Kalt 'Whisper' kit review

There have been rumours of an impending Kalt electric helicopter for at least four years (in fact, I saw a picture of a prototype flying well over a year ago). The fact appeared at Sandown Park this year and its sparkling climb performance made a big impression on me. The full name is the 'Baron Whisper', the name 'Baron' being synonymous with Kalt models.

Having just reviewed the 'Space Baron', I was surprised (and delighted!) to be invited to do a kit review of the 'Whisper'. Actually, I was hoist by my own petard, since I had openly stated that I did not consider electric helicopters to be a practical proposition at this point in time. My reasoning for this was based on the fact that a lot of charge time was needed for what I felt was bound to be a fairly short flight.

In fact, with the recommended charger, a charge time of only 16-17 minutes is needed for a flight of up to 7 minutes, which completely demolishes my reasoning.

How is it done?

The 'Whisper' is very light. Claimed weight is 1150 to 1250 grams and the review model came out at exactly 1200 grams (42.5 ounces), complete with 8 cell 1100 mAh battery pack. This is achieved by the use of quite delicate construction and the model needs careful handling.

At the root of it all is a very complex one-piece moulding which makes up the complete chassis, including all bearing housings and servo mounts. These mounts are fully adjustable and can accommodate full-size servos, although mini servos are obviously preferable. The chassis also includes a clamping socket for the tailboom, the motor mount and platforms for the gyro and receiver.

A miniature undercarriage, of the now familiar 'tuf-strut' type bolts to the bottom of the chassis. The kit includes a modified form of mounting which adds a damper between the U/C and the chassis. This is to avoid problems with ground resonance when flown from smooth surfaces.

Pitch input is via a modified form of the old 'Baron 50' system and utilises two swinging arms which translate a twisting motion of the pitch slider into an up and down motion. However, instead of one piece of wire moving in a slot in the mainshaft, two external wires take the movement up to the mixer unit. These wires pass through the top bearing and the swashplate. The really ingenious part of all this is that the swashplate moves on two gimbals, instead of a centre ball, leaving the centre of the swashplate clear and giving completely slop-free support. This is so obvious, that it took a genius to think of it! Watch out for many copies.

Apart from being made up of very skinny plastic mouldings, the rotor head design is very conventional. It utilises a 'flexiplate', rather like the original 'Cyclone', made of GRP material. A reinforcing plate supports it from below and prevents the rotor blades sagging. The mainshaft is a very thin walled tube, as is the flybar. This latter component is very easily bent and should be treated with respect.

Another thin tube is used for the tailboom which accommodates a very small toothed belt tail drive to the gem-like tail 'gearbox'. The drive is taken from the bottom of the first stage of the double reduction drive from the motor to the mainshaft. The fin is mounted on the side of the tailbox and there is no tailplane.

Between the main chassis and the U/C legs there are half formers which brace the whole unit. The front one of these also holds the canopy via four self tapping screws. Very similar in shape to the 'Baron Alpha' (known in the US as the 'Excalibur'), the canopy is very thin and light. Like the chassis, it sets very high standards of plastic moulding.

Almost like an afterthought, the drive battery is held by two reusable nylon tye wraps attached between the U/C legs. If the previously mentioned damper is not fitted, the canopy blends nicely into the battery and extra cooling is supplied via the nose intake.

Some thought has gone into the very comprehensive decal set. This not only includes two basic trim designs, but these are designed in such a way that they can be cut up into several pieces and used in numerous different ways. If your model looks like anyone elses, it is pure laziness on your part!

Also available, but not included in the kit are a new miniature gyro and a very compact MOSFET speed controller. The gyro has a single gain control and a neutral adjustment, plus a reversing switch, and weighs just 1.5 ounces. Included in the speed controller is a battery elimination circuit which supplies the power for the receiver, servos and gyro from the drive battery. A starter button is included so that you can check out the radio without any danger of the motor starting. There is no cut-out included to switch off the motor before the receiver voltage drops to a dangerous level. This is not a problem since, being a helicopter, the model stops flying well before the radio is affected. However, if you persist in running the motor beyond this point you can get a situation where the motor is still running slowly and you cannot switch it off.

Assembly

As is now becoming standard practice, the kit box consists of a moulded foam tray housing the components, with many of the basic items pre-assembled. The main chassis unit has the mainshaft ready installed, together with the second reduction gear, pitch slider, swashplate and mixer unit. Rotor head and tail box are fully assembled, but it does pay to check that threadlock has been used in vital areas.

Section 1 of the very comprehensive manual covers the assembly of all those items which are supplied pre-assembled and provides a useful maintenance check. Section 2 covers assembly from this point onwards. At the rear of the manual, there are some updating instructions which cover the fitting of the undercarriage damper unit and several other small improvements.

As stated earlier, the purpose of the damper is to avoid ground resonance problems when operating from a smooth surface. It adds around 1.2 ounces to the weight of the model and gives it a rather untidy appearance. If you intend to operate from smooth surfaces, particularly indoors, it should be fitted. However, for normal outdoor use, from grass, it can be omitted. If in doubt, fit it anyway! I fitted it originally and removed it later.

Having decided on that issue, the undercarriage and battery retaining tye wraps can be fitted and form a useful handhold for further work. With the half formers fitted between the chassis and U/C the whole unit becomes much more rigid and easier to work on. This and much of the rest of the assembly is carried out using self-tapping crosshead screws, usually of M2 size and frequently only 5mm long. Apart from my well publicised dislike of crosshead screws (purely personal - no criticism!), my rapidly aging fingers did have the odd problem handling these. My own reaction to this situation is to regard it as an enjoyable challenge, but those who have dexterity problems may need help.

The next stage is to add the flybar and paddles. The flybar is actually tapped to take the fixing screws, despite the fact that it is a very thin walled stainless steel tube. This is not immediately obvious and not referred to in the instructions. You can then make up the various linkages that complete the rotor head.

At this point, the manual moves on to fitting the tailboom and tail box. I found it much easier to fit the servos and remaining linkages first since the model is much more manageable without the tailboom. The adjustable servo mounts work very well but are very fiddly. You can go on to fit the receiver, gyro, speed controller and receiver too if you wish, since the boom is not essential to any of this. No recommendations are made in the instructions for the position of the switch and start button, which are part of the speed controller. I mounted the switch on to the cyclic servos with servo tape and the start button at the front of the chassis where it is accessible via the cooling intake. I always prefer to keep the actual canopy unencumbered by such things to make removal easier.

The motor position is adjustable to set the correct mesh to the first reduction gear. This gear includes the take-off point for the toothed belt tail drive and is normally added after installing the tailboom. However, if you do it my way you can install it temporarily to set the mesh and complete the radio installation without the boom. A reasonably tidy installation is possible with the use of miniature nylon tie wraps, although the collective servo lead will probably need extending. The lead from the recommended gyro to its electronic package is just long enough.

Fitting the boom is very straightforward apart from threading the drive belt through it and ensuring that it is not twisted (the belt that is). Belt tension should be fairly light. After some years experience of toothed belt drives on various helicopters, I have come to the conclusion that the correct tension is the lowest that you can get away with.

The boom is braced to the rear undercarriage legs by two metal pushrods with adjustable clevice’s at each end. These seem to be mainly cosmetic at first glance, but try flexing the boom sideways with and without them and you will see that they stiffen things up quite considerably. The clevice’s supplied for this, and the head linkages, have quite a lot of moulding flash and need careful cleaning up. I still had difficulty getting them to work satisfactorily and resorted to using short lengths of silicon tube over them to act as 'keepers'. Kalt used to include some superb links of similar design, complete with keepers, in their kits for use on the tail rotor linkage. These are not in the same league.

Tail rotor control is via a piano wire pushrod in a plastic sleeve. This is attached to the boom by the usual vinyl tape and the manual insists that this must be dead straight. The problem here is that it passes around numerous protuberances along the way and the tape will deform its path considerably. I resorted to using plasticard packers, attached to the boom with cyano, at each tape point.

Very little trimming is needed on the body halves which are joined with cyano adhesive. The canopy needs some trimming to achieve a good fit and is secured by the usual Kalt system of small self-tapping screws. I have always found this system to work beautifully and am baffled that so many people seem to adopt other, less neat, methods of fixing. I did find it necessary to reinforce the hole points in this case since the body material is so thin. Interestingly, reinforcing pieces are supplied for the points where the body is attached to the chassis, but the manual makes no mention of them! Attachment is by means of 4 of the previously mentioned M2 x 5 self-tapping screws.

Finally, the main blades have to have reinforcing pieces fitted to the roots and are then covered with heat shrink material. The blades supplied were of composite wood construction, but the manual also refers to plastic blades. Slightly different root reinforcements are used and the kit contains both types. Care is needed when shrinking the covering to avoid crushing the soft balsa trailing edges of the blades. The completed wooden blades weigh 1.6 ounces (42.5 grams) each.

Setting up and testing

Recommended servo arm length for all four servos is 8mm. The review model used JR NES-307 servos, which are supplied with a miniature servo arm which is actually 7.5mm long. These were used throughout with no problems and proved just about ideal.

