Kinkade

Original Radio Controlled Ornithopter

Slow Hawk 2

Instruction Manual

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1) Introduction and specifications

Slow Hawk 2

Congratulations on your purchase of the Kinkade Slow Hawk 2 electric R/C ornithopter. The Slow Hawk 2 is a new and unique electric powered R/C "park flyer" based upon the ornithopter principle, that is, the model obtains its lift and thrust from flapping wings like a real bird. The

Slow Hawk 2 also utilizes an articulated bird-like tail for positive control which functions as both rudder and elevator. Years of research and development went into the design, resulting in a simple and efficient model with excellent flight performance designed for the seasoned hobbyist or newcomer to the realm of R/C micro-flight.

New and improved features include:

* New sleek and aggresive looking fuselage design

* New high power Fusion 380 ball bearing motor with replaceable brushes

* New improved wingsail planform for better handling and control

* New heavy duty gearbox bearings

* New heavy duty ball bearing wing hinges standard

* New velcro battery and reciever mounting system

* New design accepts Hitec HS-56 micro servos

* Now great flight performance on only two lithium polymer cells

* New no glue required, tail parts are now factory glued for you

Slow Hawk 2 Specifications:

Aircraft type: Ornithopter, Micro R/C Park Flyer, Hand launched

Motor: Fusion 380 ball bearing D.C. electric motor

Battery: Requires a 2 cell 1200 Mah 7.4 volt lithium polymer battery pack.
or 8 cell 720-830 Mah NIMH 9.6 volt battery pack may also be used.

Construction materials: G-10 epoxy-glass, carbon fiber, aluminum, steel, Delrin plastic, polyester fabric, Dacron

Wingspan: ~ 42 inches

Length: ~ 31 inches

Weight: ~ 14-17 ounces

Channel: 3

Flight speed: 5 to 20 mph

Flight time per charge: 9 to 18 minutes depending on battery, power setting, and flying style.

Wind speed: 0 to 8 mph

Flying area required: roughly 50 X 50 yds.

Designer: Sean Kinkade

Manual written by: Sean Kinkade

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2) Required for operation :

1) 3 channel radio, 2 sub-micro servos, and a sub-micro receiver.

2) A 2 cell 1000-1500 Mah 7.4 volt li-poly battery pack.

(Examples of 2 cell packs in this range are the Apogee 830, GWS 1050, E-tec 1200, Kokam 1500, etc. OR.....one can still use a 7 or 8 cell, 720 mah nickel metal hydride battery pack)

3) One electronic speed control (ESC) with battery eliminator circuit (BEC), min. 8A rating.

4) DC quick charger capable of charging 2 cell li-poly batteries (or 8 NIMH cells, optional)

Warning: a lithium battery charger must be used to charge lithium batteries!

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3) Tools required

1) One small Phillips (cross-head) screw driver

2) One 3/32" and one 5/64" hex wrench.

(Hex wrenches are usually sold as a set such as by Bondhus or Allen brand. The Bondhus brand set with sizes ranging from .050" to 5/32" with ball end drivers is recommended for ease of use)

3) One 40 watt soldering iron with 1/8" tip, solder, and solder paste (flux).

4) One pair of wire strippers, wire cutters, and/or scissors.

5) One 1.5mm drill bit or equivalent, hand held drill chuck or hand drill
(drill bit and tap are often sold together as a set)

6) One 2mm tap, (available at most hobby shops, brands include Great Planes, Du-Bro, etc. If you buy your 2mm tap from a hobby shop it normally will come with the proper drill bit which takes the place of the 1.5mm drill bit listed by itself above.)

7) Small bottle of BLUE Loc-tite or equivalent thread locker. Must be BLUE thread locker and non- permanent bond, not RED!

8) Heat gun for shrink tubing on solder connections (soldering iron may also be used)

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4) <u>Before You Begin</u>

Please read entire manual before you begin so you have an overall idea of what to do.

Check all parts. If you find any missing or defective parts, contact your local HobbyTechnik dealer or HobbyTechnik.

Your **Slow Hawk 2** box should contain the following items:

1) One fuselage plate with assembled gearbox, motor, connecting rods.

2) One main parts bag.

3) Two main carbon wing spars with aluminum hinge ferrules and vinyl end caps.

4) Two smaller diameter carbon rods with ball link housing ends.

5) One wingsail and one tail assembly.

6) One instruction manual CD.

