# *TAKING OFF WITH*

# *RC HELICOPTERS*

# *- FAQs 102 -*

*Jack Clarke*
*CaptJac*

**FAQs 102**
takes off where FAQs 101 left off and adds another 102 questions and answers – plus 17 more that snuck in at the end. It is written and organized like FAQs 101 but we'll be leaving the coaxials and basics in the hangar and heading over to where all the single-rotor **fixed-pitch** micros and **collective-pitch 450's** are parked. Our flight plan will start with orientation of the 45 degree rotor-head micro design and do some basic hovering, turns, and circuits, followed by climbing into a Trex-450 and becoming familiar with the controls of collective-pitch helicopters, the setup and adjustments, and some of the programming steps. As an added feature and with the additional complexity of the 450 and CCPM, a HEADS-UP warning system will be used to advise beginning pilots of rotor turbulence. Have a great flight!

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## First Time Flying

Watch your head as we climb into one of the micro helis - they may be small but don't be fooled by their size, they are a giant step in acquiring the feel of a 450 sized helicopter. If this is your first time flying, micros may have a steeper climb rate than you think, but whether your goals are zipping around in your living room or doing tic-tocs, funnels, and inverted flying outside, FAQs 102 is designed to help you follow a step-by-step progression to get you off the ground and in the air in the shortest time possible.

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## One Step at a Time

Learning to fly RC helicopters is really not that much different than learning to play a musical instrument or any skill that takes time and repetitive practice. You practice like crazy - you progress - then you regress - and progress. The more you try to hurry it, the slower it gets. Don't give up – you are making more progress than you think. *Muscle memory* is learning with you. Muscle memory is controlled by the sub-conscious mind but the sub-conscious mind doesn't give any hints how it is doing. It learns at its own rate and its own pace. You can't hurry it - but suddenly when you aren't looking - everything will click! The question that students always ask - how much time does it take for it to click? The answer is - as much as it needs. But when the demands are met it may well be the most rewarding clicking and learning you have ever taken off with.

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**DEDICATION –** To my loving wife and co-pilot - who without her never ending support and encouragement and patience and understanding this second book would still be in the hangar. And to the many students of my Phoenix Simulator Flight School who taught me more than I taught them – this writing is a testimony of their dedication, their patience, their endurance - with me.

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## LEARNING ON YOUR OWN

Can you learn to fly on your own? Of course. Anyone can. The problem with learning on your own is how do you know when you are making a mistake? Crashing is certainly one way of knowing but it can be very expensive and frustrating. You try to correct your mistakes but what are your mistakes? It's like teaching yourself golf. You get to the point where you can hit the ball pretty good, but you can't control where it goes and you spend more time in the woods than on the green. Pilots of full scale helicopters (the kind you are sitting at the controls) require hours and hours of instruction before they can solo. With RC helicopters you are doing your first solo with NO instruction. No wonder it is so difficult! Setting up and flying a 450 helicopter can be pretty overwhelming for a beginner. As an adjunct to this FAQ, consider getting some hands-on instruction with a qualified instructor. You will be amazed the difference it makes and how much faster you learn when you aren't teaching yourself the same mistakes.

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## DANGER – ROTATING BLADES

If you done your basic training on a coaxial and thinking about climbing directly into a 450 – two words of caution. **Rotating Blades**. The blades on a coaxial can give you a pretty mean bite if they hit you. A 450 size doesn't just bite - it slices. It can remove a finger – cut a leg to the bone – even decapitate. Carbon fiber blades spinning at 200 MPH with a rotating diameter of more than 2 feet are lethal. They command a lot of respect and demand a lot of skill. Before you fly on your own get a check-ride. **Safety is NO accident**. It is amazing how fast a 450 can get away from you and you lose orientation. Try not to be in a hurry. Check everything 2 or 3 times. Private pilots use a checklist not because their memory is so bad but because there are so many things to think about. Read some of the comments on the RC forums from other students who are learning. There is considerable collective wisdom in their experience. Safety talk completed - it's time to switch on the ignition and start spooling up our engines!

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## SINGLE ROTOR HELIS

Single rotor **micro** helicopters is a very advisable and logical progression from coaxials and are in fact starting to replace the coaxials for learning. They provide the same 4 channel control as a coaxial but have a much different feel and response which makes them ideal as a 450 trainer without the costs and crash characteristics of a bigger heli. There is a proliferation of micros for about $100 that have taken over the earlier versions of the mid-size fixed pitch helis. They can be flown in a small space but move the furniture first – they can move awfully quick.