The recommended pitch range is 0 degrees at the low point, +9 degrees in the hover, and +12 degrees at the high end. If you are an experienced pilot and intend to perform aerobatics, these figures become -3 degrees, +8 degrees and +9 degrees respectively.

No recommendations are given for total control throw, but the servo arm length mentioned gave almost the maximum available movement of the swashplate. Full movement of the tail rotor bellcrank was also available, which gives a colossal range of tail rotor pitch (something like -15 degrees to +30 degrees at the blades).

Kalt's own speed controller has just one adjustment. This sets the bottom end of the range so that the motor can be set to stop at the lower end of the stick travel. Actually, I set things up so that the motor started at low stick and about half trim. I also set the throttle hold so that it prevented the motor from starting - belt and braces! If you start the motor by advancing the stick, the start will be quite sudden and the rotor blades will be thrown back with possibly damaging results. My method is to advance the trim slowly until the motor starts and then use the throttle stick.

A prototype model that I flew a little time ago had a speed controller which also stopped the blades very suddenly, which took some getting used to. The production version does not seem to have this problem and closing the throttle suddenly lets the blades coast gently to a stop. One thing you should be aware of, however, is that the full range of the speed controller is much less than the normal stick throw. This means that you will get full power at around half throttle, or less. This is no problem if you have a modern transmitter with adjustable throttle range, since you can reduce the stick range to suit the speed controller, but may give problems with older sets.

The miniature gyro available for the kit works very well provided that you do not turn the gain up too high. If you do, the neutral becomes very difficult to set consistently and the response to the transmitter becomes very excessive. This does not occur at less than about two thirds of the maximum gain, which is more than adequate for the 'Whisper'.

Charging the drive battery is a matter of individual taste - you don't have to use the recommended unit. As a kit review of a helicopter, the charger is not directly relevant to this article anyway, but I did find the Union Model unit which is available from J.Perkins (Distribution) Ltd, the Kalt importers, to be very efficient and easy to use. The fact that it is fully automatic, removes much of the 'hassle' from electric flight and it can be used with just about any drive battery having 4 - 8 cells. It includes a booster to give 15.5 volts from a standard car battery and is a good investment if you have other electric models.

At the time that I finished the model, the weather was being uncooperative and I really wanted to try it out. If you remove the main blades and are careful, you can run the model up in your hand by holding firmly on to the battery. Be especially careful with the tail rotor input if you do this - it is very powerful. In fact, I don't really recommend this practice at all, but if I didn't mention it, someone would try it anyway!

Don't be tempted to fly indoors unless you have lots of clear space available.

Flying

I did try flying indoors and found that ground resonance was a problem. I had set the model up with some negative pitch and the first reaction, when the model began to shake violently, was to turn it off. The result was a minor boom strike. I removed the negative, but soon learned that the only real solution to this situation is to open the throttle and power out of it.

The damper does help, but the biggest help is to have the main blades fairly tight in the blade holders so that they cannot move too easily. This is why opening the throttle is needed to get out of the condition, since it will pull the blades back into the correct position if they have moved. I have gone on somewhat about this to stress that you not fly indoors and/or on a smooth surface unless you are very experienced and have lots of room. trying to keep the model within a restricted area and cope with resonance is a recipe for disaster. Outdoors, it's a different story...

My first outdoor flight was in quite windy and turbulent conditions, but I couldn't wait any longer. The result was a total anticlimax. Simply opening the throttle produced a straight lift-off into an incredibly stable hover, with the throttle/collective stick well below the mid-point. Head speed was quite low and the blades adopted a noticeable coning angle, which accounts for the stability. I had started a stopwatch immediately before lift-off and 6 minutes and 40 seconds later the model sank gently to the ground.

Subsequent flights have revealed that there is a progressive change of tail rotor trim during the flight as the battery loses power. This is tied to the increased pitch which is needed to compensate for the power loss and it should be within the capabilities of the ATS system to trim it out.

I am not yet convinced that the hovering pitch figure of +9 degrees is at all necessary, as indicated by the low position of the throttle stick. However, the requirements to get photographs for this review before becoming too adventurous, together with a batch of bad weather, has so far prevented further experimentation.

Conclusions

It is a little fiddly to assemble, it needs some care in handling and you can't fly it in your front room. However, it is a practical model helicopter with a 'no-fuss' charging system.

Specification

Main Rotor Diameter	37.4 in (950 mm)
Length	35 in (890 mm)
Weight	42.5 oz. (1204gm) With 4 NES-307 servos, mini gyro, mini speed controller and 9.6v 1100mAh drive battery
Control Requirements	4 servos, speed controller with BEC and a gyro

Kalt 'Whisper' up-date - Whisper who dares

As a result of some nine months experience of flying a Kalt 'Baron Whisper' helicopter, I have discovered several interesting facts about electric flight in general and electric helicopters in particular. As an electric model flying fan of around ten years standing I had become tired of waiting for the technological 'breakthrough' which would make it a truly viable alternative to the internal combustion engine.

Does it go?

With a fully charged battery, a properly set up 'Whisper' is capable of quite startling performance, once you realise that its characteristics are different from a glow powered model. Applying a lot of pitch will cause the rotors to slow down quite dramatically. With an IC engine model, this could be disastrous, but with an electric powered model the motor draws more current and produces more torque and the result is a startling climb rate.

This performance is achieved by keeping the weight down to the absolute minimum and the result is quite a fragile model. There have been several articles in US magazines which lay great emphasis on this relative fragility - as if it were something to criticise - and go on to say that better materials could be used. It must surely be obvious that a more robust machine made from heavier materials would be a marginal flyer. It never ceases to amaze me that the average modeller thinks that models should be designed to crash, rather than fly.

My own opinion is that the design is a marvel of 'just enough' engineering and could not be improved. The one item that should be treated with extra care is the flybar, which is a very thin-walled stainless steel tube.

Starting up

It is very easy to treat any electric model with contempt and assume that it cannot do you much harm. In fact, they are more dangerous in many ways than glow powered models. You actually have to work to start a glow motor. Make one mistake with an electric model and it will start itself! Stall a glow motor and it will stop. Do the same with an electric motor and it will draw more current and hit you harder. Apply enough resistance to stop it and it will restart again when the resistance is removed. Hold it in a stalled state for more than a few seconds and it will set fire to something!

Have you got the message? Adopt a starting sequence that reduces the possibility of mistakes and ensure that you can stop it when required. With an electric motor, minimum speed means maximum torque. What this means is that if you start your model by simply opening the throttle, the probable result is that the rotor blades will be left way behind the rotor head and the model will destroy itself!

The set up that I use is as follows:
1) The throttle hold is set up to stop the motor.
2) Low throttle stick and low trim stops the motor.
2) Idle up is set up so that low throttle stick and low trim does not stop the motor.

Starting procedure:
1) Turn on transmitter and set the throttle stick and trim to low, throttle hold 'on' and idle up 'off'.
2) Turn on the receiver and check that the controls work.
3) Press 'arming' button on speed controller and stand clear.
4) Throttle hold to 'off'.

5) Advance throttle trim slowly until motor starts.
6) Open throttle to just below lift off point and turn idle up 'on'.

You can now fly the model without any danger of inadvertently stopping the motor in the air by lowering the throttle stick or trim. If necessary, the motor can be stopped by the throttle hold switch.

Rotor blades and ground resonance

I imagine that the models designer must have presented himself with quite a dilemma when he came to the rotor blades. Part of the models performance can certainly be attributed to the fact that the rotor blades are very light - and we all know that heavy blades fly better, don't we?

Originally, I had lots of problems with the blade tracking. Having got the model to fly reasonably well in still air, even the lightest wind would send the blades way out of track and produce lots of shaking. A discussion with Jim Davey produced the consensus that the blade CG was too far back. I made various attempts to correct this without success, until I realised that the real problem was that the chord wise CG's of the two blades were markedly different - not an easy thing to check.

Because the blades are so light (about 1.3 ounces in unfinished state), the quality of the balsa wood used in the trailing edges is very critical. Two apparently identical blades (same weight and span wise CG location) were found to have chord wise CG's at 32% and 39%. No amount of added weight to the leading edge of the blades could correct this situation. After much experimentation, I now have a set of blades which run quite well, but one of them actually has lead tape added to the trailing edge!

It would seem that the only practical way to produce very light blades with a well forward CG is to add a piece of piano wire to the leading edge. If this is wrapped around the blade root, it is about the safest way of adding weight. A quick check reveals that 16 swg wire (1.5 mm) will add about 8.5 grams to each blade (a 20% increase) which seems about right. I intend to try this and will keep you informed.

Unmatched blades will contribute considerably to ground resonance problems - particularly in still air. I believe that part of the problem lies in the fact that the lower fin is very close to, or in contact with, the ground. The kit includes an undercarriage damper which, apart from cushioning the vibration, also raises the fin above the ground. I very soon discarded this damper since it did not really seem to help very much and it added 1.2 ounces to the weight.

Ground resonance is caused by one of the blades moving so that the rotor disc is out of balance. This starts a shaking which is made worse by the fin hammering on the ground. In this situation, you should not reduce power - it will make things worse. The correct action is to increase power to pull the blades back into line. It helps a lot to have the blade fixing bolts fairly tight. Loose blades make things much worse.

