# Has everyone told you to buy a Raptor?
# Read this . . . make up your own mind.



When the heli bug hit me, we didn't live in the USA. We were in fact only four years into what ultimately would be fifteen years working in a foreign country! This actually was my second go round with helis because in 1975 I made an attempt with a scratch built model called a Pole-cat (after reading a magazine article describing how to do it). What a disaster! Anyway, I got myself a Kyosho Concept 30 (this was ca. 1989). Like many of you, I was the only guy at a field dominated by fixed-wing pilots – and amusing for all in the peanut gallery, each bump in the learning process was gleefully viewed, as proof positive R/C model helicopters didn't work!

Human nature is a funny thing and, odd as it may seem, when your friends hold a certain viewpoint they can make the absurd seem normal. This just means what surrounds something may mask things – which later become obvious! I bring this up because there came a time many of the guys with whom I was flying flew Hirobo Shuttles. Following a severe crash, instead of fixing my Concept I got a Shuttle because everybody said I should. But after gaining experience with the Shuttle, the urge to go my own way overcame the urge to blend in, and after yet another bad crash, I switched back to a Concept (which I still own).

Over time I've observed helicopter pilots seem to be cut from different cloth than fixed-wing pilots. We basically march to a different drummer. In fact, my mother even refers to me as her wildflower in a field of daisies . . . but I digress. Anyway, when asked why I'd switched back to the Concept 30, while there were a myriad of things, I'd usually just mention glow plugs and shut up.

That's because swapping out a glow plug on a Shuttle vs. Concept was an absurd bother. So while it actually was a matter of features, part of it also was everybody and their brother had a Hirobo Shuttle!

Back then, the usual progression led to a 60-class helicopter because the push for more power was an exercise in futility in the 30-class. This was because despite higher nitro fuel and tuned pipes, the 30-class engines basically lacked the *cojones* required for the most advanced maneuvers. It was an issue with the power-to-weight-ratio. Nevertheless, I kept a 30 on hand because it was easier on fuel, cheaper to crash, and still loads of fun (but all the while, like most, I was yearning for more horsepower).

I remember the day in 1998 I noticed an advert for a Chinese (vs. Japanese) heli called a Raptor. Amongst my friends, prevailing wisdom all said the Raptor was a cheap piece of Chinese junk. But I saw features that made good sense. Things like the aft mounted fuel tank (under the main shaft) versus hidden by the canopy as on my Concept and Shuttle. This was a killer feature because it was both easier to see the fuel level, plus there wasn't an adverse rearward shift in CG (center of gravity) as the fuel load burned off. The Raptor was simply a better design!

So I parked my Concept and got myself a Raptor. And while the naysayers were right about how cheap it was, it certainly wasn't a piece of junk! By the way, it's important to recognize that at the time of its debut, 30-class helis often cost upwards of $400. Anyway, the rest is history because the Raptor went on to become the best selling helicopter of all time!

As both an engineer and a modeler, I happen to be the kind of guy who can rarely leave well enough alone. So while I thought the Raptor had some great features, and was inexpensive to boot, as I got to know it I discovered there were weaknesses too. But what really bugged me was how bringing them up was an exercise in futility . . . I might as well have been speaking to the Great Wall of China for all the good it did me!

Anyway, while the Raptor is a great helicopter, it's an older design. Thus, the Tiger 50 is an opportunity to put my money where my mouth is – so basically, it's put up or shut up time!

As for improving on the Raptor, it's actually easy; it's beating it that's a tall order because it's a great model – and it has had years to become entrenched, i.e. it's popular! What's more, for a small American business like ours to succeed, it means going up against a giant Chinese company; a company with more than 600 employees (and with manufacturing interests in Mainland China where labor costs are far, far less). Hence, when we work to compare Tiger 50 vs. Raptor 50, it's pretty much David vs. Goliath all over again – and of course, we're David!

Thus, for us to succeed we'll have to apply old fashioned Yankee ingenuity. One way is to make our small size into a virtue by reacting faster to market conditions than they can. Of course, we'll also try to work harder and smarter, but they're tough. And another thing, it's going to take some luck!

Anyway, here's the plan for how we went about it. Like every first year engineer learns, the way to solve a big problem (i.e. making the Tiger 50 a worthy competitor to the Raptor 50) you begin by breaking the big problem down into several small problems.

Of course, R/C model helicopters, like most complex machines, can be thought of as being made up of a multitude of sub-systems. By working on the small details, I figured the big picture would work itself out – in short, we chipped away at the big problem by solving issues one sub-system at a time!