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***MICRO FAQs***

Q1 - I'm pretty darn good with flying my coaxial - is a single rotor heli that much harder?

*Answer - Coaxial helicopters are self stabilizing by design. Single-rotor helicopters are unstable. They require constant correction. They have a different feel, a different response, a different attitude than a coaxial. They move faster than your fingers can react.*

SAMPLE COPY

Q3 - Why can't I just skip the micro helicopters and go right into 450's ?

*Answer – One good reason is the cost of repair. Crashing is part of learning. Crashing a 450 is expensive. A micro helicopter is a lot more forgiving and a lot less expensive to fix. Another good reason is micro helicopters are house broken and can be flown inside. A 450 is not only too big to fly indoors (unless you live in a hangar) but they are hazardous to anything and everything they get near to and can do some real serious damage. A micro is not only a blast to fly around in the house, but they provide an excellent foundation for getting the feel of the controls of a 450. Alternate between training and having fun on a micro and in a short time you will be having more fun than you ever thought possible and you will be ready for your 450 solo outdoors.*

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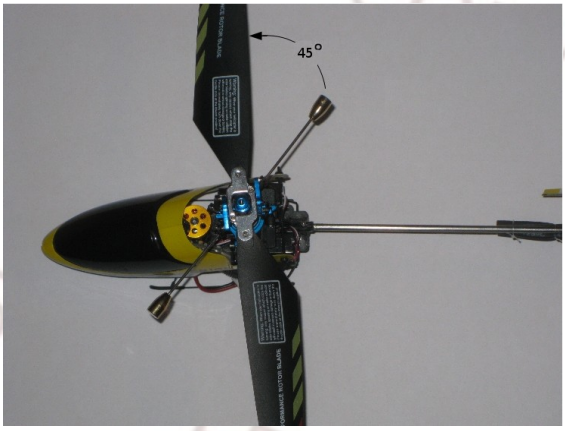
Q4 - It took me about 10 hours to learn how to fly a coaxial. How long does it take to learn a single-rotor micro helicopter?

Q6 - Is there a way to make them more stable?

*A –Although single-rotor helicopters are unstable compared to coaxials, there have been some substantial improvements in the head design in the last year or two. More and more micro helicopters lining up on the runway are using* ***45 degree offset rotors****.*

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Q7 – Can they hover “hands-off” like my coaxial?

*A – No problem – as long as you don’t take your hands off the controls for more than 2 seconds. They tend to start moving towards the nearest wall or table or chair as soon as you take your eyes off of them.*

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Q8 - I want to buy a heli that I can fly both indoors and outdoors. Which is better, a micro or a 450?

*Answer - Unfortunately neither of them. Micro helis are great for indoors. Outside they make better kites than helicopters. They are blown away with even the slightest breeze. More than 20 feet away they shrink to almost invisible. A 450 is made for flying outdoors because it is collective-pitch but don't even think about flying them indoors unless you are in a hangar or gymnasium.*

***Pilot Advisory***

*Getting hit by a micro heli will give you something to think about while you are getting a band-aid. Getting hit by a 450 size helicopter won't give you something to think about as you will probably be in shock from loss of blood and seeing the bone in your leg. It is not a pretty sight.*

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## *SIMULATORS*

Q10 - I want to learn as fast as possible. Is there a way I can minimize the crashes and optimize my learning curve?

*Answer - The photo realism and flight physics of a good flight simulator is nothing less than amazing and pays for itself in reducing the number of crashes and optimizing your learning curve.*

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## *FLIGHT TIMES*

Q12 - What is the typical flight time of a micro helicopter? I want to fly at least 30 minutes.