You can get into a situation here where you want to stop the motor and find that every attempt gets you into the resonance, whereupon you have to add power to stop it and you eventually become afraid to stop the motor - with the battery rapidly running down. The solution is to set up the throttle hold switch so that it stops the motor. When the resonance starts, add power and hit the hold switch. Keep the pitch on until the motor stops. This will add drag to stop the rotors as soon as possible and also ensure that you don't get a boom strike.

The alternative is to keep the throttle open and wait until the battery runs itself completely flat. You will lose control of the radio well before this point so it is not recommended.

Incidentally, trying to stop a wildly shaking helicopter by closing the throttle is guaranteed to produce a boom strike.

Of speed controllers and ferrite motors

Many people have told me that the use of a speed controller with a normal ferrite magnet motor will result in a short motor life. Let's say straight away that my own direct experiences with the 'Whisper' do not confirm this - at least, I don't think so!

Before flying the model, I charged the battery a couple of times and discharged it by running the model without the main blades fitted. This could just about qualify as 'running in' the battery, but not as running in the motor. In retrospect, this is a very important omission.

The first flight was outdoors in very blustery conditions and was timed at 6 minutes 40 seconds, all in the hover. The next few flights were all in similar conditions and all lasted between 6.5 and 7 minutes, though they were not timed with a stopwatch as was the first flight.

A reasonable day eventually arrived and I was at last able to indulge in some circuit flying. Throwing the model around and indulging in some rapid vertical climbs to considerable height resulted in flight times of around 5 minutes 50 seconds.

The onset of a long spell of poor weather led me to find a site where I could fly the model indoors. This gave a very good means of checking the motor performance as all flights consisted of a still air hover (the worst case) and were directly comparable. Some 20 flights were made in these conditions with a slow but steady reduction in flying time becoming apparent. Initially, this was around 6 minutes, but after a total of 28 flights, the average flying time was down to 4 minutes 20 seconds.

Venturing outdoors again gave flights of around 5 minutes, but with a very obvious lack of power compared with earlier flights. A check of the battery capacity showed this to be 1240 milliamphours - well above the rated 1100.

Around this time, an article appeared in an American magazine regarding the short life of normal ferrite magnet motors (not 'cobalt') when used with speed controllers. The point made was that the actual switching rate of the controller was very important. An average controller will switch at the frame rate of the radio equipment (around 50 cycles/second) - this being a cheap and convenient way of doing the job. For best results, it was claimed that a high switching rate was needed (Typically 3000 cycles/second). This being what is known as a 'high rate' speed controller.

After a total of 38 flights, an examination of the motor revealed that the brushes were now very worn. The indoor duration was down to around 3.5 minutes and all flights ended with a very hot motor and a virtually cold battery! This made it fairly obvious that the problem lay in the motor and made that magazine article look very convincing.

So try another motor

At the time that the 'Whisper' kit was supplied for review, I received another motor to try. This appeared to be a cheaper type with less robust brushes and with no facility to adjust the timing. This was 'run-in' by running on 2 volts (actually a glow plug supply) for about 5 hours. It was then given a short run on 4.8 volts and fitted to the model.

Back to my indoor test site and a first flight of 5.5 minutes. The curious point here is that it has never approached that duration since! Flight number two was 4 minutes 35 seconds and it has remained almost exactly the same ever since. A few minutes before typing this paragraph, I flew the model again (the 86th flight) and obtained 4 minutes 30 seconds. Far more important is the fact that it is just as lively as it ever was and there is no apparent decline in performance.

What have we learned from all this? Well, there is certainly some evidence that 'high rate' speed controllers are preferable with ferrite motors (as opposed to 'cobalt' motors, which appear to be alright with 'low rate' controllers), and certain of my club mates are very convinced of this, based on their own experiences. However, from my own point of view, it would appear that this is far less important than careful running in of the motor.

It would also appear that, in the current state of development, 'tuned' ferrite motors have very little to offer. This was always the case in my fixed wing flying with electric models, when the 'standard' Mabuchi 540 motor seemed as good as anything.

If there is someone out there who is able to give an informed comment on the issue of 'high rate' versus 'low rate' speed controllers, I'm sure we would all like to hear from you.

You will by now have gathered that the Kalt speed controller recommended for the 'Whisper' is a 'low rate' device. How can you tell, you may ask? If you run the motor at very low speed by slowly advancing the trim as recommended above, the motor will 'tick' and move in a series of jerks. The ticking speed will be around 50 times per second. This may sound fast but it is roughly the same speed as 'mains hum' which we are all familiar with. A 'high rate' controller will give a much smoother take up and will make the motor 'sing' or 'whistle'.

The above controller has only one adjustment which sets the slow end to suit your transmitter. It has a very narrow input range, which means that you will get maximum power around the mid point on the stick. The model can be flown quite satisfactorily like this but it is better if a programmable transmitter is used and the throttle range reduced to expand the speed range over the whole stick travel.

Gyros

The miniature gyro which is available for this model is made by Aisonics and is now produced in a Mark 2 version. This has a smaller electronics package than the Mark 1 and no reversing switch. Some very early Mark 1 versions were sensitive to both voltage and temperature variations and could not be run at high gain.

The Mark 2 version works very well and has more than enough gain for this and any other model. I always find it rather fiddly to set the gain correctly when this has to be adjusted on the model itself but, in this case, I set it at about 80% initially and have not touched it since.

There is still a noticeable change in the tail trim during the flight but this is directly related to the amount of pitch being used and can be trimmed out with the ATS system. As the battery runs down and the motor slows slightly, more pitch is required to maintain a hover. As the ATS system works by mixing the pitch channel into the rudder channel it can be used in the normal manner. More pitch means more torque, which means more tail rotor pitch.

When set up correctly, the tail is very stable yet powerful enough to perform pirouettes in blustery conditions.

Pitch range

The instructions recommend no less than 9 degrees of pitch in the hover, which sounds a little extreme. In fact the model flies very nicely at this setting, but the throttle stick is well below the mid point, RPM is quite low and there is a pronounced coning angle. This set up works well indoors.

For general flying, I found it better to use rather less pitch to bring the throttle stick back to the middle and run rather faster at about 1250 RPM. This makes the model very twitchy indoors, however.

There does not seem to be any limit to the maximum pitch which can be used. The manual recommends 12 degrees and this gives a very good climb rate. Most experienced helicopter flyers automatically feel that this is wrong and reduce the pitch to give a higher speed. This makes the model behave much more like the familiar glow powered model, but it does not give the same performance.

Aerobatics

The biggest problem here is just how much time you can safely allow for flying around the sky and throwing the model about. When the battery runs out it happens quite quickly and there is little time to get the model down. If the battery and motor are both healthy, you can realistically allow about 3 minutes.

Here again the experienced flyer may find that the different response takes some getting used to. Certainly there is no point in 'feathering' the pitch to keep the RPM up - remember, the slower it goes the more torque you have. My own fear is that of overloading the rotor at low RPM and damaging the head flexiplate by bending it too far, but this has not happened - yet.

Loops are quite straightforward, just pull the stick back and keep the pitch on. Rolls are a little odd since it wants to rotate around the battery and any attempt to combat this will produce a pronounced 'barrel' roll. You need high RPM for this too to avoid the roll rate disappearing as it attempts to heave the battery up and over.

I don't have an autorotation clutch fitted and the prospect of stopping that battery at the bottom of an auto is a little intimidating. The prospect of some auto slope soaring is an intriguing one though!

What do you do if the battery runs out?

This has happened to me once when I got carried away. The answer is to dive towards the ground and attempt to flare out as low as possible - rather like an autorotation with light blades. I got away with it - just!

If the model is in the hover and at less than about three feet altitude, you can just let it sink gently to the ground. Try to arrive at the ground with full throttle applied to avoid any chance of a boom strike (the boom is quite fragile too).

During the above I have referred several times to flying the model indoors. This is not to be attempted lightly. There are all sorts of funny effects when flying in a limited space and a mistake could be quite nasty. I did consider not mentioning the subject at all since it can encourage others to try it. However, not mentioning indoor flying would probably be even worse. Likewise, mentioning it then advising you not to do it would be unrealistic. It's rather like the widespread practice of stopping the rotor head by placing your hand on top of it. No sensible person would actually recommend this practice, but everyone does it. It's your choice.

Conclusions

I like it. The case rests.

Whisper further update

A further two and a half years now having passed, the model is still flying regularly and has amassed a total of 329 flights on no less than five different motors and four different batteries. During the first 100 flights, only about a third of the flights were timed - which I have since regretted. Since then, virtually every flight has been timed, with the exception of the odd timing glitch, or a flight that had to be terminated for some reason.

The result is a mass of data which can be interpreted in many different ways. So many ways, in fact, that you can do a lot of work and come up with no real conclusions!

Motors

The original motor supplied with the kit was a Mabuchi type, which gave an excellent performance for a very short time. I had neglected to run the motor in and this is probably the main reason for the short life. After 20 flights the performance was obviously dropping and so were the flight times. The motor was replaced after 38 flights, at which point the flight time was down to around two and a half minutes and the motor was getting very hot, although the battery remained cool.

