

# ADVANCED LINEAR MOTION KIT

Make It Real CAD Engineering Challenge

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1. Table of Contents	Page
Table of Contents.....	2
Introduction.....	3
Functionality.....	3
Design.....	9
Conclusion.....	10

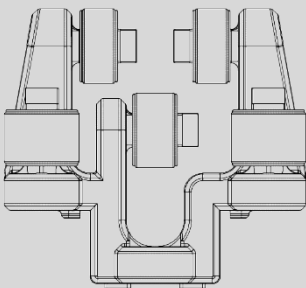
## 2. Introduction

Do you think your linear mechanisms run smoothly? It's space efficient? How about virtually zero friction? Well, think again. Engineering Freaks proudly presents: The Advanced Linear Motion Kit. The linear motion kit offers superior parts for all your linear motion mechanisms, providing very low friction, ultra-light weight, and easy assembly design.

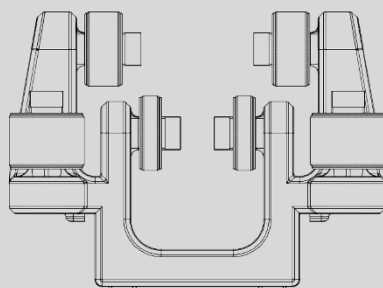
## 3. Functionality

The design functions as an upgrade from Vex Robotics' Linear Motion Kit (276-1926), with many features worth drooling for. Using any C-Channels as rails from Vex Robotics, the Advanced Linear Motion Kit allows designers to create linear mechanisms easier using roller sliders. The kit consists of two series of roller sliders: C-Series & E-Series.

