LMH Corona

By Fitz Walker

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Specifications

- **Rotor Span:** 30 in (762 mm)
- **Length:** 29.4 in (671mm)
- **Weight:** ~44 oz. (1.3 Kg)
- **Channels:** 4
- **Motor:** Electro-Fusion 7 (supplied)
- **Main & tail rotor gear ratios:** 11.3:1:2.1
- **ESC:** Electro-Fusion 35 (supplied)
- **Battery:** 6-8 cell packs
- **Receiver:** Hitec 555
- **Servos:** Hitec HS-81/MG (3)
- **Gyro:** Futaba GY-240
- **Manufacturer: Lite Machines**

The Lite Machines Corona is a marvel of simplicity and ingenuity. It's first incarnation, called the LMH-100, came out sometime in the early 90's and was powered by a COX TD .049 or .051 (with a throttle sleeve), and could be flown with a simple four channel radio controller. To my amazement, it actually flew. Engine problems notwithstanding, it was stable and had good power. It also had a unique mechanical gyro that used the phenomenon of gyroscopic progression to keep the tail rotor stable without the use of a heavy and expensive (at the time) electro-mechanical gyro. This kept costs down and simplicity up. However, the most endearing quality of the LMH-100 was that it was nearly indestructible. Low mass, clever design, and flexible plastic and metal parts all culminated into a machine that could flown into the ground at high speeds and yet still be flyable immediately after only a light dusting off, making the LMH-100 probably the first and only "rubber" R/C helicopter.

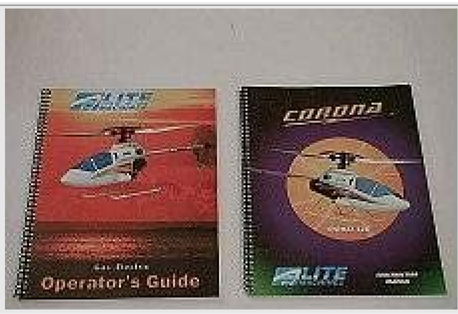
Unfortunately, the LMH-100 and later upgrade model 110 made a somewhat tricky helicopter to convert to electric. They almost always needed a small but powerful brushless motor to truly fly well. The Europeans enjoyed some success with it as well. Enough, in fact, for the Lite Machines Company to make a new crutch specifically for those who wanted to make the conversion. The problem was that the machine was a bit too heavy for 400/480 size motors, but also a little too small for 05 car type motors and the large battery pack needed to power them.

To address these issues and cater to the growing market of electric helicopters, Lite Machines has introduced the new Corona. The Corona is based on the popular LMH-100/110 design, but with some very significant changes. A new specially designed crutch has provisions for battery pack mounting and adjustable motor mounting for various sizes of motors and associated pinion gears. More importantly, the rotor blades are some 2.5 inches (63 mm) longer than before, thereby increasing the rotor span from 24 inches (610mm) to 30 inches (762 mm). This in effect increases the rotor area over 40%. What does this do? Well it lowers the rotor disk loading (akin to wing loading on airplanes) and enables the helicopter to generate more lift for the same rotor rpm. In addition, the tail boom is longer and the tail blades are larger as well.

The Corona blades (top) are significantly longer than the LMH-110 blades (bottom).