The main parts bag listed above should contain the following parts:

1) Small nylon tie straps for neatly gathering up servo wires

2) Adhesive backed velcro for battery mounting

3) Ten small 2mm screws for mounting servos, optional ESC switch, and HS-55 tail mount

4) Approximately 14 neoprene O-rings

5) Two #5-40 X 3/4" screws for wing hinge axles

6) G-10 cross shaped tail piece (for HS-55 servo use only)

7) 2mm flat head screw for elevator pushrod

8) Heat shrink tubing for solder connections

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5) Radio Selection and Preparation

The only criteria required for selecting a radio is that the receiver be of the micro variety, the radio have a minimum of three channels, and the two servos be of the sub-micro variety. An example of micro receivers currently available are the Hitec Feather receiver, the MPI MX 6800 Pico universal FM receiver, the GWS R4-P micro receiver. Slightly larger and heavier is the "M5" dual conversion 5 channel micro receiver from FMA Direct and the Hitec Electron 6 receiver.

All of the radio gear referred to in this manual is readily available or obtainable from your local hobby shop, select online HobbyTechnik dealers, or directly from HobbyTechnik. HobbyTechnik.com can provide you with complete radio, servo, ESC, and charger packages for your ornithopter.

A good complete inexpensive radio for your Slow Hawk is the Hitec Laser 4 FM which comes with rechargeble transmitter ni-cad batteries and transmitter charger. However, the best complete radio set up requires a receiver not offered by Hitec so some mixing and matching is recommended. The best overall radio system (function plus economy) for the Slow Hawk is:

1) The Hitec Laser 4 FM radio (transmitter and charger)
2) Two Hitec HS-56 servos or one HS-56 and one HS-55.
3) The GWS R4-P receiver with horizontal leads

(The above turnkey radio systems along with speed controller and battery charger are available directly from www.HobbyTechnik.com either with or without ornithopter kit in combo package.)

For flying in congested RC fields with multiple radios in use, the larger dual conversion M5 receiver from FMA Direct is recommended to avoid possible interference.

The recommended electronic speed controls at this time are the Pixie 20 from Castle Creations, the GWS ICS 300 8A controller, the GFS! 12 amp controller from Mikro Designs, Inc., or the Geat Planes C-10 Electrifly. These are all good speed controls with smooth control response and low weight. A minimum rating of 8 amps is required for any ESC used on the Slow Hawk. The GWS ESC is the most economical but there is no auto shutdown so care must be taken not to over drain the battery.

Do not use any of the 5-amp or 2-amp "slow flyer" speed controls on the market and expect them to work. They will overheat and fail. Many slow flyer planes use a Mabuchi 270 motor which has low current drain. Although almost identical in size, the motor in the Slow Hawk is a higher watt motor and therefore draws more current. Install a minimum of an 8-amp controller and you should have no problems.

Testing of various speed controls, receivers, and servos is ongoing at Hobbytechnik so other makes and models of various electronic components will most likely be suitable for use, but at the time of printing the above are the only ones recommended.

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6) Basic Assembly

Before you start assembly, it's a good idea to arrange a neat and clean work area such as a large table or work bench and if outdoors avoid working directly over grass. If a small screw or O-ring falls in the grass you may never find it.
Lay out all parts included in your kit and make sure you are not missing anything. Place small parts into bowls, or other small shallow containers to prevent them from rolling off your work table onto the ground.

A hobby vice can really come in handy for securing the fuselage of the bird while you work. If you have a vice that does not have smooth jaws, be sure to use wood blocks as soft jaws to prevent scoring of the fuselage frame when you clamp it.

Keep the wings and tail a way from the hot soldering iron!

Your kit comes with the connecting rods attached to the crankshaft for shipping and as an assembly aid but the cap screws must be backed out and loc-tite applied, then re-tightened before flying.

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7) Installing the Speed Control:

When soldering the speed control wires...PAY ATTENTION TO POLARITY! The positive speed control lead must solder to the positive motor terminal AND make sure the MOTOR leads coming off the controller go to the MOTOR, and the BATTERY leads coming off the controller go to the BATTERY side. Most controllers have leads labeled "MOT" for motor side and "BATT" or "ACCU" for battery side. If you hook it up backwards and apply battery power you may smoke the speed control and ruin it. Burning out a speed control in this manner voids manufacturers warranties on most if not all controllers so be forewarned!

Arming the speed control:

Read your speed control manufacturers instructions before operating. Some brands of controllers have safety features which require the user to arm the controller before it will operate. If your controller does not seem to work, most likely it's not due to a faulty controller, but rather due to the a safety feature so please read your ESC instructions.

All soldering should be done before the wingsail is installed on the fuselage to avoid the risk of damage to the wingsail.
Wingsail is not warranted against burns!

