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SMALL ROTORS

AN UPDATED BIG COAXIAL – THE SOVEREIGN CTX-5

There was a time when if you said 'coaxial heli' to me, the first thing I'd think of would be a hand sized indoor model weighing just a few grams… This vision was somewhat modified a few years ago when the Editor arrived at the flying patch with something rather larger, a 'Helibaby RTF'. This fitted into the 'what on earth is that' category, a 3 kg coaxial with a pair of 900 mm diameter collective pitch rotors! It flew well, but seemed to be in need of a little bit more development – that culminated in the Sovereign CTX-5FBL Jon reviewed in the March 2015 issue of MHW.

This version swapped the two-blade heads for three-blade heads and relied on a flybarless unit for stability. Not satisfied with that, there's another version now arrived, the CTX-5DUAL with an improved version of the original two-blade Bell-Hiller head, and with instructions on how to remove the paddles and go two-blade flybarless. The editor knows I like unusual models, so the kit was soon on its way.

The kit comes well packed; all the major sub-assemblies are pre-built

This model arrived as what I would term a semi-kit, the heads, swashplates, yaw unit and gearbox come pre assembled and ready to fit to the two mainshafts. Now is probably a good time to catch up on the basics. Our little indoor coaxials usually have two motors, one driving each rotor as a separate system. There's no collective pitch, relying solely on motor speed for height control, while yaw is achieved by differential throttle on the two rotors. Cyclic control is often via the lower head only.

The CTX-5 has one motor to drive both heads via a simple combing gearbox. Both heads are pretty much identical, with the same collective pitch and Bell-Hiller mixing; think of it as two normal rotor heads stacked one on top of the other. As the heads are driven together and the torque from each cancels the torque from the other out, yaw is achieved by varying the collective pitch of the top rotor via a spider and washout unit. The mechanisms look complex, but stare at the pictures for a bit and all comes clear…!

I can't fault the presentation of the kit, it comes well packed in a sturdy box holding three smaller boxes with all the sub-assemblies. The manual is quite simple, just a series of exploded diagrams showing the construction of each sub-assembly, then another showing how it all fits together. Although some of the mechanics come pre-assembled, I always tend to check the important bolts for tightness and thread lock the really important ones – I needn't have worried, everything was tight and locked out of the factory. Construction starts with the heads, each is fitted to its respective mainshaft.

The two rotor heads are very similar and come assembled, just needing the dual-arm swash drivers bolting on to each centre block. There's no through-spindle, as the mainshafts and yaw control rod run through the centres of the heads, so each grip has its own feathering shaft held by a cross bolt in the head, this forms a pivot allowing the grips to flap. There are dual rubber dampers (these feel hard, we don't want the

Each head has a swashplate driver bolted on, note the two cross bolts which act as flapping pivots

One of the heads, the mast assembly and a swashplate, as they come out of the box

The twin main gears, both have autorotation hubs

The complete yaw control assembly. The control rod fits through both mainshaft tubes

The yaw washout unit fits over the top head and adjusts the top head collective pitch for yaw control…

…while the control lever at the bottom lifts and lowers the control rod

two rotor discs flapping together…), dual axial bearings and a thrust bearing in each grip.

Both swashplates have a flybar seesaw fitted to the upper ring, the split flybars and paddles screwing into the ends of the see-saws – one has to remember to ensure the upper and lower paddles are pointing in the correct rotation! The other big sub-assembly is the dual mast and its associated bearing blocks, the lower block comes fitted with the lower washout unit and mixer arms, the upper block has split arms to form guides for the upper swash control rods. Both masts are tubes, the lower mast 10 mm, the upper one 8 mm.

Now all these sub-assemblies can be threaded over the masts – the heads are locked in place with pairs of bolts that locate in holes drilled into the mast tubes, the swashplate drivers also incorporate a clamp. The swashplates simply slide on, making sure the correct links go to the correct balls! A pair of Nylon main drive gears go on next, each gear attaches to its main shaft with three bolts that again drop into holes in the shaft tubes. There's a bearing block between them, along with another underneath.