*Answer – Micro helicopters use single-cell lithium polymer batteries (lipos). Their flight time is about 6 minutes. The only way you increase the flight time is ... well unfortunately you can't. Bigger battery weighs more – ends up with the same flight time – sometimes even less. For longer flight times– switch batteries after 6 minutes.*

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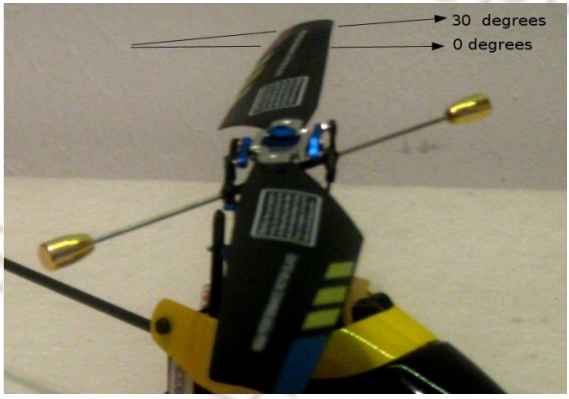
Q19 – What is the pitch of the blades on a fixed-pitch helicopter when the swash-plate is level?

*Answer – About 30 degrees – but depends on the heli.*




*The swash-plate and the fly-bar determine the pitch of the blades on fixed-pitch.*

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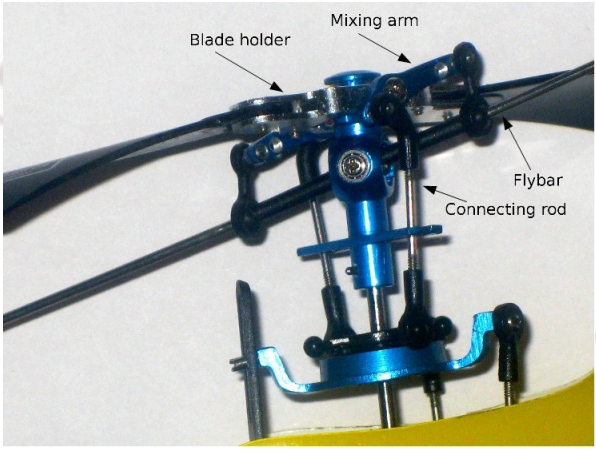
## *MIXING ARM*

*In a coaxial helicopter the pitch of the lower blades are controlled by the swash-plate - the pitch of the upper blades is controlled by the fly-bar. In single-rotor helicopters, a mixing arm combines the tilt of the swash-plate with the tilt of the fly-bar.*

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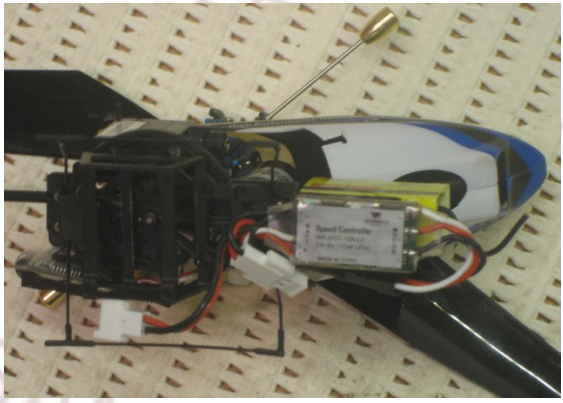
## *TAIL ROTOR*

23 – What controls the speed of the motor?

*Answer – An electronic speed controller sends pulses to the motor based on the position of the rudder control on the radio (left stick) and a tiny electronic gyro in the helicopter. The gyro, the speed controller for both the main rotor and tail rotor, and the servo controllers, are housed together in a single sealed package called a 3-in-1 controller or in some cases a separate circuit board. Be extra careful to shut off the throttle as soon as possible if you have a blade strike. Controllers are very expensive when they burn out.*



Speed controller attached to 3-in-1

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Q39 – Can't I just give it a shot of throttle to get off the ground?

*Answer – Better to ease it up than rocket it up. Rocketing tends to have a guided missile effect.*

SAMPLE COPY

## HOVERING

Q44 – This is harder than I thought. How do you get it to do what you want it to instead of doing what it wants to do?

*Answer – Practice and practice and more practice. The more you practice the easier it will get.* ***Muscle memory*** *will start taking the controls and it will free your mind to concentrate on the helicopter. When you start "thinking" about your fingers you are in trouble. It is nearly impossible to concentrate on your finger movements and concentrate on your helicopter position at the same time.*

SAMPLE COPY

Q47 – How long should I push the stick?

Answer - *The cyclic is spring loaded for good reason – to assure it is in the center position (neutralized). When hovering – avoid pushing the stick and holding it. The longer you push it the more it will accelerate and it only takes seconds for it to accelerate out of control. Gently nudge the stick in the direction you want to fly and then let it center. Try to avoid controlling it all the time. Slight corrections are all that is needed.*

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SAMPLE COPY

Q51 – When can I start turning the nose?