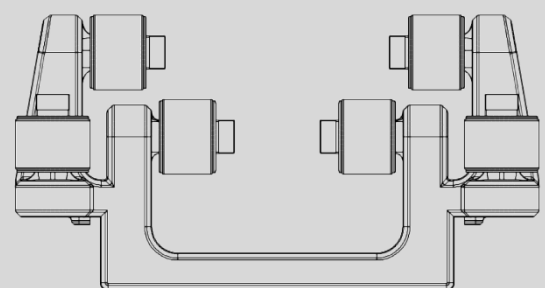
### 3.1. C-Series



**Fig 3.1A:** C-1 Model  
for 2-holes-wide c-  
channels

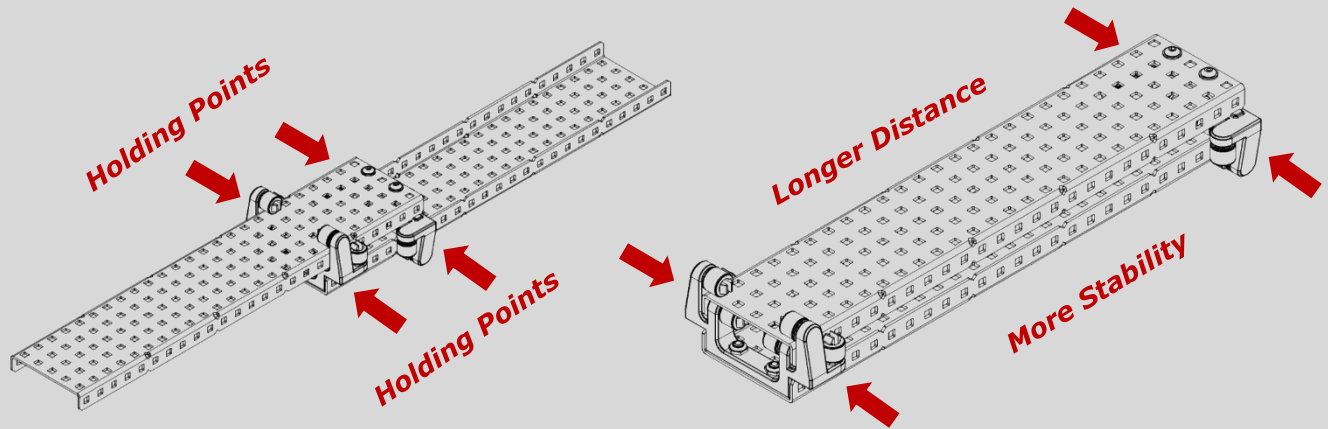


**Fig 3.1B:** C-3 Model  
for 3-holes-wide c-  
channels



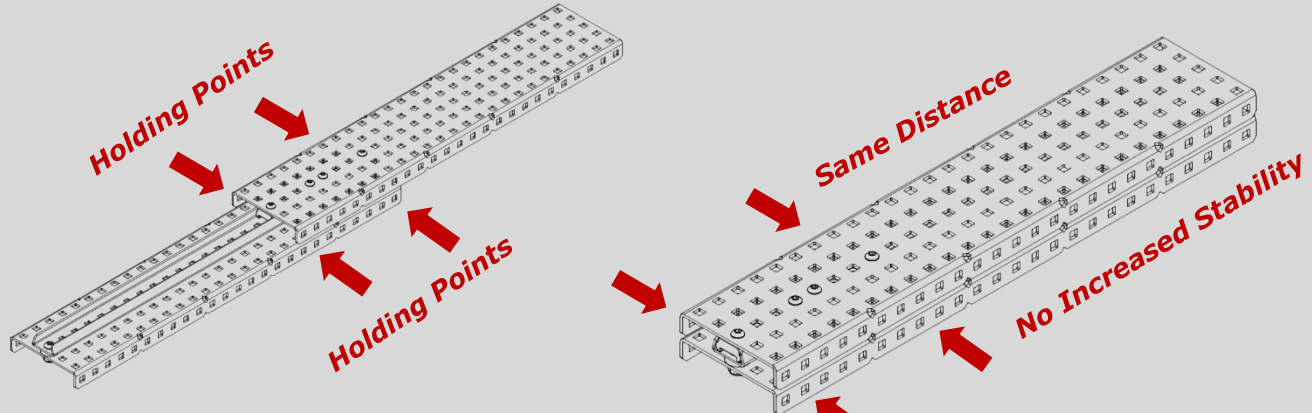
**Fig 3.1C:** C-5 Model  
for 5-holes-wide c-  
channels

The C-Series (C for C-Channels) roller sliders are ideal for designers who want to build simple and compact linear mechanisms. It contains custom wheels made with rubber material, maintaining contact with every side of the c-channel to achieve a smoother motion. The nature of this design gives major stability than the original linear motion kit due to the variable distance between the rollers as shown in Figure 3.1D to Figure 3.1G.



**Fig 3.1D:** C-5 model in expanded mechanism

**Fig 3.1E:** C-5 model in contracted mechanism

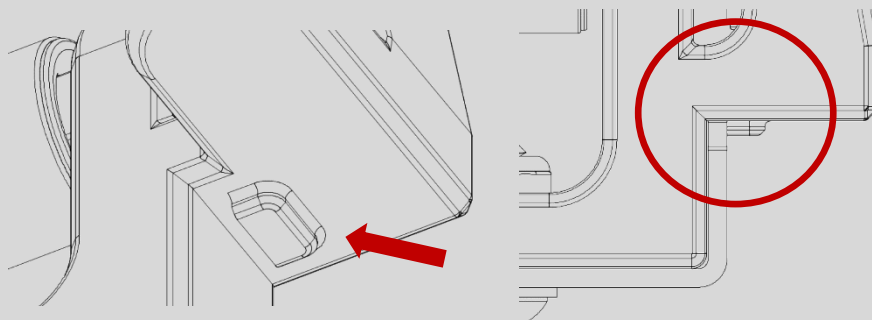


**Fig 3.1F:** Original model in expanded mechanism

**Fig 3.1G:** Original model in contracted mechanism

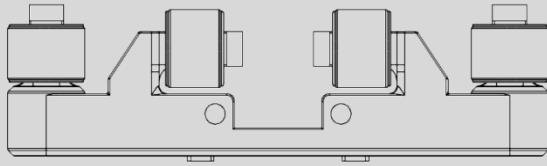
In other words, as the mechanism expands, the distance between the first and the second roller slider decreases, but when the mechanism contracts, the distance increases, obtaining greater stability than a fixed distance.

