



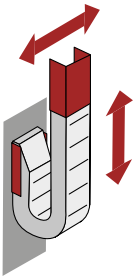
Direction of movement:
only vertical

For a purely vertical movement process, the cable carrier can be mounted without special lateral support.



Direction of movement:
vertical/horizontal combined

For a combined vertical/horizontal movement process, the cable carrier can be mounted without special lateral support.



Direction of movement:
only vertical

If the entire system moves at a right angle to and/or alongside the hanging cable carrier, an additional lateral guide has to be mounted.

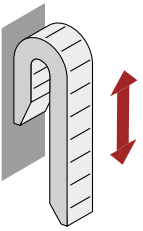
Please observe the guidelines for placement of cables in cable carriers from TSUBAKI KABELSCHLEPP, s. page 72.

It is practical to install the cable carrier **without or with only little pretension**.
As no direct load occurs in the hanging arrangement, pretension causes the cable carrier to bulge outwards from the pretension. In addition to the visual aspect, this significantly increases the installation dimensions.

The **cables have to be fixed** to the driver and fixed point in such a way that their weight and the resulting dynamic load are absorbed only be the strain relief. Determining the cable carrier length see page 67.

INV 5

Vertical arrangement, standing

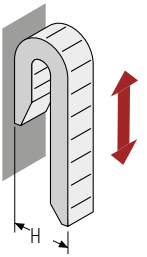


The cable carrier is mounted in such a way that parallel running of active run and passive run is ensured.

Determining the cable carrier length see page 67.

End connectors

The end connectors have to be mounted on the machine part (fixed point/driver) in such a way that the cable carrier cannot bend outwards, i.e. the connection must be **rigid**.



Connection height H

$H = 2\,KR + h_G$

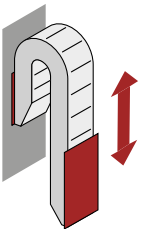
The distance between fixed point and driver connection corresponds to the selected bending radius.

Support

The cable carrier generally has to be supported on the outside at the fixed point and at the driver.

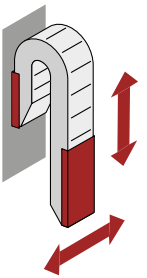
The length of the support has to be defined depending on the additional load, the fill level, the travel length and the selected cable carrier.

Depending on the version of the support, the cable carriers are very often used with a slight pretension. If a short cable carrier does not require any support and if there is sufficient installation space, the standard pretension can be used. Use without pretension may result in the cable carrier bending. This is therefore not advisable.



Direction of movement

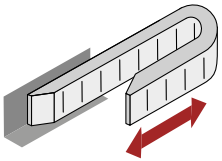
Often, the complete unit additionally moves at a right angle to the vertical standing cable carrier. In this case, the cable carrier additionally has to be guided laterally.



As a rule, only relatively short travel lengths can be implemented with the standing arrangement. If possible, the cable carrier should alternatively be used in a hanging arrangement. For this installation variant, the load on the overall system is significantly lower than with a standing arrangement.

INV 6

Horizontal arrangement, rotated 90° (straight)

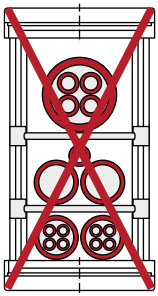


The cable carrier used in normal horizontal direction is rotated by 90°, i.e. it glides on its outside or on special slide discs on a tray or in a channel. This arrangement can be implemented with almost all cable carrier types.

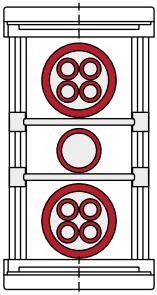
Application: Generally, cable carriers "rotated 90°" are used when the installation situation is primarily short on space with respect to height, preventing normal horizontal installation.

The installed cables have to be guided in the cross section of the cable carrier with **fixed separating elements** or in a **hole stay**, clearly separated from each other. This is the only way to prevent damage in the long run.

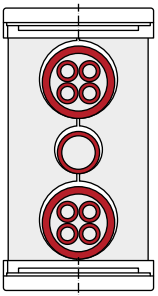
The technically best solution is the hole stay which provides the most secure guiding for the cables.