Construction

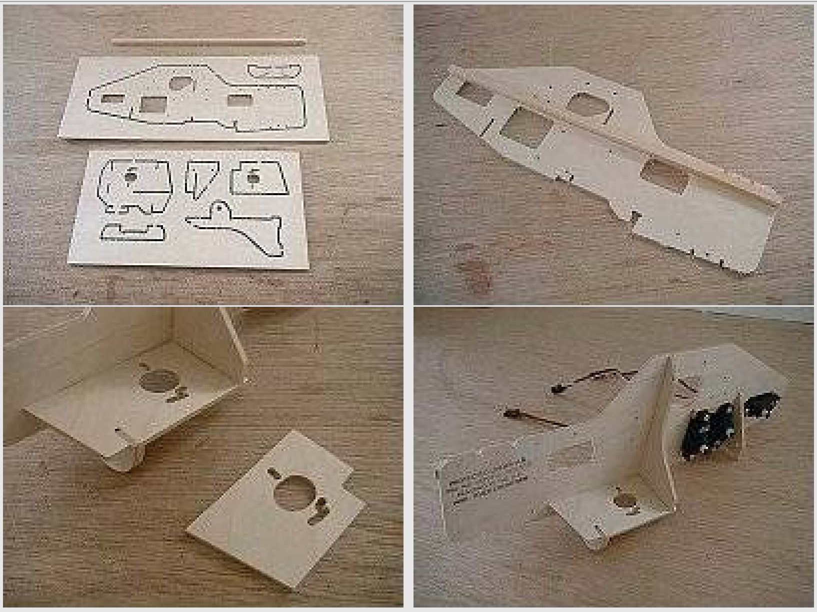
Lite Machines includes not one but two manuals with the Corona. A step-by-step construction manual and an operator's guide that outlines proper setup, care, and maintenance of the machine. The construction manual starts with the obligatory warnings, safety concerns, and required equipment needed for construction. Everything is well thought out, and includes detailed diagrams and descriptions of the various construction steps. Each step also has an accompanying checkbox for the builder to track his or her progression for when the building session is interrupted. Every other page even had a metric and English ruler printed at the bottom to help in screw selection. Parts are generally mixed together into several labeled bags. Fortunately, a small plastic egg carton-like parts container is included to help keep things organized. Also included are an assortment of sand paper and lubricants, along with various sizes of Allen wrenches and nylon tie wraps.



Two manuals provide very concise building, maintenance, and flying instructions.

All parts are neatly (although somewhat mixed) bagged together.

Construction starts with the "crutch", which is the main chassis of the helicopter. The crutch is constructed from pre-cut 3/32" (2.4mm) aircraft plywood. The parts are pre-cut with a router and are assembled like a 3-D puzzle. Afterwards, they are then glued together with medium or thick CA. The fit of the parts was excellent and self-aligning. The builder is not only told to glue the parts, but also shown how to glue the parts most effectively with detailed drawings. Once the crutch is completed, the canopy construction is outlined. I, however, decided to skip that section until later in order to go straight to the next phase, rotor head assembly.



The crutch is a simple 3-D puzzle that is glued together. Note the adjustable motor mount and that the servos are mounted very early in the constructions stages.

Since the Corona has a fixed-pitch rotor head, it lacks the complicated mixer and bearing assemblies of collective pitch machines. Therefore, the blade grips will eventually bolt to the head, which consists mainly of a one-piece molded feathering plate. This plate is held onto the rotor head hub by a small pin inserted longitudinally through the plate. In fact, most of the head and flybar assemblies are held into place with various sizes and lengths of steel pins. While this is a bit unorthodox (no ball bearings are used in the head), the finished rotor head moved quite freely.

A light tap with a hammer positions the pivot pins in place.

Nearly finished head sub-assembly

Another interesting design feature is that the flybar paddles (called the sub-rotor) uses large bolts to keep the long pivot rod in place. It seemed like overkill until I realized that the bolts also seem to serve double duty as flybar weights to add stability to the rotor head.

Large screws are used as weights and to keep a long pivot pin from flying out.

The finished head is ready to be balanced. The blade grips come in 4 and 6 degree preset blade pitch.

Once the main rotor head is assembled, the manual continues with the now glued-together crutch. The bearing block, ball bearings, and shaft collars are then arranged for the sprung steel main shaft insertion. You must be careful to note that the main shaft has two different ends with the smaller notch positioned at the top.

The upper and lower bearing blocks in place

The main shaft needed to be sanded down a little in order to slide through the bearing mounts.

