The Canadian Connection

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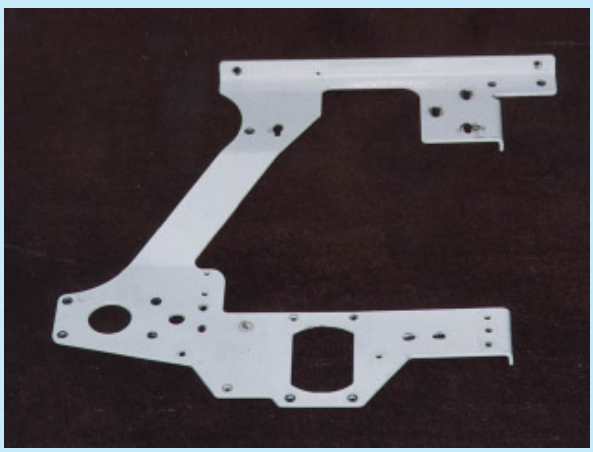
In this third part of `Consuming Considerations' Phil discusses the various merits of different frame materials and transmission types

Well, here we are again, continuing from where we left off. To date we have examined the various components from the swashplate up to the main rotor head. To recap our purpose, we are examining the various systems and components from a consumer's point of view. The longer a component operates under normal use without developing wear or play, the more we like it. The easier it is to maintain and repair the more we like it. The more versatile it's possible configurations, the more we like it. If a unit gives us more of these features than another, for less or the same cost, we like it even more.

This time we will examine some of the components to be found in the "power bay" - the main frame. First, let's examine the mainframe itself. The most economical - least expensive to manufacture - is the stamped aluminum frames that have been replaced in most designs. Frames such as those found in Kalt's old Baron/Alpha series, those we used to find in the older Hirobo Falcon series, those from the old GMP helis, and those still found in the standard X-Cell 30/46/60 kits.(see picture #1). This older technology has been replaced by newer designs because although inexpensive, they were very difficult to align perfectly, and because of this they were very prone to cracking. Fortunately, most manufacturers have moved on to better technologies as standard equipment and X-Cell does now offer upgrade units for replacement of their stock stamped frames.

Photo #1 - Current white standard X-Cell 60 one piece stamped aluminum sideframe



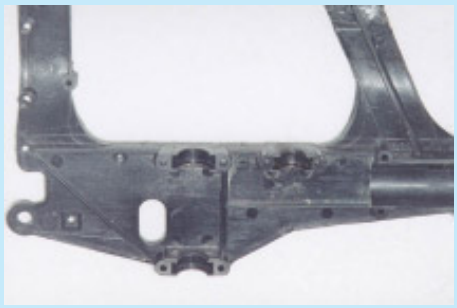
The next step in the stamped aluminum frame development was to separate the one piece stamped sideframe from the L-bent landing gear mount at the bottom of the sideframe. This helped when aligning them and did result in less expensive repairs if the L-bend mounting should fracture from vibration or hard landings. Here, in lieu of making the 90 degree bend at the bottom of the side frame part of the one piece frame, they left the bottom cut off and arranged for an L bracket to be bolted to the bottom of the sideframe - as per the later Kalt Alpha and Excaliber series.

Photo #2 - Molded plastic one piece Hirobo Shuttle side frame

A very popular solution for many years was to replace stamped aluminum with molded composite designs. This was first made popular by Hirobo's first Shuttle. These molded plastic sideframes were in the same shape and configuration as the stamped aluminum units found in the other models of the era. (see photo #2) Kalt shortly followed suit with the plastic modular frame construction seen in their Cyclone and Enforcer/Space Baron that replaced their Baron 50 and 20/30MX Series (see photo # 3). Subsequently Kyosho launched their Concept series