Frame stay with movable dividers



Frame stay with fixed dividers



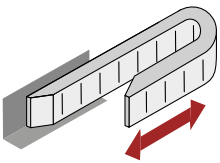
Best possible separation of cables in a hole stay

Systems for short travel lengths (with/without support)

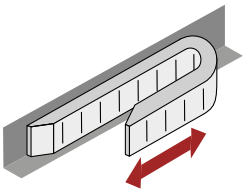
The cable carriers can be used **unsupported** in the horizontal arrangement "rotated 90°" to a limited extent. The permitted unsupported length depends on the following parameters for this installation variant as well:

- additional load q_z
- bending radius KR
- connection option
- travel length L_S
- cable carrier width B_k

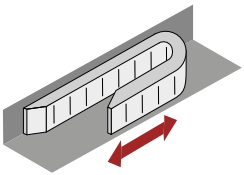
If the additional load and the unsupported length are too high, the cable carrier has to be supported on one side or overall.



System without support



System with single-sided support



System with overall support

System for long travel lengths (gliding in a guide channel)

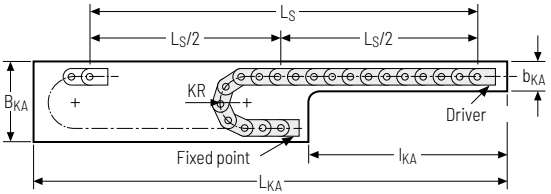
Plastic cable carriers can be used for travel lengths far over 100 m with the arrangement "rotated 90° – straight".

Over a period of more than 65 years, we have built multiple systems with the arrangement **"single-sided"** or **"opposite"** with or without special auxiliary fixtures.

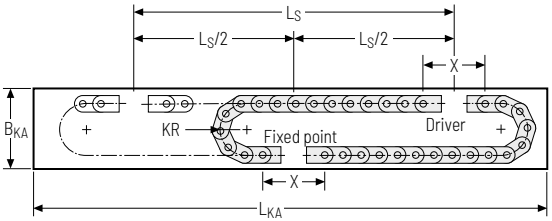
Single-sided arrangement
(with stepped guide channel)

b_{KA} = channel width of narrow section

l_{KA} = length of narrowed channel



Opposite arrangement

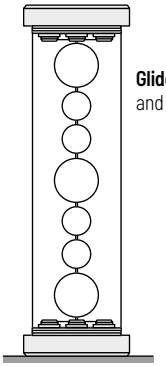


The cable carrier "rotated 90°" for long travel lengths **must** be guided in a channel. The material and texture of the channel base must be selected so they ensure low-wear travel with the lowest possible friction forces.

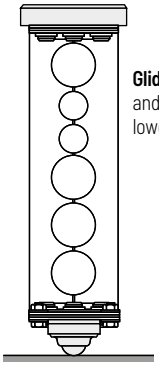
For long travel lengths, the cable carriers are used without pretension.

For **steel cable carriers**, corresponding gliding and guiding elements are mounted on the outside and/or inside of the side band, preventing grinding along the channel walls and ensuring smooth running of the system.

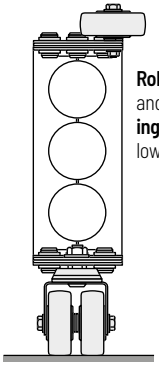
Support and guiding elements (combination examples):



Gliders on upper and lower side band



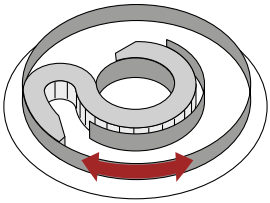
Gliders on the top and **domes** on the lower side band



Rollers on the top and **double steering rollers** on the lower side band

INV 7

Horizontal arrangement, rotated 90° (circular)



For this arrangement, the cable carrier rotated 90° is connected to machine parts which carry out a circular movement.

The combination of bending radius KR and reverse bending radius RKR causes the cable carrier to move in two circular directions in a targeted and defined manner.

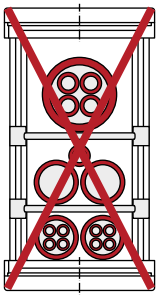
The cable carrier system is connected to the inner and outer rings of a guide channel. The rotating ring (inside or outside) is the driver connection.