The remaining item is the yaw control rod with its washout unit; this slides right through both masts. By lifting the rod up and down, we can independently alter the collective pitch of the top head on its own, thus creating differential torque between the rotor heads. The washout unit rides up and down on two pins that drop into the upper head block, while the control rod slides in nylon bushes pressed into the top and bottom of the inner mast tube.

The yaw servo moves the rod via a lever mechanism that sits beneath the masts and main gear. With the control rod passed through the masts, the lever is added, trapped between two Nyloc nuts fitted to the threaded end of the control rod. These allow a small amount of adjustment of the yaw control during set-up.

Motive power for the CTX-5 comes from a brushless outrunner, in this case a Scorpion HK-4020-1390 kV brushless outrunner and a Castle Creations Talon 90 ESC lifted straight from Jon's original Helibaby model. The motor is bolted to a simple plate motor mount, and a 12-tooth brass pinion is added. The motor drives the rotors via a very simple reduction gearbox, a 47-tooth spur gear linked to a 16-tooth bevel gear that sits between the two main gears.

All of these assemblies can now be laid into one of the side frames, several aluminium cross bars and the servo rails are added, and the other side frame can then be dropped into place. The whole lot is held together with a total of forty-eight M3 bolts. The mouldings are spot on, everything fits in place exactly, and with the frames closed, the whole chassis is very stiff.

The motor and gearbox are slid into place and bolted up, there's no adjustment available for gear mesh, but with everything tight the meshes were fine. A simple undercarriage and tail boom are added, so all that's left now is the radio installation. I used three Spektrum H5000 servos for the cyclics, a Spektrum H5020G for the tail, an Ace TG7000 yaw gyro and a Spektrum AR9000 receiver. It's a good idea to centre the servos before putting the arms on, as you can't get at the arm screws once the servos are fitted – ask me how I know…!

Motive power comes from a Scorpion HK-4020-1390 kV brushless outrunner

The reduction gearbox couldn't be simpler – note the bevel gear to drive the main gears in opposite directions

The heads, masts and main gears laid into the right side frame – it's a perfect fit

The upper bearing block and the servo rails

A view of the yaw control lever under the main gears

All that's left now is to fit the blades. These are 390 mm long, 40 mm chord and made from injection moulded black glass filled Nylon – I weighed them and they were within 1 gram of each other. Jon lent me some batteries, 6S 3600 mAh packs, which slot perfectly into a trough in the front of the chassis, retained with a Velcro strap. I popped the CTX-5 on the scales with the battery in – a smidgen over 3 kg, slightly heaver than my little indoor coaxials!

No excuses, so it's off to the flying field. The first hops were a little wobbly as I had the gyro gain and the cyclic rates too high. With the rates down to 80% and the gyro down to 40%, the CTX-5 settled into the hover, vibrating slightly but all functioning correctly.

The vibes were down to tracking, so we spent some time tweaking both rotors to get the smoothest ride. The hover is quite stable, there seems to be something of a pendulum effect with the tall mast, needing little input to sit still. Yaw control is surprisingly powerful, while the Scorpion motor gives bags of spare power.

Moving into forward flight is easy enough; you have to keep some forward cyclic in, just not as much as a small indoor model. You soon get used to giving it the occasional extra nudge forward, and treat it like any other heli. You have to 'fly' the CTX-5 more than a traditional heli, but to me that's all part of its charm, just some gentle figure of eights leaves me with a silly grin!

A highlight of the day was getting the CTX-5 airborne alongside Jon's three-blade-head version, although after that I've decided formation flying isn't for me! So with the CTX-5 flying well, it was back to the bench to prepare for part two of the review.

The reduction gearbox installed, ready for the motor to slide in behind

Although the boom is more of an orientation aid, it does come with a hefty mounting block

Scooting around the field with the flybar version of the Sovereign CTX-5

A bit of formation work with Jon's three-blade version, or is that a six-blade version?!

