Heli-Chair /HC1
Pilot's Operating Handbook
Rev 2005.8.31

Heli-Chair.com

Section 1 - General

This flight emulation device has been designed to teach you the fundamentals of flying a helicopter. The feel and movement of the controls is substantially similar to a full size helicopter. The major muscle groups and reflexes learned while flying in the Heli-Chair will prepare you to pilot any helicopter in the world.

Descriptive Data

Heli-Chair Model Designation HC1

Engine

O.S. .32 SX-H Ringed 2-Cycle Engine

Airframe

Kyosho Caliber 30

Length	43 in.
Height	16 in.
Empty Weight	6.5 lbs
Gross Weight	9.5 lbs
Rotor Diameter	48.4 in.
Tail Rotor Diameter	9.4 in.

Fuel

Methanol, Oil, Nitromethane mixture

Capacity	12oz.
Endurance	20 minutes

Electrical

Nickel Cadmium rechargeable batteries
4.8V Receiver battery
9.6V Transmitter battery
Endurance 1.0 hours

Recommended training protocol

Exercise 1, learning the torque pedals (5-10 minutes per lesson)

To learn the torque pedals is to be in command of the aircraft. Orientation of the helicopter pointing directly away from you is **very important**. As the helicopter swings more than 20 degrees off of heading, your controls will be out of phase with what you see in your mind. Eventually you can master the art of 'pedal turns' and nose-in hovers but not yet! In this exercise you will hold the cyclic in the neutral position or simply not touch it. Leave the collective lowered throughout. Gently roll on the power until the clutch engages and the rotor starts to spin, apply about 1/8 throttle and leave it at that setting. The helicopter will transition through a period of 5 seconds where you have no tail rotor authority. This is because the RotoPod training gear presents no friction to the torque reaction of adding power and your tail rotor is not yet spinning fast enough to compensate, even with full deflection. Let it spin and you will feel the pedals get more responsive. Leave the collective lowered and the cyclic neutral. Now focus on keeping the heli pointed directly away from you. This task will be rather easy unless a wind is blowing. Try turning left and right and getting the feel of control inputs. Perform 45 degree turns, 90 degree turns and then just try to really nail down a solid heading and hold it. Try this at various rotor speeds from the minimum required to maintain orientation to something near full RPM (1700) which you will learn by sound.

GOAL: be able to carry on a conversation with a friend while at the same time stabilizing the heading of the helicopter at any orientation you choose.

Exercise 2 - learning to compensate engine power with pedal input (10-15 minutes per lesson)

Expanding on the lessons learned in Exercise 1, you will now vary the throttle settings and perform the same exercises. When you feel like the helicopter is very stable and heading exactly where you want it, give the throttle a quick burst to perhaps 1/4. You will notice the helicopter immediately spins to the left. More engine power going into the rotor means you have to compensate now by giving an opposite torque to the helicopter with, you guessed it, right pedal. This is why they are called anti-torque pedals and not rudder pedals as on a fixed wing aircraft. Practice rolling the throttle on and off at varying rates, all the while holding the heading constant.

GOAL: to conscientiously think about making power changes and subconsciously make corrections with your feet.

Exercise 3 - First baby steps with the cyclic (20 minutes per lesson)

With the rotor RPM at a reasonable setting, the collective lowered and the heading stabilized and pointing away from you, begin feeling the response of the cyclic. Never make full inputs of cyclic, small displacements will tilt the disk aggressively. Focus on keeping the rotor disk level. Make a left input and observe the response, likewise for all directions. Try this at different rotor speeds to get a feel for the mushiness at low rotor speeds. Turn the helicopter to a nose-in orientation and give it a try on the cyclic. If it starts tipping too much, just let go of the cyclic and put the throttle back to idle...at the same time command the tail to a position of tail-in hover.

GOAL: to play with the cyclic while at the same time using throttle and pedal inputs to command the rotor speed and hold heading in a tail-in orientation; to learn that tail-in orientation is your friend.

