MINIATURE AIRCRAFT

Whiplash

Awesome performance from this flybarless electric heli

The Whiplash is a series of new 700 class helicopters from Miniature Aircraft. Engineered and designed by Bobby Watts and Chris Lund, it features a low parts count, easy maintenance, and outrageous 3D performance. The Whiplash is offered in electric, nitro, and gasoline powered variants. Each of the variants can be purchased as either flybarless or flybarred, depending on your preference. The main rotor assembly, tail rotor assembly, and the canopy are common throughout the three versions, with the main frames being unique to each individual power plant. For this article, we are reviewing the flybarless electric-powered version of the Whiplash.

WHAT'S IN THE BOX

Besides the basic airframe, the kit includes an excellent pre-printed manual and a beautifully pre-painted canopy. No electronics, main blades or tail blades are included in the kit, as it is left up to the end user to choose based on their personal preference. Parts for each subassembly are packaged together along with the mating hardware which is typical for a helicopter of this caliber.

DESIGN FEATURES OF THE WHIPLASH

MAIN ROTOR

The main rotor of the Whiplash is predominately constructed out of machined aluminum and anodized in gunmetal grey. All pivot points are supported by ball bearings for minimal slop and friction. Each main blade grip has two radial bearings and a thrust bearing to support the flight loads. The control arm for blade

NEED TO KNOW

MANUFACTURER: Miniature Aircraft

DISTRIBUTOR: HeliWholesaler

TYPE: High-performance, 700 class, electric powered 3D helicopter

FOR: Intermediate to advanced Pilots

PRICE: $899.99

Author's Opinion

The Whiplash's mechanics are bullet-proof, and it has a number of new innovative design features. The pre-painted canopy has a great color scheme, which will turn heads while still being extremely visible in flight. Because it is flybarless, how you program the controller will decide whether your Whiplash to be mild or WILD! However, depending on how you equip your model, the Whiplash may come out tail heavy, but this is easily fixed with a minor modification. Still, the overall package is excellent, and if you can overlook this solvable issue and you'll be rewarded with a great flying helicopter that will stand the test of time.

★★★★★ AUTHOR RATING

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PHOTOS BY WALTER SIDAS AND TONY YAP

SPECS

FLYING WEIGHT: 12.4 lbs.

LENGTH: 52.48 in. (1333mm)

HEIGHT: 16.5 in. (419mm)

WIDHT: 8.9 in. (226mm)

ROTOR SPAN: 63.03 in. (1601mm)

ROTOR DISC AREA: 3120 sq. in.

ROTOR DISC LOADING: 9.16 oz./sq. ft.

TAIL ROTOR DIAMETER: 11.26 in. (286mm)

RADIO: Futaba 8FG Super heli, Futaba R6208SB S-Bus receiver

SERVOS AND GYRO: Mikado VBar Blueline 5.2 Express flybar-less controller, three Hitec HS-7945TH high voltage, high torque servos for swashplate, Futaba BLS-251 high speed brushless servo and Spektrum SPMVR5203 regulator for tail

FLIGHT BATTERY: Two Thunder Power RC 5000mAh 65C G6 Pro Power LiPo battery packs

POWER SYSTEM: KDE Direct KDE700XF-495 motor and Castle Creation ICE2 120HV brushless speed control

MAIN ROTOR RPM AT HOVER: 1800

DURATION: 4-10 min, depending on power system and flying style

MINIMAL FLYING AREA: RC flying club field or large park

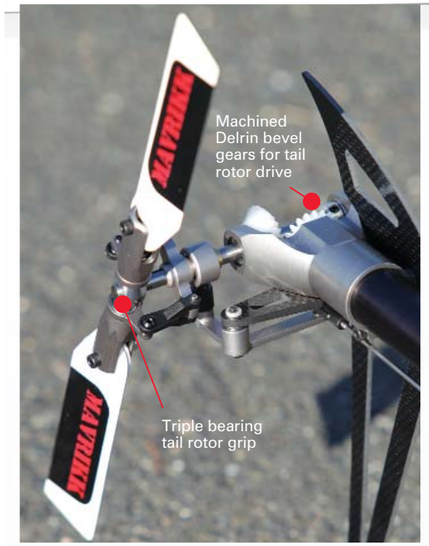
COMPONENTS NEEDED TO COMPLETE: Brushless motor, ESC, receiver, servos, two 6S 5000mAh LiPo batteries, BEC or suitable receiver battery, suitable connectors for battery and motor, main and tail blades

PROS

- Beautiful, pre-painted canopy with great visibility, bulletproof mechanics, high quality parts, outrageous flight characteristics

CONS

- Battery changes could be easier, can be tail heavy when not using separate receiver pack, but fixable with minor mod (see text)



grip is a separate piece, and attaches to the side of the grip using two 3mm screws.