Photo #3 - Molded plastic modular sideframes of Kalt Enforcer/ Space Baron

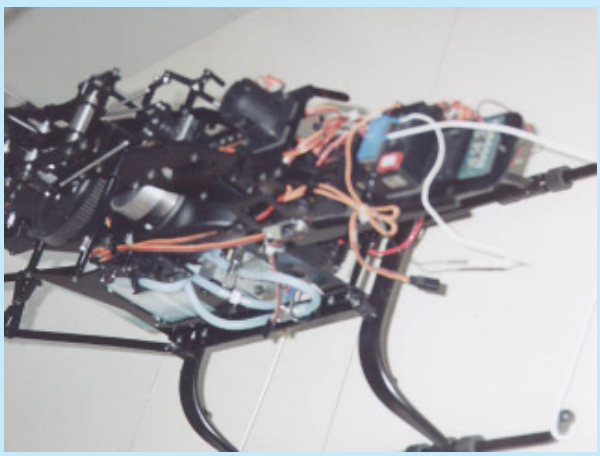
with the modular molded plastic mainframes. These modular frame systems are tougher than the single piece Shuttle frames but suffer the same bearing seat (picture #4) compression problems etc. An interesting combination of the modular molded four part side frame (two upper side frames and two lower ones) is that of the newly released, entry level, Century Hawk (picture #5). This looks to be a molded unit with the same general power/control systems layout as the standard stacked frame designs.



Left, photo #4 - View of the plastic molded bearing seats of the Shuttle sideframe and right, photo #5 - The two piece molded plastic "stacked" frame design of the Century Hawk

The molded plastic frames are generally stiff enough for 30 size machines but leave a lot to be desired when used in the more demanding environment of a 60. Most of these designs also have the various bearing seats molded into the plastic frames. These seats will ultimately show compression wear leaving the bearings loose in their mountings. Consequently, the start shaft assemblies, main shaft and T/R front drive assemblies will start to have unwanted lateral movement. This will contribute to the overall slop in the control systems and in many cases increase the level of undesired vibrations.

The next step in this technical evolution was the development of "stacked" frames (photo #6). These consisted of various modules made up of flat sideplates of aluminum (e.g. Schluter, TSK, Hirobo, JR,) G-10 fiberglass (e.g. Intrepid), or graphite (X-Cell's upgrades), together with spacers/joiners and separate bearing blocks, preferably of machined aluminum (e.g. Robbe Futura, all TSK's, Hirobo Tsurugi XX, JR Ergo, Kalt Alphas and the X-Cell Pro). In some more budget models, one will find molded composite side plates, spacers and / or bearing blocks (Tsurugi).

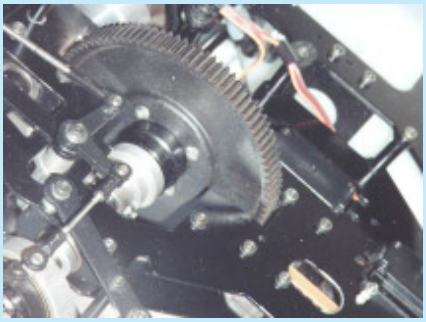


Above, photo #6 - The complete stacked mainframe/servo tray design of the TSK Mystar 60

Right, photo #6B - A close up of the rear right side of the TSK Mystar 60 mainframe showing the aluminum lower mainframe sideplates joined by the spacers to the upper aluminum mainframe sideplates and the top mainshaft machined aluminum bearing block.

These type of frames may take a little more effort to assemble and disassemble, but the effort pays big dividends because they are very easy to align perfectly. Consequently, the aluminum sideplates will not crack from vibration and the frame, once assembled, becomes quite rigid. This makes for very precise movement of all systems, less wear of all bearings, and gets rid of a lot of unwanted vibrations.

Having spent a good deal of time flying all of these different frame designs, my first choice is for the stacked frames, preferably with aluminum sideplates and machined aluminum bearing blocks. (photo 6B) The other type of sideplates all enjoy the same alignment advantages, but have some disadvantages. The carbon graphite sideplate may look spiffy and be a bit lighter (the graphite upper and lower mainframes sideplates and servo tray of a popular 30 size, were only 2 1/2 oz. lighter than the original aluminum units), but unfortunately these graphite sideplates flex much more under load (take an aluminum side plate and it's equivalent graphite replacement and try to flex them manually over the side of your workbench to prove this to yourself). As in any composite under continual load, the attachment screws are prone to compress into the side plates



over time, making for higher maintenance. Another big disadvantage of these graphite units is their high initial purchase price and the high cost of replacement parts after the inevitable mishap. The G-10 units may be less expensive than their graphite cousins, but they are even heavier than the aluminum equivalents and suffer the same flexing and compression under the screw/washer attachment points as the graphite units.

