

# Scorpion Helicopter Motor Application Guide

Since we get so many questions about the application of the Scorpion HK series helicopter motors, we have put together this guide for the entire family of motors that are currently available. Hopefully, this will help you select the proper motor for your particular application.

## HK-22mm Series Motors

At the time of this writing, there are 16 different motors in the HK 22mm line, ranging from the HK-2208-24 to the HK-2221-1630. Here is a breakdown of each motor and its usage.

**HK-2208-24, Kv = 3590, Pmax = 220W, Imax = 21 Amps**

**HK-2208-28, Kv = 3125, Pmax = 200W, Imax = 18 Amps**

**HK-2208-34, Kv = 2600, Pmax = 160W, Imax = 15 Amps**

These motors are for the smaller helicopters in the 200-370 class size that require a 3.17mm output shaft. They can be used on 2 or 3 Li-Po cells as a replacement for a stock brushless motor, or as an upgrade from a brushed motor set-up to a brushless set-up. Three different Kv values are available to match the gearing of the particular helicopter being upgraded. When choosing a motor, select the one that has the Kv which is closest to the motor being replaced. These motors have become popular in machines such as the E-Sky Honey Bee, E-Flite Blade CP and others of this size.

**HK-2208-3600, Kv = 3600, Pmax = 210W, Imax = 20 Amps**

**HK-2208-4660, Kv = 4660, Pmax = 190W, Imax = 18 Amps**

These motors are special variations of the HK-2208 motor that has the output shaft ground down to 2.3mm to fit the smaller MOD 0.4 pinions that are used on several of the smaller 200 class helicopters. These two motors were primarily designed for use in the new Gauji 200 helicopter, but will work in a wide range of smaller machines that require a 2.3mm pinion shaft. The 3600Kv motor is designed for use with a 3-cell Li-Po battery, and the 4660Kv motor is designed for use with a 2-cell Li-Po battery.

**HK-2213-14, Kv = 3585, Pmax = 330W, Imax = 32 Amps**

**HK-2213-16, Kv = 3200, Pmax = 310W, Imax = 30 Amps**

**HK-2213-20, Kv = 2640, Pmax = 280W, Imax = 26 Amps**

These motors are designed to power helicopters in the 370 to 400 size class that require a 3.17mm output shaft. They can be used on 2 or 3 Li-Po cells as a replacement for a stock brushless motor, or as an upgrade from a brushed motor set-up to a brushless set-up. Three different Kv values are available to match the gearing of the particular helicopter being upgraded. When choosing a motor, select the one that has the Kv which is closest to the motor being replaced. These motors are popular as a stock replacement for the E-Flite Blade 400, Heli-Max 400 and other machines of this size.

**HK-2216-12, Kv = 3350, Pmax = 375W, Imax = 35 Amps**

**HK-2216-14, Kv = 2920, Pmax = 340W, Imax = 32 Amps**

**HK-2216-16, Kv = 2608, Pmax = 320W, Imax = 30 Amps**

These motors are designed to power helicopters in the 400 to 450 size class that require a 3.17mm output shaft. They are normally used with 3 Li-Po cells as an upgrade from a stock brushless set-up. Three different Kv values are available to match the gearing of the particular helicopter being upgraded. When choosing a motor, select the one that has the Kv which is closest to the motor being replaced. These motors are popular as an upgrade replacement for the E-Flite Blade 400, Heli-Max 400 and other machines of this size.

**HK-2221-6, Kv = 4400, Pmax = 525W, Imax = 50 Amps**

**HK-2221-8, Kv = 3595, Pmax = 475W, Imax = 45 Amps**

**HK-2221-10, Kv = 3000, Pmax = 440W, Imax = 42 Amps**

**HK-2221-12, Kv = 2500, Pmax = 400W, Imax = 38 Amps**

These motors are by far the most popular ones in the 22mm series. They are designed to provide the maximum performance in 400 to 480 size electric helicopters. Because these motors are so popular, we will spend a little more time here giving specific application notes on each one. In addition to use in Helicopters, the HK-2221 series are also used very successfully in Airplane applications such as Pylon Racers and Hot-Liners that require a high power, high RPM motor. More recently, they have also become very popular for powering 65 to 75mm ducted fan units that are capable of utilizing a motor that is 28mm in diameter. For the purpose of this article, we will stick to Helicopter applications.