The Slow Hawk 2 is designed to use either JST connectors or the 2 pin polarized Deans connector (Deans part no. 1001, available at hobby shops) to connect the battery pack to the speed control.
When using polarized connectors, the POSITIVE battery lead (red wire) goes to the side of the connector with the exposed pin. The mating polarized connectors are opposite of each other so this means you will have to solder the mating speed control connector so the NEGATIVE lead (black wire) goes to the side of its connector with the exposed pin. There is no on/off switch with this arrangement if you use a typical 10 amp controller. Plugging the battery into the speed

control is "on" and un-plugging it is "off".

Some speed controllers, such as GWS ICS 300 eight amp ESC and the 10-amp Electrifly C-10, come pre-wired with two main JST type connectors. If you intend to use the JST connectors for your model and have one of these controllers, then it is only required that you solder a mating connector to your battery unless your battery also came with a JST connector.
The GWS lipo batteries do come with JST connectors attached so the GWS speed control mates to the GWS lipo battery with very little modification.

If your controller has a JST connector going from the motor side of the controller for connection to a motor, we suggest you snip the JST connector off and solder the wires directly to the motor terminals. This makes for better electrical contact. However, if you plan on swapping the speed controller from model to model, a mating connector should be soldered to the motor terminals to allow this. Just be sure to keep the leads short to reduce electrical resistence.

If you choose to use the Deans polarized connectors with a speed control please follow these directions:

With wire cutters or scissors snip the stock main connectors off but **DO NOT CUT OFF THE SERVO LEAD CONNECTOR.** Identify which set of leads go to the motor and which set of leads go to the battery (source). Strip each set of wires and tin with solder. Solder the leads on the motor side of the speed control (usually labeled MOT)directly to the motor terminals.

Please pay attention to polarity.
The new Fusion 380 motor has a small visible plus sign indicating the positive terminal.

No heat shrink tubing is neccessary on the motor terminal connections as long as the bare wires are configured so they do not touch the motor can. If you prefer, you can remove the motor from the fuselage for soldering by loosening and removing the mounting screws. Just be sure to pay attention to motor terminal polarity and be sure to adjust the gear mesh properly when you re-install the motor. The gear mesh should have a very slight degree of play, and rotate freely.

Solder the leads on the side of the speed control designated to the battery to the two exposed parallel prongs on the Deans connectors. Make sure the polarity is correct and use heat shrink tubing to cover the solder joints.

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8) <u>Installing the Receiver</u>:

Installing the receiver is very easy because it simply velcro's to the velcro mounting area on the fuselage. Cut a small piece of "fuzzy" velcro to go on the side of the receiver opposite the crystal, clean receiver with alcohol and stick velcro to receiver. The receiver can then be positioned as needed on the mating fuselage velcro.

As a safety precaution, make sure thet receiver crystal is secured so it won't fall out of the receiver in flight. A piece of Scotch tape across the crystal and receiver case is sufficient. Plug the speed control servo type lead into the **THROTTLE CHANNEL** of the receiver.

Refer to the receivers manufacturers instructions for proper polarity, but rule of thumb is: **negative lead** on wires (black or brown wire) always faces **against the circuit board of the receiver** when the lead is plugged in to the receiver. This applies to speed control and all servos as well.

Whatever speed control you choose, **it must have a battery eliminator circuit (BEC)** so the receiver can operate directly off the motor battery without the need of an additional battery. The receiver receives its power from the speed control lead going into it.

To shorten the receivers antenna length, neatly coil the antenna wire around a two inch length of a plastic drinking straw and tape to fuselage.
Make sure not to criss cross the antenna wire. You should make a clean coil of wire around the straw.
If you prefer to use a whip antenna instead of the bobbin, the new "M-72 LITE" micro Azarr whip antenna from E-Cubed R/C is recommended.

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9) Installing the Servos:

The Hitec HS-55 **(and new HS-56)** servos have thin plastic mounting flanges and no rubber mounting grommets and are therefore mounted with the short pan head 2mm screws which are in the main parts bag.

The elevator servo installs in the rear cut-out from the right side of the fuselage with the output shaft offset mounted so it is closest to the TAIL of the bird. The servo cutout has pre-tapped holes for either the HS-55 or HS-56 servos. Slip the servo in place and secure with the 2mm screws. Use a small screwdriver to tighten.

The rudder function servo mounts directly to the rocking servo tray which also has tapped mounting holes. **The servo output shaft offset is placed UP towards the top of the bird with the output shaft facing THE REAR**. Secure the tail servo to the rocker tray with the provided 2mm screws.