Application: Generally, cable carriers in this arrangement always have to be guided in a channel. The driver can be positioned inside or outside.

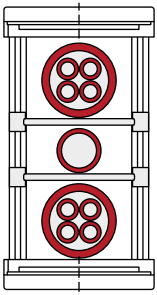
A special chain link design is required to allow the cable carrier to execute a circular movement.

The installed cables have to be guided in the cross section of the cable carrier with **fixed separating elements** or in a **hole stay**, clearly separated from each other. This is the only way to prevent damage in the long run.

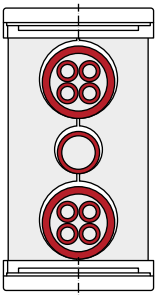
The technically best solution is the hole stay which provides the most secure guiding for the cables.



Frame stay with movable dividers



Frame stay with fixed dividers



Best possible separation of cables in a hole stay

Due to the strong relative displacement and the continuously changing radius ratios, cables should only be installed in one layer to ensure maximum service life.

For **steel cable carriers**, corresponding gliding and guiding elements are mounted on the outside and/or inside of the side band, preventing grinding along the channel walls and ensuring smooth running of the system see page 84).

TSUBAKI KABELSCHLEPP technical support

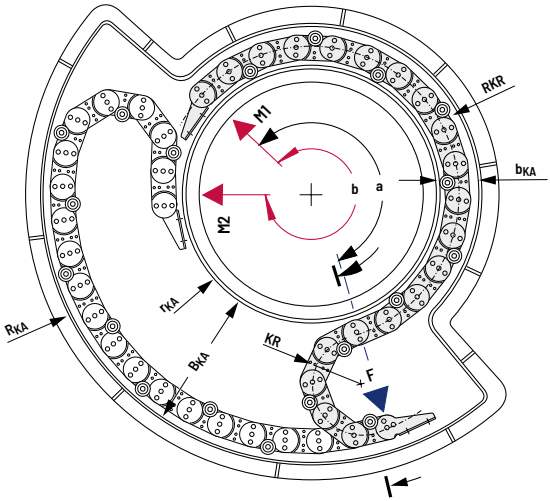
If you have any questions about cable carriers or technical details please contact our technical support service at technik@kabelschlepp.de. We will be happy to help you.

Configuration guidelines | Installation variants

Single-sided arrangement
with offset guide channel (schematic diagram)

The cable carrier system shown here has the driver on the inner radius. There are also frequent applications where the driver has to be positioned on the outer radius.

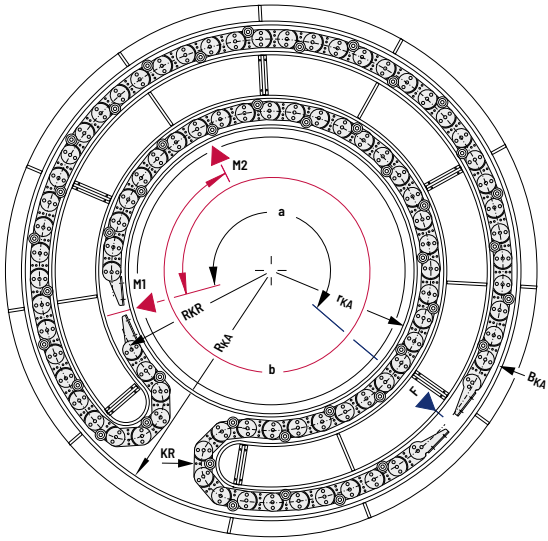
To ensure sufficient guiding of the cable carrier in this case, moving guide plates are required for larger angles of rotation. As this version is more complex, the "inside rotating circular arrangement" should be preferred.



Opposite arrangement
with guide carriage
(schematic diagram)

For opposite arrangements, a moving support fixture or a guide carriage has to be positioned in the channel due to the combination of KR and RKR.

Coupling of multiple circular systems is possible for angles of rotation over 500°.