The feathering spindle that goes between both blade grips is 9mm in diameter. These go into urethane dampers that press into the main rotor's head block. Two different types of dampers are included in the kit. The standard dampers are clear and are suitable for most flying styles. The other dampers are blue, and are harder, to increase the responsiveness of the rotor head and is meant for high head speeds and faster cyclic rates.

The head block itself is machined from a solid block of aluminum. It has a triangular shaped cutout in the top to lighten up the piece and add a little style to the part. It is attached to the mainshaft using a 4mm thru bolt along with clamping features that are also machined into the part. The swashplate follower arms bolt directly to the head block eliminating the need to perform any type of phasing adjustment between the swash follower arms and the main grips.

The swashplate is all metal, and had three set screws around its perimeter. The function of the set screws is to allow the user to apply slight pressure to the outer ring of the swashplate ball bearing to adjust out any slop between the inner and outer stars of the swashplate. Be sure not to over tighten these screws, as it will cause the bearing to not spin smoothly. I found the best way to adjust these screws is to tighten each one until the bearing has some friction and then back off slightly until it becomes smooth again. Repeat for the other two set screws and you'll be left with a swashplate that ultra smooth and slop free.

All of the main rotor components sit on a 10mm mainshaft. The mainshaft is supported by three ball bearings, each sitting in an aluminum bearing block.

IN THE AIR

I set up the Whiplash to provide +/- 13 degrees of pitch on the rotor head. I outfit the Whiplash with a set of Mavrikk 690 rotor blades and 105 tail blades. Using the V-Bar setup software, I set up the flybarless controller to the recommended default settings for a 700 class helicopter. Initially, I set the main rotor speed to about 1800 RPM.

During my first flights with any flybarless helicopter, I like to bring it into a hover and see how it behaves. The Whiplash easily lifted off the ground and was very easy to maintain position, even with a stiff breeze. To test the main rotor gyro gain, I like to give quick jabs of elevator. Ideally, the helicopter should pitch quickly and smoothly and then quickly stop and stabilize without any bobbles or oscillations. Typically, if oscillations are observed, the gyro gain is too high and should be reduced until the oscillations go away. I found that the recommended default settings for the VBar were near perfect. I didn't have any reason to change them based on this quick test. After checking the main rotor, I like to repeat this same test with the tail rotor. As with the main rotor, I initiate quick jabs of tail rotor which resulted in very predictable motion with no oscillation or bobbles.

After verifying that all the gyro gains were acceptable, it was time for the Whiplash to stretch its legs! With the raw power of the KDE motor, the Whiplash can be fast! The bright green canopy is great for visibility. The rear of the canopy wraps around the frames pretty tightly making backwards flight as fast as forward flight. With the Mikado VBar controller doing its thing, the Whiplash tracks on the proverbial rails.

One of the best things about flybarless helicopters is that you no longer need insanely high head speeds to get good flip rates. At 1800 RPM, the Whiplash will do pretty much any stunt imaginable. The only caveat of this head speed is that the collective response will be a little bit slower and smoother. At this speed, flight times can be over eight minutes.

The ease of swapping batteries between flights is so-so. While it's nice that you don't have to remove the canopy to change the batteries, it's not as easy as some helis which mount the batteries to a quick release tray. The batteries that I used were too large to fit through the cutouts in the side frames and had to be slid in from the rear of the frames.