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10) Tail assembly and servo arms:

Tail Assembly:

The tail has one interlocking part that is fitted and glued to it with CA glue. This is now factory assembled for your convenience.

Attaching tail and adjusting servo arms:

The Hitec servos come with a bag of servo arms.

When using the **HS-56** servo you will be using the cross shaped plastic servo horn that comes with the servo, eliminating the need of the previously supplied G-10 part. It is used by itself to achieve the same 4 point O-ring tail mount so the supplied cross shaped G-10 part is not required when using the **HS-56** servo.

If you are using an **HS-55** servo in the tail rocker, the double ended plastic servo arm must be drilled. Carefully drill the two OUTER holes on each end with a .085" micro drill bit, or a 3/32" bit max. A drill press is recommended but the holes can also be drilled carefully with a hand drill. Take the cross shaped fiberglass piece and slip it over the inside of the servo arm (over the hub). Run two 2mm screws through the drilled holes in the servo arm and screw them into the adjacent tapped holes in the cross shaped G-10 part. Tighten down securely.

If you are using the recommended **HS-56** servo in the tail rocker the assembly is much simpler and does not require the G-10 part. Simply attach the cross shaped plastic servo arm to the servo as indicated below.

For those who need higher durability in the tail for various reasons, an HS-81 servo rocker tray is available from HobbyTechnik.

Attach the servo arm assembly to the servo:

You must turn radio on with your trim tabs at neutral and let the radio center the servo shaft before attaching the servo arm.

Refer to diagram. With radio transmitter ON and trim tab centered, align servo arm assembly properly relative to servo shaft and press in place. Secure arm assembly with servo screw.

Now take the tail and notice two hook shaped areas in the tail yoke area. Take the smaller sized O-rings and pull them in place into these hook areas. Mate the tail up against the servo arm assembly and carefully pry O-rings around left and right side of cross shaped piece (or cross shaped plastic servo horn) with the aid if a small flat head screwdriver. It is tricky, but with patience you can do it. Once these O-rings are in place, pry two more O-rings over top and bottom of cross shaped piece into the notched areas. You may use the same smaller size O-rings for top and bottom, but we recommend you install the two larger heavier O-rings in the top and bottom spots for a more rigid attachment. This makes elevator commands more responsive but still allow side impacts to the tail to be absorbed.
This completes the tail assembly.

This is a new shock mounted tail system that is forgiving towards servo gears and is easily removeable for transport. The O-rings are strong, but must be regularly inspected for any deterioration. If cracks or wear becomes visible, replace O-rings. Spares are included in your kit. Additonal O-rings are available from Hobbytechnik.

Elevator servo arm:

On the other servo, which controls the elevator function, you will use a 1/16" drill bit to drill out a hole in the servo arm. This hole must be tapped with a #2-56 or 2mm thread OR drilled through for a screw to pass through and a nut used.

Use the longer, heavy duty double ended stock servo arm that comes with the HS-55 (or the cross shaped horn on the new HS-56 servo.) Use these heavy duty arms only as any other arms are too fragile. Mount the pushrod screw to the OUTER hole (farthest from center) for maximum pushrod travel or the middle hole for less travel but more holding power.

As briefly stated above, once the servo arms are prepared you will need to turn on your radio so the servos center before you attach the arms or wheels to their output shafts. To turn the radio on, plug the speed control connector into the battery pack and if your controller has an on/off switch, turn it on.. The speed control radio receiver lead must be plugged into the **THROTTLE CHANNEL** slot on the receiver. Set trim tabs on your transmitter to neutral and slip the tail servo arm onto the servo shaft and secure with supplied screw. Make sure the servo arm screw is tight because this will be holding the tail onto the bird. The tail should set on the servo as straight as possible with the trim tabs centered. When viewed from the rear of the model, a left turn command should rock the tail to the left and vise versa. **Set the servo travel to 150% if your radio allows this as you will need this extra servo travel to turn tightly sometimes.**

The elevator servo set up is slightly different. Set the elevator trim tab to neutral and pull the elevator stick on the transmitter all the way back in the "up" position. Rock the tail as far as it will go forward and then slip the servo arm onto the elevator servo shaft with the tail in this position with the transmitter stick being held back the whole time. **Please note that the elevator servo arm mounts in a vertical position onto the elevator servo and the pushrod attaches to the top of the arm, not the bottom.** This will set the maximum tail pitch deflection at the full up transmitter stick setting but still allow some "up" trim to be added when the stick is at neutral. This "up" trim will be used when hand launching the Slow Hawk.

The neutral pitch angle of the tail should be about 20-25 degrees from the horizontal.

