Selection, assembly and installation guide for e-chain® systems from igus®

www.igus.eu/designing
Foreword

With this manual for the-chain igus® has designed a guide for the selection, assembly and installation of energy supply systems.

It is intended to provide all the necessary basic information to allow the quick and easy use of our products.

All of our experience has gone into the preparation of this manual as well as the online configurator for the-chain. The details about our products are accompanied by clear images.

We hope that, by providing this manual for the-chain, we give you a clear guide for your application.

We are, of course, always grateful for comments and suggestions for improvements, which can be included in the next edition.

Legend

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<tr>
<td>HRi</td>
<td>Trough inner height</td>
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<td>K</td>
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FLn = S/2 + K2       |    HRI ≥ 2 x ha    |    BRI ≥ Ba + 4
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- **5.1 Torque settings**
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More information, 3D CAD files, prices and delivery times ➤ www.igus.eu/designing
Visual inspection of cables and hoses

**correct**

![Correct Image]

igus® chainflex®-cables can have strain relief fixed directly to the mounting bracket.

**wrong**

- too loose
- too tight

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**Layout rules**

The layout rules ensure sufficient space around the cables and hoses.

![Layout Diagram]

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Laying guidelines for media carriers | General rules

General rules for cables and hoses in e-chains®

The great advantage of igus® e-chains® is that you can safely guide different types electrical cables and hoses together in one system. Also, you can separate and subdivide the various media in anyway you want. Besides the quality of the cables used, the arrangement of cables within the e-chain® play a crucial role in the service life of the system. With many separation options, it is easy to customise the e-chains® to the specific requirements of each application.

In this section we offer detailed advice and tips in this area.
We are happy to support you with our free project planning service, just ask us.

Round electrical cables

For electrical cables, the round cable is a safe, simple and cost-effective solution for e-chainsystems®. When purchasing, we recommend that you pay attention to the following criteria:

- Minimum bend radii and mounting heights
- Service life at minimum bend radius
- Service life required for your application
- Possibility for strain relief of cables on the mounting bracket
- Bend-resistant shielding for shielded cables
- Abrasion-resistant outer jackets
- For bus cables and fibre optic cables, how well the transmission rates and the shielding effects are preserved after millions of cycles at the minimum bend radius.

Round cables are the best option; flat cables are only conditionally suitable for e-chains® due to their shape and construction.

igus® GmbH has a wide range of cables which are optimally matched to the material of the e-chains® offering very low wear. igus® chainflex® cables in combination with e-chains® also offer a tested and proven long service life, even for millions of strokes! For information on our chainflex® product range, please see our current chainflex® cable catalogue or visit our website (www.igus.eu/cf)

Laying guidelines for media carriers

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<th>General rules</th>
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Flat cables

Flat cables must be able to move freely at the bend radius. Two flat cables next to each other should be partitioned by separators. If two flat cables should be laid one above the other, we strongly recommend the use of igus® horizontal interior separation options. Flat and round cables should be routed separately in the e-chain®. Strain relief should be used at both ends. Flat cables are only considered conditionally suitable for use in e-chains®, because of their shape and the outer material (usually rubber) meaning higher abrasion in e-chains®. The use of round cables improves the service life of the application.

Hydraulic hoses

When planning you should pay attention to the linear or lateral growth of the hoses when pressure is applied. It is necessary to provide enough space (20% clearance all around). When selecting hoses, make sure that they are sufficiently flexible so that they can be bent to a predetermined radius. Also important is a low friction, abrasion-resistant surface. Usually hoses with textile braiding are more flexible than those with steel wire. Since transverse movements of the hydraulic hoses in the e-chain® can lead to increased abrasion of the hose material, they should be fixed in place with vertical separators. Special locking separators that grip the crossbars of the chain very firmly, ensure that the hoses retain their fixed place in the e-chain® even under severe vibration and movement. In most cases hydraulic hoses exhibit a linear extension in use. This must be taken into account when strain relieving by providing more hose length or a floating strain relief. Generally, a strain relief only on the moving end is recommended.

Pneumatics

In principle, the same rules for round cables apply to pneumatic hoses. Practical experience, however, shows that pneumatic hoses are less prone to faults. Generally, they can also be laid together more closely than using the the “10% clearance” rule. Strain relief at both ends is recommended. In pneumatic hoses made from rubber, we recommend sticking closely to the “10% clearance” rule, because they can stick together or to other cables.
This must not happen!

For igus® e-chainsystems®, corkscrewing cables are a thing of the past...

The maximum cable diameter corresponds to the clearance height (hi) of the selected e-chain® or e-tube minus a clearance. This is, for example, 10% for round electrical cables. An e-chain® is ideally filled, when a minimum lateral distance is allowed to the next cable or wall. The minimum distance is always 1 mm! More clearance needs to be provided according to the nature of the cables, the dynamics and the service life. In exceptional cases, the filling can be laid out more closely. You may talk to us about this.