Going Flybarless

The kit comes with a choice of running the heads with or without the flybars, so once I'd done some flying with the flybars, I decided to do the conversion. It's a relatively simple job, a short evening's work, but does need a bit of head scratching here and there. The 'conversion kit' is quite simple, and consists of a single sheet of A4 paper with a CAD diagram of the finished flybarless head, and a small bag holding four tiny spacer sleeves!

As both rotor heads need to come apart, I wanted to get the mainshafts out without breaking the frames apart, so after a bit of thought a plan was hatched… I removed the blades, the servo links to the lower swashplate and then the two nuts on the bottom of the yaw control rod. At this point the six M3 hex screws can be undone which connect the two main gears to the two masts. A good hard pull and the two masts pull out the top of the model.

I then removed the yaw mixer by unclipping its links, and removed the two screws and clamp bolt holding the top head on. The inner and outer masts then come apart releasing the two swashplates, following which; the flybars and their seesaws can be unscrewed. As we no longer need any of the Bell-Hiller mixer arms, these are removed too, but keep them to one side as some of the control balls will be needed later…

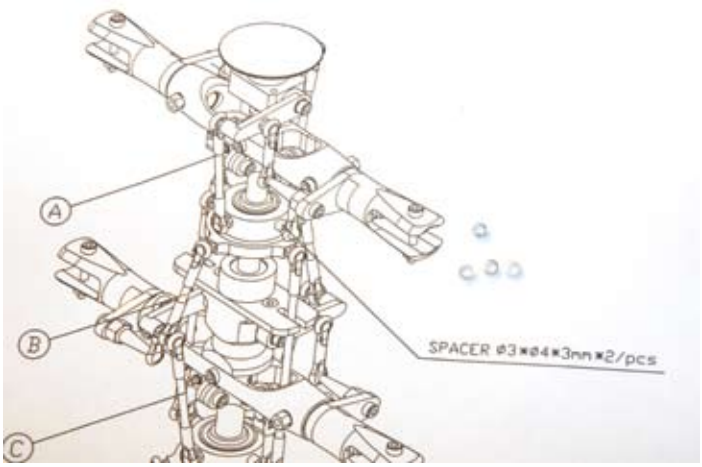
Reassembly can now begin. The control balls that held the flybar seesaws are screwed back in place, using the aforementioned sleeves to keep the ball to swashplate spacing correct. Where the Bell Hiller mixers were screwed in place, we simply screw in a control ball salvaged from the old mixer arms. That's the main part of the conversion done, so at this point, I simply reassembled the two mainshafts and dropped the assembly back into the frames. Getting the six hex screws back into the main gears is a bit tricky, especially as I had to do it twice…

Having got the screws in, I stepped back to admire my handiwork, only to realise the heads have to be phased correctly, so that the blades cross either left/right, or fore/aft. Mine were set at a really odd angle, as I'd screwed one shaft in 120º out…!

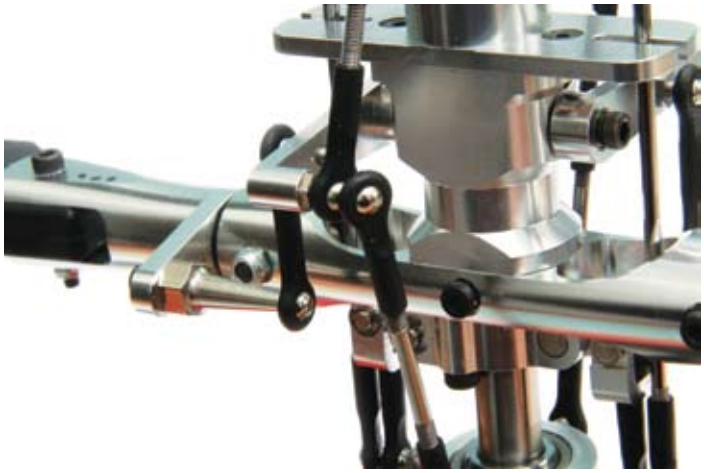
Next job is the links; these again are salvaged from the flybar version. The instruction sheet gives lengths for the three pairs of links, taking care to ensure that the ball links aren't unscrewed too close to the end of their threads. I had to make some small adjustments when it came to clip them in place, ensuring each side was adjusted the same amount.