For operation on 3 Li-Po cells, there are 3 different motors that can be used, the HK-2221-6, -8 and -10 models. The most versatile model is the HK-2221-8 motor. This motor can utilize a wide range of pinion gears, and this allows the motor to “Grow” with the pilot as their flight skills improve from beginner up through moderate 3D type flying. Here are some common applications of the HK-2221-8 motor. These numbers assume a main gear with 150 teeth, which is very common for the 450 size machines.

HK-2221-8 with an 11 tooth pinion, providing a head speed of around 2800 RPM: This is good for entry level flying, hover practice and basic aerobatics

HK-2221-8 with a 12 tooth pinion, providing a head speed of around 3050 RPM: This is good for advanced Sport flying and beginning to intermediate 3D Flight.

HK-2221-8 with a 13 tooth pinion, providing a head speed of around 3300 RPM: This gives enough power for just about any 3D maneuvers, but still allows the use of a 20C 2200mah battery back, without pulling too much current.

The next most popular motor is the HK-2221-6 motor. This is THE motor for people that want maximum performance from their 450 class helicopter. Use of this motor requires a minimum of a 25C 2200mah battery and a 55 amp ESC, and carbon fiber blades are a MUST. Don't even try running wood blades with this motor! The Scorpion 60 amp Heli Edition ESC is also a very good choice for this motor for pilots that want an ESC that has a 6.0 volt BEC circuit for more speed and torque from their servos. Here are a couple common set-ups for this motor:

HK-2221-6 with a 10 tooth pinion, providing a head speed of around 3150 RPM: This is a good place to start with this motor. You have all the power needed for just about anything except for the most extreme 3D type flying.

HK-2221-6 with an 11 tooth pinion, providing a head speed of around 3400 RPM: This will get you all the power that most helicopters can handle, and will allow for any type of 3D flying out there.

If you do try to go to a 12 tooth pinion with this motor, you will get a head speed approaching 3700 RPM. This is bordering on insanity, but some pilots will try it. There are only a couple helicopters on the market that will stay together with this kind of head speed, but for those that venture into this realm of power, the sky is the limit!

The HK-2221-10 motor can be run on a 3-cell pack for those pilots that want a very gentle flying machine for just doing laps around the field. A 13 tooth pinion will get you a head speed of around 2700 RPM, and will fly a 450 class machine quite nicely. A 14 tooth pinion will get the head speed up to around 2900 RPM for a little more power.

For people that want to run a 4-cell battery pack, the HK-2221-10 and HK-2221-12 motors work very well. Basically, if you run the -10 motor on 4 cells, you will get similar performance to the -6 motor on 3 cells, but with a higher efficiency. Likewise, running the -12 motor on 4 cells will get you numbers similar to the -8 motor on 3 cells, again with a higher efficiency due to the higher voltage.

For helicopters that are designed to run on a 6-cell pack, like the Outrage G5, the new HK-2221-1630 motor is the one to use. This motor was designed for 6-cell Li-Po use to take full advantage of the efficiency that is available from running a higher voltage system in a 450 class helicopter. Many people are converting their Trex 450 and Thunder Tiger Mini-Titans to 6S power, and this is just the motor for that. Normally a 13 tooth pinion gear is used, and some are using the 14 tooth pinion as well.

That pretty much covers the 22mm series of motors, now let's take a look at the 30mm series.

## HK-3026 Series Motors

The HK-3026 series motors are designed to run in helicopters with main blades in the 400 to 450 mm size range such as the Logo 400, Trex 500, MSH Protos and others. There are a total of 6 motors in this series with Kv values ranging from 880 to 1900, depending on the battery cell count and helicopter gearing.

Here is a listing of all the motors with their basic specifications.

**HK-3026-880, Kv = 880, Pmax = 1450W, Imax = 52 Amps**

**HK-3026-1000, Kv = 1000, Pmax = 1300W, Imax = 62 Amps**

**HK-3026-1210, Kv = 1210, Pmax = 1365W, Imax = 65 Amps**

**HK-3026-1400, Kv = 1400, Pmax = 1680W, Imax = 80 Amps**

**HK-3026-1600, Kv = 1600, Pmax = 1470W, Imax = 70 Amps**

**HK-3026-1900, Kv = 1900, Pmax = 1450W, Imax = 80 Amps**

The most common power system for this class motor is a 6-cell Li-Po set-up, usually in the 2500 to 2600mah range. For this there are two motors that are most often used.

