igus® design guide

www.igus.com/info/e-chain-short-travel-unsupported

# 10 Tips for durable energy supply in “unsupported” applications

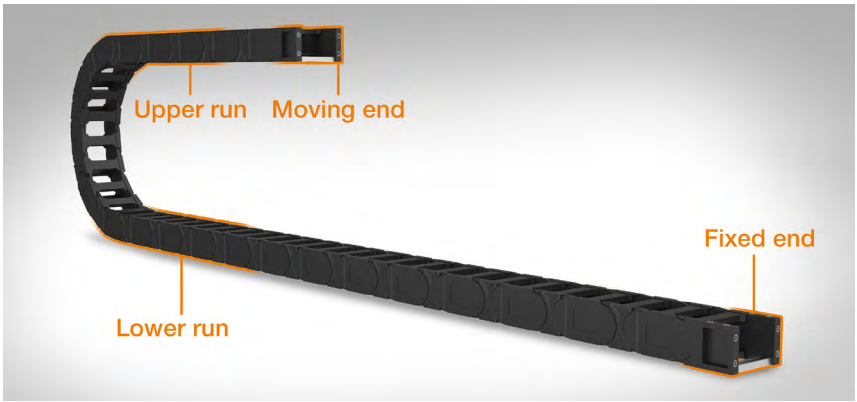
# Contents

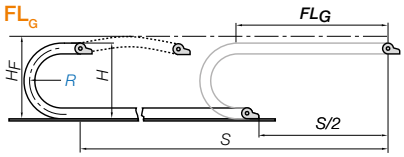

| | |
|---|---|
| Introduction | 03 |
| Tip 1: Minimum length for maximum travel | 04 |
| Tip 2: Enough installation space? Include pretension in your planning | 05 |
| Tip 3: Take speed, acceleration, and cycle frequency into account | 06 |
| Tip 4: Maintain clearance space within the e-chain® | 07 |
| Tip 5: Extend the service life of cables and hoses with strain relief | 08 |
| Tip 6: Choose the right e-chain® material | 09 |
| Tip 7: Choose the right mounting brackets | 10 |
| Tip 8: Ahead of time, determine how loud the e-chain® can be | 11 |
| Tip 9: Cleanroom, ATEX, etc. — consider the application-specific requirements | 12 |
| Tip 10: Consider Industry 4.0 compatibility | 13 |

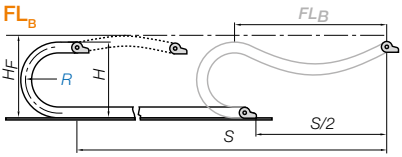
# Introduction

Unsupported application: This is when the upper run (the upper guided part of the e-chain®) does not touch the lower run (the lower guided part of the e-chain®) over the entire travel distance.

Almost 95% of all applications can be covered with unsupported e-chains® – with travels of up to about ten meters. What is characteristic here is that the upper part of the e-chain® (the upper run) does not touch the lower part (the lower run). This arrangement is remarkable for its great dynamics and long service life – usually at least ten million cycles. To achieve this durability with optimum efficiency, you should take advantage of the following tips.



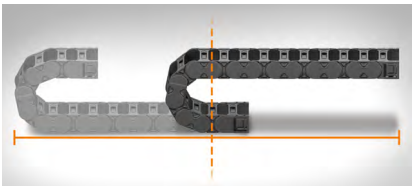



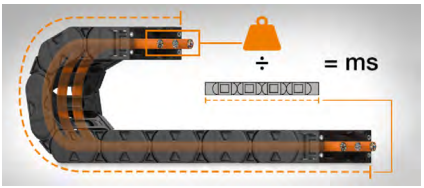

$FL_G$: unsupported with straight upper run
$FL_B$: unsupported with permitted sag

Unsupported length: The unsupported distance between the moving end and the start of the e-chain's® radius arc. The maximum unsupported length varies according to chain type (series) and fill weight.

# Tip 1: Minimum length for maximum travel

To reduce costs, you should achieve as much travel as possible with as little chain length as possible. You can do this by positioning the e-chain® end that does not move (the fixed end, or FP) in the center of the travel (S). This gives you maximum movement efficiency and reduces length – for both the e-chain® itself and the cables.

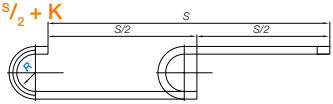




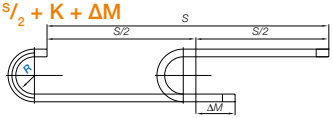

You can calculate the necessary chain length ($L_K$) by halving the travel and adding the bend radius (K). The formula is as follows: $L_K = {}^{S}/_{2} + K$. If you cannot place FP at the center, integrate a deviation from the center (ΔM) into the formula: $L_K = {}^{S}/_{2} + K + \Delta M$. Ensure that the e-chain® has a suitable width-to-bend-radius ratio. If the e-chain® is too narrow and the bend radius too large, the chain can overturn.

