

# VEX Parts

The VEX® V5 Kit contains a variety of parts to build **mechanisms**, structures, and robots. There are three basic types of VEX parts—assembly, hardware, and motion.

- Assembly parts connect together with hardware to form the skeleton or frame of the model or robot.
- Hardware parts are pieces that hold assembly and motion parts together.
- Motion parts allow your model or robot to move.

## Assembly Parts

The basic assembly parts are metal. They come in a variety of shapes and sizes and have square holes (0.182-inch square) on a standardized half-inch grid.

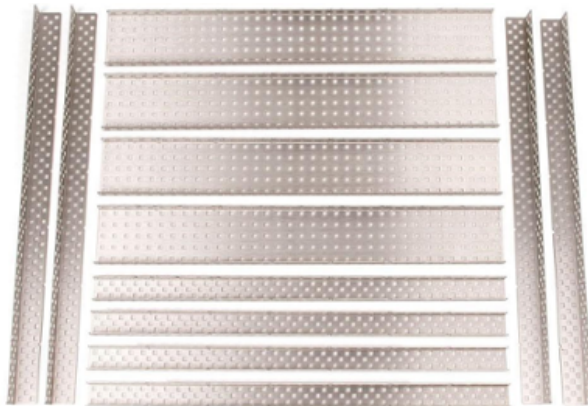


Figure 1. Angle and C-Channel

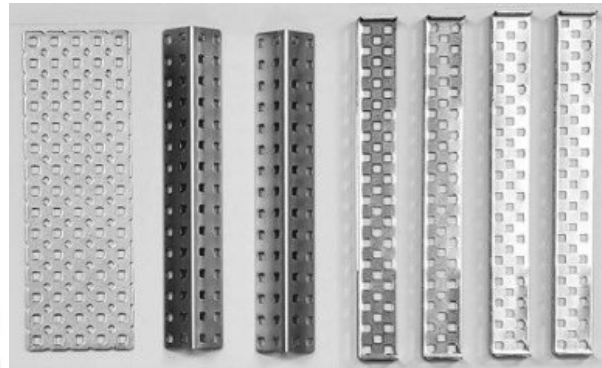


Figure 2. Steel Plate, Angle, and Rails

The standardized hole spacing allows you to connect VEX parts in almost any configuration.

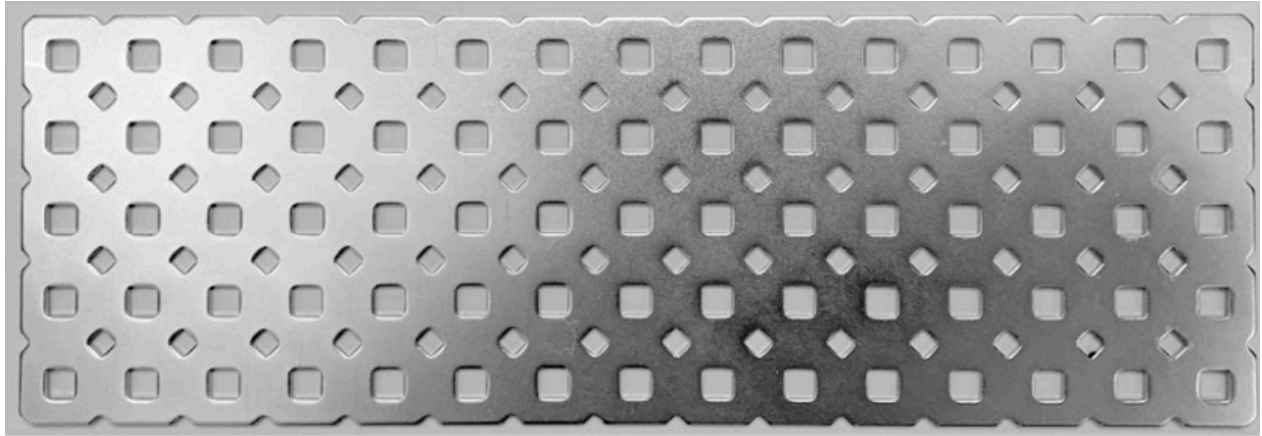


Figure 3. 15 x 5 Hole Steel Plate

The metal assembly parts are measured by the number of square holes they have, and the part name often describes their shape.



Figure 4. 1 x 2 x 1 x 35 C-Channel



Figure 5. 2 x 2 x 25 Angle

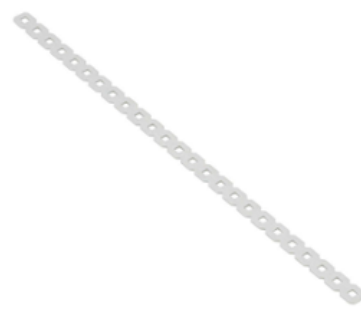


Figure 6. 1 x 25 Bar



**How to Pick Which Parts to Use:** The size of your robot or model will determine which metal parts work best for your design. As you build and study each type of mechanical gear, you will begin to learn the size and type of metal part that each mechanism requires to function. You will then be able to apply your knowledge to the unique designs you create.

