

[Home](#) / [blog](#) / [Drone Motor](#)

# What Motors Are Used in Drones & How to Choose It?

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The motor is the power source of the UAV. The UAV changes its flight state by changing the speed of the motor so that the drone can achieve hover, rise or fall in the air. This article focuses on the basics of industrial drone motors and indicate how to choose the right motor.

## Drone motor definition

Definition: A drone electric motor converts electrical energy into mechanical energy. A motor consists of a stator, a rotor, an iron core, and a main part of a magnet. Motors are divided into brushed motors and brushless motors. The motor of the UAV is mainly a brushless motor. One end is fixed on the motor base of the frame arm, and the other end is connected to the propeller, which generates downward thrust through rotation.

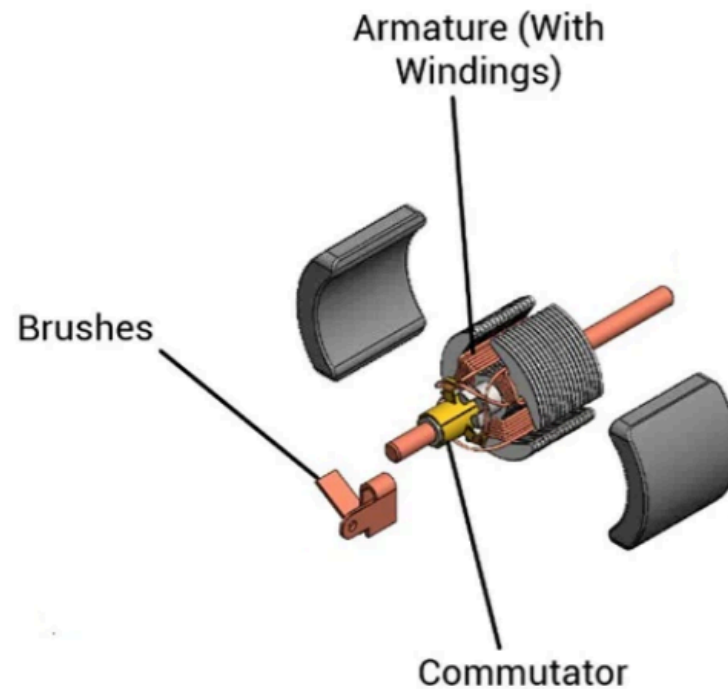


## What type of motors are used in drones?

There are two main types of motors for drones. One is a coreless brushed DC motor, which is mostly used in small toy airplanes; the other is the brushless DC motor, which is mostly designed with an external rotor. Motors of low energy consumption, low noise, ultra-long life, and high reliability are widely used in the drone industry.

The main structure of the brushed motor is the Brushes + Commutator + Armature+Casing. Because there is no iron core, there is no iron loss, so it is called a "coreless motor". The rotational torque is obtained through the rotating magnetic field, thereby outputting kinetic

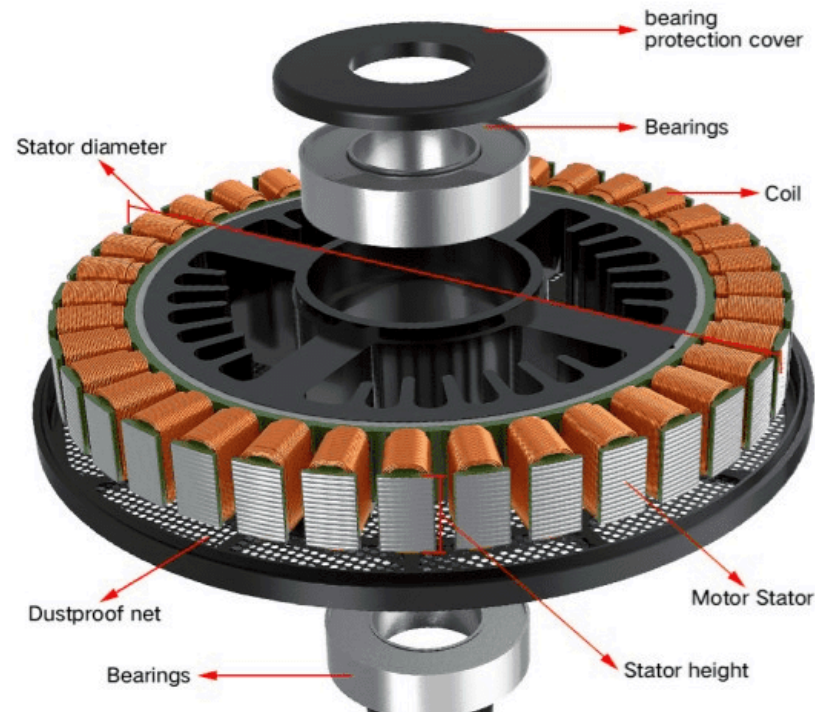
energy. Coreless motors have high efficiencies. But because of overheating under high operating conditions and mechanical performance reasons, their size couldn't be big.



