We've all been there: standing in our local hobby shop staring at a sea of parts, trying our best to figure out what to buy. It's a common problem, and at times can be even more stupefying than figuring out which movie to rent at the local video store. Like engines, brushless motors, blades, fuel, radios, and batteries, the servo market serves up an incredible array of purchasing options. Luckily we're here to make sense of it for you, and here in this article you'll discover the various ways servos are classified, named, and designed with specific features and applications in mind, so you can easily dissect your needs and quickly select the correct servo.

**METAL GEAR vs. PLASTIC GEAR**
As the name implies, these servos have either an all-plastic or all or mostly metal gear train. There are pluses and minuses to both types, depending upon the application. The most basic difference is that metal-gear drive trains are much stronger and break-resistant than plastic-gear servos. Metal gears can, however, occasionally cause glitching with certain receivers or ESCs, and they can wear over time. It's a safe idea to replace your metal gear train before each flying season.

**CORELESS MOTORS vs. STANDARD MOTORS**
Without getting overly technical, coreless and standard servos are named as such due to their motor's internal construction. A standard cored motor has a dense iron core wrapped with wire windings and magnets surrounding it. As the motor spins, the core (which has multiple sections) causes the motor to hesitate slightly as the sections pass by the magnets, and the result is a servo that feels notchy and less precise than a coreless motor. Coreless motors, on the other hand, have a single magnetic center rather than an iron core, with the windings formed into a cylinder or bell shape around the magnet, according to Hitec and Airtronics. The coreless design is both lighter in weight and section-free, which results in quicker response and a smoother, notch-free feel. Naturally, coreless motors are more expensive to produce but offer higher levels of control, torque, and speed when compared with standard servos.

**DIGITAL vs. ANALOG**
Digital servos incorporate a type of high-frequency servo motor controller that allows them to center perfectly, hold their positions when pushed, and offer smoother and faster response. Unfortunately, some digital servos will not last as long as analog servos on throttle duties because the digital amplifier will continue to pump current into the servo motor at full throttle or idle. This dead short can cause digital servos to burn out more quickly. Analog servos, on the other hand, use regular servo motor controllers that are less accurate and less smooth, but are more affordable and more durable when subjected to throttle duties.

**What's Inside**

The servo’s control wire receives a pulse of some length, which determines where the output shaft should move to. The potentiometer senses where the output shaft currently is, and applies voltage to the servo motor until the desired position is reached. A higher voltage means a faster speed and more torque.

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**BALL BEARING vs. BUSHING**

All servos have an output shaft that must pass through the servo case, either through a plastic bushing or a metal ball bearing. Just like your heli’s bellcrank system, servos operate most accurately and smoothly when equipped with ball bearings on the output shaft. Ball-bearing servos also wear less and remain more accurate than bushing servos because the plastic bushings eventually wear out and cause slop between the output shaft and the case. It might cost slightly more, but it’s best to purchase ball-bearing servos over bushing servos whenever possible, regardless of the application.
HIGH SPEED vs. HIGH TORQUE

For the most part stronger and faster a servo is, the better it is. However, high-speed servos are best used when the pilot can respond to the heli's quickness or when super fast response is required. Most pilots don't realize that a servo may be too fast for their own reflexes, and that can make for a heli twitchy and more difficult to fly. As far as speed is concerned the rudder/ tail rotor is where servo speed is most important. Torque is useful on the cyclic and collective controls. Especially on a larger heli. Being able to hold a position and coming back to center is key to 3D maneuvers.

Picking the Right Servos

With any helicopter the best place to look for servo guidance is from the helicopter's instruction manual. Most manufacturers will indicate the basic requirements of the machine. Another place to look for guidance is in the manual of your gyro or governor. It's very important that the gyro and governor requirements are adhered to. Standard, budget servos will handle most heli loads, but because of the constant work load on servos in a helicopter the budget ones are more prone to failure. As you can imagine servo failure means crashes, crashes mean $$$ and possible injury. So it's best to stay away from the bargain bin when shopping for servos. At the very least you want middle of the road, ball-bearing servos to use on all controls. These will handle normal wear and tear and perform to a sufficient level. If you're looking to do some serious 3D or are piloting anything above a 60 size you'll want to seriously consider top of the line servos. Even if extreme 3D isn't in your immediate future, better servos are an upgrade that's yields immediate results in controllability and performance.