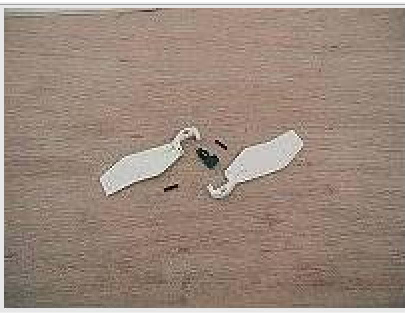
The manual then covers in detail how to balance the rotor head and blades. I was very happy to see this, as it is a very important step that is commonly missed by those new to the hobby. At this point, I'll point out that the main rotor blades are made of a durable but flexible plastic with a slightly under cambered airfoil. The solid plastic blades also feature small molded in turbulators near the roots. These are small strips of raised plastic about three inches long that serve to prevent airflow separation of the blades by purposely 'turbulating' or breaking up the airflow over the blades. How well it works, I can't say, but it indicates an impressive attention to detail on the part of Lite Machines. Once the blades were properly balanced, it was on to the tail boom assembly.

The manual outlines proper balancing. Black and white balance tape is included to match the color of the blades and paddles. I purposely used contrasting colors for photo purposes and to make in-flight orientation easier.

Danger Will Robinson! These blades may be plastic, but they can still hurt you. Note the turbulator molded into the leading edge of the blade root.

My review kit came with a snazzy blue anodized aluminum tail boom. It uses a simple wire drive with bevel gears on both ends and supported by three Teflon bushings, which are inserted into the boom. One end of the tail boom has a slot cut in it for the tail rotor hub. To help prevent the bevel gear from slipping, I filed a flat spot onto the drive wire before attaching the front beveled gear. Don't forget to apply grease to the beveled gear inside the tail gearbox.

The tail blades sort of key together onto the center hub with the aid of large set screws. It is interesting to note that the tail blades are under cambered and have built in pitch (side thrust) in the neutral position. I did find it necessary to trim a little bit of the molding flash from the blade parts with a hobby knife to assure free movement or the blade pitch mechanism.



Tail rotor pieces before assembly

The tail pitch rod goes through the center of the tail shaft.

Completed tail assembly

The review version of the Corona doesn't have the famed Arlton mechanical gyro of the previous LMH models. Since piezo gyros are cheap and easy to use now (unlike when the clever Arlton gyro was first introduced), this is a wise move. With out the need for a mechanical gyro, it has a much simplified tail rotor hub and collar with a pitch control rod that runs through a hollow tail shaft. After the tail rotor assembly is completed, the vertical tail fin is glued on with thick CA. I noticed that the tail fin has a few degrees of right trim built into it (presumably to offset any yawing that may occur in forward flight).

In going along with Lite Machines' unusual design philosophy, the swashplate must be completely assembled by the builder. The swashplate consists of three pieces (inner race, outer race, and race ring), in which 16 ball bearings are inserted. Despite the little extra work required, the swashplate went together with little trouble, as long as the instructions are followed.

These are the swash plate parts prior to assembly. The white container holds lubricating grease.

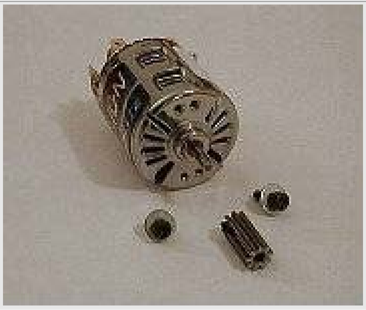
The nearly completed swashplate is ready for final top piece to be screwed on.

After the swashplate is completed, the landing skids are attached to the crutch with nylon tie wraps. (This is simple yet effective). The manual then covers very clearly how to set up the control linkages for their correct geometry, in which nothing is left to guess. After this step, the tail boom is bolted on with three screws. When mounting the tail boom, be careful to make sure the two bevel gears mesh properly.

Nearly completed helicopter

A drafting triangle is used to align the tail boom.

The next step is to install the motor and pinion. The motor is curious as it carries the name, Electro-Fusion 7, but little seems to be known about it. By appearances, it is a typical R/C car type motor and has the words Yokomo (Japanese R/C car company) on the plastic end bell. Close inspection seems to indicate that it is a 13-turn, double wind motor, which would place the Kv somewhere around 4500 rpm/volt. The motor also has neat looking cooling slots arranged around and in front of its case. According to the manual, the moveable timing has been pre-adjusted to around 10 degrees or so. Rather surprisingly, the motor does not have ball bearings but brass bushings. This will require routine oiling of the bushings for prolonged life. Lastly, capacitors are included, and must be soldered onto the motor to help eliminate any electrical noise generated by the motor. A nine-tooth pinion is also included with the kit.