*Answer – Turning the nose while hovering requires a tad of cyclic to neutralize the forces (vectors) that is causing the heli to move in the direction it wants to move instead of the direction you want it to move. A tiny bit of drift gets amplified instantly when you turn the nose and since drift is random the correction is random – although with practice the random pattern starts becoming recognizable and the correction becomes easier to make.*

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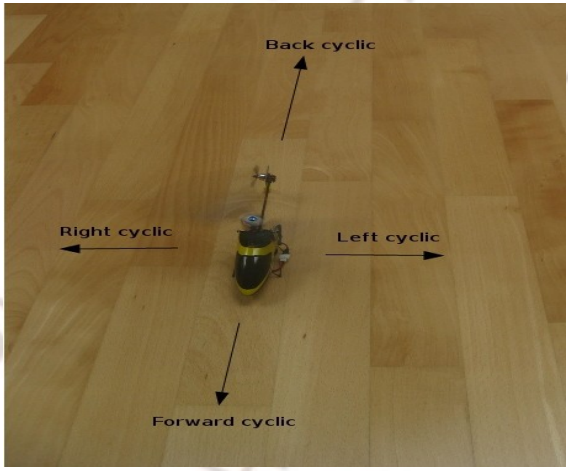
Q55 – OK, I can hover tail-in and side-in with one hand tied behind my back but I can't hover nose-in worth a can of beans. What's the best way to learn nose-in hovering?

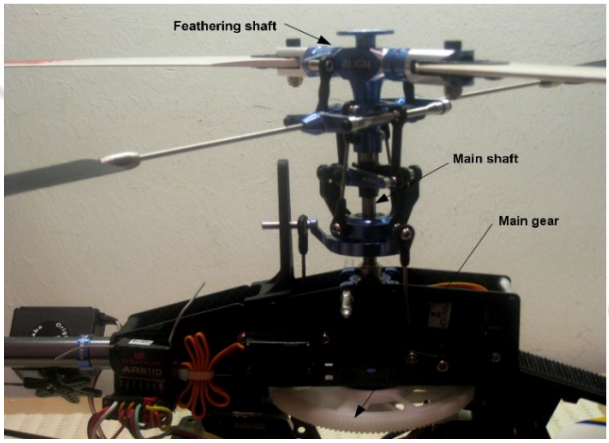
*Answer - Don't force nose-in. Allow yourself to gradually work the nose-in as you are practicing hovering. It is very easy to get disoriented with nose-in. Talk to yourself when moving the cyclic. Stick left moves right – stick right moves left - forward goes backwards – backwards goes forwards. After a few hours of conversation your fingers will start to listen. Simulator practice really helps.*



***450 FAQs***

Q60 - I just bought a 450 with a programmable transmitter but I'm like totally confused on how to set everything up. What settings should I start with?

Q62 – What usually breaks when you have a crash?




HEADS-UP

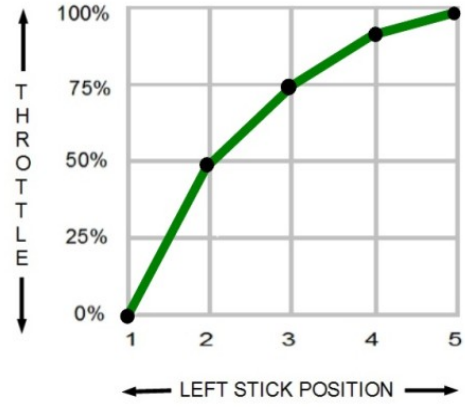
*The feathering shaft is an 1/8 inch steel rod inside the rotor housing.*

SAMPLE COPY

Q66 – I'm on a pretty limited budget. How much does a kit cost?

Q70 – What is CCPM and what does it stand for?

Q76 – Wow, this can get confusing fast!! Is there any such thing as beginner settings so I don't have to understand all of the 625 settings at once?




SAMPLE COPY

Q78 – What is a good curve for a beginner?

Q79 – Does the pitch of the blades also use a curve?

Q80 – Does the swash-plate have a 0 degree pitch position?