IMPORTANT: We must emphasize that the recommended servos for this model are the above mentioned **Hitec HS-56 or optional HS-55.** These servos are not only known to be suitable for their size, weight, speed, and torque, but also because they have strong output arms or discs that can withdtand the flight loads. Other brands may not and can cause a crash!

Please use the recommended Hitec brand servos only.

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11) Installing the Wing:

Lay the wing out flat on a large table. One side of the wing has dacron sleevs running down it. This is usually considered the top of the wing but in reality the wing is reversible and either side up will fly equally as well.

Unbundle the spars. The main spars have an aluminum ferrule attached to them. The diagonal spars are thinner and have a plastic ball housings attached to them.
Slip the main spars into the dacron sleeves in the leading edge of the wingsail.
Slide the spars in the sleeves running down the wingsail.
Slip the bare carbon end first into the sleeve. The plastic ball housing will protrude out the back and center of the wing and will snap onto the metal balls mounted at the root of the fuselage.

2) Ball bearing wing hinge assembly:

The hinge bearing plates are installed on the fuselage with the bearings already installed in them.
The wing spars are attached simply by slipping them between bearing plates on each side and screwing in the supplied #5-40 X 3/4" socket head cap screws. Screw the cap screws in from the front of the bird and apply BLUE Loctite to screw at the center hole at the end of the aluminum spar ferrule and screw the bolt in and out slightly to disperse the Loc-tite. This is done to avoid getting Loc-tite in the ball bearings which may damage them. Tighten the cap screws down tightly against the front of the bearing plates. Tighten down gently and the check and make sure there is no binding. The spars should move freely at the hinge. Let the Loc-tite set up once adjusted.

3) Fasten the wingsail

Now notice there are 3 slots in the center Dacron strip running down the center of the wingsail.

Slip these slots down over the corresponding posts on the top of the fuselage.
The wingsail is held in place with small included O-rings (in the main parts bag) which snap down onto the fuselage posts.

Once you have the wingsail slipped onto the posts, now snap the diagonal batten ball link housings onto the metal balls at the rear root of the fuselage. Check that the wing can freely pivot up and down.

Now get the loc-tite ready

Shake the loc-tite well and apply a drop or two to the threaded aluminum spar ferrule holes and attach the large ball link connecting rods with the cap screws provided. Depending on the date of manufacture, your kit may have #4-40 cap screws, or 3mm cap screws. Whichever it has, the threaded ferrules holes will match the screws.
Now back out the screws mounting the bottom of the connecting rods to the crankshaft, apply loc-tite and re-tighten. Tighten all four screws tightly but within reason to avoid stripping the threads. Allow the loc-tite to set up (an hour or so).

This completes the wing assembly

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12) Battery Charging and Precautions:

The new lithium polymer batteries offer even better power to weight and duration than NIMH batteries. Li-poly's are the latest trend in electric R/C and will probably replace NIMH batteries in R/C applications altogether in the near future.
Lithium batteries are extremely light for their energy output and storage. They do not have the self discharge trait of NIMH batteries, not do they require cycling, however they are affected by cold temperatures. Performance may suffer greatly as a result in temperatures below 50 degrees F.

Batteries must be kept warm when flying in cold weather or else they may not provide enough power for flight. It is recommended to keep them in a warm car with the heater on between flights while charging. An insulating pouch or wrap for the batteries is recommended to keep the batteries warm in flight. An inexpensive heating pad or small electric blanket adapted to run off a cars cigarette lighter is one possibility for keeping lithium batteries warm between flights.
For fire safety the batteries should be placed in a nonflammable container if inside a car while charging.

Never put the battery and charger near flammable material while charging as this may cause a fire. When modifying or disassembling batteries never use a sharp knife or puncture the cells because you may short circuit the battery and there is an explosion risk. Never dispose of batteries into a fire because they can explode or emit noxious gases and heavy metals.

If you are using lithium polymer batteries USE LITHIUM CHARGER ONLY! Refer to manufacturers safety warnings.
Lithium batteries MUST ONLY be charged by a lithium battery charger and manufacturers precautions must be adhered to.
Never leave batteries charging unattended!

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13) Flying and Operating Tips:

-- Please be aware of the gears moving at high speed and treat this model with caution when running up the motor! --

Once you have your model fully assembled with the radio gear installed and the battery charged you are ready to fly. The Slow Hawk 2 is park flyer, and at low throttle setting a slow flyer, however weather-wise it should be treated like a conventional slow flyer. Completely calm conditions are optimum for the the best flight performance. It can fly fine in a smooth steady wind from 5-7 mph but gusty conditions are to be avoided. Due to its ultralight design and construction it can be blown about and tumbled by choppy air. We recommend you save your Slow Hawk for calm days and try to fly it in the calm air of the early morning or late evening hours. In those conditions you will be delighted with the way it flies.