But perhaps more importantly than working to make a better helicopter, I am also a factor. You see, unlike with the big guys, I am accessible to you. What's this mean? Well, perhaps you have an idea for how we can make the Tiger 50 better than it is, or you don't like how we advertise, or you wish a part were made differently. Furthermore, I remember only too well the frustration of being ignored, and I don't ever want you to think that we here at Audacity Models are a wall you shout at with absolutely no effect. Plus there's one other thing, I happen to think we can learn a thing or two from listening to you! Anyway, these are the seven sub-systems we focused on improving:

- **Frame**
- **Fuel**
- **Radio Components**
- **Control**
- **Power**
- **Main Rotor**
- **Tail Rotor**

Upcoming, in the frame sub-system, we'll address how engineering the Tiger's frame depends on our understanding the forces involved in 3D flight. Thus, we reduced play, used better fasteners, and bigger bearings as our basic tactics in crafting a better foundation.

*Captured during a slow hovering pass, the reflected image of the model can just barely be discerned as a reflection on the undersides of the blades. The Tiger 50 in this photo is equipped with a cast aluminum PDR0068 2-pc muffler.*

*Carved from a solid billet of aluminum by a Swiss CNC mill, this glimpse of a prototype is sure to whet the appetite of electric enthusiasts. But before you're carried away imagining an aluminum side frame model, you should realize these aluminum frames mass about twice that of the final molded-plastic parts. Also, sharp-eyed readers will see another prototype just behind this one. We're always thinking of new models but the exciting thought to take from this photo is the observation that other than the frames, all the Tiger 50 components are reused. If this makes it to market, wouldn't it be neat if it were offered just as an economical electric side frame conversion kit? Tell us what you think!*

*The Tiger 50 standard flybar paddle is perfect for smooth aerobatics like loops, roll, stall turns. The hole in the leading edge is where you insert the supplied weights for making it easier to hover.*

An axiom of engineering is *"The structure's only as good as the foundation upon which it is built."* The Torre Pendente di Pisa in the Piazza dei Miracoli – the bell tower better know as the Leaning Tower of Pisa is pictured above. Remember when I said your surroundings affect what you see? Eyeball the page 2 photo (which I used to demonstrate this to make a point). Do you understand why?

Begun in 1173 AD, before long the lean was obvious. What's absurd was they tried to fix a fundamental problem with band-aid solutions instead of starting over. So one after another – from offsetting the construction to compensate for the lean, adding lead to the opposite side to weight it down, through pumping concrete to shore it up, various fixes have been tried to save it. Thus, while it's a lovely tourist attraction which still supports the bells, it's not really a good structure – all due to a poor foundation. So what's the point?

With our models, the foundation is the frame sub-system. It's what connects the other sub-systems, i.e. the engine, fuel supply, radio, linkages, both main and tail rotors, etc. With the frame there were four areas we felt we could improve on the Raptor – Rigidity, Fasteners, Bearings, and Breadth. We compare to the Raptor because it's the most popular in the class. It got that way due to people recognizing it as a good model.

Observing the stresses imposed on the frames of older designs like the Raptor (as a result of violent 3D maneuvers) principally influenced our clean sheet approach to the Tiger foundation. It's important to remember that back in the '90s when Mr. Taya designed the Raptor, maneuvers like piro-flips and tick-tocks hadn't been invented – the Tiger frame benefits from hindsight being 20/20!

Also, unlike today – where 50-class machines are often the only model a top pilot wants – in the past, the goal was to create an inexpensive heli for beginners to learn to hover as it was expected they would progress to a 60-class helicopter. The Raptor 30, designed to be suitable for aerobatic maneuvers of the day like loops, rolls, and stall turns was never intended for today's 3D maneuvers. The subsequent installation of .46 engines and then later the 50-class engines into the 30-size airframe changed that and caused problems – resulting in band-aid fixes to fundamental issues because of 3D use (or abuse) far beyond what the eminent Mr. Taya envisioned! These are the four areas we looked into.

### 1) Frame Sub-system

- **Rigidity**
- **Fasteners**
- **Bearings**
- **Breadth**

An obvious Raptor issue when it's subjected to violent 3D is with the frame. Proving it is simple because a patent manifestation of issues with inadequate structural rigidity is a bearing that can walk (wiggle) within the frames – an oft noted area of concern.

The causes can be forces exceeding those envisioned by the designer (like aggressive3D flight), undue play between the parts (leading to frame creep), weak fasteners clamping the frame halves together, bearings too narrow for the imposed loads, or a combination of all these factors.

Over the years both hardcore Raptor devotees and TT (Thunder Tiger) have attempted various fixes. Classified as band-aid solutions because, like those used on the Leaning Tower of Pisa, they address the sympton rather than the underlying cause, the "fixes" range from messy (epoxy in the frame's bearing seats prior to assembly), to substituting aluminum inserts for some of the plastic inserts, through the addition of parts (like a carbon fiber reinforcing plate) to the frame – all with varying degrees of success. Regardless, it's a foundation issue and all the fixes in the world merely serve to mask the problems.