Exercise 4 - Getting dangerous with the collective (hours and hours)

Now, while keeping the tail-in orientation, keeping the rotor disk level, add some power. As the rotor spins up, go ahead and pull some collective. Now that you are absorbing energy with the rotor, you will have to increase the throttle to maintain RPM. As you continuously add power and pull more collective the helicopter will start getting light on the skids. At some point it may start sliding off in one direction. Move the cyclic in 1/4 to 1/2" increments to offset the drift. If you can't make it stop drifting then DO NOT CONTINUE, cut power and lower the collective. Reposition the helicopter and try again. The more you are lifting the helicopter's weight off of the ground, the more important cyclic becomes. As you pull collective, you will have to add throttle and at the same time some right pedal. When you get out of whack and roll the throttle to idle, you will need lots of left pedal. The idea here is to get the helicopter to lift off the ground for 1-3 seconds at a time, lower the collective an inch or two to set it back down, then try again.

Exercise 5 - A genuine hover (numerous hours of practice)

First and foremost, the golden rule of flying this helicopter and any aircraft for that matter: fly with your fingertips!

This exercise is a direct extension of the last. Your goal is similar but just a little bit longer in duration. The learning in this exercise is devoted to understanding the use of the cyclic in a hover. It takes very little to make the helicopter deviate from a hover, even forces inherent to the rotor system can cause perturbations that make it wander from neutral. The key to understanding cyclic inputs is this: spend 75 percent of your time with the cyclic at neutral, spend the other 25 percent of the time making short "jabs" of input. A helicopter in a hover is an object that is getting "batted" around rather than "pushed" around. If you see the helicopter just begin to drift to the right, respond by displacing the cyclic to the left about an inch and for about a half second. As you return the cyclic to neutral the helicopter will have just begun to slow its drift to the right and subsequently begin drifting to the left ever so slightly (if the input was the correct magnitude and direction). If you hold a corrective cyclic input until the drift stops, you are already 2 steps behind the machine and in a few moments you're going to be 4 steps behind. Pilot induced oscillations are those where the pilot makes a control input mistakenly in phase with the oscillation he/she is trying to dampen. In a helicopter this is easy to do and this is why a hover is so hard. Not to mention you have to keep the pedals working and the collective must be correctly mixed with the throttle to maintain a reasonable head speed.

Section 2 - Limitations

Rotor Speed 1100-1800 RPM

With respect to the operation of your Heli-Chair, the single most important limitation is rotor speed. It will be hard at first to know what the best rotor speed is. Low rotor speed will make the helicopter sluggish. High rotor speed usually causes harmonic vibrations and can lead to destructive failure of any component of the airframe.

Section 3 - Emergency Procedures

Your transmitter is pre-programmed for fail safe operation in case of signal loss. The fail safe mode of the helicopter will freeze the last position of the cyclic, collective and torque pedals. Fail safe will also position the throttle to low idle. Temporary glitches or fail-safe events are very rare. Usually the cause of this condition is low battery voltage on the helicopter or radio interference. If you suspect that the helicopter went into the fail-safe mode, it is imperative that you determine the likely cause and correct it before continuing.

In the event you become disoriented during flight or loose control of the helicopter, IMMEDIATELY roll the throttle to IDLE and drop the collective. Never try to regain orientation of the craft in an emergency. It is best to set it down and risk a boom strike or other damage. If the helicopter has enough lift to remain airborne, it simply gives it more opportunity to fly closer to you. A common mistake would be to let the tail drift into the “nose-in” hover attitude. In this orientation the cyclic inputs are reversed and your instinct when something goes wrong will be to push forward on the cyclic. Of course the helicopter is pointed at you and thus would now be moving directly at you. The best thing to do in this and most any other case is to cut the power and drop the collective, if you have time to think about it, put the cyclic to neutral.

A condition to be avoided

If you are hovering and loose your orientation or control of the aircraft, **DO NOT drop the collective to neutral without either first bringing the engine to idle** (on the order of 1 second to do this) or better yet roll off the throttle as you lower the collective. The power required to hover will overspeed the rotor when the collective lowers to 0 degrees pitch. It is imperative that you reduce power when you reduce pitch. Blades and blade grips can fail if overstressed.