Many times, we tend to forget that technological advancement is not just with the use of newer or different materials, but also with new designs. The "stacked" mainframes are the latest design technology and are far better than designs of the past. On the other hand, aluminum may be an "old technology" material, but it may still be the best material for the task. In this case we seem to be able to combine the best from both worlds.

How do they compare after the dreaded unintentional landing? The straight aluminum sideplates may bend in a crash while the composite will flex and return to it's original shape or simply break. In my humble opinion, if the force of a crash on a flat composite sideframe is light enough to only make it flex, than it is too light to even bend the aluminum. If on the other hand it is hard enough to bend the aluminum, then it probably would have broken some part of the composite unit. In either case a new part would be required to replace the bent or broken unit and the flat aluminum one would probably prove less costly. Also worth considering is that a flat aluminum plate without any stamped bends that is not bent to where it shows "stretch marks" is usually very easy to tweak back into it's original flat form.

Moving on to other assemblies within this main frame we will now examine the power transmission system. A single, one piece, machined aluminum engine mount (photo #7) is far better than a two piece system as the engine loads and vibrations are absorbed by much more mass. They also can be used as a convenient alignment "jig" for the lower sideframe module.

Photo #7 - The Shuttle one-piece motor mount (left) and the Hawk one-piece unit (right) with the back machined out to save weight.

Photo #8, above - A well machined fan hub that needs no dial indicating or balancing - TSK 60 for OS61SFN

Photo #9 - The stock beautifully molded Five Star nylon fan that was perfectly balanced.

Moving to the front of the motor, the fan hub (photo #8) should be precisely machined with a runout of less than 2/1000ths of an inch. The fan (photo #9) should also align as accurately, should be perfectly balanced and large enough for the task of cooling the intended engine when enclosed in a properly designed shroud. Most of today's fan/shroud designs used with our methanol burning engines perform this task amazingly well. I have yet to fly a helicopter that I could blame any heating problem I have ever encountered on the stock fan/shroud cooling system *(Ed: You must be flying a different set of machines to me then...)*. Though the machined fans in some cases may be slightly more efficient (there are some that are even less efficient than the stock units), I think the main reason to add one to my heli would be for the

bragging rights. Even though they may be touted as perfectly balanced, I have never had any problem balancing a stock unit (in fact the TSK stock units I have used recently have been perfectly balanced as assembled right out of the box), and the price of a machined cooling fan can usually purchase one of the better balancers on the market. This balancer can then be used to balance the many other rotating systems that will need balancing on the heli.

A very important area that is often overlooked is the clutch system. This consists of the clutch, clutch bell, bearing support system, usually connected to some sort of start system. It is this area that has the potential to cause some of the biggest headaches.

Some of the entry level helicopters use plastic clutches in order to save money. I have found this to be false economy. I think that a metal one piece clutch (photo #10) to be one of the most important items that will give the largest airtime/dollar return on one's investment. I think that the plastic clutches belong anywhere but in an R/C helicopter! The grief and frustration that will result from their use far outweigh the small amount of money saved. Even entry level heli's should come with metal versions of these units.

Photo #10 - Machined one piece metal clutches - (from left) TSK Mystar 60, X-Cell 60, Century Hawk

The clutch bells come in three basic configurations (photo 11) - stamped aluminum bell with pinned/ welded pinion gear (Shuttle Z), molded plastic around the metal drive gear (Concept, Hawk) and machined aluminum with the pinion gear snugly pressed into a machined collar and secured by two grub screws (most 60's and the top 30's). *(Ed: Shuttle ZXX and 30 Baron, probably others, use a pinion which screws into the aluminium bell, a very secure system)*

The stamped aluminum one is very inexpensive and should be relegated to the shelf just above the garbage bin in which reside the plastic clutch shoes. In very short order the spot welds that attach the pinion gear to the stamped bell break free. When the pinion breaks loose, the engine starts to rev indiscriminately as no power is being transferred to the rotor systems The results can vary from a nervous autorotation to a destructive landing. The plastic bell molded around the drive gear is better, but it will distort and not work properly if ever it gets too hot (if ever you start up with the idle up on, throttle trim too high, throttle stick too far forward or throttle reversed - believe me, these all are things that happen more often than we would all wish to admit). The machined aluminum clutch bells are by far and away the best. Over the life of the heli, one will only have to occasionally change the lining. If the lining is allowed to become too worn the clutch shoes will start to fail on a regular basis as there will now be too much clearance between them and the lining, forcing them to swing out beyond their design limit - result: failed clutch shoes and a lighter wallet.