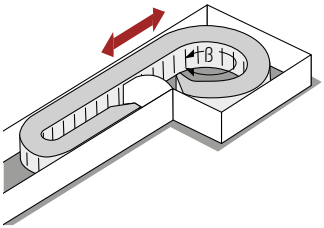
Abbreviated symbols:

a	= fixed point angle
b	= travel length
B_E	= width of cable carrier
b_{KA}	= channel width of narrow section
B_{KA}	= channel width
H_E	= height of cable carrier
H_{KA}	= height of the guide channel
r_{KA}	= channel radius - inside
R_{KA}	= channel radius - outside
F	= fixed point
M1	= driver end position 1
M2	= driver end position 2

Due to the variety of configuration options for this installation variant, we recommend contacting our technical support. We require the following parameters for preparing a solution:

- » inner diameter
- » outer diameter
- » travel length (angle of rotation)
- » single-sided or opposite arrangement?
- » driver on inner or outer radius? (inner radius preferred for single-sided arrangement)
- » restrictions for the installation space? (e.g. installation height)
- » cable list
- » environmental conditions (e.g. chips, dirt)

INV 8
Horizontal arrangement, rotated 90° (rolled)

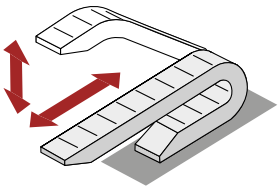


For this arrangement, the cable carrier rotated 90° is connected to a consuming unit which carries out a circular movement. The travel length "β" is indicated in degrees!

Application: The application is designed for circular movements which are wound on a rotating body. This type of cable carrier is preferred for smaller systems, usually with large movement angles.

A standard cable carrier is used. A reverse bending radius is not required. The winding of the carrier limits the angle of rotation to approx. β = 270°. For the implementation of larger angles of rotation, additional guide plates are required to prevent a collision on the driver. This application is practically a combination of installation variants 6 and 7. Accordingly, similar configuration criteria are used.

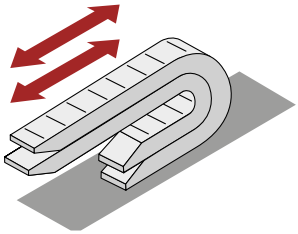
INV 9
Horizontal-vertical combined arrangement



Our cable carriers can also be used for combined horizontal/vertical movements.

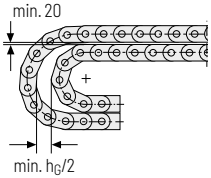
This arrangement requires no special technical preconditions, but calculation of the cable carrier length is more complex and should be carried out by our technical support.

INV 10
Unsupported arrangement, nested



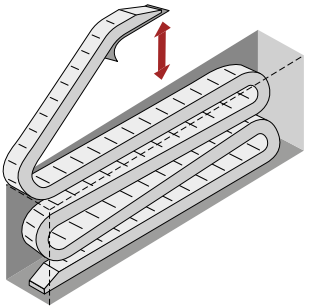
This arrangement is possible for all cable carriers. If the available space do not permit installation of a cable carrier due to the required width, the system can be configured in a **nested** arrangement.

For smooth running, it has to be ensured that both cable carriers can move freely. This means sufficient distance between the upper run (min. 20 mm, depending on cable carrier type) and the carrier bends (min. half of chain link height).



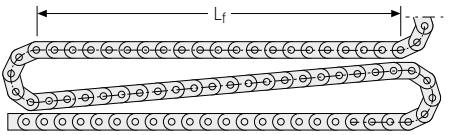
For long steel cable carriers there is an option for positioning guide plates at the side band of the outer carrier to ensure alignment of the inner carrier.

INV 11
Zig-zag arrangement



For some areas of application (e.g. stage and storage systems), it is often not possible to use a vertical hanging or standing cable carrier due to space restrictions. The so-called zig-zag arrangement is used in these cases.

As several bends fold on top of one another, the cable carrier has to be guided in all directions and therefore settles into a type of basket or sheet steel housing.