ADJUSTING CENTER OF GRAVITY (C.G.):

The Slow Hawk is designed with a layout that basically does not allow for much misplacement of its components thereby insuring the proper CG range is maintained with little concern as long as the recommended radio equipment is used. The degree of adjustment of the CG is really left only to mounting the battery either for or aft on the fuselage and this is up to the user to select according to flight characteristics.

As a rule of thumb, start with the battery pack mounted to the velcro strip on the fuselage towards the rear **area** of the velcro strip. Adjust as needed.

As stated, as long as the recommended micro radio gear is used and the battery is mounted in its proper place, the CG falls in place, basically **around** the front post where the wing sail

attaches. The receiver mounting area on the fuselage is designed for the feather and sub micro receivers ONLY if you really want the bird to float. **The Slow Hawk will still fly with an added payload, but the use of any non-micro radio components, bigger motors, heavier battery packs, etc, will possibly stress the airframe and mechanics and lead to structural failure even if the center of gravity was kept correct. Therefore, USE THE RECOMMENDED TYPE OF RADIO GEAR ONLY!**

LAUNCHING:

NOTE: Always "pre-flight" your model before each flight to make sure everything is in order and nothing has vibrated loose.

Launching is accomplished simply by setting your elevator TRIM TAB back to full up, (or about a 30 degree angle of the tail from horizontal), powering the bird up to full throttle flapping and giving it a gentle toss forward and upward. The model should climb out quickly. (If you have your elevator trim set back, and yet the model does not climb out smartly, your battery pack does not have a proper charge AND/OR you may have too much up elevator. Often times flattening out the tail and allowing the bird to gain airspeed results in a faster claimb than trying to hold the nose of the bird up with too much elevator.

Once you have it at a comfortable altitude, you can then trim the elevator trim tab forward to flatten out the tail of the model so it flies with less drag. Turn inputs will always be amplified by pulling back on the elevator stick simultaneously. Once up to a comfortable altitude you may throttle back considerably and still maintain altitude. Maintaining altitude with the lowest possible throttle setting is the key to obtaining the longest flights. Experiment cautiously with different throttle settings and flapping rates until you get a feel for flying.

GLIDE LOCK FEATURE:

The Slow Hawk 2 comes with a standard provision for gliding flight. This simple yet effective "glide lock" device, invented by Sean Kinkade, allows the wings of the bird to lock in at an optimum dihedral for both thermal glides and for safe glide-in landings. There are actually two glide modes and the model will go into one mode or the other automatically when the power is shut off by throttling down. The first mode is called the "pigeon glide" mode and the second mode is the flatter glide or lock-in mode. The pigeon glide is when the wings automatically go up to full up dihedral position when power to the motor is shut off. The lock-in mode locks the wings at a flat, more conventional dihedral which produces a better glide ratio. The glide lock device is a simple lightweight randomly activated system so throttling down will not always lock in the flatter glide on each try so several consecutive tries may be required until the wings lock in. Nevertheless both glide modes are entertaining and fun to experiment with. Here are some basic guidelines on gliding flight:

First, this ornithopter by virtue of its flexible membrane wing does not have a great glide ratio so brief glides are all to be expected in the absence of thermals. However,
you are likely to experience some great glides from time to time due to various weather conditions. This has been seen quite frequently and without an obvious explanantion.
It seems that thermals and rising air currents can come about wherever and whenever they want to and odds are the Slow Hawk will find its way into them providing the owner with a delightful glide, or even powered climb for that matter.

Tips on gliding flight:

1) Initially, gain adequate altitude to before attempting to throttle down to a glide. Once you have a feel for it and are adept at throttle control and its effect on flight, then glides can be attempted at lower altitudes.

2) It's recommended that you recover from a "pigeon glide" before getting too low to the ground by throttling back up to flapping mode.
During thermal activity you may find the bird will decend rather gently even in the pigeon glide mode.
Use your own descretion when landing.

A lock-in glide on the other hand, will almost always make for a nice landing. You will be able to discern the difference between these two types of glide modes in no time at all since the pigeon glide mode is more like a parachute maneuver and when the wings lock-in, the wing angle is much flatter than full dihedral and the model will actually glide.