**Laying guidelines | Clearance height - maximum cable diameter**

**Clearance space**
- Round electrical cables: 10%
- Flat electrical cables: 10%
- Pneumatic: 5-10% (rubber: 10%)
- Hydraulic: 20%
- Media hoses: 15-20%

**Laying guidelines | Cable weight - inner distribution**

Consideration of weight distribution is strongly recommended. Otherwise, one side of the chain wears out more leading to more clearance between pin and bore, and ultimately to a reduction of the service life of the application. The cable weight should be distributed symmetrically along the width of the e-chain®, with the heaviest cables laying on the outside. This ensures that the outer links which bear the fill weight are not over stressed. Generally speaking, the faster and the more often the e-chains® move, the more important is the layout of the cables in the e-chain®. Because of the large number of options, we are happy to support you with your specific application.

Optimum weight distribution in an e-chain®
Laying guidelines for media carriers | Filling rules

- The cables must be routed in such a way that each individual cable can move freely in the longitudinal direction.
- The cables must be able to move freely at the bend radius. This must be checked when the upper run is at either extent.

The division of the interior by separators is necessary when multiple cables with different diameters are fitted. It is important that the cables do not tangle. For cables with different outer jacket materials, it must be ensured that they do not stick together, and ideally separated.

- Strain relief should be used at both ends of round electrical cables.
- In exceptional cases (for example, in circular motion) the cables must be attached with strain relief just at the moving end of the e-chain®.
- A distance of no more than 10-30 times the cable diameter between the end of the bending motion and fixing is recommended for most cables. For igus® chainflex® cables, however, the strain relief may be directly integrated to the mounting bracket, which have been proven to be very effective.

Filling of side mounted applications

<table>
<thead>
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- Maximum of 2 cables next to each other
- Use locking separators (E4 family) or spacers (E2 family),
- so as not to pinch the cables (see interior separation)

Interior separation

Cables with very different diameters should always be routed separately using vertical separators. The cables must never have the opportunity to slide over each other. The igus® interior separation ensures low abrasion by having large, smooth areas. The clearance height of a compartment with several equally thick cables next to each other should never be more than the cable diameter plus 50%.
Rules

A separator is required when the sum of the diameters (D) of the cables laid side by side falls below 1.2 x the chain inner height (hi) or the chamber formed by horizontal shelves.

Formula: \( D_1 + D_2 < 1.2 \times h_i \)

Example:

If the inner width of the energy chain® is not sufficient to separate the cables from each other according to the rules above, it is also possible to run two cables with similar diameter stacked one above the other. It is important that the two cables are prevented from wrapping around each other by using separators.

A horizontal sub-division using shelves is required when the diameter of the cables vary too much or when the number of cycles of the application exceeds 10,000 double strokes per year and speed is higher than 0.5 m/s.

Formula:

\( D_1 \leq 0.5 \times d_4 \)

\( v > 0.5 \text{ m/s} \) & \( \text{cycles} > 10,000/\text{year} \)

Example:

Filling of side mounted applications

igus® e-chains® are offered as standard with internal separation fitted every other link. This means that an interior separation only appears every second chain link. Upon request, or if a very demanding application is required, the e-chain® can also be supplied with an interior separation fitted every chain link.

e-chains® with interior separation fitted every other link provide the same stability as e-chains® with interior separation in every link, but are cheaper. A second advantage is lower weight, which in turn requires less power for the movement. Thirdly time savings during assembly and from the easier access to the interior separation and cables are an additional advantage.

An application can be particularly challenging if a number of very large or heavy services have to be laid in the chain (e.g. hydraulic hoses). Some other cables or hoses could get crushed, if they are under pressure from an adjacent hydraulic hose in an e-chain®. In applications with high speed, acceleration and cycles combined with high fill weights are also challenging. In such cases interior separation is recommended to be fitted every link.

Bend radius

The bend radius of your e-chain® is always determined by the largest or stiffest cable or hose to be fitted. The bend radii of e-chains® should be chosen to reflect the recommendations of the cable manufacturer. The choice of a bend radius larger than the minimum will have a positive effect on the expected service life. The minimum bending radii specified for cables refers to the use at normal ambient temperatures. Other bending radii may also be prescribed.

Correct unreeling

Cables must be laid straight, without any twisting. Cables must not be uncoiled from the top of the drum. igus® chainflex® cables are ready for fitting immediately, and don’t need to be suspended or laid out before the assembly. This may not be the case for other cable manufacturers.
# Content | Strain relief

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3. **Assembly options | Tiewrap plates**
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**Strain relief | Definition**

**Definition**

The strain relief is a mechanical device to protect flexible electrical cables.