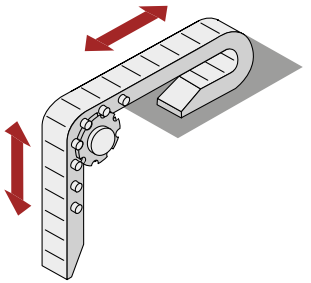


The following parameters are required for dimensioning the system:

- travel length
- travel speed
- cables installed
- minimum bending radius of guided cables
- maximum permitted height
- maximum permitted basket dimensions (length, width)

When dimensioning the basket length, ensure that the unsupported length L_f of the selected cable carrier is not exceeded. Depending on the length and weight of the cable carrier, supporting the bend on the driver with a bent plate is a measure which has a positive effect on the service life.

INV 12
Vertical arrangement, hanging with support bolt

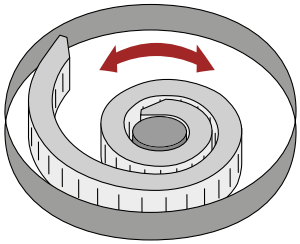


The vertical arrangement of the cable carrier with additional support elements offers the option of using the cable carrier as a lifting element for the attached system parts (e.g. operating panels, manipulators).

The cable carrier is driven via chain wheels. The pitch circle diameter has to be equal to or greater than the selected bending radius of the cable carrier. The drive is motorized or via a counterweight.

Due to the great number of configuration aspects, we would ask you to contact our technical support.

INV 13
Horizontal arrangement, curled

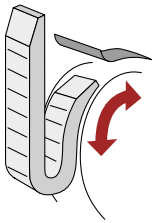


In some cases, a large angle of rotation cannot be implemented with one of the usual applications for circular movements. In these cases, an examination with regard to the options for curling up the cable carrier is recommended.

A standard cable carrier can be used, but a relatively large installation space is required for curling up the configuration.

The rotation in this application is limited by a maximum double wrapping of the inner diameter. Multiple wrappings cause the cable carrier to jam.

INV 14
Vertically rotating arrangement, hanging

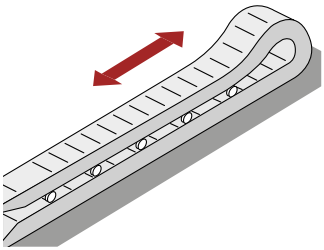


This installation variant is often used for swiveled drums and turning devices.

The part rotating around the diameter requires chain links with KR and RKR in this area.

If the angle of rotation is over 180° (depending on the arrangement), an additional guide plate is required on the outer radius to prevent the cable carrier from tipping over.

INV 15
Roller chain



Roller chains are primarily used where very long travel lengths lead to very high push and pull forces and gliding cable carriers reach their limits. The most effective installation variant is the RSC (rail supported carrier) system. This is a cable carrier where the design in combination with an optimized guide channel ensures 100 % roller operation over the entire travel length. This results in minimum mechanical load and a low noise level.

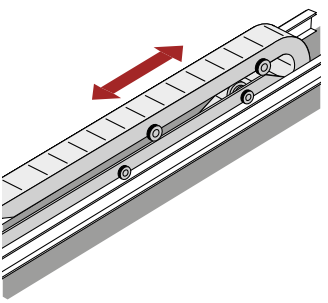
This makes the system suitable not only for extremely long travel lengths, but also for travel speeds over 5 m/s.

Despite the roller design, the RSC system can be fully wound on a reel and is therefore ideal for complete solutions with inserted cables for long travel lengths.

Dimensioning is similarly easy as for a gliding cable carrier. For effective and fast implementation, especially for large projects, we can offer our expert help.

INV 16

Arrangement with continuous support structure



While this installation variant is also possible for plastic cable carriers, it is primarily used for steel cable carriers.

If the technical conditions no longer permit the use of a gliding cable carrier or a cable carrier with support rollers with regard to travel length, acceleration or speed, a so-called cable carrier unit with a continuous moving support structure can be used.

Cable carrier units are particularly suitable for use with large travel lengths and high travel speeds under rough operating conditions and heavy loads. There is a variety of different versions of this installation variant. As an example, we present the most used type 225 here.

Due to the complexity, this type of cable carrier system should be dimensioned in cooperation with our engineers.