4) Here's an important rule of thumb: THROTTLE DOWN SLOWLY to lock in the glide-lock device. Once locked into a glide, THROTTLE UP SMOOTHLY BUT QUICKLY to resume flapping without experiencing a transitional period of instability. Throttling up very slowly from a flat glide mode can result in a porpoise effect that can sometimes lead to the bird somersaulting! Throttling up from a pigeon glide mode is not as critical and can be done slower.

5) To get the ornithopter to turn tightly in a glide you will need to pull back on the elevator stick simultaneously with the turning command. Coupling the elevator command with the rudder command accentuates the turn. This applies for powered flapping flight as well.

6) There is much to be experimented with in the realm of ornithopter flying techniques. There is a strong throttle component involved in flying the ornithopter and you will learn that precise throttle control is an important factor in putting the bird through its paces. We suggest making the throttle stick on your transmitter smooth and therefore more sensitive to speed control commands by opening the transmitter case and flipping over the flat brass spring on the throttle gimbal. This will eliminate the indents and ratchet like feel to the throttle stick and provide a smooth pressure to the throttle stick. You will find the throttle control resolution much higher as a result.

LANDING THE MODEL:

Landing is done by gradually lowering the throttle until the bird starts to descend and flying the bird gently to the ground and chopping the throttle at the last second, OR, by locking into the flat glide mode and gliding in for a landing. DO NOT attempt a landing in the pigeon glide unless you have good thermals and see that the bird decends slowly in the air first. If you find yourself coming down fast in a pigeon glide, recover with at least a burst of flapping to slow the model down before touch down.

Another more skilled form of landing is carefully flying the bird back to yourself and catching it.

And also, be careful not to exceed the range of your radio receiver as the micro receivers do have limited range.

TRIMMING THE MODEL:

1) PITCH TRIM (elevator function)

The pitch trim is seldom an issue if the proper radio gear is installed, the battery pack positioned properly, and the CG range is correct. The included ball link elevator pushrod is factory set to mechanically position the tail within limits that are trimmable with the radio transmitter trim tabs. The pushrod is threaded nonetheless so the length of the pushrod can still be adjusted if needed.

2) YAW AND ROLL TRIM: (rudder function)

The Slow Hawk 2 wingsail is manufactured with great care to ensure a symmetry between the left and right wings. Even so, various factors in the flexible wing design may lead to a tendency for the model to pull to the right or to the left during flight. Some of these factors may include a subtle but inherent difference in left/right carbon wing spar stiffness, or a slight inherent bias in the wingsail fabric. Most people report little if any trim adjustments needed in their model and small trim adjustments can simply be made with the transmitter trim tab on the rudder stick. However, if you find that your model pulls to the right or to the left in flight to a degree that it is awkward and perhaps even annoying, there are some adjustments that can be made to correct the problem. A properly trimmed model is also a more efficient flyer so trimming the model properly is recommended if needed.

First a little ornithopter theory which willl make more sense out of the wing trimming adjustments plus since you bought this kit you are probably of the mindset that wants to know a little about how the machine flies.

The debut of the commercially available RC ornithopter by Sean Kinkade as a successful flying machine was a result of side-stepping much of natures complexity and replacing it with a bare minimum of requirements to facilitate a machine that looks and flies similar to a bird. The membrane wing on Kinkade ornithopters is more like a hybird of a bird wing and an insect wing, since it has an unjointed main spar. One FAQ heard by us over the years is "how can the ornithopter fly when the wing pushes up just much air as it pushes down since it has no joint to spill the air like a live bird". What this question doesn't take into account is thrust, and subsequent airspeed which generates lift due to the angle of attack of the wing just as with a fixed wing airplane. So although there ARE some curious aerodynamics at work in a flexible flapping wing, which you will most likely observe during the course of flying the model, the wing basically consists of an inner lifting section and an outer thrusting section separated by a diagonal batten. This batten however is flexible and allows lift and thust to be shared by both sections along the wing.

The ornithopter derives most of its thrust from the outer portion of the wing membrane. The thrust is coming off the wingtips in a semi-circle relative to the fuselage axis and the wings are in essence oscillating linear propellers. The thrust is coming off both the left and right wings and any difference in thust between the two wings will result in a turning tendency. One way to look at it is similar to a twin engine plane so to speak. Due to the mechanical advantage of the thrust against the wing spars which are of course attached to the fuselage, any imbalance of the wing thrust will easily overcome or fight against any other forces that might counter these forces such as the tail angle or weight shift of the battery, etc. So, what a trim problem usually boils down to is a thrust imbalance of the wings which can be corrected in several ways. Below

are the recommended corrective actions which are listed sequentially. Naturally the minimal amount of adjustments to correct the problem should be made, so the steps should be followed in the order listed with test flights after each step until the trim issue is resolved.