In addition, the C-series have tiny supports shown in Figure 3.1H that decreases bending and overall stress caused when your mechanism is at work.

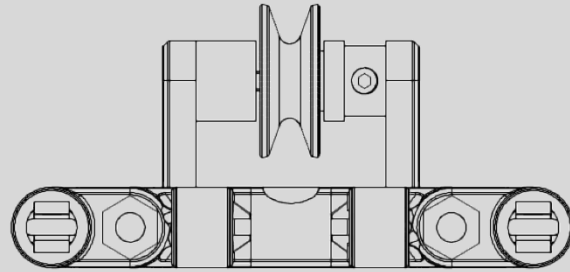


**Fig 3.1H:** C-5 model with tiny support shown with & without C-Channel

## 3.2. E-Series



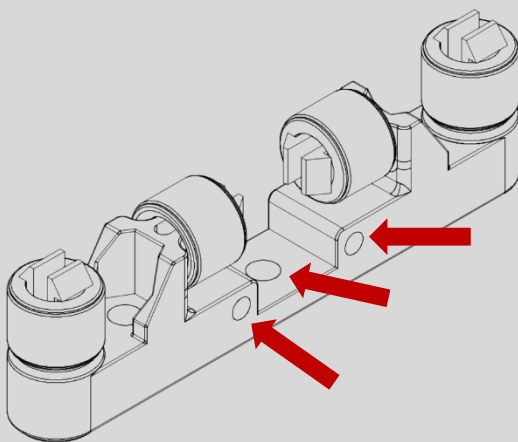
**Fig 3.2A:** E-1 Model shown



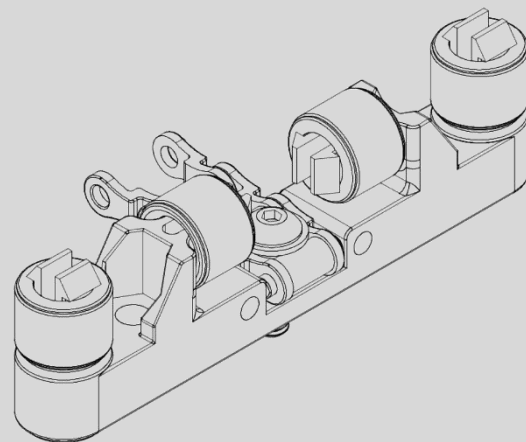
**Fig 3.2B:** E-2 Model shown

The E-Series (E for Elevation) roller sliders are ideal for designers who want to build elevators using chains/rope attached with motors. While it has the same elements and concepts as the C-Series, the E-Series include extra features that can be useful when building elevators. Note that E-Series are only compatible with 5-hole C-Channels. Both E models are needed for them to function properly.

The E-1 model contains an extra hole in the middle as shown in Figure 3.2C, that serves as a tight holder for high strength chains (276-2172).



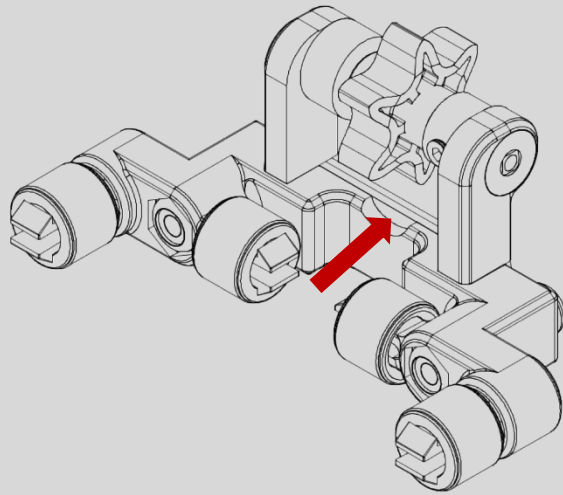
**Fig 3.2C:** E-1 Model showing the extra holes for chain and rope insert