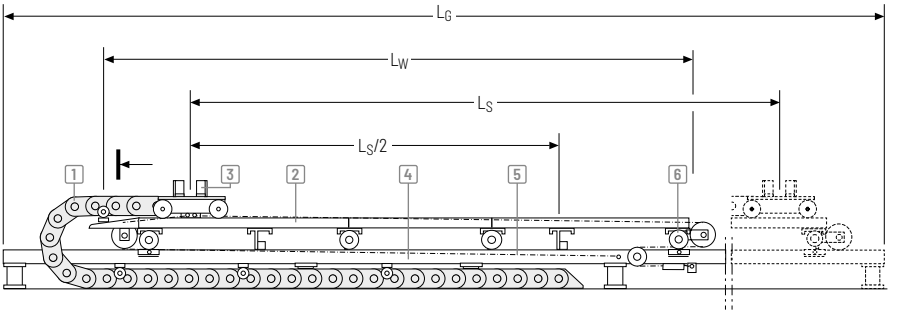
Cable carrier installation type 225

The cable carrier installation is either configured as a single-sided system with one cable carrier installation or as an opposite arrangement with two cable carriers.

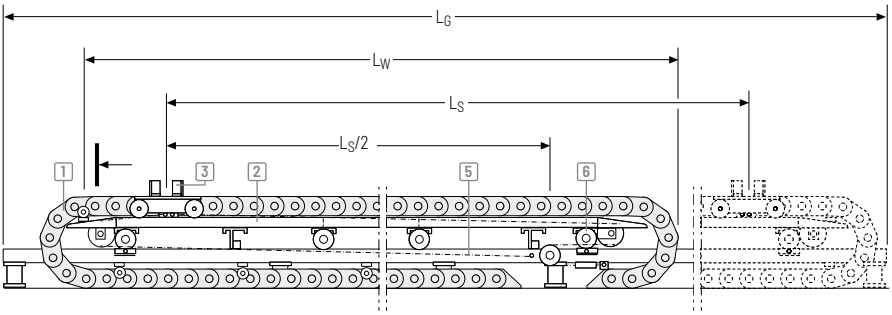
A carriage guided on rollers in a running frame supports the cable carriers along their entire length. The support structure is moved in both directions with a cable pull system which is attached to the rolling carriage system. Due to the roller support and roller guiding of the cable carriers on the support carriage and of the support carriage on the running frame, only minimal friction forces are generated in the system. Systems with the following limit values have been supplied so far:

- » longest travel length: $L_{S\,max.}$ = 222 m
- » highest travel speed: v_{max} = 4 m/s
- » greatest travel acceleration: a_{max} = 8 m/s²

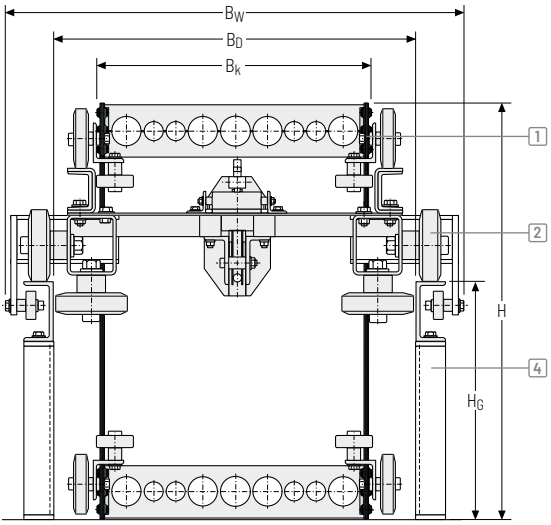
Single-sided arrangement
(schematic diagram)



Opposite arrangement
(schematic diagram)



Cross section of the cable carrier installation



Abbreviated symbols:

B_D = clear width in the running frame
B_G = running frame width
B_k = cable carrier width
B_W = support carriage width (max. width)
H = installation height of the cable carrier(s)
H_G = running frame height
L_G = running frame length
L_S = travel length
L_W = support carriage length

The cable carrier installation type 225 consists of the following assemblies:

1. **Cable carrier(s)** with laterally attached track rollers and guide rollers
2. **Support carriage** with track rollers and guide rollers supporting across the entire length
3. **Rolling carriage system** with track rollers and guide rollers
4. **Running frame**
5. **Steel cable**
6. **Cable tensioning roller**
7. **Tensioning device**