Trimming the wing:

Step 1) Flip Wingsail:

If you find your Slow Hawk has a turning tendency that cannot be comfortably corrected by the radio transmitter trim tabs, the first thing to do is remove the entire wing sail (leaving all spars intact) and flip it over and re-install it onto the spars. You may unsnap the diagonal battens off the steel balls in order to slip them into the wing sleeves. Be sure to snap the plastic housings back onto the steel balls afterward.
This often corrects the trim problem. If this does not correct the trim problem or reduce it to a satisfactory level, follow the instructions below:

Step 2) Use Small Paperclip Ballast

If your bird still has a turning tendency after implementing step one, a small office paperclip may be used to counter the turning effect. A very small paperclip can be used which adds very little mass to the wing and will not effect the efficiency of the model.
The smallest available common black steel type clip with the chrome handles available at large office supply stores is recommended. Once attached to the wing, the chrome handles can be removed leaving a small unobtrusive black clip.

The paperclip should be attached to the leading edge of the wing opposite the direction of the turn tendency, beginning with just 2 or 3 inches out from the aluminum ferrule. If the bird tends to turn to the right, the clip should be added to the left wing and vice versa.
The paperclip can be moved outward along the wing in slight increments as needed until the trim problem is solved.

This technique not only works by counterweight alone, but by adding inertial mass to the wing during flapping. The added inertia mass (however small) is enough to cause the opposite wing to make a slightly larger stroke thus creating more thrust which corrects the trim problem.

The above two steps should have by now corrected the trim problem. If not, continue to step 3.

Step 3) Adjust membrane tension:

A looser wing membrane "feathers" more during its wingstroke and takes a smaller bite of air which produces less thrust. A tighter wing membrane (up to a point) feathers less and take a larger bite of air and produces more thrust. So, a model with a trim problem has one "faster" wing and one "slower" wing.

To "speed up" one wing, or cause it to produce more thrust, the wing membrane must be slightly tightened ALONG THE SPAN.

A) If your model pulls to the RIGHT, tighten the RIGHT wing membrane.

B) If your model pulls to the LEFT, tighten the LEFT wing membrane.

Tighten the wing membrane by opening the overflap, then grasping the dacron FLAP at the wingtip and giving it a quick tug to pull it loose from its adhesive. Don't worry, the adhesive is pressure sensitive and it will stick back after adjusting. Once you have the flap un-attached, pull the dacron sleeve slightly along the span of the wing towards the wing tip no more than about 1/4 inch. Re-cap the wingtip flap around the spar tip tightly and apply pressure to it to hold the new position. Tightening this wing will give it more thrust. If you notice any excess tension in the opposite wing indicated by taughtness and tension wrinkles, that wings tension can also be relieved by uncapping its wingtip flap and relieving its membrane tension. Loosening the other wing will give it LESS thrust. The objective is to have both sides of the wings in equal tension but if one side needs a bit more tension than the other to properly trim the model then that is what is required. (NOTE: SOMETIMES doing this adjustment OPPOSITE to the above instructions corrects the problem! There are several variables involved and it has been observed that sometimes this process works oppositely. This little mystery is yet to be solved but we're working on it.) If this still does not correct the trim problem go to step 4.

Step 4) Swap spars:

Main Spars:

Swap main spars, or swap main spars and rotate them. Flight test.

Diagonal Spars:

Swap diagonal spars, or swap and rotate. Flight test.

You may want to start with the diagonal spars first since they are simple and quick and if they correct the trim issue, no need in troubling with the main spars.

If you have a trim problem with your Slow Hawk wing that cannot be corrected by the above techniques, please contact HobbyTechnik or your HobbyTechnik dealer.

14) <u>Disclaimer</u>

Thank you for purchasing this ornithopter model. Using careful building practices, you will produce a fine flying model. Due to the model being built outside the control of HobbyTechnik and it's dealers or distributors, the company can not accept liability for the final results of your model. Likewise, the performance of the model and any occurrences resulting from the use of this model are solely the responsibility of the purchaser. Remember that at all times this model is capable of severe physical and property damage, possibly even death. Treat it with the same respect you would a loaded weapon.

Kinkade ornithopters are not meant to be used to control nuisance birds at airports, golf courses, landfill sites, or vineyards, nor used in conjunction with any other type of wildlife control.

15) <u>90 Day Limited Warranty</u>

HobbyTechnik warrants all Kinkade RC ornithopters against manufacturers defects for 90 days from date of purchase.

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