**Application**

By using strain relief, the connection between a flexible cable and the end of the e-chain® is protected against mechanical stress. To achieve this, cables are fixed using clamps. The cable is clamped so that the length of the cable within the e-chain® remains constant, the cable also cannot be pulled in or out.

Strain relief can be custom made or consist of standard parts. For most applications, our standard range of C profiles in the mounting bracket and slim “chainfix” clamp can be used, or a simple strain relief using tie wrap plates and cable ties. Cables should be ideally fixed with strain relief at both ends of the e-chain®.

**Strain relief | Assembly options**

**chainfix-clamp solutions**

In order to use chainfix clamps, a “C” profile is required which is integrated into our KMA mounting brackets. If another “C” rail is used, pay attention to the dimensions required: an 11mm opening is needed for the foot and the retaining elements of the clamp. The maximum rail width of 35mm is also determined by the clamp. The height of the C rail can be 12mm or more.

Chainfix clamps have more than 3 times the tensile strength of standard clamps. This is due both to the material and the design. Ribs ensure that the cable is secured to prevent slipping.

We use chainfix CFXL with a larger foot for the 92.52 profile rail for very demanding applications, because the larger foot is stronger. Typical applications include crane installations. The rule is a slot width of 17mm and a maximum rail width of 35mm.
Strain relief | Assembly options

Special criteria

- Optimal igus® chainfix clamp with reduced height
- High tensile strength
- Long service life for dynamic applications
- Space- and time-saving assembly
- Polyamide compression elements means the rigidity, hardness and toughness are higher than those of polypropylene, with significantly increased reliability.
- Long service life for dynamic applications due to optimised saddles and clamps, captive within the housing.
- Can be fitted directly into the KMA mounting bracket
- Simple assembly with hex head set screw
- Good readability of part number and marking of the correct fitting direction
- Additional mounting options with universal double and mating troughs
- Optional CFXL clamps with increased holding power for heavy-duty applications (CFXL clamps are always installed ahead of the e-chain® and CANNOT be integrated in KMA mounting brackets with “C” rail)

Fitting

The cables should ideally be fixed at both ends of the e-chain®. The minimum should be to be fixed to the moving end of the e-chain®. When the e-chain® glides on itself on long travels, the screw heads of the strain relief must have a minimum clearance of 10mm to the upper edge of the e-chain® at the fixed end. As a consequence of this, many strain relief elements described here may not be suitable for use at the fixed end on long gliding e-chains®.

When fitting the chainfix clamp, just clip it into the C profile and screw it down; that’s it!

Strain relief | Installation options

Tiewrap plates

- The tiewrap plate is integrated on the end of the mounting bracket, and cables and hoses can be fixed using cable ties. When the mounting bracket is screwed down, the tiewrap plate is secure.
- Quick and easy to use
- Longer service life for cables
- Space-saving design
- Mounting within the “C” profile on the KMA mounting brackets is also possible

Detachable tiewrap plates for the “C” profile

- Space-saving design
- Direct mounting within the “C” profile of the KMA mounting brackets is possible

Fitting

The detachable tiewrap plate can be clipped directly into the C profile without screws or other parts. The tiewrap plates can be loosened and moved, just using a screwdriver as a lever. Tiewrap plates can be used as separate parts to a mounting bracket using a countersunk screw.

For both options you need to use cable ties for strain relief. These are simultaneously tightened around the teeth of the tiewrap plate and around the cable to be secured.
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Unsupported application | Definition

Unsupported application:
An “unsupported application” is when the upper run of the e-chain® does not touch the lower run over the entire travel length.

Unsupported length:
The unsupported length is the unsupported distance between the moving end and the start of the radius arc of the e-chain®. This varies according to the chain series and the fill weight.

 Unsupported application:
The unsupported application is the most common of all operating modes. igus® e-chains® are designed for high dynamics and long service-lives in this mode.

Special criteria:
The unsupported application is only used for relatively short travel distances - the maximum unsupported length for each e-chain® series can be found in the e-chain® catalogue. Igus e-chain® are made with pretension to guarantee the longest unsupported length. If you are designing an application and the unsupported length is not enough, please contact us for a custom solution.

Unsupported applications | e-chain® application properties

Installation options:
➤ Unsupported with straight upper run (FLG)
➤ Unsupported with permitted sag (FLB)
➤ Unsupported with critical sag

01 FLG ➤ Pretension or straight upper run (max. ½ chain link height sagging) ➤ This design is ideal!
02 FLB ➤ The sag is less than the minimum bend radius of the selected e-chain®. ➤ This limits the speed and acceleration
03 Critical sag ➤ Not recommended
The service life and the speed and acceleration are significantly reduced.
Unsupported applications | Application properties of the e-chain®

Unsupported length straight (FLG):

![Diagram of unsupported length straight (FLG)]

Max sag: \( \frac{1}{2} \) chain link height

Unsupported length (FLB):

![Diagram of unsupported length with sag (FLB)]

Max sag: Minimum bending radius of the used e-chain®

Critical sag:

If the sag is greater than the allowable \( FL_B \), this is “critical sag”. An application with critical sag must be avoided.