Electro Fusion-7 motor and included 9-tooth pinion

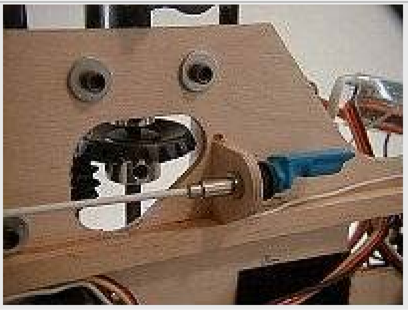
The only real change I made was to remove the white Molex type connector from the speed controller in favor of the Sermos type commonly used by electric fliers.

Mounting the motor onto the crutch is easy as there are elongated slots in the motor mount that allow easy adjustment of the motor's position for proper gear mesh. It also allows different size pinions to be used if one wants to experiment.

Finally, the receiver and battery pack are mounted using Velcro (hook & loop fabric) to the frame. I elected to use double-sided tape to mount the gyro (Futaba GY240), as I think it makes for better gyro performance. Connecting the speed controller and mounting the servos completed the electronics portion of the helicopter. For the speed controller, I changed the provided Molex style connectors to Sermos type, as I prefer them and use them on all my battery packs. For the servos, I used Hitec HS-81 servos for all four controls. Again, the instruction manual clearly illustrates how to set up all the linkage lengths and geometry.

The Futaba GY-240 heading hold gyro is small and light-weight.

The completed helicopter is ready to go!



The kit even included a Deans base-loaded whip antenna.

Construction of the canopy was saved for the last step, as I thought it would make a great symbolic finish of the helicopter's construction. The canopy halves come on two separate vacuum formed styrene sheets (~0.015" thick) and have clearly molded cut lines. Using curved Lexan car body scissors, I carefully cut out the canopy halves while making sure to leave a glue lip on one of the canopy halves. The canopy halves and assorted reinforcements are then carefully glued together with thin CA. Installation of the rubber grommets and decals finished off what turned out to be a pretty attractive canopy. The finished weight (not including battery pack) came to 28 ounces.

The canopy was cut out with curved scissors.

Thin CA was used to glue canopy halves together. Follow the instructions carefully as not all of the parts are completely glued.

The kit comes with a nice set of decals, and additional decal styles are available from Lite Machines.

Flying

Using a 7-cell CP-2400 battery pack, I was able to get the Corona to balance as shown in the manual with no problems. Total weight with the battery went up to 43 oz. (1.3 Kg). It was ready to fly!

Flying the Corona proved to be a quite an entertaining experience, with the first couple of flights being done without the canopy so as to facilitate easier monitoring and adjustments of the various electronic components. So, with a fully charger battery pack, I was off to beat the air into submission. (Some people call it helicopter flying).

It's ready for action. The black and white stripes are the blade tracking tapes. (Opposite colours were used for effect.)

The speed controller is easy to use and arms its self automatically when it "sees" the throttle off position for a couple seconds after first "seeing" the full throttle stick position. With everything plugged in and ready to go, it was time to spin up the blades and see how she flew, and flew she did. I was actually startled how quickly it took off. At a rotor speed that seemed too slow to do anything, it practically leaped off the ground into the air. The kit includes an extra six-degree (six dots) blade grip for blade tracking adjustment, but using the two 4 degree grips showed no tracking problems.

After a few clicks of trim and some minor gyro sensitivity adjustment, I had a machine that was surprisingly stable and easy to hover. Being fixed pitch, there is some delay in the throttle when trying to maintain a level hover but this is common to all fixed pitch machines. However, I noted that the throttle response of the electric motor was noticeably better than the old LMH-100 with a glow engine I had flown previously. Hover rotor speed was generally around 1600 rpm.