For brushless motors, the work of commutation is done by the three phases carrying AC current which leads to the direction of current and magnetic fields being changed, repulsion, and attraction between the rotor and the associated permanent magnets to induce rotation.

The stator of the brushless motor is the part that generates the rotating magnetic field, which can support the rotor in rotation. It is mainly composed of silicon steel sheets, enameled wires, bearings, and supports. The rotor is made of NdFeB magnets and other materials), which rotate under the action of the stator's rotating magnetic field. The components are mainly composed of a rotating shaft and magnet.

It has the advantages of high efficiency, low energy consumption, low noise, super long life, high reliability, frequency conversion speed regulation, and etc.



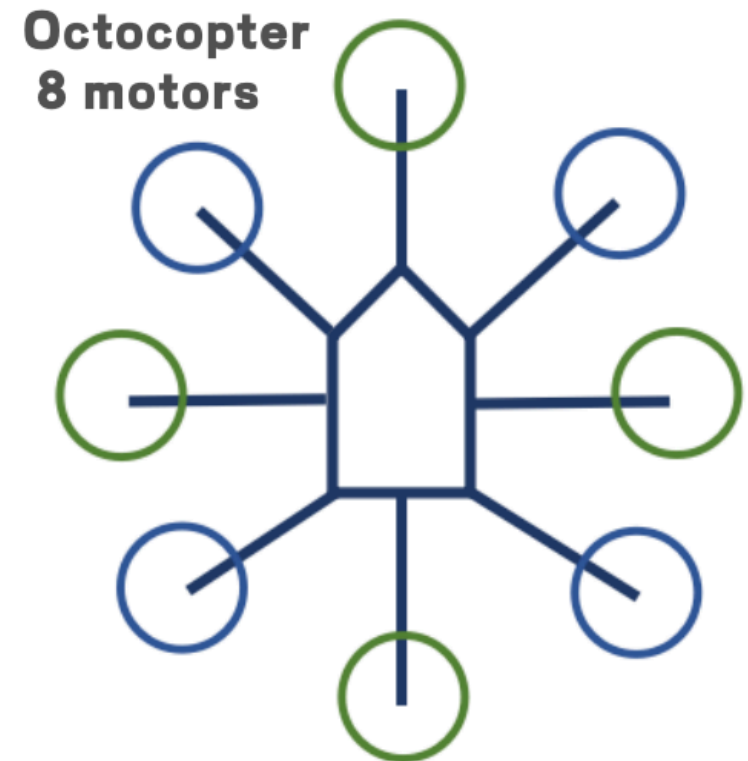
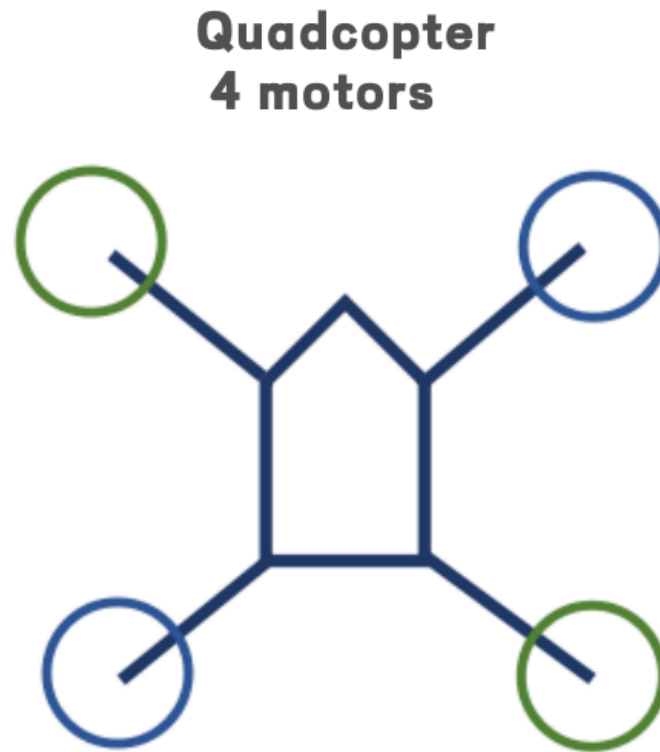
## How to choose a drone motor?