With the kit I also received another motor 'to try'. The logo on the end bell said 'Air Supply', but no other details were available (no label). This motor was carefully run-in and, although not giving quite as good a performance as the original motor when new, stayed in the model for almost 200 flights with only a very slow, almost negligible, drop in performance. Towards the end of this period, the commutator was re-skimmed by a model car shop and new brushes fitted (Reedy type). This produced a noticeable improvement.

In an attempt to improve the motor further, the can was sent off to be re-magnetised. I haven't seen it since!

I now had a dilemma as I didn't have a motor and the importers could not supply either an original type or another example of the 'Air Supply' motor. I had heard reports that the MRI '19D' motor worked well, but this was also unobtainable at that time. The easiest way out seemed to be to look at the Kyosho range, and I eventually selected a 'Mega 20x2' (20 turns, double wound), as this seemed the nearest to a '19D' (19 turns, double wound) and it was fairly cheap.

At first, this looked like a mistake! There was barely enough power to lift the model out of ground effect. Advancing the timing (more on this later) didn't seem to help until I twigged that the instructions for doing this, which were enclosed with the motor, were actually wrong! In fact, they told you to rotate the end bell of the motor in the wrong direction. Turning it the right way made a huge difference and the motor was now as good as the 'Air Supply' motor. When I came to plot some graphs of the flight times for this article, I also realised that this particular motor showed only a small difference in flying times between indoor and outdoor flying.

This motor would probably still be in the model except that J Perkins sent me two more motors to try. These were labelled as (surprise!) Air Supply 'Trix Pro Series' triple wound motors. One motor has a blue label and is intended to be a 'duration' motor, while the other has a red label and is said to he a 'hot' motor.

Both motors were carefully run-in and the 'blue' motor fitted to the model. Initially this was also disappointing, but advancing the timing did the trick and, although the performance was not quite as good as the Kyosho motor, the flights were slightly longer. It would be a good idea to do some more flying on this motor since the times generally were very inconsistent. In particular, my original battery seemed to go through some kind of decline during this period, from which it has since recovered. The average flight times on this motor actually seem to be longer indoors than outdoors, which is curious.

I didn't bother to try the 'red' motor in standard trim, I advanced the timing right from the start. This gave by far the best performance since the early days of the original Mabuchi motor, but the flights were shorter. After 40 flights with this motor, the performance now seems to be dropping.

Suppression

The original kit was supplied without any form of suppression on the motor and I did experience the occasional 'glitch'. Many motors are supplied with suppression capacitors already fitted, including the latest 'Air supply' types.

If none is present, the addition of a .05 - 0.1 microfarad capacitor between each brush and the motor ‘can’ will normally prevent any interference problems. If you are having real problems here, it maybe necessary to fit RF chokes in the motor leads, but this will limit the motors performance. A better solution would be to try another receiver, or improve the installation. The receiver can be fitted immediately adjacent to the motor without problems.

Running-in

The correct way to do this is to run the motor for several hours, unloaded, on a low voltage. If you have a large capacity glow plug supply, or power panel, this is ideal. Most manufacturers suggest around 8 to 10 hours running on this type of supply. The purpose of this is to run in the brush gear. Some authorities state that this process should be repeated every time the motor is dismantled.

My experience suggests that running-in is essential, but possibly not to the extent described above. If you have a friend, or acquaintance, who is heavily involved with R/C electric cars, ask him, he will usually have strong ideas on the subject.

Advancing/retarding the motor timing

Many of the motors currently available have a facility to alter the 'timing' of the brush gear by rotating the end bell which contains the brushes. Advancing the timing means the motor will produce more power at the expense of drawing more current (which means shorter flights). Assuming that the motor is giving adequate power, it can be tailored to give the required compromise between power and flying time. In helicopter use, it can be assumed that most people just want the maximum power.

'Advancing' means that the brushes contact the commutator earlier in its rotation. This means that the brushes must be rotated against the direction that the motor is rotating. Assuming that you are looking at the brush gear and the motor rotates clockwise when viewed from that end, then the motor endplate should be rotated anticlockwise. Be warned that the amount of 'advance' that can be used is very limited.

A motor which is designed to have the timing altered will normally have some kind of scale to indicate the amount of change. This will normally allow for no more than 6 degrees each way. Try 4 - 5 degrees as a starting point.

Indoor/outdoor flying times

For many reasons, an electric helicopter will fly for longer outdoors than indoors. Not only is there translational lift, which means that less power is needed, when you are flying around, but even in the calmest conditions, there is always some wind effect to produce translational lift when you are hovering. I use a different set-up for outdoor flying with a higher rotor speed. What seems to be very 'twitchy' indoors can he very tame outside.

Outdoor flight times will also vary much more due to the different types of flying that can he indulged in. Interestingly, however, a flight with lots of autorotation’s thrown in will not be any longer than a flight with no autorotation’s. This is due to the fact that much more power is used in climbing to altitude, before the descent. Another point to be considered here is that the better the motors performance, the greater the difference between indoor and outdoor flying times, due to higher current drain when the motor is heavily loaded.

From this, you could infer that if you want to assess the differing qualities, and flying times, of various motors, batteries, etc, you should fly indoors in a restricted space to even out the possible variables in flying style. This may be true, but the dangers are obvious, so be very careful if you try it.

Batteries

I gather that the original 1100 mAh 'SCR' batteries, sold for the 'Whisper' are no longer available. As a result, other larger capacity batteries have been made available in a suitable pack. This means that three different sizes have been generally available for the 'Whisper': 1100, 1400 and 1700 mAh capacity - all in 8 cell packs.

Without the battery, the 'Whisper' weighs 29 ounces. This gives the following flying weights:

Battery	Battery Weight	Flying Weight
1100mAh	13.0 ounces	42.0 ounces
1400mAh	16.0 ounces	45.0 ounces
1700mAh	16.5 ounces	45.5 ounces

The 10% weight variation seems to make very little difference to the performance. The larger capacity batteries seem to have a little more 'zing' at the start of the flight, but this is largely an illusion caused by slightly higher revs and there is no increase in performance.

After averaging out the flight times achieved by the three different batteries indoors, the actual flying time seems to vary more or less pro rata with the capacity, on a given motor. However, the actual nature of the pack regarding the matching of cells, etc, has a considerable effect on the flight characteristics.

My original 1100 mAh pack has well matched cells and has always been charged and treated in the same manner. As a result it runs down (or 'dumps') very rapidly at the end of a flight (5 to 10 seconds), see Fig.1. I had amassed well over 100 flights on the original battery before I obtained another similar pack. This was acquired second hand, consistently flies for about 10% less time and has a much longer 'dump'. It was used as a shop demonstrator and certainly received rather variable treatment.

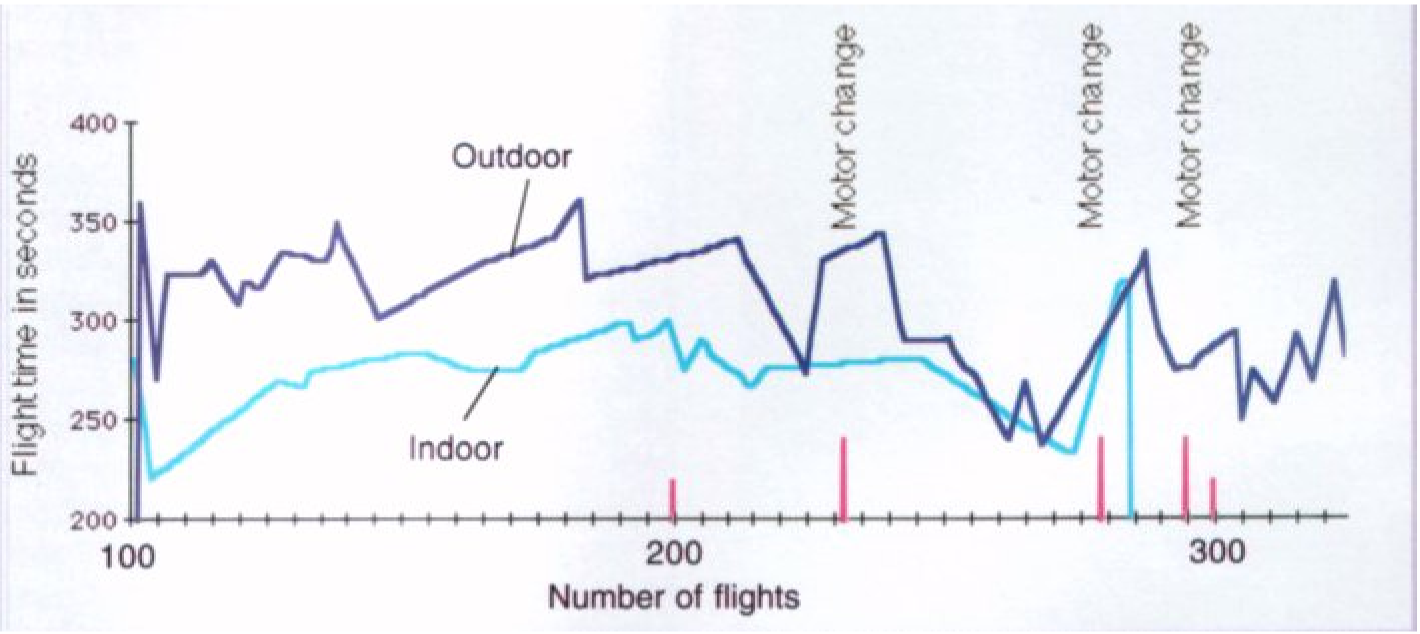


Fig.1 Comparison of indoor and outdoor flying times on 1100 mAh battery.