Sag: Sag ➔ minimum bending radius of the used e-chain®.

Unsupported length straight (FLG):

The e-chain® is in the FLG area, if its upper run either has pretension, is straight or reaches the maximum allowable sag.

The unsupported length straight (FLG) is always the first choice, as it offers the greatest security and the longest service life.

The minimum expected service life is 10 million cycles.

Unsupported length with sag (FLB):

An application with sag (FLB) e.g. with longer travel distances or higher weights is possible but is always dependent on the acceleration.

If the velocity and acceleration are low, FLB can be a good solution.

The best expected service life is between 5 to 7 million cycles.

Critical sag:

Critical sag must be completely avoided! There are applications (FLB), that reach critical sag after a very long period of use. The e-chain® should then be replaced.

In that situation, please contact us.

(1 cycle = 1 double stroke = 2 movements)

All data on the load rating of the individual chain series can be found in our catalogue in the first chapter: “Designing with igus®.”
Unsupported applications | Supporting surfaces

Unsupported e-chains® require a support surface on which the lower run can roll. This surface can be made from many different materials: metals, plastics, stone, wood, glass, etc. If you want to minimise the rolling noise on the surface, we have special solutions - just call us!

In dirty environments it is important that the dirt cannot accumulate in the path of the e-chain®.

At least three chain links and the mounting bracket at the fixed end of the e-chain® must be supported.

Unsupported applications | Mounting

Mounting brackets

Mounting brackets are separate parts which are attached to both ends of the e-chain®.

We recommend pivoting mounting brackets as standard for unsupported applications. They compensate for the pretension and relieve the first chain link in operation.

Exception: if the acceleration is greater than 20m/s² and the installation height is limited, locking mounting brackets keep the e-chain® below the clearance height (HF).

Installation height

e-chain®:
The pretension must be taken into account when calculating the installation space required for an e-chain®. This depends on chain series, and the value is given for any chain with any radius in our catalogue.

Moving end mounting bracket:
The installation height of the moving end is the nominal installation height (H) and corresponds to double the chain radius, with the upper run and the lower run parallel to each other.

T = pitch  ha = Outer height  X = Camber clearance
HF = Clear installation height  H = Nominal installation height

More information, 3D CAD files, prices and delivery times ► www.igus.eu/designing
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   1.2 Application
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4. Rotating moving end links

5. Support plate
Gliding applications | Long travel

Definition

A “gliding” application is when the upper run of the e-chain® runs on the lower run.

Application

If the unsupported length is not sufficient, the gliding application is the best alternative for long travels.

Technical specifications

Velocity: \( v_{\text{max}} \) 10 m/s
Acceleration: \( a_{\text{max}} \) application-related, can be 50 m/s +
Travel distance max.: 600-800 m
Fill weight max.: application-related, can be 70 kg/m +

Special criteria

The gliding application is common for long travels, but the maximum speed and acceleration are reduced. For a reliable gliding application, the moving end of the e-chain® must be lowered and the first chain links rotated. In general, the moving end of the e-chain® is set at an angle of 3-5°. If the e-chain® is used in a gliding application, then it should run in a guide trough, so that the upper run glides squarely on the lower run without any offset.

If you are planning a gliding application, please get in touch with us for assistance with project planning.

Unsupported applications | Application properties of the e-chain®

Note:
The e-chain® must be able to move freely over the entire travel distance. Any objects that could interfere with the free running of the system should be removed.

Installation

To achieve the shortest chain length, the fixed end is placed at the middle of the travel. The upper run glides on the lower run for part of the travel and on glide bars set at the same height for the rest of the travel. A guide trough is required for lateral guiding. If more than one e-chain® is required side by side in a gliding application must always be installed in separate guide troughs.
Travel speeds and accelerations in a gliding application:

Travel speeds of up to 5m/s are possible in continuous operation. Even higher speeds are possible in special cases. In crash test facilities, for example, E4 system e-chains® reach speeds of 22 m/s and accelerations of 784 m/s². In these cases, however, only a few thousand cycles are required per year.

Acceleration plays a crucial role in the life calculation. Sudden varying accelerations impact differently form normal continuous steady acceleration. In all cases the correct specification is important - just ask us to advise on any application.

Service life calculator:

Extensive tests enable us to understand the behaviour of our products. Typical tests carried out are: tensile and shear forces under temperature, humidity and dirt, friction coefficients of plastics in conjunction with various materials, behaviour of electric cables under tension/compression, behaviour of hydraulic and fluidic hoses under tension/compression.