After the battery swap it was time to try out the Whiplash at 2000 RPM. At this speed, collective response is awesome. Full collective tic tocs are ultra fast, with direction changes being absurdly fast. Onlookers will have their jaws open as they marvel how an R/C heli could hold together under such abuse. Fortunately, the Whiplash is designed to handle this stress with ease so stick bang away! At this head speed, expect to get flight times to be around five to six minutes. For those looking for even faster response, rotor speeds up to 2200 RPM can be used, but be prepared for lower flight times!

I was concerned that the unique clutch arrangement would hurt autorotation performance. On the bench, there does seem to be more drag on the rotor head. This is because the main rotor now has to back-drive the pinion gear during autorotation. However, my concerns were unwarranted, as I couldn't discern any large performance reduction compared to other 700 class helicopters. So, if you're up to it, you should still be able to nail those pinpoint autorotations with the best of them.

During my flight tests, I achieved the following rotor speeds and hover currents with the throttle settings shown below:

THROTTLE PERCENTAGE	ROTOR SPEED	CURRENT DRAW IN HOVER
31%	1630 RPM	20.2 A
38%	1800 RPM	23.3 A
46%	2000 RPM	28.1 A

SPECIFIC SPECS

FRAME

MATERIAL: Carbon Fiber with metal and carbon fiber spacers

TYPE: Single plate non-stacked

SERVO LINKAGE TYPE: ECCPM with direct linkages to swashplate

ROTOR HEAD

GRIPS: Machined aluminum with thrust bearings

HEAD BLOCK: Machined aluminum

LINKS: Composite with large diameter steel rods

SWASHPLATE: All metal with play adjustment

MAINSHAFT: 10mm stainless steel shaft

TAIL

DRIVE SYSTEM: Aluminum torque tube with aluminum tri-lobe ends

AUTO CAPABLE: Yes, tail is driven during autorotation

TAIL PITCH SLIDER TYPE: Brass sleeve with aluminum housing

TAIL BLADE GRIPS: Machined aluminum, triple bearing

TAIL CASE: Single piece, machined aluminum

BOOM MATERIAL: Aluminum Fiber

BOOM STRUT MATERIAL: Carbon Fiber with aluminum ends

GEAR RATIOS

ROTOR TO PINION: 1:8.85 std., 1:9.53 and 1:8.26 optional

MAIN TO TAIL: 1:4.59

TRANSMISSION AND MAINFRAMES

One thing that is unique to the Whiplash is the location of the autorotation clutch. Typically, this is mounted coaxial to the mainshaft. In the Whiplash, this clutch has been moved from the mainshaft to the motor shaft. This reduces the amount of torque the clutch sees by about one ninth, greatly reducing the stress on the component. It also has the advantage of simplifying the main gear arrangement. Now, instead of a typical complicated split gear arrangement, the main gear assembly is simply composed of a single large gear and a machined hub.

This hub attaches to the mainshaft in a fashion similar to the head block, by a 4mm thru bolt along with an integral clamping feature. This main gear assembly is situated between the bottom and center main bearing blocks. Instead of having extra locking collars to hold the mainshaft in place, the main gear hub is elongated so that it spans the full distance between these bearing blocks. The lower mainshaft bearing block is mounted on slots, to allow the builder to adjust out any play that might exist.

With high power electric motors becoming the norm, the Whiplash's transmission is beefed up to handle the power. The top and center mainshaft bearing blocks have an 'X' brace tying them together. This greatly increases the assembly's resistance to racking during hard maneuvers. Another strength improvement is that the motor mount is bolted directly to the center bearing block, again to eliminate the chance for deflection under heavy stress. Both these improvements ensure that the pinion to main gear mesh remains constant throughout the flight.

Speaking of the gear mesh, the motor mount is designed so that no gear mesh adjustment is required. You basically bolt the motor mount to the frames using the appropriate holes in the side frames and you've got the perfect gear mesh. The stock motor pinion has 14T, achieving an 8.85:1 ratio. Optional 13T and 15T pinions are also available, for those looking for higher or lower gear ratios.

The main frames of the Whiplash are milled out of 2mm thick carbon fiber plates. They have to be some of the largest carbon fiber frames that I've seen on an RC helicopter! When fully assembled, the frames are extremely rigid. The Whiplash uses direct eCCPM, meaning that each of the three swashplate servos has a single linkage that goes directly to the swashplate without any intermediate linkages. This has the benefit of fewer parts and less wear points. Also, rather than having the canopy mounting posts attach directly to the side frames, they are first bolted a small sacrificial piece that acts as a mechanical fuse during a mishap. This should reduce damage to the canopy and spare the mainframes should an impact occur.