The choice of a motor will depend on the specific requirements of the drone and the desired performance characteristics. It is important to consider these factors when selecting a motor to ensure that the drone is able to perform as intended

### ***1.Motor thrust***

The first thing to consider while choosing a motor is its thrust required. How to calculate drone motor thrust, see this formula below:  $\text{thrust per motor} = \text{MTOW (Maximum Take-off Weight)} / \text{number of motors}$ .

It is not difficult to understand this formula if you understand the two necessary calculation conditions that appear in the formula: **MTOW (Maximum Take-off Weight)** and **Number of motors**.



MTOW means the drone Maximum Take-off Weight, the Maximum Take-off Weight should include

Drone weight: includes the weight of the drone frame, motors, propellers, ESCs (electronic

speed controller), batteries, landing gear, etc.

Equipment weight: any additional equipment like cameras, GPS, and FC (Flight control).

Payload weight: Any load should take into consideration.

Number of motors, you can understand how many motors a drone is composed of. For example, a quadcopter has 4 motors, octocopter has 8 motors. The number of

axes of the drone is different, and the number of motors is different.

Take an octocopter as an example. supposing the MTOW is 20 kg. Then the thrust required for each motor would be 2.5 kg ( $20 \text{ kg}/8$ ).

After knowing the pulling force required from each motor, will you see these two values marked on the motor manual: Motor maximum thrust & recommend thrust. That may be understandable. By definition, motor maximum thrust represents the maximum thrust that the motor can offer. The recommended thrust is one that we generally recommend for its job.

A drone not only needs force to lift and land, but also moves forward or backward, and rolls left and right. It is necessary to leave the motor with enough spare

power to handle resistance and emergency during flight to make sure of safety.

## 7. Specifications

➔ Max Thrust	14 kg/rotor (44.4 V, Sea Level)
Recommended Battery	12S LiPo
➔ Recommended Takeoff Weight	4.5 - 7.0 kg/rotor (Sea Level)
Powertrain Cable Length	Power cables: 720 mm Signal cable & data cable: 900 mm
Compatible Frame Arm Outer Diameter	30 mm

## 2. Motor design

When looking for motors, you will find that even motors with the same level of thrust have different appearances. Some are enclosed while others are open.



**Closed design**



**Open design**



Enclosed structure is effective to prevent sand, water, and other foreign matter from entering the motor. If the drone's operating environment is dusty, or it is inevitable that drones will come into contact with water, such as agricultural drones, it is necessary to consider closed-design motors.

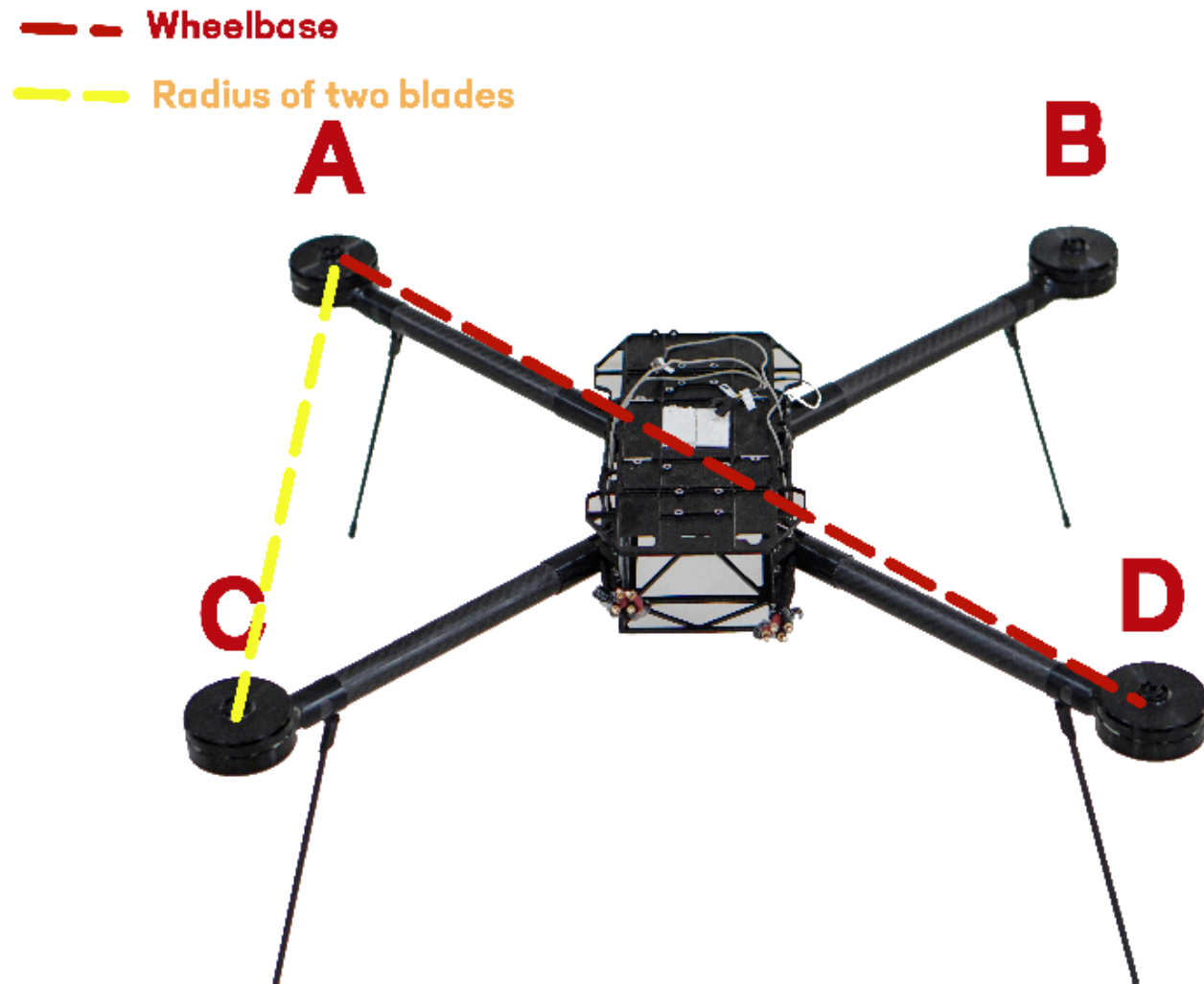
Open design motor is especially for drones that have a long-endurance requirement. Its unique structure is beneficial to motors' heat dissipation to ensure efficient rotating under long-term operation.