Autorotation

Should the engine fail in flight, an autorotation must be executed. It is recommended that you study the nature of energy management in relation to auto-rotations. The Rotorcraft Handbook should have sufficient information for study beyond the text presented here. With your Heli-Chair, a very unique situation exists because the rotor system on this helicopter does not store very much energy. Engine failure at low altitude must be immediately compensated by full collective to soften the fall to the ground, there is not time or altitude to try to manage rotor speed. High altitude auto rotations are conducted in accordance with the techniques presented in the Rotorcraft Handbook. The Caliber 30 helicopter has a driven tail-rotor. Some models do not have this feature. When the engine quits on the Caliber 30, you will have tail-rotor authority until the main rotor stops because there is no clutch to disengage the tail rotor from the main rotor.

Tail Rotor Failure

The primary concern with tail rotor failure is the ensuing yaw that will occur. The helicopter will spin rapidly to the left until the power is set to idle, at which point the rotation will slow but not stop. If you loose command of the tail it is best to bring the power to idle and salvage what is left of your rotor inertia for an autorotation effort. Jut keep the cyclic at neutral if the heli is spinning, it will be on the ground in a very short time.

Fail-Safe Event Checklist

Transmitter antenna	Extended
Receiver antenna	In-tact
Battery Voltage	Check under a load if practical
Radio Interference	Investigate

Section 4 - Normal Procedures

Preflight inspection is important. The fact that the aircraft flew normally the last time is not an indication that it will fly again. A thorough preflight is suggested every time you fly. Check the following items:

preflight inspection	
	servos, servo horns, and control linkages
	frames, structure for looseness
	tailrotor assembly
	main gear, swashplate and rotor head, flybar and linkages
	main rotor blades
	engine, carburetor and throttle control
	fuel plumbing secure
	wiring, other systems
	training gear (if used)
	training system set and tested (chair/buddy box)
	flying area secure
	fire extinguisher, safety briefing
	student and bystander briefing
pre-start	
	transmitter switches SET and antenna OUT
	transmitter ON
	transmitter model memory, check
	transmitter trims CHECK
	transmitter voltage >9.4
	receiver ON, check Tx-Off FAILSAFE MODE
	flight controls CORRECT
	transfer of controls/buddy box CHECK
	throttle verify IDLE, verify FULL, verify IDLE
	engine start and warmup
	starting equipment REMOVED
pre-takeoff	
C	controls CHECK!!
I	instruments - switches DEFAULT ALL UP and BRIEFED
G	gas QUANTITY
A	avionics - transmitter antenna OUT
R	runup
landing/ shutdown	
	engine OFF
	throttle PARK OFF
	receiver OFF
	transmitter OFF

postflight	
	clean and inspect
	look for loose and missing parts
	logbook entries, scheduled inspections, etc

The engine starting procedure is as follows: double check the positive control of throttle and that it works in the correct direction. All transmitter switches default to the up position prior to start. Engage the glow ignitor and insert the starter shaft into the receptacle. Set the throttle position no more than a couple “clicks” from idle. Run the starter until the engine comes alive, remove the starter shaft from the engine. Double check that you have removed the glow ignitor from the aircraft before continuing.

Section 7 - Systems Description

The Heli-Chair comes pre-programmed with 3 modes of flight. The first mode is called “Chair1” and more closely resembles the function of a typical piston engine helicopter where throttle and collective must be managed independently by the pilot to maintain rotor speed. The next mode is called “Chair2” and is pre-programmed so that the throttle control is non-functional (or only about 5% effective in ‘trimming’ the power setting). As the pilot pulls the collective, the throttle will be automatically rolled on to maintain rotor RPM. This is an excellent learning aid as it reduces workload. Additionally the Chair2 mode has an option of mixing the torque pedal input to partially compensate for power changes automatically.

The third flight mode, “Box” is the traditional flight mode and allows for the flexibility of flying like the rest of the RC world does, with the gimbals on the transmitter box.

Using a second transmitter and an appropriately qualified RC helicopter pilot, the chair can be operated in training mode. This mode allows the pilot flying with the transmitter box to either have control of the functions that the student is not responsible for or to take over full control should it become necessary. The Futaba radio operations manual will describe this process in detail.

If you have purchased the computer simulator option, you will have an additional mode called “Sim” which allows you to connect to the comptuer via. USB cable.

In most cases you will operate with all switches in the up position. This is an easy way for you to remember the “default” condition of all switches on the radio, as there are many to consider. The switch labled “H” with red tubing on it is the engine kill switch. This switch is used to kill the engine from the idle condition. Another switch, “A”, is used only in CHAIR2 mode where the tailrotor can be automatically mixed for you with throttle. This switch is used to turn on and off the automatic mixing of the tail rotor. The Futaba radio system has many different programing options, please let us know if you need more help understanding how to operate the radio.