The main flight batteries are mounted on a carbon fiber plate that runs parallel to the skids and about halfway up the frames. They are simply installed through the large cutouts in the sides of the frames and fastened with Velcro and Velcro straps. There is enough clearance to install and remove the batteries without having to remove the canopy, which helps reduce the downtime due to battery swaps.

TAIL ROTOR

Like the main rotor of the Whiplash, the tail rotor is fully machined, mostly composed of gunmetal anodized aluminum. The tail case is a single piece, which is both stronger and lighter than one made of multiple pieces. The tailshaft is 6mm diameter, larger than the 5mm shafts typically found on a helicopter in this class. Each of the metal tail grips has triple bearings, for minimal slop and maximum precision.

The tailboom itself is black anodized aluminum. Rather than a complicated assembly of the past, the Whiplash's torque tube is simply an aluminum tube with 3 cross holes drilled on each end. Each end of the tube has a tri-lobed fitting which bolts into the tube with three M2.5 socket head screws. Two ball bearings help support the tube along its span. In the event of a mishap that causes damage to the torque tube, the tube itself only needs to be replaced, and the machined ends and the support bearings can be reused.

The front and rear tail transmissions come partially pre-assembled out of the box. Each has machined plastic bevel gears, with a center metal hub. These gears attach to the shafts using dog point set screws. Take the time to disassemble to ensure that each set screw has thread lock and is fully tightened as you don't want the tail rotor to let go during a hard 3D stunt when you are inches off the ground!

PRO TIPS

- Be sure to sand the edges of the carbon fiber frames prior to assembling to prevent cut wires or fingers. Pay special attention to the cutouts for battery access and the slots for the Velcro battery straps.

- Use Loctite 242 thread lock on all machine screws that go into metal to prevent fasteners from vibrating loose during flight.

- For all shafts that go into bearings, I used Loctite 609 bearing retaining compound to prevent the shafts from spinning on the inner race of the bearing. Although this makes disassembly more difficult, it will prevent the shafts from wearing due to fretting corrosion.

- Be sure to lube the one way sprag clutch regularly to keep it spinning smoothly.

- Add a small patch of extra fine grit sandpaper between the tailboom and the tailboom clamp to prevent the parts from slipping on each other.

- The canopy comes painted, but the holes to mount it on the frames need to be drilled. Drill the front two holes first, and then mount it to the airframe. Then mark where the rear standoffs are relative to the canopy prior to drill the rear holes. This will ensure perfect alignment between the canopy and the frame with no built-in stress.

- After installing the rubber canopy grommets, apply some thin CA from the inside. This will wick in and bond the grommets and canopy together which will make the grommets last a lot longer.

- Because I didn't use a receiver pack mounted on the front radio tray, the Whiplash ended up tail heavy even with the flight packs pushed as far forward as they would go. The solution to this (which was recommended by Miniature Aircraft), is to flip the bottom plate of the mainframes so that it mounts on top of its standoff, rather than on the bottom. Then mount the batteries on the top of the bottom plate, instead of on the underside of the upper horizontal plate. This lets the batteries to sit a bit lower and clear the tail servo, which gives you the ability to slide the batteries a couple inches forward. This is enough to bring the CG perfectly in line with the mainshaft and also makes battery removal and installation easier.
- I used two small pieces of red striping tape to mark where the batteries should be positioned in the frame to get proper CG.

- To ease battery installation and removal, I used the loop style Velcro on both the battery tray and the flight packs. This prevents the battery from sliding on the tray when it is held down with the Velcro strap but make it easy to remove when changing packs.

- The manual recommends a motor with a Kv rating of 500-560. This recommendation is fine for those looking for hardcore 3D power. For those looking for longer flight times and smoother aerobatics, don't be afraid to choose a motor in the 450Kv range. With the stock gearing, this will provide a governed head speed of 1700-1800RPM, which is great for smooth aerobatics.