We can calculate the the service life for you, and you can also use our service life calculator online: www.igus.eu/ECS-lifetime

Is the maximum fill weight indentical for all bend radii? – No!

The following applies: The larger the bending radius the smaller is the additional load!

Why?

A larger bending radius means a longer unsupported length causing a higher bending moment on the e-chain®.

Is the maximum fill weight dependent on the speed? - No!

The higher the speed the lower the allowable fill weight!*  

<table>
<thead>
<tr>
<th>Speed [m/s]</th>
<th>Fill weight [%] max</th>
<th>Example: E4.32.Bi.150.0 [kg/m]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 m/s</td>
<td>100 %</td>
<td>(5 kg/m)</td>
</tr>
<tr>
<td>2 m/s</td>
<td>50 %</td>
<td>(2.5 kg/m)</td>
</tr>
<tr>
<td>3 m/s</td>
<td>33 %</td>
<td>(1.65 kg/m)</td>
</tr>
<tr>
<td>4 m/s</td>
<td>25 %</td>
<td>(1.25 kg/m)</td>
</tr>
</tbody>
</table>

*For optimum use! If the this is exceeded, the wear increases disproportionately!

Ensuring stability of the e-chain®

To ensure stability of the e-chain®, the following rule of thumb applies when selecting the minimum width to bending ratio:

Stability formula: \( \frac{\text{Bending radius}}{\text{Inner width}} < 4 \)

If the ratio is > 4, the height of the guide trough must be increased.

<table>
<thead>
<tr>
<th>Bending radius R (mm)</th>
<th>63</th>
<th>75</th>
<th>100</th>
<th>125</th>
<th>150</th>
<th>175</th>
<th>200</th>
<th>220</th>
<th>250</th>
<th>300</th>
<th>350</th>
<th>400</th>
<th>500</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum inner width (( \text{Bi} )) of the e-chain® is not less than:... in [mm]</td>
<td>16</td>
<td>19</td>
<td>25</td>
<td>32</td>
<td>38</td>
<td>44</td>
<td>50</td>
<td>55</td>
<td>63</td>
<td>75</td>
<td>88</td>
<td>100</td>
<td>125</td>
</tr>
</tbody>
</table>
Gliding applications | Mounting

Mounting brackets
Are attached to each end of the e-chain®, They are separate components, and are absolutely required for correct installation. Pivoting mounting brackets are required for gliding applications, as it is necessary in every gliding application to lower the moving end height and to angle the mounting bracket. In this way the e-chain® is prevented from moving upwards in a gliding application.

Installation height

Chain
Since the pretension is not taken into account in a gliding application, an installation height of double the chain radius only is required.

Moving end mounting bracket
For the moving end, the height H2 is dependant on the chain series, and can be found in our catalogue or datasheets.

Gliding applications | Lowered Mounting Height

Lowered Mounting Height
A lowered mounting height is absolutely necessary for every gliding application:

➢ To prevent chain breakage through critical sag.
➢ To reduce wear (if the moving end is not lowered, there is more abrasion)

Example: If we move the e-chain® from right to left till the gap between upper run and the lower run is 1mm, the chain would be at its maximum unsupported length. The application is in critical sag, which must be avoided.

If the installation height is left at the height of the e-chain® radius, the maximum allowable fill weight and push/pull force (F_{ppf}) decrease drastically. This is improved if the mounting height is lowered or if a larger stringer e-chain® is used.
Gliding applications | Mounting angle

Pivoting

Why is an angled moving end bracket beneficial?
- With a mounting angle between 3-5°, the e-chain® is slightly forced downward by the push/pull force. This prevents the rising up of the e-chain®.
- This angle is also ideal for reducing wear.

To lower the mounting height and save space, we rotate the first chain links, so that the moving end forms a shallow “S” shape.
- This reduces the built-in pretension improving the behaviour of the e-chain® in gliding mode.
- By rotating the chain links we support the downward force helping to prevent the e-chain® from rising up.
- Without the rotation of these links, we would need more space, to allow the upper run to rest on the lower run resulting in a longer unsupported length. This would mean less fill weight and acceleration would be possible.

Support plate:
A support plate is needed if the calculated push/pull force is greater than 50% of the max. push/pull force specified for a given e-chain® series.

Rule: Support plate needed if \( \frac{F_{PPF}}{P_{PPF}} >= \frac{F_{max,PPF}}{2} \)

Support plates are there to prevent forces produced at the stop-dogs of the rotated chain links, i.e. it protects the first chain links against over-stressing.