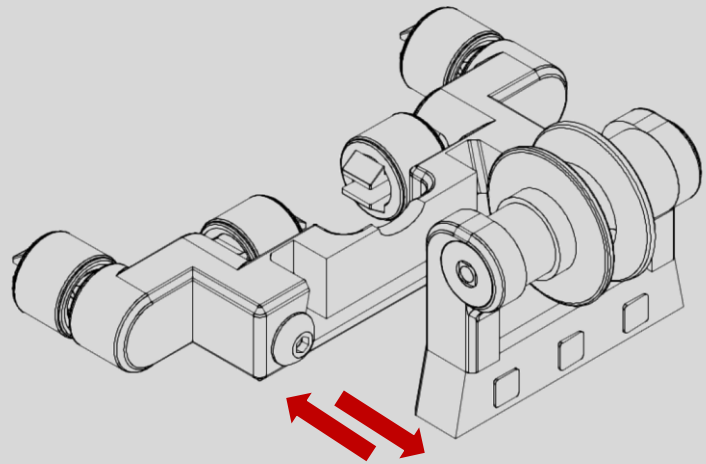
**Fig 3.2D:** E-1 Model with high strength chains inserted

As an alternative to chains, nylon rope can be inserted in either hole on the ends, ending with a knot to imitate a rigid behavior in tension.

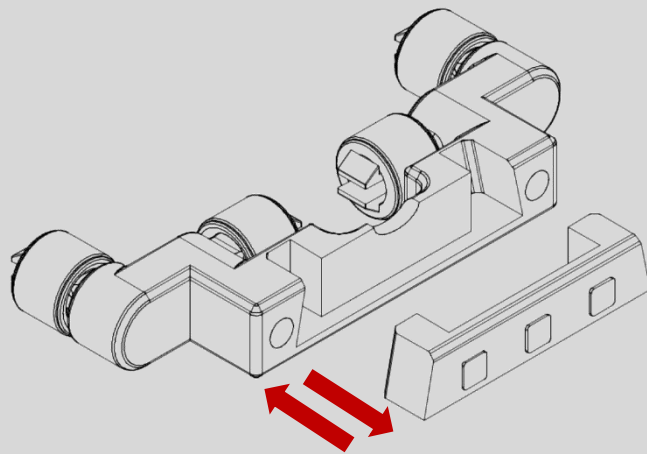
The E-2 model includes a removeable part where you can change between sprocket, pulley, or none. As shown in Figure 3.2E, there's an area where you can easily push with your fingertip to change the customizable part.



**Fig 3.2E:** E-2 Model showing how to remove the subpart



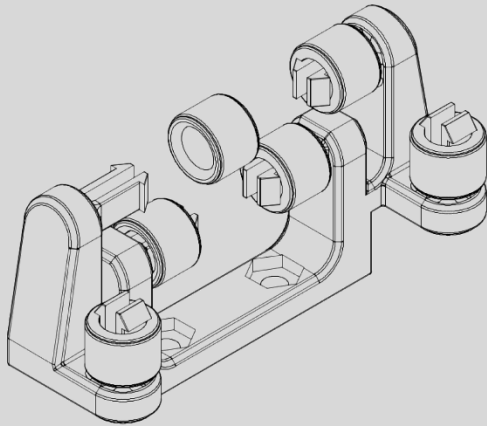
**Fig 3.2F:** E-2 Model with subpart changed into pulleys