Soon after this, I was supplied with a 1400 mAh 'SCR' pack to try. Initially, I was rather disappointed with this, as the useful flight time was very little greater. The reason for this was that it had a very long rundown time (around 45 - 50 seconds). Expert opinion is that this is due to the cells being badly matched. It has improved somewhat with further use, although the duration, as you might expect, has reduced. In other words, the capacity has remained the same, but the characteristics have changed. So much for 'memory' effects! See Fig.2.

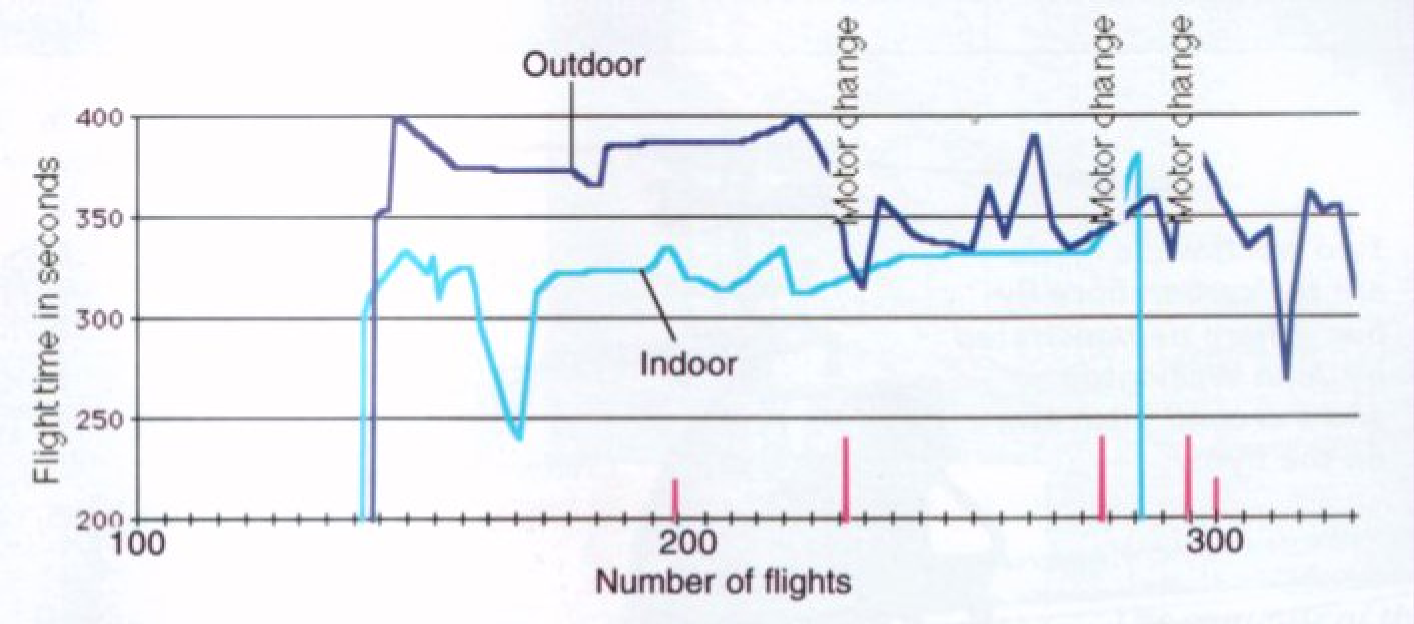


Fig.2 Comparison of indoor and outdoor flying times on 1400 mAh battery.

To complete the set, I now have a 1700 mAh 'SCRC' pack (originally supplied to Jon Tanner). This too seemed disappointing until I realised that this was the first time that I had flown the 'red' motor indoors and that all the batteries were producing poor flights. Going outdoors showed that this pack was producing the longest flights yet, but with disappointing power output. Hopefully, more use will produce an improvement.

Charging

All of my charging has been carried out using the original Union Model 'Pulse Charger' with 'Power Up' booster, which I believe is no longer available. At an early stage, I decided that some form of charge indication was necessary and I fitted an ammeter into the charging leads. The current normally jumps to around 9 amps at the start of the charge and drops to around 4 amps before cut-off. At the end of the charge, the battery is normally warm to the touch. Experience indicates that a battery which is not warm is not fully charged.

In normal circumstances, the 1100 pack takes about 16 minutes to fully charge it, while the 1400 takes 25 minutes and the 1700 pack takes 35 minutes. This tends to indicate that the charger is struggling a little with the larger packs.

Speed controllers

The same speed controller has been in use throughout, this being the original Kalt unit, which is a low frequency type. There are two basic types of speed controller available - low frequency and high frequency. The low frequency type came first, mainly because they are easier and cheaper to produce. They are easy to identify, because at low throttle settings they buzz at about 50 cycles per second (AC mains frequency).

The high frequency types 'sing' or 'whistle'. They are supposed to be much easier on the motor if it is a normal ferrite magnet, type. I say 'supposed' because some people don't agree with this and because it is not borne out by my own experience. It is certainly possible that the high speed type gives the motor an easier time, but it would appear that careful running-in is much more important for good motor life.

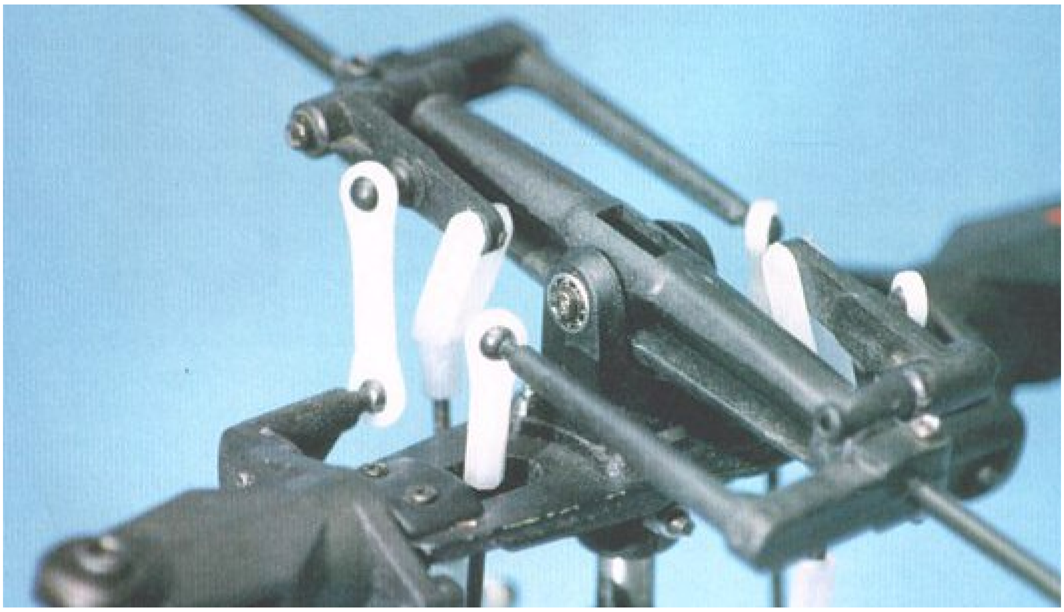
If you talk to anyone in the electric model car world, they will tell you that the motor should be rebuilt after every race and certainly after a few runs or so, and replaced frequently. So anything over, say 10 flights, could be considered as a good motor life!

Despite the rapid demise (by electric flight standards) of the original motor, and despite comments published elsewhere, I don't feel that the low frequency Kalt speed controller has any detrimental effects on the motor.

Wear, tear and modifications

The only replacement on the model in well over three hundred flights is the plastic pinion on the first reduction gear stage, which suddenly became badly worn after 260 flights.

An absolute essential is the carbon fibre flybar! The original stainless steel tube item can be bent by looking at it too hard! The carbon version can be treated anyway that you like, without damage. It is weIl worth fitting a second pitch control arm to the flybar, which eliminates a lot of slop in the system and makes it easier to balance the head.



Another worthwhile modification is some form of clamp, or brace, between the top of the motor and the frame, to stop the motor rocking from side to side. Apparently, some types of pen have a removable pocket clip which is a snug fit on the motor and this has been used to make a brace. I made my own from piano wire and tinplate.

Although the model autorotate’s very well, there have been a few 'arrivals' in nearly 400 autos. Despite this, the only damage has been a couple of boom strikes. These merely produced dents which, due to the thin boom material, can be pushed out with a suitable sized mandrel. I have never damaged an undercarriage strut, or the frame adjacent to the tailboom, both of which are supposed to 'weak' spots.