The HK-3026-1600 is a good “Stock Upgrade” motor for the Trex 500 helicopter. With a 13 tooth MOD 0.6 pinion gear, this motor will provide a bit more power than the stock Align 500XL motor, but do so at a higher efficiency. Because of this, you can still use the stock Align ESC with the HK-3026-1600 motor if desired.

The HK-3026-1600 also works well with the Logo 400 helicopter on 6 Li-Po cells. Since the Logo 400 uses a 200 tooth MOD 0.5 main gear, you will need to run a 15 to 16 tooth MOD 0.5 pinion gear with this setup.

For a performance upgrade in the Trex 500, the HK-3026-1400 is the motor of choice. A 15 tooth pinion gear is normally used, and will provide you with unlimited 3D power. This motor can draw 10 amps more current than the 1600Kv model, so you will have to upgrade the stock speed controller to a larger model when using the 1400Kv motor. We recommend something in the 80 to 90 amp range.

For a Trex 500 running on 5 Li-Po cells, the HK-3026-1900 motor is normally used with a 13 tooth pinion gear. Due to the higher current draw of a 5-cell set-up, we recommend that a 5-cell battery in the 3000 to 3300mah range be used.

For a Trex 500 running on 8-cell Li-Po power, the HK-3026-1210 is the correct motor, with a 13 tooth pinion gear.

The HK-3026-1000 motor is used in helicopters like the Hirobo Lepton, which require a motor with a Kv in the 1000 RPM/Volt range.

For the new MSH Protos, Scorpion has just released the HK-3026-880. Due to the unique belt drive system used in the Protos, and the narrow range of available pinion gears, a motor with a lower Kv is required.

The HK-3026 motors are also used in 85 to 100mm ducted fans, as well as hot-liner type planes and Pylon racers.

## **HK-4020 Series Motors**

The HK-4020 series of motors is designed for helicopters with 500 to 550mm main blades, such as the Logo 500, Logo 14, Logo 16, Century Swift 16 and others. There are a total of 3 motors available in this series, depending on the Battery cell count and helicopter gearing. Here is a list of the basic specs for these motors:

**HK-4020-910, Kv = 910, Pmax = 1820W, Imax = 65 Amps**

**HK-4020-1100, Kv = 1100, Pmax = 1640W, Imax = 78 Amps**

**HK-4020-1390, Kv = 1390, Pmax = 1890W, Imax = 90 Amps**

For most applications, the 1390Kv motor is for use with 5-6 Li-Po cells, the 1100Kv motor is used for 6-8 Li-Po cells, and the 910Kv motor is for use with 8-10 Li-Po cells.

## **HK-4025 Series Motors**

The HK-4025 series of motors is designed for helicopters with 600 to 650mm blades such as the Logo 600 and Trex 600. There are 4 motors available in this series, for a variety of battery sizes and gearing options. Here is a list of the basic specs for these motors.

**HK-4025-630, Kv = 630, Pmax = 2520W, Imax = 60 Amps**

**HK-4025-740, Kv = 740, Pmax = 24500W, Imax = 70 Amps**

**HK-4025-890, Kv = 890, Pmax = 23800W, Imax = 85 Amps**

**HK-4025-1100, Kv = 1100, Pmax = 2200W, Imax = 100 Amps**

The 1100Kv motor is designed for operation on 6 Li-Po cells, the 890Kv motor is designed for use on 8 Li-Po cells, the 740Kv motor is designed for use on 10 Li-Po cells, and the 630 Kv motor is for use with 12 Li-Po cells.

## **HK-4035 Series Motors**

The HK-4035 series of motors is designed for helicopters with 690 to 720mm blades such as the Trex 700E Or for people that want a lot of power in a 600 class machine. There are 3 motors available in this series, for a variety of battery sizes and gearing options. Here is a list of the basic specs for these motors.

**HK-4035-500, Kv = 500, Pmax = 2520W, Imax = 60 Amps**

**HK-4035-560, Kv = 560, Pmax = 24500W, Imax = 70 Amps**

**HK-4035-630, Kv = 630, Pmax = 23800W, Imax = 85 Amps**

The 630Kv motor is designed for operation on 8-10 Li-Po cells, the 560Kv motor is designed for use on 10-12 Li-Po cells, and the 500 Kv motor is for use with 12-14 Li-Po cells, depending on the gearing used and the desired head speed.

The HK-40mm motors can also be used in larger ducted fan units, ranging from 4-1/2 to 6 inches or 110 to 150mm.