*Answer – When the collective (left stick) is all the way down than the swash-plate is at its lowest position on the main shaft and the pitch of the blades are at their minimum. But minimum is not necessarily 0 degrees as this depends on the amount of swash-mix.*

SAMPLE COPY

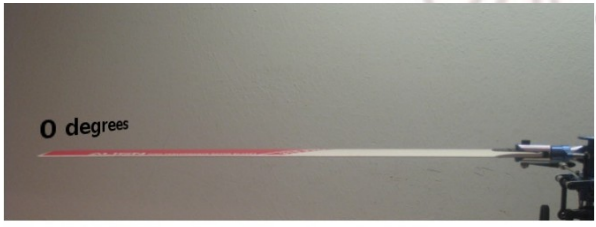
Q81 - I'm confused again. How do you translate the values on the pitch curve to the pitch of the blades?

*Answer – Pitch curves are always confusing the first few times. The first step is to mechanically set the pitch of the blades. This is accomplished by setting the collective stick to center position and adjusting the length of the blade-holder connecting rods so the blades are at 0 degrees*

SAMPLE COPY

Q82 – How do you know when they are at 0 degrees?

*A – You can "eyeball" the angle of the blades by sighting down them from one end. Positive pitch tilts the leading edge (thickest part of the blade) upwards.*

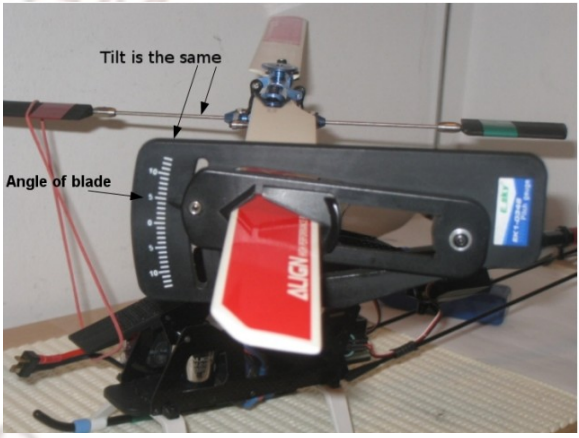




SAMPLE COPY

Q83 – I'm lucky if I can see 5 degrees with my eyeball. Is there an easier and more accurate method to measure the pitch?

A – An easier and a *more accurate* method *is by using a* ***pitch gauge.*** *The pitch-gauge slides over the blade and has gradient marks in degrees to measure the pitch angle using the same principle as a basic protractor. When the tilt of the top surface of the pitch gauge is parallel with the tilt of the fly-bar, the angle of the blade is shown on the degrees scale. Cost is under $20 and a must in your helicopter toolbox.*




SAMPLE COPY

Q85 – WOW!! This is awesome stuff but I think I'm getting it? Is there any such thing as a normal pitch curve?

Q88 – I want to fly inverted more than anything!! Is there any way to make my fixed-pitch helicopter fly inverted?

***HEADS-UP***

*The range of the pitch is set by the the amount of swash-mix in the swash-mix menu of the transmitter.*

Q90 – Could you review cyclic again?

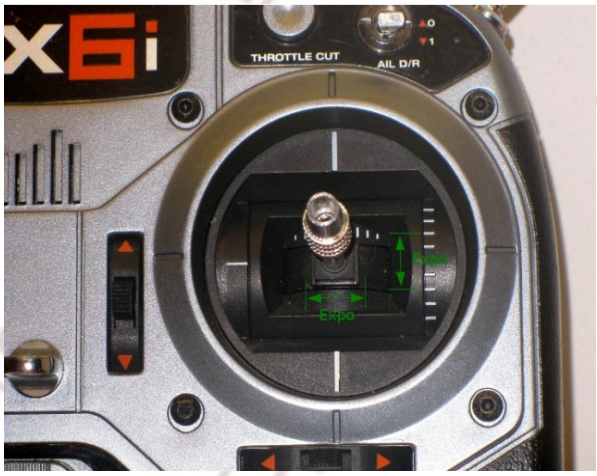
*Answer – Moving the cyclic stick forward and back causes the nose of the helicopter to move up and down – also known as attitude. The attitude (pitch of the nose) controls the airspeed. Moving the cyclic left and right (aileron) causes the helicopter to roll left and right.*

**HEADS-UP**

*Attitude is a change of pitch.*
*Altitude is change in elevation.*

SAMPLE COPY

Q91 – How do you make the cyclic exponential in the radio?