The throttle may have had some delay, but the cyclic controls certainly didn't. When building the rotor head, I set up the z-links for the standard, milder control response setup. This has proved to be more than adequate as the control response is very good, and it responds quickly to cyclic inputs, yet it is not too sensitive either. I don't use any exponential on the controls and haven't found the need too. The tail rotor control works well enough, but it is obvious that the combination of the wire drive and low blade speed (the tail rotor ratio is only 1:2.1 instead of the more typical 1:5) was causing the gyro to hunt and wag the tail on occasion. In fact, I had to turn the gain up to nearly 100% to get it to hold the tail the best. Anything other than slow to moderate backward flying would cause the tail whip around as well.

What I was rather impressed with the amount of power provided by the stock motor. Full power climb outs were quite fast and you could really hear the blades winding up in speed. Forward speed could also get pretty fast if you wanted it to. I had great fun zipping it back and forth over the field doing high-speed turns and chandelles. Handling was pretty good with a slight tendency to pitch up in fast forward flight. It also flies quite well on windy days since it has a good amount of mass to it.

Of course, going up is easier than coming down (gracefully). Being a fixed pitch machine, you simply can't bring it down as fast as a collective pitch machine. You can reduce the throttle and hover it down, but it will take a little while. (But if you are just learning, you have no other choice.) If you reduce the throttle too much, though, the controls become very sluggish as the rotor speed is slowed way down and very little thrust is generated. A better option is to sort of fly it down like an airplane, but you have to be comfortable in forward flight in order to do it that way.

Aerobatics flying

Mk, yes, it can do it. Pirouettes, stall turns (180 and 540 degree), and even loops can be done with the little guy. Make sure you start your loops very high, with lots of height, and with lots of forward speed, as it will lose quite a bit of altitude on the back part of the loop. I've found it loops better if you go from forward flight to a 45-degree climb for a second, then pull full back cyclic to complete the loop. Whatever you do, don't reduce the throttle until the manoeuver is complete. Rolls are possible, but the few I did weren't pretty. It does a sort of corkscrew barrel roll. Pretty funny to watch, I must say.

The main selling point of the Corona, however, is its durability, and durable it is! Lite Machines used to have a video showing their machines being purposely whacked into bridges and various other inanimate objects, only to be picked up and flown immediately afterwards. Flying in a tight space, I've managed to have it fall ten feet to the ground after hitting a tree. I've also subjected it to medium speed flights into terra firma (must watch those wind gusts), and even pancaked it into the ground after looping it with a rapidly dying battery. Crashes that would necessitate parts replacements on any other helicopter only resulted in a couple small dents on the tail boom and some stripped servo gears (I've since gone to metal-geared servos, which have proved much more durable).

Different types of battery packs were tried include a 6-cell, 7-cell, and 8-cell pack. All will fly the helicopter pretty good. The 8-cell of course had the most power, but at some weight penalty. However, it works really well for windy days. I've since settled on 7-cells as my preferred pack as it is a good balance of weight and power. Average flight time with a 7-cell CP-2400 pack is about 7.5 minutes. When the power does fade, it does somewhat quickly, so I recommend the first couple of flights be done low and monitored with a timer to give warning before the battery charge is used up. I've also noticed that the motor gets quite hot with the canopy on. I recommend cutting some cooling holes in the top of the canopy, and perhaps even adding an R/C car heat sink on the motor. Regardless, after dozens of flights, I've found the Corona to be a capable and reliable machine.



Sorry if these are not the most exciting pictures ever taken. However, she flies quite well and is easy to see even from pretty far away.

While appearing to be limited by being fixed pitch, flying the Corona has proven to be loads of fun.

Plastic blades that can fold in a crash, a spring steel main shaft, robust frame construction, and simple mechanics work to provide an ultra durable helicopter that is great for helicopter training and flies really well. The beginner flier can also use it to carry them into basic aerobatics before moving onto larger more complicated machines. In addition, the added ultra-reliability of the electric motor makes for many trouble free flights. The Lite Machines' Corona is great for those looking to get into the hobby or for those casual fliers who literally want to "beat around the bush."