- I did find that the M3 button head screws that hold the tail rotor bellcrank arm to the tail case were touch too long. They bottomed out in the tail rotor case before completely securing the arm. Using my Dremel tool I removed close to 1mm off the length of the screws to fix the problem.

COMPLETING THE WHIPLASH

To power the Whiplash, I used the KDE Direct KDE700XF-495 motor along with a Castle Creations ICE2 120HV ESC. I've had great luck with this setup in the past, and in this case it was no different. Yes, the KDE motor is heavier than most 700 class motors, but it makes up for the extra weight by being extra efficient. It also has gobs of torque and power, exactly what you want for a hardcore 3D machine.

I used three Hitec HS-7945TH high voltage, high torque servos for the swashplate. These servos are capable of running directly off a 2S LiPo and are rated at 0.1s/60deg with a whopping 319 oz. in. of torque. When combined with the three-quarter inch servo arms I used, these three servos are capable of delivering over 75 pounds of force to the swashplate. Do you really need this? Not really... But, do you want it? Oh yeah!

For tail rotor control, I used the Futaba BLS-251 brushless tail rotor servo. For the flybarless gyro I used a Mikado V-Bar Blueline controller.

Rather than use a separate receiver pack, I used a Castle Creations BEC Pro regulator to save weight and eliminate the need to charge another battery. It's rated for up to 20A of current. Using the Castle Link interface, I set it to output 8V to the receiver and servos. I wired it so that it is powered off of ONE of the two flight packs rather than both of them in series. This had the advantage of reducing the stress on the BEC as it only has to regulate from 25V to 8V, rather than from 50V. It also allows me to hook up only one flight battery to test out the servos and radio without having the power to the ESC. Between the tail servo and the flybarless controller, I used a Spektrum VR5203 regulator to drop the line voltage from 8v down to 5.1v as the Futaba BLS-251 servo is not rated for high voltage.

WE USED

Futaba 8FG Super Heli radio

Futaba R6208SB S-Bus receiver

Hitec HS-7945TH high voltage, high torque servos for swashplate

Mikado VBar Blueline flybarless controller

Futaba BLS-251 brushless servo for tail rotor

Spektrum VR5203 5.1V regulator

KDE Direct KDE700XF-495 motor

Castle Creation ICE2 120HV brushless speed control

Mavrikk 105mm carbon fiber tail blades

Mavrikk G5 Pro 690mm Flybarless wide chord Main Blades

Two Thunder Power RC 5000mAh 65C G6 Pro Power LiPo battery packs

Castle Creations BEC Pro regulator

THE FINAL WORD

The Whiplash definitely lives up to its name when it comes to flight performance. In capable hands, it will do everything in the book and then some. The mechanics are some of the most robust I've seen, without being overly heavy. I liked the break-away canopy mounts as well as the heavy duty transmission, which should be strong enough to handle the power from even the strongest 700-class motor. The fact that it is from an American-owned company is a bonus, as product support is a mere phone call away.

The process to swap flight packs could be easier; perhaps Miniature Aircraft will offer a quick change mechanism in the future. Until then, it's a minor annoyance, but the Whiplash makes up for it with great flight performance and robustness.

We reviewed the flybarless, electric powered version for this review, but for those who prefer nitro or gas, flybarred or flybarless, the Whiplash will be offered in those variations as well. If you are looking for your next 700-class helicopter, the Whiplash could be your machine!

Links

Castle Creations, www.castlecreations.com, (913) 390-6939

Futaba, distributed exclusively by Great Planes Model Dist., www.futaba-rc.com, (800) 682-8948

Hitec USA, www.hitecrcd.com, (858) 748-6948

KDE Direct, www.kdedirect.com, contact@kdedirect.com

Mavrikk Blades, distributed by HeliWholesaler, www.heliwholesaler.com, (877) 454-9757

Miniature Aircraft USA, www.miniatureaircraftusa.com, (406) 245 4883

Spektrum, distributed by Horizon Hobby, www.spektrumrc.com, (800) 338-4639

Thunder Power RC, www.thunderpowerrc.com, (702) 228-8883

Mikado, distributed by ReadyHeli.com. www.readyheli.com, (888)739-4354

For more information, please see our source guide on page 97.