**Note:** It is important to calculate the fill weight (ms) before purchasing an e-chain®. In no case may the fill weight be great enough to cause critical sag in the upper run. You can calculate fill weight (ms) by dividing the weight of all cables (ml) by chain length ($L_K$): ms = ml/$L_K$.

$L_K = {}^{S}/_{2} + K$

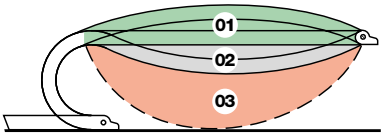



$L_K = {}^{S}/_{2} + K + \Delta M$




The top formula is generally valid for all installation types if the fixed end is in the center of the travel.

**Exceptions:** circular movements and most long travels. The bottom formula is valid if the fixed end is outside the center of the travel.




**Installation options:**

**1:** unsupported with straight upper run (FLG) – Pretension or straight upper run (max. ½ chain link height of sag) – this design is ideal!

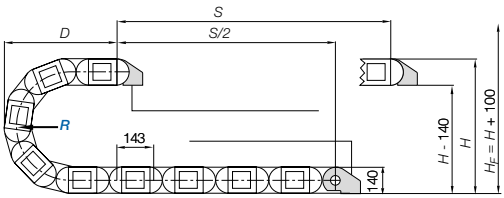
**2:** unsupported with permitted sag (FLB) – The sag is less than the minimum bend radius for the selected e-chain®. This limits speed and acceleration.

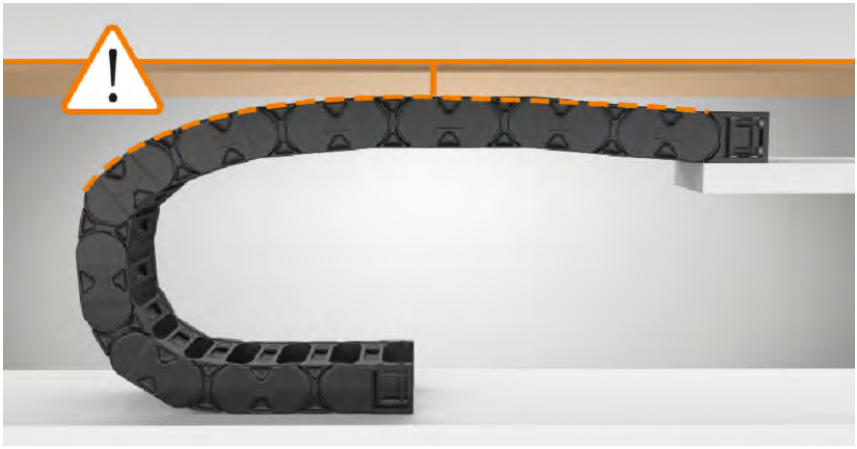
**3:** unsupported length with critical sag – not a recommended state. It greatly reduces service life, speed, and acceleration.

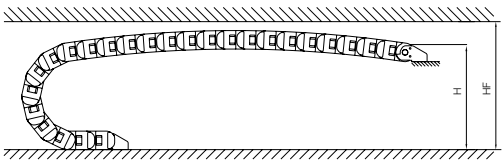
Quick online configuration?
Our online expert can help:
echain-expert.igus.tools/home

# Tip 2: Enough installation space? Include pretension in your planning

Before purchase, consider the necessary clearance height (HF). It equals twice the bend radius (R) plus the chain link height (HG): 2 · R + HG. Caution: You must include the safety reserve in this calculation. Why? e-chains® have pretension. Unladen, the upper run curves upwards, but straightens when the payload is added. You must take this curvature into account when selecting the right e-chain® for your installation space.