Depending on the size of the helicopter and the servo task, here are some recommendations to follow when selecting servos. If you have a 30 to 90 size nitro machine:

- When upgrading servos, switch out the rudder/tail rotor first. Go with the fastest servo you can afford; anything with a transit time below .15 seconds is perfect. Torque is less important but never go with less than 50 oz/in. of torque. Some gyros require a specific servo or servo type so consult the gyro's manual beforehand.
- Throttle and collective servos should always be as close to each other as possible in speed. If they're not close, the throttle and pitch response will not feel right.
- Throttle torque is not important, but stick with a ball bearing servo on throttle.
- Unless you're planning on competing at the next XFC, super fast servos are not a requirement. Almost any type of flying can be done with a servo that has a transit time
between .20 and .15 seconds controlling the cyclical and collective.
• It's best to buy matching model numbers on any servo that connects to an electronic CCPM swash plate. Find a particular servo that works for your needs and stick with it.
• For repairs at the field, buy an extra cyclical servo as a backup. Be it eCCPM or mCCPM, if you match your servos you'll find it easier to keep a backup. Also keep a stock of gears just in case.
• For 3D flight, look for servos with no less than 70 oz/in. of torque on the cyclical and collective. On a 90 size go with nothing short of 80 oz/in.

Tips For Micros
• Size and weight are more important than speed and torque.
• Always use the same servo model for cyclic.
• The faster the better for the rudder/tail rotor.

How Servos Are Rated
The most obvious and easy-to-find details available on a particular servo are its speed and torque rating. On nearly all servo packages, the following are listed clearly: brand name, model name/number, transit speed, and torque output at 4.8 volts and 6.0 volts. You may also read about metal or plastic gears, digital versus analog operation, and coreless motors. Use the information on the following pages to sift through these names and determine which servo will best fit your application.

**SPEED & TORQUE**
Servo Speed is measured by the amount of time (in seconds) it takes a 1 inch servo arm to sweep through a 60 degree arc at either 4.8 or 6.0 volts. So, a servo rated at 0.22 seconds/60 degrees takes 0.22 seconds to sweep through a 60 degree arc. That may seem fast, but not when you consider that some of the fastest servos on the market clock in at 0.06 to 0.09 seconds!

Servo Torque is measured by the amount of weight (in ounces) that a servo can stably hold 1 inch out on its output arm in the horizontal plane, again at either 4.8 or 6.0 volts. The result is a measurement that looks something like this: servo ABC = 100 oz/in. @ 6.0 V. That means that servo ABC is capable of holding 100 ounces using a 1 inch output arm without excessive deflection at 6.0 input volts.
Sealing Servos
Before heading out to the field, it's a good idea to seal your servos against the elements and fuel to prevent damage. Most high-end servos come sealed from the factory with O-rings, but the following prep will add even more protection and will not harm a thing. What are you waiting for?

1. Clean the servo if it's not brand new. Wipe away any grit or mud, and then spray the servo with motor cleaner or denatured alcohol to remove all oils and greases on the case.

2. Use a dab of silicone sealant around the wire harness where it enters the servo case. Apply it completely around the case area where the harness enters, as well as around any creases and screw holes on the case. Allow the silicone sealant to cure completely before reinstalling the servo.

3. Apply a dab of thick grease around the output shaft, and reinstall the servo horn. The grease will protect the output bearings or bushings, and it will seal the case's internals from moisture or fuel.
The Ideal Servo?
Does an ideal servo exist? That depends on whom you ask and what application you're buying for. Ideally, the "perfect" servo will move the swash plate or collective as quickly as you need, while offering lots of torque, holding power and accuracy at a cheap price. As you know, however, that servo has yet to be invented, and every servo company will do their best to convince you that their servos are superior to all the others. In the end, choosing a servo comes down to field experience and your own personal needs, because no matter how good the performance numbers or prices look on the servo box, none of that matters if the servo doesn't get the job done and keep you in the air.