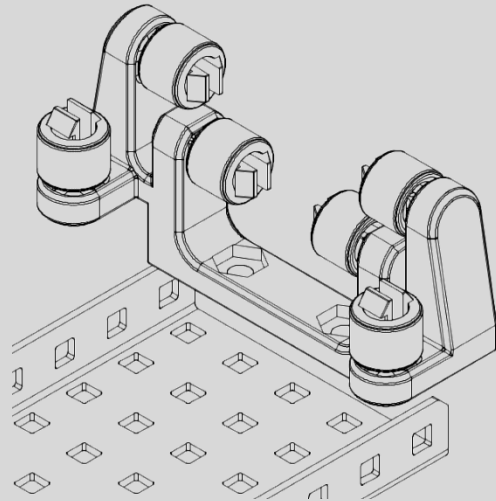
**Fig 3.2G:** E-2 Model with subpart changed into none.

## 3.3. Assembly

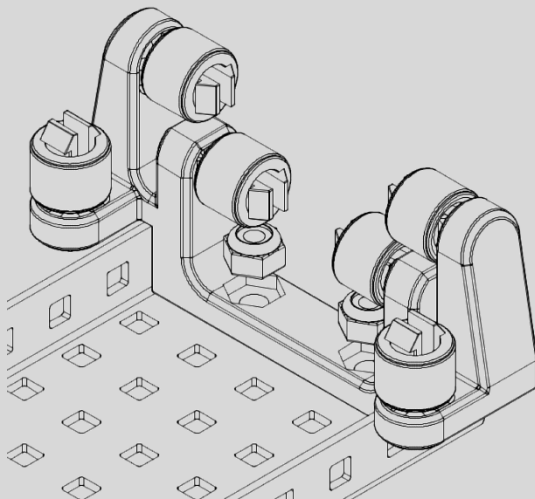
The Advanced Linear Motion Kit is designed for easy assembly. Follow through the straightforward steps for the C-3 model from Step 1 to Step 6.



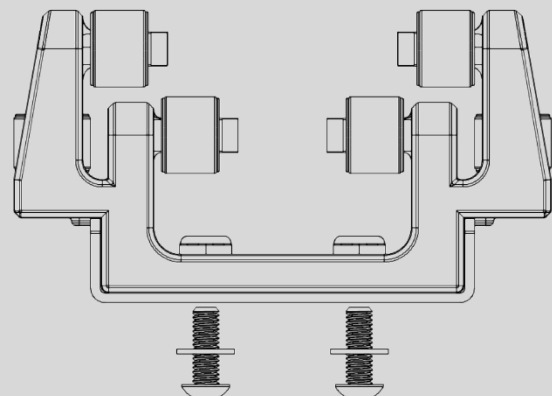
**Step 1:** Insert all the rollers into the C-3 model.



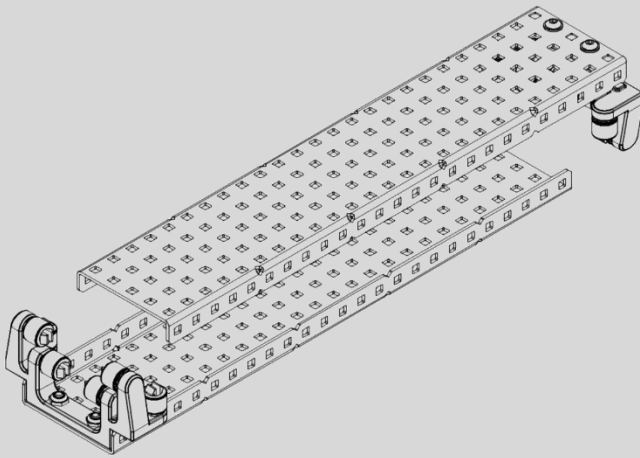
**Step 2:** Place the roller slider on the 5-hole c-channel. Use the rounded & squared structure below the roller slider to help you align the part perfectly on the c-channel.