Without support plate

Critical force at the stop dog

With support plate

PPF = Push/Pull force (driving force/friction force calculation)

More information, 3D CAD files, prices and delivery times www.igus.eu/designing
Content | Vertical hanging applications

1. Vertical hanging applications
   1.1 Definition
   1.2 Application
   1.3 Application parameters
   1.4 Special criteria

2. Installation options
   2.1 Vertical application without horizontal acceleration
   2.2 Vertical application with horizontal acceleration
   2.3 Camber
   2.4 Installation space
   2.5 Mounting

3. Filling
   3.1 Layout
   3.2 Strain relief

4. Support
**Vertical hanging application | Definition**

**Definition**

A vertical hanging application is when the e-chain® is suspended in the vertical direction of motion and the arc of the chain radius does not touch the ground.

**Application**

A vertical hanging or standing application should be used where moving power or data is required for a vertical motion. This might be required for example for crane elevators or machine gantries. The use of an e-chain® ensures that individual cables do not get caught or damaged by other parts of the system structure or machinery.

**Application parameters**

- Maximum travel length: 100 m
- Velocity: \( v_{\text{max}} \) 20 m/s (dependant on travel length and stability)
- Acceleration: \( a_{\text{max}} \) 50 m/s² (depending on lifting height and stability)

**Special criteria**

With hanging applications, installation heights of over 100 m are possible for a purely vertical movement. A normal e-chain® with camber can be used for a hanging application if there is sufficient space. If the vertical movement involves a horizontal movement, the e-chain® must be supported. Cables and hoses in the e-chain® must have strain relief at both ends in order to carry their own weight. Locking mounting brackets are recommended so that the structure does not sway.

In contrast to a standing application, the e-chain® is far less stressed and more stable in a hanging application, because the e-chain® and the filling each bear their own weight.

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**Vertical application without horizontal acceleration**

If the application requires a purely vertical movement, extra support is not required. A normal e-chain® with camber can be used for a hanging application assuming it has sufficient space. If space is restricted, an e-chain® without camber is required, which slightly reduces the required installation space. If this is required, please contact us!
**Vertical hanging application | Installation options**

**Vertical application with horizontal acceleration**

If the application has an additional horizontal movement, a support of the e-chain® is required (B). If the motion is lateral then the e-chain® is guided laterally too (A).

![Diagram](image)

**Camber**

A normal e-chain® with camber is used for a hanging application assuming there is sufficient space. If space is restricted, an e-chain® without camber can be used. In a vertical hanging application of the e-chain® in a guide, an e-chain® must be used with camber to ensure that the chain stays pressed into the trough.

**Installation space**

The installation space required is double the chain radius plus the outer depth of the e-chain® (and also the dimension of the guide system).

**Mounting**

We recommend the use of locking mounting brackets as standard. Other solutions are also possible in confined spaces. In this case, please contact us!

![Diagram](image)

**Pivoting Mounting bracket**

**Locking Mounting bracket**
Vertical hanging application | Filling

Layout

When setting up a hanging application, the distribution of the cables and hoses within the e-chain® is secondary, since they should be strain relieved at both ends and should be suspended in the e-chain® without actually touching it. The e-chain® only fulfills the function of containing and protecting the cables and hoses, and should not absorb any tensile forces. If this is the case, the service life of the application is reduced! igus® interior separation is recommended for a structured and safe layout of the cables and hoses.

Strain relief

The cables and hoses should have strain relief at both ends and should not actually touch the e-chain®. In this way they bear their own weight. The tensile strength of both the e-chain® and the cables and hoses must be checked before commissioning of the application and adjusted if necessary. A regular inspection is strongly recommended.

Vertical hanging application | Support

A support of the e-chain® is only necessary if there is a horizontal acceleration. The e-chain® must then be guided horizontally and/or laterally. igus® offers numerous possibilities to achieve this. Where possible we recommend the use of our guidelok® systems. Details are available in our catalogue or in data sheets. The support is not required for the entire travel, but must be used in the area in which the e-chain® could swing.

(For information on assembly, please refer to the section on trough installation)
1. Vertical standing application
   1.1 Definition
   1.2 Application
   1.3 Application parameters
   1.4 Special criteria

2. Installation options
   2.1 Vertical application without horizontal acceleration
   2.2 Vertical application with horizontal acceleration
   2.3 Camber
   2.4 Mounting
   2.5 Installation space

3. Filling
   3.1 Layout
   3.2 Strain relief

4. Support
Vertical standing application | Definition

Definition

A vertical standing application is when the e-chain® has a vertical direction of motion and the arc of the chain radius moves upward on top of the chain links.

Application

A vertical hanging or standing application should be used where moving power or data is required for a vertical motion. This might be required for example for crane elevators or machine gantries. The use of an e-chain® ensures that individual cables do not get caught or damaged by other parts of the system structure or machinery.