# Hardware

Robots and models need something to hold them together; that is where hardware comes in. You will use three types of hardware: screws, nuts, and standoffs.

## Screws

Metal components can be attached together using the 8-32 screws and nuts.

- The 8-32 screws fit through the standard square holes.
- These screws come in a variety of lengths and can be used to attach multiple thicknesses of metal together or to mount other components onto the metal or plastic parts.

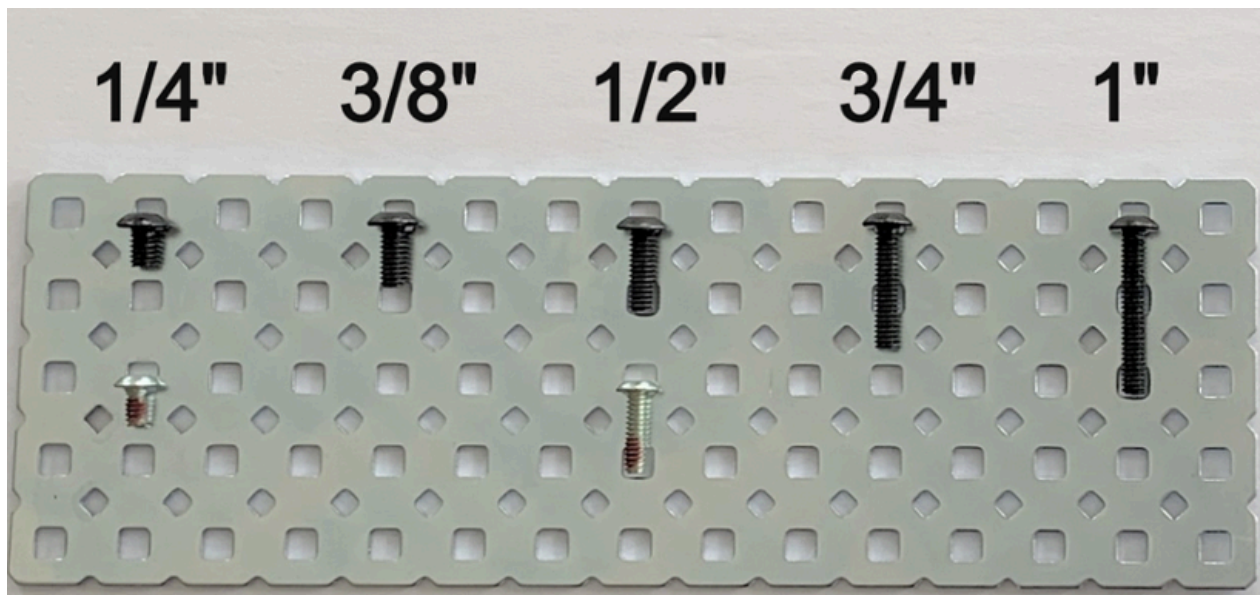


Figure 7. Black 8-32 Screws, Gold 6-32 Motor Screws, and 15 x 5 Hole Steel Plate



### What do 8 and 32 mean in an “8-32” screw?

- The first number is the diameter. The bigger the number, the bigger the screw.
- The second number is the number of threads per inch. A thread is a continuous spiral ridge on the outside of the screw.

## Nuts

When you use a screw to attach parts, you must also use a nut to help hold the screw in place. Three types of nuts are available: KEPS nuts, Nylock nuts, and regular nuts.



Figure 8. KEPS Nut

**KEPS nuts** have a ring of “teeth” on one side of them. The teeth grip the piece they are being installed on. These nuts are installed with the teeth facing the structure. Be sure to properly tighten them, or these nuts might loosen over time.



Figure 9. Nylock Nut

**Nylock nuts** have a plastic insert in them that prevents them from unscrewing. These are harder to install, because you need to use an open-ended wrench to tighten them. These nuts will not come off with vibration or movement.

**Regular nuts** have no locking feature. These nuts require a wrench to install and can loosen over time, especially when under vibration or movement. They are very thin and can be used in some locations where it is not practical to use a Nylock or KEPS nut.



Figure 10. Regular Nut

## Standoffs

Metal assembly parts can be offset from each other using 8-32 threaded standoffs. A standoff is used to create space between two parts, while adding stability. These standoffs come in a variety of lengths and attach to metal plates with 8-32 screws.