Of note at this time is the system used to support any clutch/pinion power transmission arrangement. Though many entry level heli's may choose bushes in this area, unless kept meticulously lubricated they will wear in a very short time. Because of the loads, heat generated and high Rpm's dealt with in this area, you will find radial bearings (the larger the better) here to be far more dependable and maintenance free than plain bushes.

The clutch pinion drives the maingear. Most times, these maingears are made from a molded nylon or reinforced plastic that is strong enough to take the power and transmit it to the two flight systems - main rotor and tail rotor. There have been cases, though rare, when these stock units have not been up to the task and required replacement with upgrade CNC machined nylon units that are both stronger and smoother. Unfortunately they are substantially more costly then the stock molded ones. Fortunately, most stock molded units perform the intended power transmitting with adequate smoothness, and when set up properly, with minimal wear. I have purposely set them up with inordinate amounts of play between maingear (photo #12) teeth and pinion and found that it still took a long time to wear to the point of needing replacement.

Photo #11 - Various Clutch bells - (from left) Machined Aluminum TSK Mystar 60 unit with built in one-way bearing hex start system, the plastic Century Hawk unit molded onto the steel pinion gear and the stamped aluminum Hirobo Shuttle Z unit that is pinned/welded to the pinion.

On the other hand, the play between the tail rotor drive pinion and the teeth molded or machined into the top or bottom of the maingear in shaft drive systems has proven to be far more critical. Stripping these teeth (photo 12B) results in a total loss of T/R control. This is one of the main reasons why a belt drive tail rotor system is much more dependable and less costly to repair in most crashes.

Photo #12 - Two maingears for the TSK Mystar 30. On the left is the unnecessary upgrade CNC machined nylon unit and on the right is the stock molded reinforced plastic unit.

Many crashes that involve the shaft driven T/R drive system result in the need to replace the maingear because of the stripping of the T/R drive teeth on the top or bottom of it. Also needing replacement would be the bent (wire) or shattered (carbon tube) drive shaft along with the tail boom, and possibly some of the shaft bearing support parts that reside inside the boom. With a belt drive, it is indeed rare that one will have to replace the maingear and/or the belt, so generally one is left with only the tail boom to replace. Though the belt may need a little more power to drive, in practice I have found this difference to be marginal. I have found that a 180 auto with a slipper drive T/R equally easy in a belt system as in a tube shaft system. Because of the simplicity of the belt system, there are far fewer parts (much less weight) in the rear/aft portion of the airframe, thus assisting in keeping the CG slightly forward of the main mast. The two or more shaft bearings within the tail boom, the forward and rear shaft attachments, the two extra bearings and gears in the T/R gearbox far out on the aft moment arm, not only add to the cost of the drive system but also to the weight and maintenance.

Photo #12B - An X-Cell 60 stock molded plastic maingear with the stripped T/R drive teeth molded on the top. They also come with a set of T/R drive teeth on the bottom.

This leads into the next and probably the final part of this series, the T/R drive and control systems.

I hope the past verbal meandering has helped any potential R/C heli consumers to analyze their choices with a more intelligent eye. Let us never forget that regardless of the "value rating" of any R/C heli, nothing improves one's flying skills more than practice. And as one becomes more skilled, and wishes to improve the precision of their flights and expand their flight envelope, the quality and durability of any helicopter system will become increasingly obvious and desirable.

Until next time, may that smile of contentment be ever present while you are pushing those transmitter controls.

Phil Noel

Ed: I'd be failing in my duty if I didn't point out that Phil is the Canadian Importer for both TSK and Century (Hawk). However, I'm also quite happy to point readers to Phil's Website at

http://www.lance.co.uk/w3mh/ltech.htm

and to note that his email address is

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Remember - Safe Flying is No Accident

Let us remind you that model helicopters are not toys - there's enough energy in (even) a set of 30 size blades to seriously injure someone so please take care!