Application parameters

- Maximum travel length without support: ≈ 4 m
- Lifting height max. with the support of the first chain links: ≈ 6 m
- Lifting height max. with full support: ≈ 20 m
- Velocity: vmax : 20 m/s (depending on lifting height and fill weight)
- Acceleration: amax : 50 m/s² (depending on lifting height and fill weight)

Special criteria

If the application has a purely vertical movement, a support is not necessary. A normal e-chain® with pretension can be used for a standing application if there is sufficient space. If the vertical movement involves an additional horizontal movement, a support is required for the e-chain®. In a standing application travels of up to 20 m are possible. Locking mounting brackets are recommended for mounting the e-chain®. The mounting brackets are highly stressed in the vertical standing application, since they have to bear the weight of the application and the gravitational forces are concentrated on this point.

Vertical standing application | Installation options

Vertical application without horizontal acceleration

If the application has a purely vertical movement, a lateral support is not necessary. For longer chain lengths we recommend using a guide trough for the whole e-chain®.

Vertical application with horizontal acceleration

If the vertical movement also has a horizontal component, the e-chain® must be supported. If the horizontal motion is lateral then the e-chain® must be guided laterally too. For longer chain lengths, it is recommended to support at least the first 3 links on the outside of the radius. For maximum heights and fill weights, it is advisable to support the complete chain. Given the numerous combinations of fill weights, travels, chain types and bend radii available, we will be pleased to offer our advice for your application.

Camber

A normal e-chain® with pretension can be used for a standing application with sufficient space.

Mounting

The mounting brackets should be attached in such a way that the e-chain® cannot move outwards. For almost all chain series igus® offers locking mounting brackets. The use of locking KMA mounting brackets is recommended, as they have more attachment options.

Installation space

The required installation space corresponds to twice the radius of the e-chain® plus outer height of the e-chain® and the dimensions of any guide plate used.
**Vertical standing application | Filling**

**Layout**

In a standing application, the weight distribution of the cables and hoses should be symmetrical, and must have strain relief at both ends. Cables and hoses must be laid out in the e-chain® in such a way that they are free to move in the longitudinal direction. The e-chain® should guide and protect the cables and hoses but shouldn’t absorb any extra tensile forces. If this should be the case, the service life of the application will be reduced. igus® interior separation is recommended for a structured and safe layout of the cables and hoses.

**Strain relief**

Cables and hoses must be able to move freely and bear their own weight. They must be fixed at both ends with strain relief elements.

The tensile strength of both the e-chain® and the cables and hoses must be checked before commissioning of the application and adjusted if necessary. A regular inspection is strongly recommended.

igus® strain relief can be attached directly the mounting brackets - no minimum distance to the last curved chain link is required!

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**Vertical standing application | Support**

If locking mounting brackets are not used, a guide plate must support the first 3-4 chain links. If no horizontal acceleration is present, no guide is required for the e-chain®, unless the chain length necessitates it. For longer chain lengths, supporting at least the first 3 links on the outside of the radius is generally recommended. For maximum heights and fill weights often the entire chain must be supported to ensure stability.

The support for a standing application is achieved by using a guide plate on the outer radius side of the e-chain®. The camber of the chain ensures that the e-chain® presses against the guide plate. In this way swinging up of the e-chain® radius is prevented at high speeds or accelerations. A guide plate therefore increases the expected service life of this application! If you are designing such an application, please get in touch with us!
Table of Contents | Guide troughs, support trays and special solutions for long travels

1. Guide troughs
   1.1 “Super Aluminium” guide trough -
       The igus® standard for guide trough
   1.2 Steel guide trough - heavy duty
   1.3 Support tray - supporting the lower run

2. igus® guide troughs
   2.1 Trough type
   2.2 Glide bars
   2.3 Delivery details
   2.4 Long travels with igus® guide trough
   2.5 Design and installation of guide trough
   2.6 Fixed end module for steel trough
Guide troughs | "Super Aluminium" guide troughs

Super aluminium guide troughs
The igus® standard for guide troughs.
► Very simple, modular assembly
► Side-mounted glide strips for wear protection at high-speed
► Corrosion resistant, seawater resistant aluminium profile
► Flexible assembly - easy mounting on existing structure
► Trough can be fixed directly to the surface or on a C profile - inside or outside of the trough.
► Heavy duty bracket for a secure hold even in demanding applications

Heavy duty installation kit
The heavy-duty version uses a different type of installation set. The heavy-duty installation set consists of a strong aluminium bracket, fastened outside of the guide trough. The heavy-duty installation sets are recommended for heavy duty plant, construction equipment and other extremely demanding areas. The part numbers for these can be found in the Super-Alu-Trough pages in our catalogue.