Section 8 - Maintenance

The most routine maintenance you will perform is charging of the batteries. The endurance of the batteries on your Heli-Chair should be considered to be around 1 hour, unless you have purchased upgraded systems. After each day of flying (or after 3 to 4 full tanks of fuel), you should use the

included chargers to restore the batteries to normal voltage levels. The charging is automatic and requires between 6 and 12 hours for full charge. If you need to fly more often, we can easily upgrade your battery and charging system to give you up to 2 hours flight time with less than 2 hours recharg time inbetween cycles. The transmitter and receiver both need to be in the OFF position for the charging to work. The process is described in detail in the Futaba manual.

Maintaining your Heli-Chair is focused mainly on the mechanics of the helicopter. The Heli-Chair unit itself will require very little long term maintanence. Everything is lubricated with high quality grease when we assemble the Heli-Chair, so there should be no need for lubrication unless problems arise, in which case we need to evaluate what went wrong. Periodically inspect for loose bolts, wires that are rubbing and components that may have been inadvertantly abused. If you are experiencing any problems with the unit, contact us and we will gladly help you to fix it.

The helicopter you fly with the Heli-Chair is a very dangerous aircraft. Rotorblades can depart the helicopter and fly upwards of 100 meters before coming to rest. Helicopters have killed people and sent countless others to the emergency room for stitches. Treat the helicopter with a lot of respect. It is recommended to do a good 5 to 10 minute pre-flight inspection each different day that you fly. Just because the helicopter landed successfully the last time you flew doesn't mean it is still safe. If you experience any sort of mishap while flying that involves broken rotor blades, ground contact or otherwise abnormal operation, a full inspection must be completed. Parts on the helicopter can be easily bent, cracked or fatigued without showing external signs. Rotational components which are bent will increase vibration levels leading to eventual failure of a critical component of the helicopter.

The most common maintenance item for the helicopter are checking the control linkages and the hardware holding everything together. The nylon rod ends that snap onto either metal or nylon balls tend to get gritty and eventually loose. They can get loose to the point that they come off in flight leaving an uncontrollable helicopter. Additionally, it is a good idea to make sure each servo control arm is tightly attached. The entire helicopter is held together with screws and bolts of various type. Some are more likely to come loose with vibration than others. Periodically inspect all screws for tightness. It is not necessary to tighten each screw on all inspections. Apply an appropriate amount of torque and if the fastener is suitably tight to begin with, it will not spin.

The best source of maintenance information starts with the helicopter maintenance manual. Kyosho has written a detailed manual describing the maintenance procedures for the Caliber. In general you will not need to lubricate any of the moving components. The reason for this is the oil mixed into the fuel for engine lubrication tends to get everywhere as it is exhausted out the engine. As with any other aspect of the Heli-Chair, if you are unsure or have questions, we are more than happy to help you.

Appendix 1 - Heli-Chair Computer Simulation Interface

The Heli-Chair will interface with your computer in the same way as any regular radio transmitter. Simulation software such as Great Planes RealFlight G2, or Realflight G3 and Reflex XTR will allow you to learn maneuvers and coordination that otherwise is beyond your skill level, all in the safety of your home. We recommend using the simulator primarily to learn the coordination of flying the nose-in hover orientation. An interface is available that allows the Heli-Chair to work with flight simulators such as X-Plane or Microsoft Flight Simulator.

Even flying with a only the transmitter unit itself can expand your understanding of how the helicopter

will fly. Utilizing a combination of computer simulation and real world flying with the Heli-Chair will maximize your learning. You will notice immediately when transitioning between setups that the Heli-Chair has many benefits the computer software does not. The fidelity of the Heli-Chair flight emulatior is much more detailed because it is a real helicopter flying in a real atmosphere.

If you have purchased a modified radio transmitter from Heli-Chair, you will find a model program called “Sim”. This is the model memory you must load in order to properly interface with your computer. Follow the manufacturer’s recommendations for connecting the transmitter with a USB cable. If you are having any problems we will be glad to help you.

Index (to be improved in the future)