The technique used for autorotation’s is a little different to other models. In the descent the head speed is roughly twice that at the hovering speed. This means that the model drops at a high rate until the speed builds up. The actual landing is very gentle. Don't try to auto from the hover!

Average flight times

Taking the average flight times on the three motors which are currently available, we arrive at the results shown below.

Reference has already been made to the fact that the 'Blue' label motor seems to run for longer indoors than outdoors, but note the large difference in the times on the 'Red' motor

Motor	Kyosho 'Mega 20x2'	Air Supply 'Blue'	Air Supply 'Red'
1100 battery indoors	261	302	204
1100 battery outdoors	279	294	268
1400 battery indoors	332	370	276
1400 battery outdoors	349	361	340

All times in seconds.

Conclusions

Your opinion of the 'Whisper' will, inevitably, depend on your expectations of it and the use you intend to make of it. It is a low-tech approach to the problem of producing a successful (which it certainly is!) electric helicopter. It works by the simple expedient of cutting everything to the bone. In other words, it is designed to fly, not to crash.

Most of the modifications and upgrades which have appeared have involved compromises, which have disadvantages in some respect. Apart from the flybar modifications mentioned above, my own feeling is that the model in its original form, with an 1100 mAh battery, gives the best all-round performance. Although longer flying times are possible with larger capacity batteries, the extra weight means that there is very little increase in the useful flying time. Also note that variations in the motor certainly have much greater effect than variations in the battery used and this is a subject worthy of much further research.

I have heard comment, even from the importers staff, that Kalt should have put some development into the model. Where? Surely the only way to improve it would be to start with a blank sheet of paper and, if possible, a revolutionary new battery.

Look at the opposition and decide for yourself.

Third 'Whisper' up-date

The story so far

The current position (early May 2001) is that the model has a total of 1019 flights on the same five motors and a total of six different batteries. Very little has been replaced on the model itself, although I did eventually replace the original tailboom which had been dented and knocked back into shape so many times that the material had started to disintegrate. I have also replaced one undercarriage strut, which was broken in a particularly heavy landing.

The original Kalt gyro became very erratic in operation and was replaced by another (obtained second-hand). This was never as good as the original and was replaced by a Century piezo gyro. The complete gyro is virtually the same size as the mechanical part of the original unit, and the performance is all that anyone could wish for.

I'm still using the original set of weighted blades, although the heat shrink covering was replaced after many flights, when the original became very tatty.

Everything else is as originally supplied, including the speed controller (low frequency type). The current total of autorotation’s is 603, including the one that broke the U/C strut.

Motors

When I last wrote about the model I was using an Air Supply 'Red' motor, which gave good performance after advancing the timing. This suddenly stopped working after 212 flights. The brush gear had become very hot - enough to unsolder the connections - and the commutator was badly burned and pitted. There was no real explanation other than the failure of one of the brush springs.

I refitted the Kyosho 'Mega 20x2' motor which had already given good results and this motor is still in use, having completed 555 flights in all. At 535 flights there was a marked drop in performance. Investigation showed that the brushes were so worn that the springs were unable to apply any pressure to the commutator. A new set of brushes were fitted and the motor run-in for several hours on a low voltage. Initial performance was disappointing, but this has now returned to normal (as near as I can tell).

This is, to my mind, a quite unbelievable life and performance from what is, after all, a cheap motor. Other motors have given a marginally better performance - for a very limited time. The Air Supply 'Red' motor, which had around one third of the life, cost around three times as much!

Batteries

The four batteries that had been used up to the time of the last writing were two examples of the 1100 mAh battery originally supplied, a 1400 mAh battery and a 1700 mAh battery, all of 8 cells. Since then, a further 1700 mAh battery has been used plus, very recently, one of the new 2400 mAh type. This last battery uses the new(?) type 'N' cells. All the others used Sanyo 'SCR' type cells.

The 'SCR' cells are well established and understood, but appear to be no longer available. This is due to the fact that it will soon be illegal to sell nickel cadmium batteries of any type in Europe (I believe the deadline is April 2002). From that point we will have to get used to Nickel Metal Hydride (NMH) batteries.

Based on this single example it would appear that the 'N' type cells are inferior to the 'SCR' type, despite having a nominally larger capacity. Cells up to 3000 mAh are available in this size.

One of the original 1100 mAh batteries is still in use, but the average length of a flight is down to around 3 minutes with a generally poor performance. The other suffered a failed cell at around 200 cycles.

The 1400 mAh battery also had a cell fail at around 200 cycles. I replaced it, but performance was not as good and another cell failed shortly after. Like the 1100 mAh type, this size of cell has not been available for some time.

My first 1700 mAh battery is still in use, but has had two cells replaced (at different times). Flight time is down to around 5 minutes.

A second 1700 mAh battery now has 100 cycles on it and is beginning to show a reduction in flight time. This particular battery gave the best performance to date and would average over 7 minutes indoors with a very short drop off period at the end of the flight (a short 'dump'). The best outdoor flight was over 8 minutes with good power. Indoor flights have now dropped below 7 minutes, with an occasional flight below 6.

The new 2400 mAh battery was initially disappointing, with noticeably less power and indoor flights of less than 8 minutes, with a long 'dump'. This means 15% more flight time from 40% more capacity! The power has improved and the 'dump' shortened, but the flights haven't lengthened!

I recently saw 8 cell 1700mAh NMH batteries on sale, which were roughly half the size of ni-cads. I must investigate further!

Despite my earlier misgivings, the use of the larger capacity ni-cads gives better flights and a generally better performance. The down side is the greater lump of dead weight hanging under the model which tends to increase the damage if you make a mistake. I know I've been lucky so far...

Electric flight in all its forms really hammers ni-cads and it is clear that around 100 cycles is all that you can realistically expect. If you can reach 200, you are doing well.

Battery	Capacity	No of cycles to date
1	1100 mAh	293 (failed)
2	1100 mAh	212
3	1400 mAh	208 (failed)
4	1700 mAh	215
5	1700 mAh	102
6	2400 mAh	19

Battery 1 was used long past the point where it was any real use, with flight times below 2 minutes and low power. Yes, the figures do add up to more than the number of flights!

Chargers

The original Union charger consisted of two separate units: a voltage booster and the charger itself. A couple of years ago, the booster section failed (I don't have a record of exactly how many times it was used). I can still use the charger section but for a maximum of 7 cells.

I replaced it with an RCLINE 'Multi Plus 12' charger. This is a one-piece unit capable of charging up to 12 cells and equipped with an ammeter. The absence of a meter on the Union charger had prompted me to fit an external ammeter. This showed that the 'Whisper' batteries (all capacities) were initially being charged at around 9 amps, with this falling to around 3 amps just before cut-off.

The RCLINE charger has a quoted maximum output of 4.2 amps. Monitoring this with the same external meter showed an initial charge of 5 amps or so, and this remained above 4 amps until cut-off. As you might expect, this lower initial charge rate does give a little less power at the start of the flight. It is clear that the booster voltage from the later charger is somewhat higher, thus explaining its ability to maintain the charge rate till the end of the charge. In fact, there is a definite crack from the connector when you insert it, confirming this.

I checked the actual output in each case and the original (separate) booster had an output of 15.5 volts, whereas the later (integral) unit supplies some 24 volts. Despite all of this, the actual flight times are very similar from the two chargers.

It seems that a properly charged ni-cad of the type used should be noticeably warm at the end of the charge. This is totally against most accepted advice that batteries should not show a temperature increase during charging. This may well be causing long-term harm to the battery (hence the life expectancy of 100 cycles), but you will not get the full performance if they don't become warm.

Flying time

This has already been covered at some length. It is clear that the flying time under a specific set of circumstances is more or less proportional to the battery capacity. Beware, however, that the stated capacity may not be the true capacity and that this depends on the batteries health and age.

Hovering uses up the battery faster than flying around. Indoor hovering gives the shortest flights. Forward flight outdoors gives the longest flights.

Autorotation’s don't make a big difference to flying time. The fact that the motor is switched off on the way down is balanced by the extra power needed to climb to height in the first place.

Indoor Flying

My general advice here is still that you should not fly indoors, unless you are a capable flyer and willing to accept the risks involved. However, people are going to do it anyway so here are some tips.

Ground resonance is a real problem and can seriously damage the model and the smoother the surface, the greater the problem. It is caused by the main blades moving as power is reduced. This causes a vibration which leads to the vertical fin hammering on the floor. Once it starts, the only solution is to add power and lift off. The extra power also straightens the blades and reduces the vibration.

If the battery is running down this may not be possible. In this situation, the only recourse is to hit the throttle hold and go to full positive pitch. This will, at least, reduce the damage.

Running the blades fairly tight in the blade holders helps, as does raising the vertical fin clear of the floor. There was a modification of the undercarriage which was supposed to help. This consisted of adding some damping between the undercarriage and the frame. It was not very successful and the only real effect was to raise the whole model slightly.

Flying indoors has all kinds of unexpected effects. One of these is a mental one where there is a tendency to haul the controls around to avoid surrounding objects and end up in a totally uncontrolled situation where the pilot is way behind the model.

Do be careful.