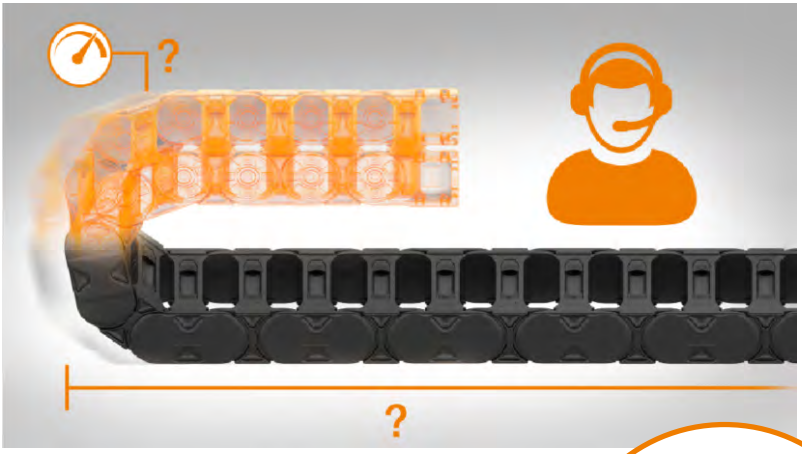

Principle of pretension for igus® e-chains® HF = required installation height

## Tip 3: Take speed, acceleration, and cycle frequency into account

Before buying an e-chain®, consider what forces it will be subjected to: what acceleration, speed, and cycle frequency. Because the interplay of these factors is complex, we recommend consulting an igus® expert. Our professionals will work with you to find the right solution.

If the e-chain® needs to move especially fast, for instance, an E6/E6.1 series chain will work in many cases.

Such a chain uses plastic connectors instead of classic pin/bore connections between the chain links, allowing especially fast, low-vibration operation.



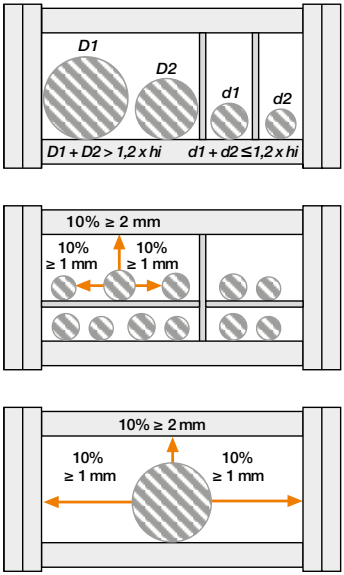

E6/E6.1 system

Calculate service life online:
echain-service-life-calculator.igus.tools/service-life

## Tip 4: Maintain clearance space within the e-chain®

Cables and hoses rubbing together in the e-chain® may cause premature failure. That is why you should select e-chain® width and height that will ensure enough room for cables and hoses. The clearance space all around depends on diameter: for flat and round cables, it is 10%; for pneumatic lines, between 5% and 10%; for hydraulic lines 20%; and for media hoses 15% to 20%.

Distribution rules – clearance space all around electric cables



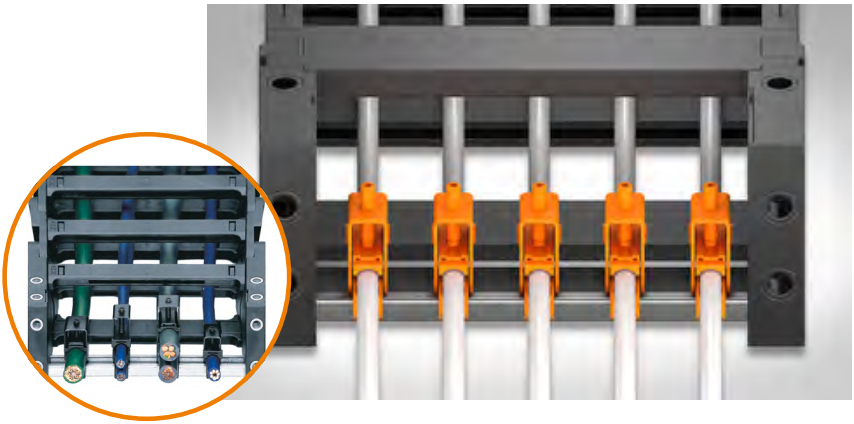

Optimum weight distribution in the e-chain®

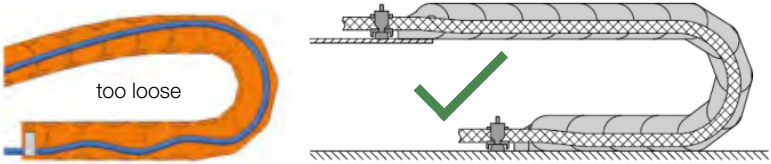
The cable weight should be distributed symmetrically along the width of the e-chain®, with the heaviest cables on the outside. This ensures that the outer links, which must bear the fill weight, are not overstressed. In addition to maintaining the clearance space all around the e-chain®, ensure that the cables and hoses have no opportunity to overlap. A compartment's clearance height must therefore never be more than the cable diameter plus 50%.