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Q92 – Does the tail rotor use exponential?

*A – Good question. Because the tail rotor is relatively small and runs at very high speed (6 times faster than the main rotor) it is usually best to keep it linear. It is also a good question because it leads us into the next adjustment – tail rotor pitch.*

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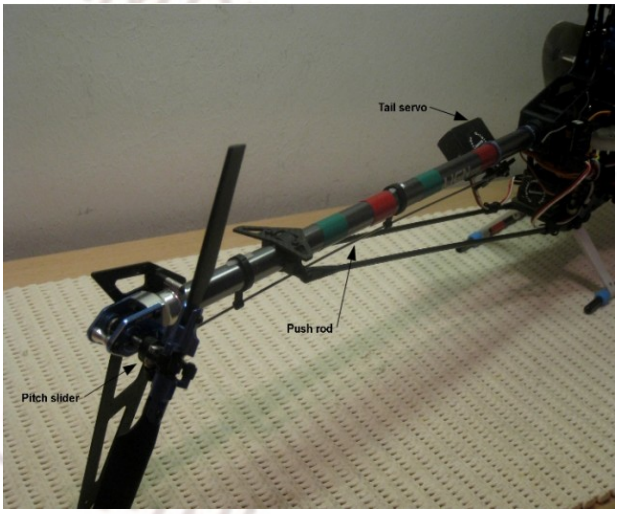
Q94 – If the speed is constant than how is the tail controlled?

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Q95 – What controls the yaw rate?

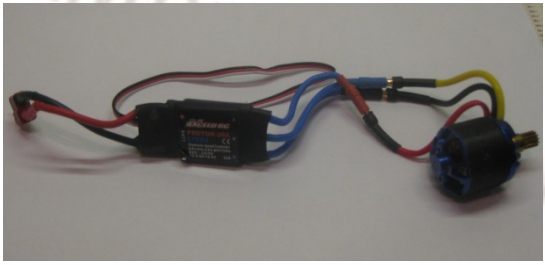
Q97 – How do you switch gyro modes?

***HEADS-UP***

*Not all gyros are the same. Some of them are programmed by the radio. Some of them are programmed by moving the sticks of the radio. Gyros have 3 basic adjustments. The gain – the end points – forward and reverse. The settings and adjustments are critical. This is not for a beginner. The tail can violently whip-lash if the phase is incorrect. Get some help if in doubt.*

SAMPLE COPY

Q98 – Anything else I should know about before take off?



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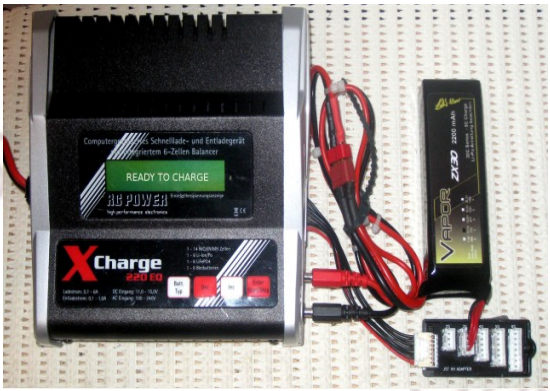
Q99 – How do you program an ESC ?

Q100 – Why do 450 lipos have 2 connectors?

Q101 – *Why do you have to balance lipos?*

Q102 - How do you balance them?

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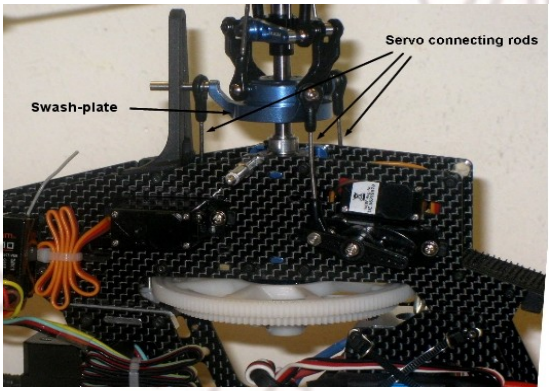
Q102 – Batteries are charged – anything else on the list?