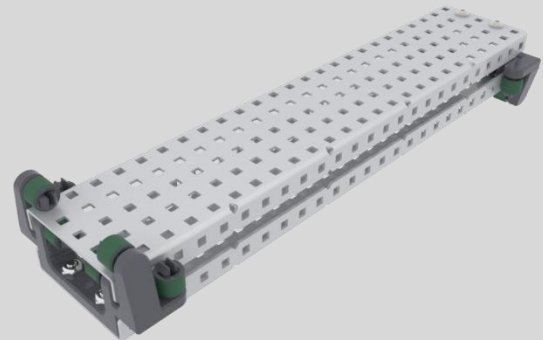
**Step 3:** Insert the nylock nuts into the hexagon shapes.



**Step 4:** Fit 0.635 in screws and steel washers into the holes and nylock nuts. Remember, wrench is not needed! The hexagon shape locks the nylock in place.

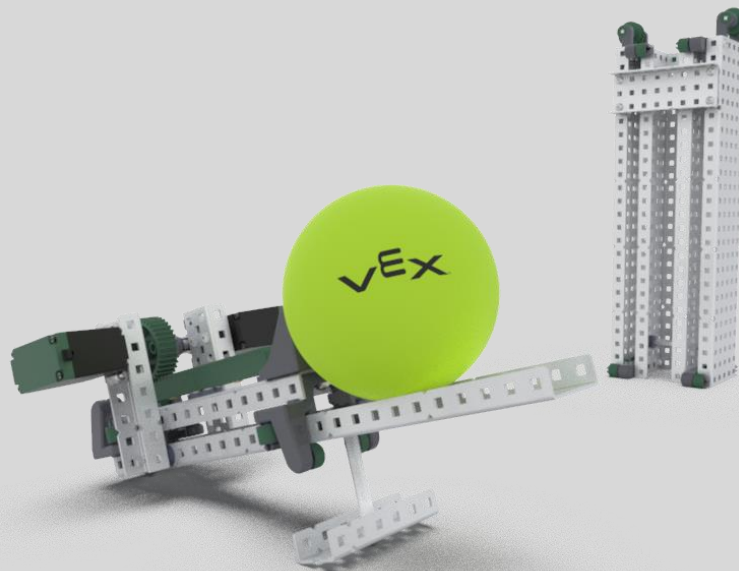


**Step 5:** Repeat step 1 to step 4 to obtain a second assembly.



**Step 6:** Mount it! And you're done.

Applications include robotic arm extenders, linear punchers, elevators, wallbots, and long-range linear mechanisms.



**Fig 3.3A:** Linear Puncher and Elevator as valid applications using the Advanced Linear Motion Kit

## 4. Design

For the In the Zone season, we developed many elevator prototypes, and realized that custom parts would significantly alleviate overdesigning and ensure simplicity. Brainstorming for ideas, came our roller sliders design which were superior to VEX's Linear Motion Kit. From there, the Advanced Linear Motion Kit is born.

Autodesk Fusion 360 (Educational License) was used to sketch, design, and simulate the Advanced Linear Motion Kit. Basic functions such as extrude, revolve, chamfer, fillet, and combining methods were used to achieve the design model of every part. Printing the parts resulted to be effective for verifying the tolerances when assembling a real-life model.

In the assembly environment, move, align and rigid tools were used. A static analysis in the simulation environment was made to ensure the pins to insert the rollers wouldn't break.

The Keyshot Plugin was used to render and animate the model, using realistic materials, and the product became a life-like visual that exceeded our expectations. Each part is then printed using UP 3D Printer, and resulted 2-4 hours for each part.



## 5. Conclusion

The Advanced Linear Motion Kit offers an upgrade from VEX's Linear Motion Kit with more stability, functionality, and elegance. Be a linear puncher or an elevator, the Advanced Linear Motion Kit is prepared to tackle the job.

Simplicity, elegance, simulations, drawing, rendering plugins; Fusion 360 has it all. Tackling a project like this gave me an insight of what real engineers do. It's a requirement to learn a 3D design software to demonstrate visualization and organization of your future product; in addition, less errors are produced when prototyping. Thanks to Fusion 360, we're able to design and break barriers in engineering solutions.