Configuring a chain with cables made easy:
echain-expert.igus.tools/home

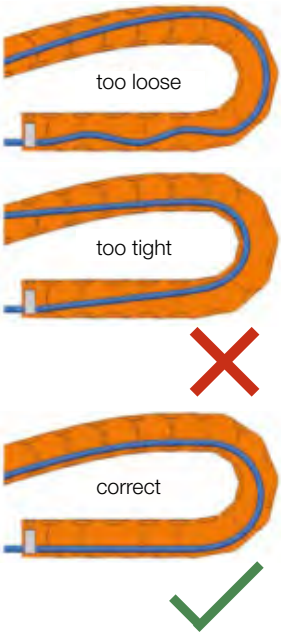
## Tip 5: Extend the service life of cables and hoses with strain relief

To protect cables and hoses during constant movement, you should incorporate strain relief into your unsupported e-chains®. This protective device fixes the cables and hoses to the e-chain's® end pieces. This keeps length within the e-chain® constant. Lines and hoses have no opportunity to move in and out during operation. Cable service life is extended.





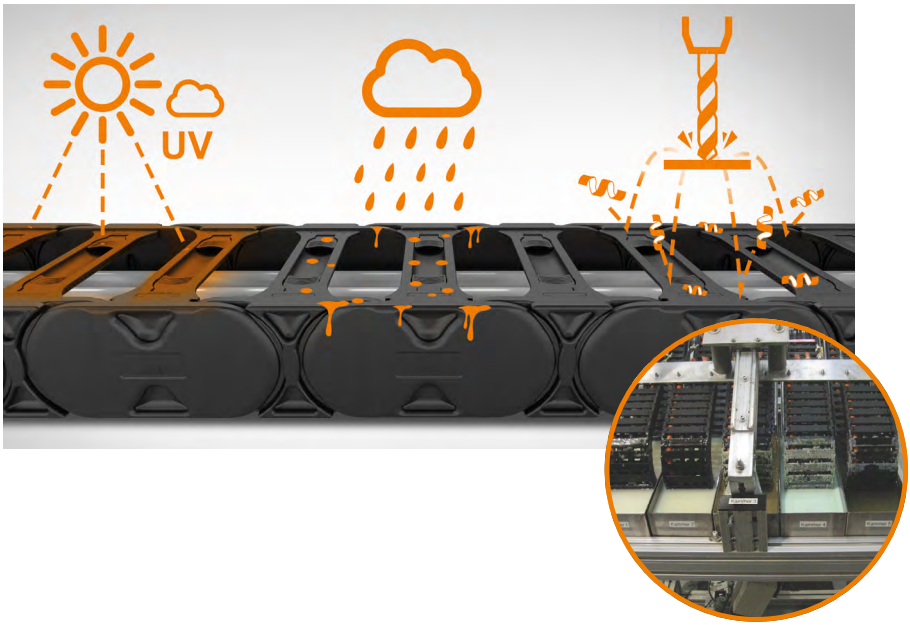
For most applications, a combination of C-profiles in the mounting bracket and space-saving clamps is recommended. Strain relief can also be implemented with tiewrap plates and cable tiewraps.




Cable and hose visual inspection: correct – igus® chainflex® cables can have strain relief fixed directly to the mounting bracket.

# Tip 6: Choose the right e-chain® material

If e-chains® are to run safely for a long time, they must be able to withstand a wide variety of environmental conditions, including heat and cold, hight humidity, dust, and chemicals. igus® has developed the right model for almost any combination of these environmental parameters.



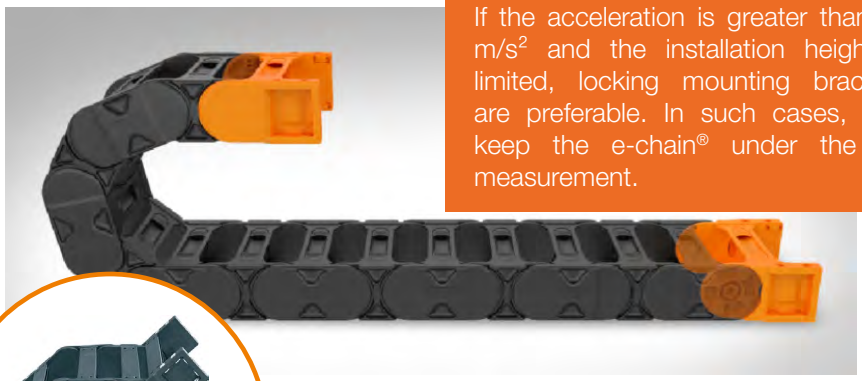

To find the best solution, we will analyze your scenario before you buy: How hot or cold is it? What temperature extremes will it experience (due to electric sparks, for instance)? How high is the humidity? What type of soiling is there on site, and how fine are the particles? Will the e-chain be subjected to oil or chemicals?