*Answer – Three mechanical adjustments to make and we are ready to fly. First one is leveling the swash-plate.*




*HEADS-UP*

*Before the swash-plate can be leveled, the servos must be mechanically centered first and then programmed so the servo arms all move in the right direction with both the cyclic and the collective.*

SAMPLE COPY

## *SWASH-PLATE LEVELING*

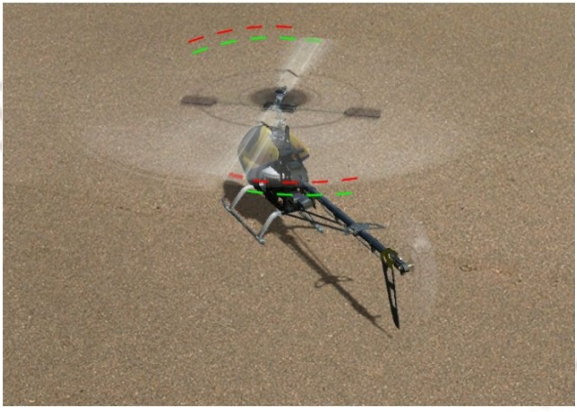
*The swash-plate needs to be almost perfectly level so there is no pitch or roll when the cyclic is neutral. In order to level the swash-plate, the receiver and servos have to be activated.*

*CAUTION: To eliminate the possibility of the motor inadvertently starting up, disable the motor by disconnecting 2 of the 3 motor leads.*

SAMPLE COPY

## *TRACKING*

*Each blade is like a wing of an airplane. If they don't have exactly the same balance and pitch they will "fly" at slightly different heights. This causes a tracking error and results in instability and wobbling. You can not only see tracking error but you can hear it as well. Marking the tips of each blade with different colors will show which one is low and which one is high.*



*Tracking error example: The red tip blade is above the green tip blade when spinning*

SAMPLE COPY

## *PRE-FLIGHT*

*Begin by doing a careful preflight of the **blades and rotor-head**. Assure the blades are not cracked or damaged and are able to move freely in the blade holders – not too tight and not too loose. Check all the ball links are secure and can move freely. Verify all the servos move freely and can change the tilt of the swash-plate with binding. Check the tail rotor servo and verify the pitch slider moves without binding and the tail rotor changes pitch. Verify all machine screws are secure with loctite – without loctite they will work loose in minutes. Install **training gear**. Ping pong balls on the end of 18 inch carbon-fiber rods may look a little silly but they will prevent you from rolling over and having a blade strike which is like pushing the self-destruct button on your heli. Be methodical with your thinking and preparation for take off. Make a check-list Trying to remember everything invites forgetting something.*

### HEADS-UP

*The pre-flight check list and final check list that follows is an example only.*

SAMPLE COPY

## *HOVERING*

Q105 – Seems like it is flying me more than I'm flying it. How can I make it more stable?

SAMPLE COPY

## *TURNING THE NOSE*

Q109 – I'm good to go for 90 degrees but I'm all over the place when the nose starts turning towards me. Is there a way to make that easier?

SAMPLE COPY

Q110 - My thumbs keep getting confused. Should I be teaching my toes?

Q113 - Awesome stuff!! When can I fly further out?

SAMPLE COPY

Q114 – How do you make full circles?

SAMPLE COPY

SAMPLE COPY

Q115 - I've been training forever and my turns still suck. Is there some kind of ratio of how much aileron and how much rudder to use to prevent it from slipping instead of nice smooth turns the police helicopter makes circling around my house?

*A – Welcome to coordinated turns.*

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Q118 – How difficult is inverted flight?

*Answer – One of those most exhilarating and fun maneuvers to make in 3D is inverted flying. The only thing difficult about inverted flight is everything is upside down!! Pulling the collective down makes it go up and pushing the collective up makes it go down. The cyclic is almost like nose-in flying – right cyclic it moves left – left cyclic moves it right. Pushing the cyclic forward pitches the nose UP and increases the speed. Pulling the cyclic back pitches the nose DOWN and increases the speed. Very confusing for the brain. LOTS of practice on the simulator recommended.*

SAMPLE COPY

## *GRADUATION CONGRATULATIONS!!*

*JOB WELL DONE!! The ground is below you now and the only direction is up. Buckle your seat belt – the ride has only begun and the sky is no longer the limit. Have a great flight and wear those wings with pride!!*


*"The only difference between a beginner and a non-beginner is when you started"*

*captJac*

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