### ***3.Be sure the range of propeller sizes those compatible with motors match the drone wheelbase***

The wheelbase of the drone frame refers to the distance between the center holes of the symmetrical two-axis motors. The size of the wheelbase determines the upper limit of the size of the propeller. And the size range of the propeller that the motor can match is usually fixed.

Think of the four motors in the picture below as ABCD. The wheelbase is the distance from point A to point D. Then the distance from point A to point C can be obtained. It is the size of the propeller blades that can be carried.





The range of propeller sizes for each motor is fixed for a specific drone. When choosing a suitable motor, you have to ensure the maximum blade range applicable to the motor shall not exceed the allowance. Otherwise, the blades of the propeller would clash.

## How to maintain drone motors

The drone motor, as a relatively sophisticated electronic mechanical device, is the key to maintaining the balance of the drone. Be sure to get in the habit of maintaining your drone's

What type of motors are used in drones?

How to choose a drone motor?

How to maintain drone motors

motors with these tips below.



***1. Be sure the drone's work environment is within the allowable temperature range.***

Depending on the motor brand, there will be a different adaptation to the working temperature. Take the T-Motor motor as an example. The usual operating temperature of the motor is  $-20^{\circ}\text{C}$ ~ $65^{\circ}\text{C}$ . Ensure your motor starts working at a suitable temperature.

***2. Avoid water entering the motor and keep the interior dry***

If the motor indicates that it is not a waterproof one, water ingress may cause bearing rust, accelerate bearing wear, and reduce the life of the brushless motor. In addition, there is also a possibility of rusting on parts like the silicon steel sheets, shafts, and motor casings if there is water inside.

***3. Regularly check the motor bearing***

The inspection method of the motor bearing is to remove the propeller and drive motor to see how it sounds. The normal rotation has no noise, and the sound is strong. If the sound is noisy, and there are noises as if sand is inside, the bearing might have been damaged and needs to be replaced.

#### ***4. Using a mat***

It is recommended to use a thick mat on the ground when the drone takes off if the environment is dusty. Because of the strong wind during takeoff, some fine sand particles can be easily rolled up. Using thick mats on the ground during drone take-off can effectively prevent foreign objects from being drawn in by the wind hitting the motor.

#### ***5. Remember to check the motor for wear before each use***

For example, sometimes there are small stones in it, which may cause the motor to get stuck after running. Before each use, you can blow it with air or buy a can of compressed air to spray it.

#### ***6. Check for normal operation***

If a motor does not rotate or makes abnormal noise when powered on, it should be powered off immediately.

### **How to tell if a drone motor is bad?**

#### ***Pay attention to the following situations:***

1. The external structure of the motor damaged.

2. For most multi-rotor motors, if the axial movement clearance is greater than 0.5, please replace the motor.(Judgment method: measure the distance from the steel ring to the back cover).
3. Motor leakage occurs.
4. The internal resistance of the motor is abnormal.
5. The motor stops working completely/does not rotate .
6. The motor shakes or freezes abnormally, slow in reacting.
7. The winding is burned or broken, and there is abnormal noise.

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