Further conclusions

In my earlier writings I stressed the need for a systematic start-up sequence for safety reasons. Despite this, I have had a couple of near accidents due to carelessness on my part. The most obvious possibility for error lies with selecting the wrong model on a computer transmitter.

Do remember to select throttle 'hold' on the transmitter before switching on the model and be sure that the throttle is set to 'low'. After going through all of this, I now hold the model well clear of myself before pressing the arming switch on the speed controller.

I have built and flown many model helicopters. This one I wouldn't part with willingly.

KALT WHISPER ELECTRIC

The theme of this article is exploring the flying envelope of an electric model helicopter. In Part One, I will discuss my experiment with the Kalt Whisper. In Part Two, I will discuss the computer controlled Whisper that can fly by itself.

Since 1983 I have owned six electric RC helicopters: two Ishimasa EH-l's, a Kyosho EP Concept, two Kalt Whisper's, and a Keyence H-610. The fixed pitch EH-1 was the first commercial electric RC helicopter, it was introduced in 1983. It was powered by two plain bushed Mabuchi 540 motors and an 8-cell 1200 ma pack. It could barely get 30 seconds of flight time. Electric RC helicopters became practical after Kyosho and Kalt introduced the EP Concept and the Whisper. Coincidentally, they were both introduced in 1989. My stock EP and Whisper could both get four to five minutes of flight time on a set of 8-cell, 1700ma battery packs.

Contrary to speculations, the EP and Whisper are actually super easy to fly. On a calm day, they are extremely stable. However, after flying these two models for two years, doing nothing but hovering and beginning forward flight, they became unchallenging. My palate is to push the models to the edge of their design limit; sometimes they go beyond the flying envelope and don't come back. But, I never do that when flying a full-size helicopter.

Not long ago, I decided to find out what the flying envelope of a state-of-the-art electric helicopter was? I decided to use my second Whisper as a guinea pig. The poor Whisper so far has gone through six crashes during the envelope expansion testing. This does not imply the Whisper is a bad design. My first Whisper is three years old and has never crashed yet. I purposely pushed my second Whisper to the extreme for the purpose of this article. Now, I will share my experience, so you will not have to repeat the suffering.

After extensive flight tests, my modified Whisper can now perform loops, rolls, 540 stall turns, autorotation’s, and limited switchless inverted flying. It will do a flip from a right-side-up hover into an inverted hover. Just don't do it at low altitude, because there is no brute power to abort or recover from fatal mistakes. In order to do these manoeuvres, it is absolutely necessary to replace the stock 19 turn motor by a 13, 14, or 15 turn double wind, or triple wind motor in order to have high enough main rotor rpm. With the stock motor the rotor speed is too slow to get crisp control response. With a good 14 or 15 turn motor it can reach 35 mph in cruise. That is boogying for an electric helicopter. Even without a horizontal tail the Whisper does not pitch up abruptly in forward flight. This is because it does not fly extremely fast, and I rarely put it into a dive.

Here are my suggestions for making your Whisper aerobatic. The philosophy is also applicable to the EP Concept. I have divided the comments into six categories: power train, weight saving tips, aerodynamics, how to minimize radio noise, control set up and how to repair after a crash.

POWER TRAIN

My objective for this project is to get 4 minutes of aerobatic flight time on a 7 cell 1700 ma battery, (the Whisper is designed for 8 cells). I want to use 7 cells because they are cheaper, lighter, and readily available. Most of the RC car battery packs

come in 6 or 7 cells, only. Furthermore, any inexpensive RC car charger can charge a 7 cell pack from a 12 volt car battery at 3 amps without a step up transformer. With an 8 cell pack, most 12 volt or 110 volt chargers can only charge it at less than 2 amps.
The stock motor in the Kalt Whisper is a 19 turn motor (21 turns in the EP Concept), which is suited for duration flying. More turns in the motor winding means improved motor efficiency, and longer running time, but lower power output. If the stock motor is used, then switching the stock 17 tooth pinion to more or fewer teeth will not improve the Whisper's performance. I have tried 13, 14, 15, 17 and 18 tooth pinions for the stock motor, the Whisper's performance was about the same. I even tried advancing or retarding the motor timing on the stock motor; it did not have any significant change in performance.
The stock electric motor timing can be changed by + or - 5 degrees by rotating the top brush assembly relative to the motor can. In an electric motor, the current is fed to the rotating armature through a pair of carbon brushes that wipe against the rotating commutator. By controlling when the current can flow to the commutator, the magnetic field generated by the armature can push and pull itself against the earth magnet inside the motor can. Changing the timing means modifying the relative position between the armature and the magnet for when electricity is fed to the commutator. This changes the push-pull characteristics.
After I switched to a 15 turn, double wind, wet magnet motor (the Hurricane motor made by Twister for RC cars) the Whisper can now peel off rapidly from a hover. It now produces 20% higher rotor rpm than the stock 19 turn motor. The trade off is the flight time is reduced by at least 30%. My friends have tried 13 and 14 turn motors and reported equally impressive performance. In general, the less turn, the better the performance, but less flight time. When buying an electric car motor for the heli, get one with double or triple windings. Triple winds cost more.
With a 7 cell 1700 ma SCR battery and the 15 turn double wind motor and a 15 tooth pinion, I get three minutes of forward flight aerobatics. With a 13 tooth pinion I get 15 to 20 seconds longer time, but the reduced gear ratio lowers the rotor rpm and reduces the performance. One problem with using the 14 or 15 turn motor is that near the end of the juice, the power drops off very, very rapidly (less than three seconds of warning). It is almost like an engine suddenly running out of gas! Then, after another two seconds the BEC circuitry usually shuts off the motor completely. With the stock un-weighted blades, it means adios! This may sound bad, but actually, it is a blessing because it means you get a flat discharge curve. With the stock motor, it "gradually" loses rotor rpm with every second of flight. Therefore, after installing a new motor, hover for the first flight at two feet high for the entire flight to get a feel for the discharge characteristics.
Hover uses more power than forward flight. In slow forward flight, the main rotor disk has higher aerodynamic efficiency. For the Whisper, the most efficient flight speed is between 10 to 20 mph. If I only hover, then I get 30 seconds less flight time.
My final conclusion is, get a 15 turn double wind motor, a 14 tooth 32 pitch pinion, and a 7 cell 1700 ma Panasonic or Sanyo Ni-cad pack. If you want more power, use a 15 turn motor with 15 tooth 32 pitch pinion, or a 14 turn motor with 13 tooth 32 pitch pinion.
After every 20 to 30 flights I would remove the top cap off the motor and clean the commutator to remove carbon build-up. However, my friend Chris, who is heavily into RC car racing, recommends more frequent cleanly maximizing the performance. He recommends using a commercial commutator cleaning stick (by Trinity, Parma or Twister) after every five flights. Chris says the commutator can be cleaned without

removing the motor cap; simply pop out the spring loaded carbon brushes. The bearings should also be cleaned and oiled every five flights. He would completely disassemble the motor every twenty flights for a thorough cleaning. The brushes are checked for wear, and should be replaced if they show excessive scarring or pitting. I have found electric heli motors really don't require this much care because we do not brake and accelerate all the time, and we are not running on dirt. However, do clean the commutator as necessary to maintain performance.
Proper gear mesh is crucial for electric helicopters: it makes the difference between lift off, or no lift off! After one of my crashes, I found the gears were slightly chewed up, even though they looked fine, but the friction robbed enough power that the Whisper would not get off the ground. The symptom is you need a lot of right tail rotor command to compensate for the higher drag from the increased main blade pitch angle for trying to lift off the ground.

WEIGHT SAVING TIPS

Not using a rate gyro saves two ounces. A typical Whisper is 2 lbs 14 ounces, saving two ounces is equivalent to a 4.5 percent weight lost. Removing the gyro also provides more juice to the motor for aerobatics. The combination of weight saving and less current drain provides an extra 15 seconds of flight. Do not use mini servos, use micro servos. I used the Tower Hobbies TS-1l micro servos. They are very fast, and weigh less than 0.7 ounces each. They only use one screw on each side of the servo ear and the unused arms on the servo wheel can be cut away.
Remove the two - 2 mm wire supports for the tail boom. They are not mandatory. Use JR's 6 channel, NER-226 FM or NER-236 PCM, credit card receiver. They weigh one ounce each. Use an 1/8" thick double-sided foam tape to secure the receiver to the front tray. Then use double-sided tape to tape the speed controller on top of the receiver.
To save another ounce, I skipped the landing gear shock absorption system and the two metal plates. This was a bad idea; the struts broke on the first hard landing. The Whisper struts are not pliable. Even with the Kalt absorption system, a hard landing would still break the struts. I recommend installing a landing gear set from the Concept 30; for advance flyers, use the lighter weight Concept 10 landing gear set. They are one to two ounces heavier than Whisper's, but can take more abuse.
The Whisper structure is already "bare minimal," you really can not drill any lightening holes anywhere. I give Kalt engineers a lot of credit for making the one-piece moulded main frame so light.
Unless you want to do autorotation’s, there is no need to get the optional autorotation main gear for the Whisper. The autorotation unit adds another ounce. If fact, I would advise not to try an autorotation until you are really bored with flying the Whisper. With the stock wood blades there is no inertia for autorotation; it is suicide. I finally did it with a set of Tech Specialties weighted blades, and then a set of KSJ weighted washout blades. Still, carrying out autorotation’s with a Whisper is not for people with heart problems.
If the servo wires from the collective servo can not reach the receiver, then do not use an extension cord. Instead, cut it and add longer wires. Use Scotch tape to secure the tail control wire tube to the tail boom. Solder the two wires from the speed controller to the motor directly. Use the Molex battery plugs, instead of the big Tamiya or

Kyosho plugs. Molex plugs are lighter and have less electric resistance.