Attention then turned to adding some stability back to the system, so a BeastX Microbeast unit was added alongside the receiver. I ran through the usual setup on the Microbeast, simply treating it as a traditional heli, to the Beast, it is! I also used a new model-memory on my Spektrum DX9, keeping the original model in case I ever swap back to paddles.

A problem then became apparent when it came to setting the cyclic and collective travel… Due to



Conversion kits don't get much simpler! Four spacers and a sheet of paper…



The Bell-Hiller mixers are removed, replaced with dual control balls

The flybar head…

…and the flybarless version – much simpler

A Microbeast unit was mounted alongside the Spektrum receiver

Look closely and you can see the upper plastic ball link starting to bend – it's unlikely to get that far in flight

the design of the swashplates, when the upper swashplate tilts, its lower control balls swing out sideways – they aren't aligned with the centre of the swashplate ball. This offset makes the link bind in the jaws of the upper swashplate link guide, as travel increases the upper plastic control link starts to bend, adding some tension into the whole control system. I did consider opening up the guide slots, but I then realised from the travel I'd set in the flybar version that very little swashplate travel is required, and the bind point may never be reached.

Spec

PRODUCT	CTX-5DUAL
MARKET PLACE	It's unique…
MANUFACTURER	Sovereign Technology Co., Ltd., Taiwan, R.O.C. www.tech-sov.com Email: cindy@tech-sov.com
MAIN ROTOR DIAMETER	932 mm
OVERALL LENGTH	750 mm
ALL-UP WEIGHT (INCL. BLADES AND BATTERY):	3150 g
CONTROL REQUIREMENTS:	5 channel heli radio and 1/3 axis gyro system
POWER REQUIREMENT	ESC and 6S 3200 mAh LiPo
RRP	US $549

It also became clear that I had lots of negative pitch along with hardly any positive, so using a digital pitch gauge I reset the lengths of all the control rods so that at mid stick I had all the washout levers horizontal along with 5° positive pitch. It took a while but it's worth doing to save any agro at the flying field.

I really wasn't entirely sure that the BeastX would be happy with the strange model it was trying to control, but I needn't have worried. Apart from dropping the cyclic rates down even further to 60% and the tail gyro to 40%, it flew straight off the board. Everything else on the BeastX was left at the stock settings. Initially, the rpm was too low at around 1500 rpm, which caused some nodding, especially in a breeze, but bringing the rpm up towards 1800 solved this.

And it flies really well, just like the flybar version, perhaps just a little sprightlier. As before, you need to really fly it, and while you can't do anything aerobatic with it, it's immense fun to just stooge around, listening to the "what on earth is it?" comments from the assembled onlookers…

I did try flying it in a stiff breeze, around 15 mph, and while it flies OK, it does get knocked around a bit. The secret seems to be to let the model ride out the gusts rather than fighting them, and to just let the BeastX do its work. This isn't really a rough weather model, just keep it for the calmer days.

One simple question I've been asked several times is: Why…? What's the advantage over a 'normal' heli? I'm struggling to think of one, I suppose Sovereign have produced the CTX-5 'because they can!' The quality of the CNC machining and the plastic chassis is top notch, as is the smart GRP canopy.

Whenever I fly it, it always attracts attention, it's just a really novel model – the fact it flies so well is a bonus. If you fancy something out of the ordinary, give the two or three blade versions a look, you won't be disappointed.

I'm out of space again this time, but plans are brewing for the next column. If anyone wants to get in touch, then please feel free to write via the Editor, or email me at nige@modeltek.com – please put SmallRotors in the subject line, just to be sure you don't end up in the waste bin...! ***MHW***

Back in the air without the paddles – just as much fun!