10 - Motors

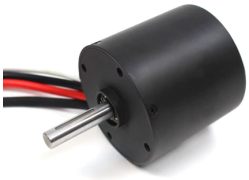
Electric motors are devices that convert electrical power into mechanical power. In other words, they use the power of the motor to make the robot move. They are the most important way that a robot can move.

10.1 - Types of Motors

Several types of motors are available to FRC teams, each suited for different applications. Additionally, the game manual every year specifies a number of motors which are "legal" to use on the robot. Below is a table that describes the most common motors.

Table 1: Common FRC motors

Motor	Image	Description	Possible Applications
CIM		An older motor that 1732 has not used in a few years, but still discussed as a common benchmark. Known for its high power and durability but also its high weight.	Drivetrains
MiniCIM		A smaller version of the CIM with slightly lower power and weight. Also not used often anymore.	Drivetrains, Arms, Elevators
775Pro		A strong motor that is remarkably light for its power output. However, it has poor thermal properties and is better suited for applications where stalling is not an issue.	Climbers, Flywheel Shooters, Arms, Elevators, Intakes

BAG		A small, low-powered motor that is typically used wherever a more-powerful motor simply is not necessary	Intakes, Other Manipulators
Neo		A brushless motor (referring to its interior structure,) which allows it to be especially powerful while still lightweight. Requires a special motor controller.	Drivetrains, Manipulators
Falcon 500		Another brushless motor, so it is quite powerful. Unlike the Neo, it has its motor controller built into it.	Drivetrains, Manipulators

(Neo Image from REVRobotics.com. All other from VexRobotics.com)

10.2 - Mounting Methods

For every motor, there are two mechanical connections that must be made: a rigid connection between the motor and the robot frame (to hold it in place) and a moving connection between gears or pulleys to transmit mechanical power. First, we'll consider the rigid connection, which is usually called the motor mounting. All of the motors listed above attach via screws on their face. To design these, simply use Inventor's measure tool to measure the holes' diameter and distance apart, or take the dimensions from a technical drawing of the motor, and create holes on a plate or other part to match.

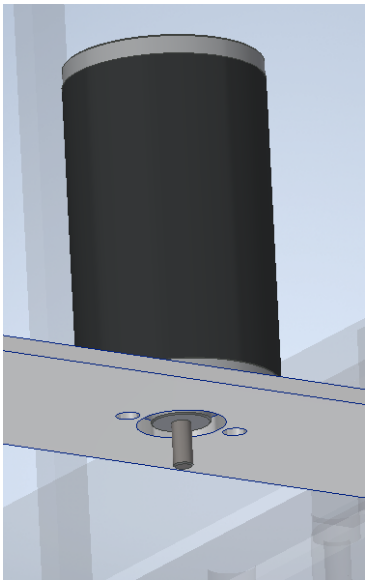


Figure 1: A BAG motor mounted to a flat bar on the 2019 robot. The holes are for bolts which are not modelled, and a pulley on the output shaft is hidden.

It is uncommon that a motor is connected directly to a structural piece, since motors more often connect to gearboxes, and the motor in Figure 1 is a rare example. Nonetheless, these motor mounting methods are important in the design of gearboxes themselves, and gearboxes often connect to frames in similar ways, too.

10.3 - Power Transmission Methods

The moving connection, which transmits power from the motor output shaft to other components, can typically be done one of two ways: either with a pinion (a small gear which drives a larger gear) or a small pulley which drives a larger pulley. Gears and pulleys are each their own complex topics, so more information will be given later sections. Motors typically connect to components via interference fits or keys. See Section 8.2 for more information on these.