AERODYNAMICS

The key to doing aerobatics with any electric helicopter is to maintain high rotor speed. You obtain this by optimizing gear mesh smoothness, using low turn motors, 14 or 15 tooth pinions instead of 13 tooth, and efficient main and tail blades. The stock main blades fly fine, but have a lot of drag. The picture shows how I tapered the blade tip leading edge to reduce profile drag. The airfoil thickness must also be reduced when you taper the tip, otherwise you are not getting the maximum benefit. The trick is to sand the blade tip so the airfoil shape does not change, except it is getting smaller and smaller toward the tip. Kalt sells optional KSJ wood washout blades for the Whisper. They have lead weight at the leading edge. They improve the performance by at least 10%, and allow autorotation capability too. These excellent blades retail at $59 a pair.

I carved my own tail blades out of hard balsa wood. This way I can have an efficient and slightly cambered airfoil shape. The airfoil looks like an R/C airplane propeller airfoil. After carving and sanding, I soak them with slow CA glue to improve strength.

MINIMIZING ELECTRICAL NOISE

Use an electronic speed controller designed for airplanes or helicopters. It must be able to handle at least 30 amps of continuous current. It should have a resistance less than .0030 ohms. The speed controller for R/C cars does not have an arming button, hence, they are less safe for aircraft use. An arming button is a safety device that disables the throttle until it is pushed. I have had good success with the Kalt controller designed for the Whisper. I get frequent glitches with some other controllers. If you are still getting electrical noise, then solder a 0.1 microfarad bipolar capacitor between the motor wire and the motor can. Do this for both wires. The PCM receiver does seem to help a little when you are using the "hold" mode.

Location of receiver antenna is critical. Do not fold the antenna! Do not attach the antenna to the vertical fin because it would run by the motor. I have found that by drilling a small hole in the front tip of the canopy and letting the entire length of antenna wire dangle out through it provides the best reception. However, that precludes doing any aerobatic flying. I CA glued a base loaded antenna underneath the servo tray. Keep the base loaded antenna as far forward as possible. The wire tip of the base loaded antenna almost touches the nose of the canopy.

Finally, I figured out why I was getting glitches that caused a crash. Surprisingly, it was due to the transmitter. When the receiver or transmitter is not well tuned, or the transmitter battery is weak, then the RF (radio frequency) signal received is very weak. This is not a severe problem for a gas helicopter, but it is a problem for an electric helicopter. Electric helicopters generate a lot of electrical noise, hence, they require a strong RF signal to maintain adequate signal-to-noise ratio. After I switched to a new transmitter, my glitch disappeared.

CONTROL

The entire up-and-down sliding washout system rotates slightly. There is nothing that can be done. It does not affect stability or control. To prevent the blades from periodically going out of track, add Delta-3 angle by moving the semi-circular pitch control arm from inside the main blade grip plate to the outside. Simply remove the two Philip screws that hold the control arm to the blade grip. Then, relocate the control arm, and secure it.

The stock Whisper has plenty of collective travel for normal right-side-up flying. For flying inverted and autorotation's, the moulded one-piece double-end ball link that goes on the blade pitch control arm must be replaced with a longer one. The new one should be 2 mm's longer and can be made out of two small ball links and a short 2 mm rod. The Kalt universal link set #44005 comes with six tiny ball links.

The Tower Hobby TS-11 micro servo is perfect for cyclic and tail rotor control. Any other inexpensive micro servo will work, too. But the collective control requires more torque. My TS-11 for the collective control has striped the servo gears twice. I suggest using a one size bigger servo (a mini instead of micro) with 40 in-oz torque for collective control. Strong mini servos include the Futaba 9601 BB coreless mini servo, Airtronics 94831 or 94407 mini servos, and JR 9021 mini servo or JR 901 and 9021 mid-size servos.

The main rotor blades should not swing too freely. When using the autorotation bearing, the Whisper has a propensity for ground resonance. Ground resonance is a phenomenon that happens when the helicopter is on the ground. This happens after a landing, when the blades are slowing down, and suddenly, the Whisper would rock back and forth laterally on the ground. I simply hit the throttle hold switch, and give full collective to bleed off the rotor speed immediately.

On my Whisper, the fore / aft and roll cyclic are set to provide maximum swashplate tilt. Set the collective throw to allow the slider ring to move up and down the full range. I have +12 to -7 degree of collective. Remember, if you do not replace the double ended ball link on the blade pitch arm, then you can twist the main rotor blade pitch around 180 degree, when at full negative stick! This happened to me the first time I did an autorotation; the blade pitch flipped 180 degrees about its feathering axis spontaneously, it crashed!

If you have never flown a helicopter without a rate gyro, then set the tail rotor throw very low for the first time. As a rule of thumb, if a gyro is not used, then set the tail rotor control throw to half of what you normally would. If you must use a gyro, then I highly recommend the new JR-160 mini dual rate gyro. It locks the heading solidly! Even though Horizon Hobby Dist. does recommend using the JR-160 in gas helicopters, I have used it extensively on a 30-size gas helicopter without any problem.

Use a toothpick to put a tiny drop of CA glue on the thread of the two Philip screws that go through the ball bearing on the flybar seesaw. I also pulled those two bearings out and used slow CA to secure the bearings solidly to the hub. Otherwise, the flybar seesaw will become sloppy after a few flights. Replace the plastic collar that locks on the flybar with a 1/8" i.d. aluminium wheel collar. Use some JB Weld metal epoxy to make sure the flybar's plastic L-arm will not work loose. Add a small drop of CA between the main rotor head flexbeam and the plastic main rotor hub. Otherwise the two pieces will become loose after a while.

CRASH REPAIR

The first crash was due to a glitch from the electric motor and speed controller. The second crash occurred on the first time I tried an autorotation; the main rotor blade pitch changed 180 degrees due to the blade pitch control system buckling. The third crash was due to a glitch because the transmitter signal was weak. The fourth crash was because the battery was drained so low in flight, the speed controller's battery eliminator circuit (BEC) shut the motor off. The fifth crash was from doing a pirouette to the left so fast, that there wasn't enough right tail rotor to recover it, and it smacked into the wall. The sixth crash was from trying an autorotation from hover (bad idea). If you follow the suggestions given here, and fly carefully, crashes can be avoided.

If you are using the optional autorotation gear, the plastic gear can be bought separately, without the one-way bearing. The part number for the plastic autorotation gear alone is 44029. Remember, bad gear mesh means the model won't even lift off the ground! Stock up on the three plastic gears; they include the 44008 EH2P pinion gear and 44007 main drive gear. Change them if they are damaged from a crash.

The reusable tie wraps for the battery sometimes break during a crash. My friend replaced the tie wraps with Velcro. Non-critical areas, such as plastic landing gear strut, frame, servo tray, and supporting arms on the Whisper may be repaired with slow CA glue. You should never repair or glue back any plastic parts relating to the main rotor; such as blade grips, hub, swashplate, etc. For the frames, struts, and support arms, I use slow Zap and Zap kicker spray to join the two broken pieces. Then, lay a 1/4" by 1/2" piece of lightweight fibreglass cloth over the fracture, and soak it with additional slow ZAP. Epoxy doesn't stick well to Whisper plastic parts. Horizon Hobby Dist. do not recommend repairing or CA any damaged part. I think Horizon's advice is valid because how does one know whether a repaired part is still strong enough? When in doubt about the integrity of a part, it is safer to replace it.

So far, I have had very good luck with buying replacement parts for my Whisper. Horizon claims a 99% fill-rate on Kalt parts. The parts for the Whisper are not expensive either.

In conclusion, electric helicopters are practical and extremely easy to fly. This article shows that electric helicopters also have the potential to perform impressive aerobatics. By following the suggestions I have outlined, you too should be able to turn your calm, electric helicopter into a wild, hot dogging machine.

After pushing the envelope of the Whisper though, I still find that I enjoy electric helicopters best when they are flown in the front yard or at a park on a calm evening. It is very enjoyable to get two or three flights after dinner. I also take mine to friends' houses and do indoor or outdoor demos for them. Everyone loves it! Try one - the fun will leave your head spinning!

Finally, my most recent acquisition is a Keyence H-610 electric RC helicopter purchased in Japan. The entire model weighs 4 ounces, including a 6-cell 100 ma ni-cad pack. The main rotor diameter is only ten inches. Both main and tail blades are made of foam sheet. This model is not aerobatic, in fact it is too stable, even people without R/C helicopter experience can fly it! In lieu of a flybar, it has a vertical gyro (not rate gyro) to stabilize the pitch and roll motions. There is a miniature yaw rate gyro for the tail.