Guide troughs | Steel guide troughs

Steel guide troughs, very stable and rugged for heavy-duty plant engineering
► Heavy duty steel guide trough
► Simple assembly
► Large selection, 2-piece, easily adjusted to the chain width
► Available in galvanized steel and stainless steel (material: 1.4301)
► Plastic glide bar made of PE
Guide trough | Support for the lower run

Support for the lower run
Guide trough as modular construction kit

- Complete system in a single unit
- Removes need for bespoke designed parts
- Simple attachment options for your machine on optional profiles or wall brackets

Guide trough

igus® guide troughs | Guide troughs

**igus® guide troughs**

Guide trough is used in long travels where the e-chain® glides. It supports the smooth low-friction operation of the e-chain® and e-tubes. The infeed point is at the centre of the travel, and the e-chain® glides by itself on one half of the travel. For the other half we supply glide bars built into the trough, on which the e-chains® can glide. igus® guide trough has glide bars made from the highly abrasion-resistant plastic igulen (except RS option with steel gliding surface).

**Trough type**

igus® offers guide trough made from corrosion-resistant aluminium, galvanised steel, stainless steel (material: 1.4301, optionally also 1.4571/1.4404) as well as tubes and other troughs (side plates made of steel). The trough type to be used depends on the requirements of each application. As standard we recommend the igus® super aluminium guide trough.

**Glide bars**

Glide bars made from igulen are optimal for use with the e-chain® material and offer the lowest gliding friction, noise and wear. Glide bars are used when the fixed point is located in the middle of the travel, which means half of the guide trough is supplied with glide bars, and the other half without.
**Delivery condition**

The trough is supplied from the factory in 2 m pieces, although special lengths of up to 6 m are possible. The left and right side parts are mounted at a set distance apart according to the width and series of the chain. The required width (BRi) can be found in our catalogue or by referring to the information in the Annex. The trough side plates can be connected to the base by bolting, welding or the standard igus® installation set. The fixed end module for the igus® super aluminium troughs is a quick way to secure the fixed end of the e-chains®. With this module, easy attachment of the e-chain® with plastic-metal mounting bracket (KMA) to the super aluminium trough is possible, even without drilling.

**Long travels with igus® guide troughs**

For long travels, the upper run of the igus® e-chains® rests on the lower run. The upper run glides partly on the lower run of the e-chain and partly on a glide bar set at the same height. If the fixed end mounting bracket and cables and hoses can be placed in the middle of the travel, the e-chain® length is calculated as: \( L_k = S/2 + K_2 \). The length of the e-chain® then corresponds to slightly more that half of the travel length. Depending on the technical data for the selected e-chain®, the mounting point of the moving end of the e-chain® must be lowered on some units. In these cases we suggest that you contact our experts.

**Design and installation of the guide trough**

The height of the guide trough must be equal to at least double the chain height: \( H_{RI} \geq 2 \times ha \). The sides must have a smooth return surface on the top to smoothly guide the e-chain® into the trough. The trough inner width is equal to the outer chain width plus 4 mm \( BRi = Ba + 4 \). On the trough side, glide bars must be installed where the upper run cannot glide onto the lower run.
**Fixed-end module for steel troughs**

When installing the mounting brackets at the fixed end, the steel trough normally needs to be drilled to match the mounting bracket hole pattern. With the new fixed end module the holes are pre-prepared so that the 2,000 mm long component can be used for centre fed, end fed and even for reverse fed applications. Fast bolted connection of the mounting brackets and additional C rails for strain relief are now possible.

**Alternatives for long travels**

Due to the complexity of these applications and our years of experience in the design of long travel systems, we are always keen to advise you when you are planning such an application. In addition, our current catalogue or our website will give you information and alternatives for long travel applications.

**Bolted connections**

(On CUs and supports) Tightening torque (screws)

**Achtung! / Attention!**

Alle Schrauben müssen mit einem Drehmomentenschlüssel angezogen werden!
All screws have to be tightened with a torque spanner!

<table>
<thead>
<tr>
<th>Thread size</th>
<th>Material</th>
<th>Torque</th>
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</thead>
<tbody>
<tr>
<td>M6, M8/A1</td>
<td>A4-73</td>
<td>16 Nm</td>
</tr>
<tr>
<td>M10, M12/A1</td>
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Befestigung der Kunststoff-Gleitschiene
Fastering of plastic slide bar

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Basically all bolted connections must be secured by using threadlock (LOCTITE) or self-locking nuts. The use of adhesive, serrated lock washers and snap rings for screw locking etc is not advised.

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**FAQ**

- **UnSupported application**
- **Gliding application**
- **Hanging application**
- **Standing application**
- **Side-mounted application**
- **Rotary motion application**
- **Horizontal + vertical**
- **Nested application**
- **Side-by-side application**
- **Zig-Zag application**
- **Combined motions**

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**Bolted connections**

(On CUs and supports) Tightening torque (screws)

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igus® GmbH is the leading manufacturer in the field of energy chain system®, and polymer bearings. The family-run company based in Cologne operates in 35 countries and employs about 2,400 people worldwide. The igus® operates the largest test laboratories and factories in its sector which enables it to offer customers innovative products and solutions, tailored to any application in the shortest possible time.

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