MOTOR TECH FOR DUMMIES

Understanding electric motors is easy. The first time you read through a motor's spec list or manufacturer's advertisement, you may be a bit lost, but basic motor tech is simple and universal for most motors across the board. If you are ever looking to upgrade your current motor—or simply understand a little more about your current setup—learning some easy terminology will pull it all together.

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SPEED CONTROL COMPATIBILITY

Much like speed control selection dictates motor choice, you need to make sure that your motor is compatible with your speed control. The three main determining factors you need to consider are whether the motor is brushed or brushless, sensored or sensorless, and the motor's power rating (Kv or Turns) relative to the speed control you are pairing it with. This selection process is actually very easy, as speed control manuals strictly outline the kinds of motors with which they are compatible. It is best to work within the same brand of motor/speed control pairs, but many allow you to mix and match manufacturers.

Not every motor and speed control are compatible. Things like motor type and power dictate which motor/speed control combinations will work together.

BRUSHED VS. BRUSHLESS

The most common term associated with motors is brushed and brushless operation. Brushed motors (which are becoming less common), rely on physical contact (the brushes touching the commutator) to conduct electricity to the motor. Brushless motors, however, house the motor's windings in a stationary stator that then pulls on the magnetized rotor, eliminating the physical contact of the brushes. As a result, brushless motors have much less friction, allowing them to operate more efficiently, and require significantly less maintenance. Although brushed motors are still good, the benefits of brushless motors are numerous. Upgrading from a brushed to a brushless system is one of the easiest and most effective upgrades that you can make to your electric vehicle.

It's easy to tell a brushless motor (far left) from a brushed motor: the brushed powerplant has a lot more hardware on its back end. Those are the brush hoods and brushes, which brushless motors do away with.

SENSORED VS. SENSORLESS

Because they are equipped with sensors inside the motor to register rotor position, "sensored" motors are generally more responsive at low rpm and provide more initial torque than a comparable sensorless motor. Sensorless systems rely on the motor spinning to communicate the rotor's position, so sometimes sensorless systems lag a bit when accelerating from a stop or at low rpm. However, both sensored and sensorless systems work well, and some users prefer the feel of one over the other. Sensorless power systems generally cost a little less than sensored systems of similar output.

Sensorless on the left, sensored on the right. A sensored motor is easily identified by its rear view: you'll see a port for a sensor-wire harness (arrowed).

REBUILDABILITY

Ten years ago — when brushed motors were still the norm — motor maintenance was pretty elaborate. But thanks to brushless motors, which are relatively maintenance-free, electric RC is now more about driving than wrenching. Many brushless motors are rebuildable/serviceable and advertised as such. Rebuildable motors allow you to disassemble them and replace things like rotors, circuit boards and bearings, so that they can last a lifetime.

Disassembly of a rebuildable motor is easy – it's typically just a couple of screws!

MOTOR SIZES

Much like the scale of RC vehicles varies, motors vary in size as well. The most common motor sizes are: 370-size (frequently used in minis or small scale), 540-size (the most typical motor on the market, used for most 1/10-scale applications), 550-size (usually used for large 1/10-scale vehicles like 4x4 short course) and 1/8-scale-size (used for 1/8-scale vehicles and large monster trucks). Everything equal, larger motors generally produce much more torque, while also consuming more power. For the most part, every vehicle is designed to be used with a specifically sized motor, and there are plenty of motor options available in all sizes.

Motor sizes refer to the nominal can length in millimeters, and represents a standard set in the early days of brushed motor power.

COOLING METHODS

Electric motors perform best under cool operating conditions, and motor manufacturers possess different methods for keeping their motors cool and efficient. Some motors include cooling fans (or sell them separately) which attach to the motor — constantly blowing cool air onto the motor while driving. Other motors have optional heat sink sleeves which attach to the motor can to aid in heat dissipation. Keeping your motor cool is a great way to get the most power and torque out of it, as well as ensuring its durability.

SHAFT DIAMETER

When researching motor specs and features, rotor shaft diameter usually appears. Essentially, the larger the shaft diameter, the more durable the rotor becomes. This is especially relevant for high rpm and large-scale motors, where durability is more of a concern. One thing to keep in mind regarding shaft diameter is pinion gear selection. Since the pinion attaches directly onto the rotor shaft, it is important that you select pinions that will fit your motor. If you aren't sure, simply inquire at the hobby shop or online.

Motors designed for larger, heavier vehicles are often equipped with larger diameter shafts.

KV AND TURNS

A motor's "Kv" rating refers to its rpm in thousands (K) per volt of electricity (V). For example, a 1000Kv motor will spin at 1,000rpm when hooked up to a 1-volt power supply. If you attach a 7-volt battery, it will spin at 7,000rpm. Some brands do not list Kv, but instead indicate the motor's "turns," such as "17.5T." This refers to the number of times the wire inside the motor is wrapped around the stator — each wrap is a "turn." The fewer the number of turns, the higher the motor's rpm. When choosing a motor, keep in mind that a higher rpm motor may not necessarily make your car faster. Heavier vehicles such as monster trucks require more torque, and the motor that makes it go fastest may not necessarily be the one with the highest rpm.

Although the relationship is opposite, the concept is simple: Higher Kv = more power and lower turns = more power.

RC motors operate best under cool conditions. Keeping your motor cool via heat sinks and/or cooling fans is an easy way to gain more power and efficiency out of your setup.

Electric motors aren't very complex, and now that you know the basics, the knowledge can be applied to all of the motors on the market, helping you to make better purchasing decisions, understand your current motor's workings and get the most out of your gear.