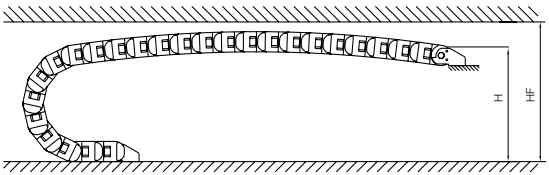
As soon as these parameters are identified, you can search for the right high-performance plastic for the e-chain® in a targeted manner. The igumid EG+ material, for instance, is resistant to even aggressive chemicals and igumid HT to hot swarf (up to 850 °C).

# Tip 7: Choose the right mounting brackets

If unsupported e-chains® are to work for as long as possible, you should plan for mounting links at the beginning and at the end before the first chain link. As a rule, the mounting brackets can be either locking or movable. Pivoting mounting brackets are standard for horizontally unsupported applications. The pivoting mounting bracket compensates for the sag resulting from the e-chain® pretension (see Tips 02 and 05). This makes it easier to install, and no other forces are transmitted through the mounting bracket to the e-chain®.

If the acceleration is greater than 20 $m/s^2$ and the installation height is limited, locking mounting brackets are preferable. In such cases, they keep the e-chain® under the HF measurement.

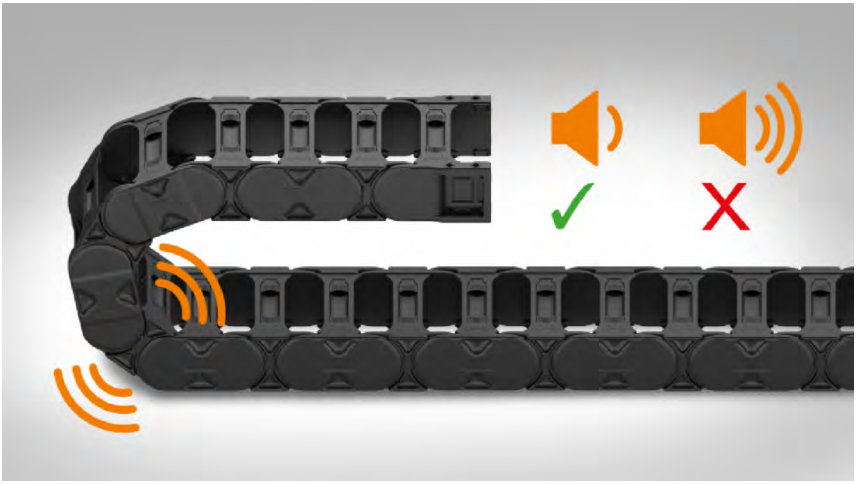





If the mounting bracket is not mounted exactly at radius height, it can compensate for small height differences.

## Tip 8: Ahead of time, determine how loud the e-chain® can be

In order to avoid unpleasant surprises after commissioning with respect to noise, determine ahead of time how loud the system can be without causing problems. If quiet operation is especially important to you, there are a number of options for reducing the noise level. For instance, there are e-chains® that are exceptionally quiet by design.



The E6.1 series achieves a sound pressure level of only 37 dB(A) in the igus® laboratory. For comparison, a room fan emits about 35 dB(A), and the twittering of birds is about 50 dB(A). Damping pads can also be mounted on the chain links without much cost or effort. This minor modification can be implemented for almost any chain type and reduces the noise level by 5 dB(A).

## Tip 9: Cleanroom, ATEX, etc. — consider the application-specific requirements

Before purchasing an e-chain®, you should check the application-specific requirements it must fulfill. You can then start a targeted search for models that meet legal cleanroom, ATEX, and ESD requirements. We guarantee that you will find something at igus®.


We are developing an IPA-tested product portfolio with cleanroom classifications up to ISO Class 1. We also have materials like igumid ESD, which is conductive and avoids static charges.

## Tip 10: Consider Industry 4.0 compatibility

Networking machines and equipment makes production safer and more efficient than ever. e-chains® have also become part of the Industry 4.0 era. As a user, you have the option of equipping your e-chain® with sensors. After this upgrade, you can use i.Sense, and IT system that continuously monitors the status of your e-chain® and can initiate a system stop when critical situations arise if you so desire. The i.Cee system, on the other hand, offers predictive maintenance capability, proactively avoiding machine downtime.

Learn more about smart plastics: www.igus.com/info/smart-plastics-overview