Figure 11. Standoffs

## Tools

To add screws and nuts to your model or robot, you need special tools. Hex keys, open-ended wrenches, and hex drivers are used to tighten or loosen the hardware.



Figure 12. Hex Keys - 3/32 and 5/64



Figure 13. Open-ended Wrench



Figure 14. Hex Drivers

There are two sizes of Hex keys.

- The 3/32 Hex keys are used for the standard 8-32 screws.
- The 5/64 Hex keys are used for the setscrews in shaft collars and 6-32 motor screws.

**Warning:** It is important to be careful when you tighten screws. The Hex keys may round or “strip out” the socket on the head of the screw if they are not fully inserted into the socket. Use care when tightening screws to prevent stripping out the head of the screw.



Figure 15. Metal Components Attached with Multiple Screws



**Building Tip:** To keep structural members aligned correctly and to create maximum strength, attach components together with multiple screws from different directions.



Figure 16. Drive Shaft, Gear with Drive Shaft



Figure 17. Drive Shaft

## Motion Parts

Parts that create movement are called motion parts. The motion parts include drive shafts, gears, bearings, wheels, and more. Most of the motion parts have a square hole which fits tightly on the square drive shafts.

### Drive Shafts

The square drive shaft has rounded corners, which allow it to spin easily in a round hole. To keep drive shafts in place, mechanisms in place, and wheels from falling off, use different types of fasteners, such as shaft collars and bearings.

# Shaft Collars

Shaft collars contain a small screw inside of their collar called a setscrew. Use the 5/64" Hex Key to tighten and loosen setscrews.

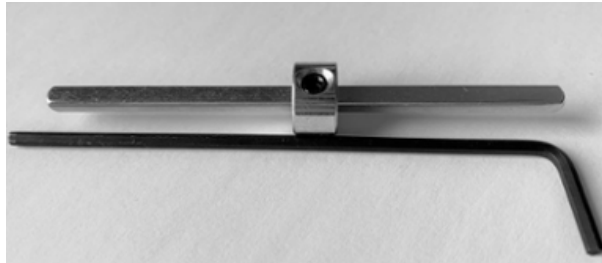


Figure 18. Drive Shaft, Shaft Collar, Hex Key

# Bearings

To provide a low-friction part for shafts to turn in, attach bearings, such as the Bearing Flat and Bearing Block, to a metal assembly part. Bearings are attached with plastic pop rivets.

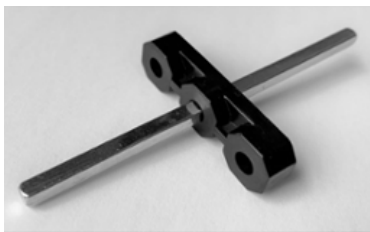


Figure 19. Bearing Flat and Drive Shaft

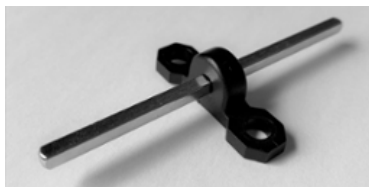


Figure 20. Bearing Block and Drive Shaft



Figure 21. Pop Rivet



**Attaching Bearings with Rivets:** The correct way to attach a bearing with a rivet is to place the bottom of the bearing with the small tabs against the metal. Then feed the rivet through the hole on the metal side, and “pop” it into place as the end of the rivet passes through the top of the bearing.

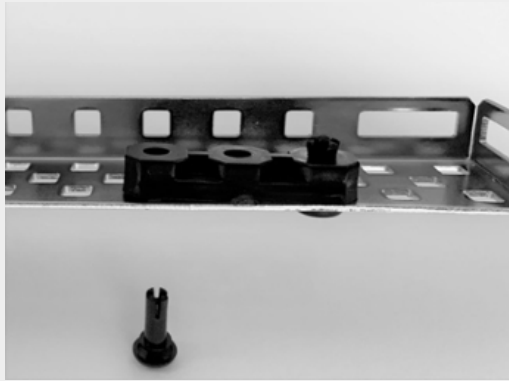


Figure 22. Attaching a Bearing Flat with Pop Rivets on a Steel Chassis Rail 2 x 1 x with Tabs

Figure 23. Bearing Flat, Bottom View

## Gears

Another type of motion part is a gear. Gears come in many sizes and are identified by the number of teeth.



Figure 24. Assorted Gears



Figure 25. 12-tooth Gears

**Note:** A variety of gears and parts will help you build different solutions. Explore the variety of parts available to you. (Select each image to enlarge it.)



Figure 26. Advanced Mechanics and Motion Kit for Mechanical Gears



Figure 27. Assorted Gears and Mechanisms Parts



Figure 28. 4" High Traction Tire and Wheel, 5" Wheel, and 2.75" Wheel



Figure 29. Tank Tread Kit