#### Rigidity – Play and Frame Creep

For example, where the Raptor frames come together, the juncture is smooth. What keeps the side frames from creeping are combinations of the mechanical clamping force of the sheet metal screws threaded into plastic inserts, plus the body of the inserts themselves.

However, play where the inserts fit is what permits frame creep – where they may actually shift with respect to each other. At its heart, this old style method of joining the frames (plastic inserts) is great for reducing manufacturing costs, but not so hot for preventing the side frames from creeping under the loads imposed by radical 3D maneuvers.

Another thing, the little plastic insert plus the two coarse Phillip-head sheet metal screws are also very inexpensive. When views form the point of view of manufacturing, it's an important factor.

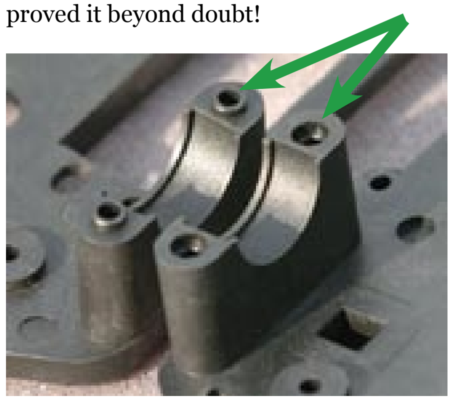
What folks may not realize is they are actually a carry over from a previous Taya design, the Concept 30. This leads us to the fasteners.

## Fasteners – Screws vs. Bolts

While inserts and screws may have been the hot ticket for reducing costs when the Raptor was originally designed (back when a wicked computer featured a 150 MHz CPU), we don't feel inserts cut it for today's requirements because high performance trumps low costs when the issue is as critical as the very foundation of the model.

The redesign of the Raptor frame (when it became a V2) included making it stronger, and recognizing the 50-class heli saw more strenuous use; they tried to fix the problem of bearing walk by substituting aluminum hex-inserts for four of the plastic inserts (one on each side of the two main shaft bearings). Of course, the aluminum inserts used stronger machine-thread fasteners. Interestingly, an extra cost Raptor option is a kit to replace all the plastic inserts with aluminum. But even replacing them with aluminum doesn't address the issue of play around the inserts themselves which still allows frame creep!

We feel frame creep is an absolutely unacceptable issue and thus, keeping the frame halves from shifting is paramount. We opted for a more precise basic design which we achieved through the use of guide pins. Extensive dynamic response analysis (i.e. stress it virtually inside the computer) indicated it would result in rigidly locked frame halves, so we went into manufacture. Empirical testing proved it beyond doubt!



Frankly, it was economically difficult to accurately mold so many guide pins, hence the use of inserts. However, our CAD system is CATIA (the exact same as created by Dassault for aerospace companies like Sikorsky and Boeing). Add in super precise Swiss CNC equipment means we can do precision guide pins!

Next we went all out with fasteners! Instead of using cheap coarse-thread sheet-metal screws, which self-thread into plastic, we used costly (but far more precise) machine-thread bolts along with Nylock nuts. A nice touch are Tiger 50's high quality fasteners feature Allen-heads vs. run-of-the-mill Phillips-heads!

The Allen-head brings convenience, precision, and strength. And because I said, "Hang the added expense!" we used them throughout the Tiger – not just in high stress areas! Folks, these are just flat out better because the much finer machine-threads are not only far more precise than the coarse threads of a sheet metal screw, but when combined with the Nylock nut, they are virtually impervious to vibration.

## Bearings – Wider

Next was the issue of the width of the bearings themselves, especially those supporting the Raptor's mainshaft. Tiger 50 bearings are 40% wider than those in the Raptor 50! Assuming the same force, increasing the bearing width increases the area and thus, resultant forces are better dispersed into the seat of the plastic frame.

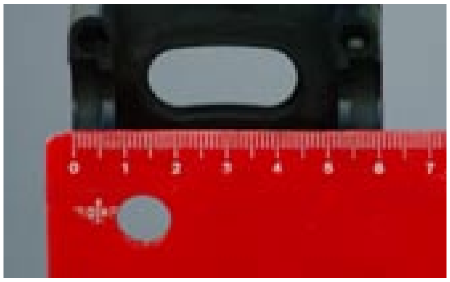
The lower loading in psi (pounds per square inch) lessens plastic compression (after all, the forces on a helicopter frame during a piro-flip are tremendous). Naturally, the converse is also true, and a narrower bearing increases the psi to which the plastic seats are subjected.

## Bearings – Breadth

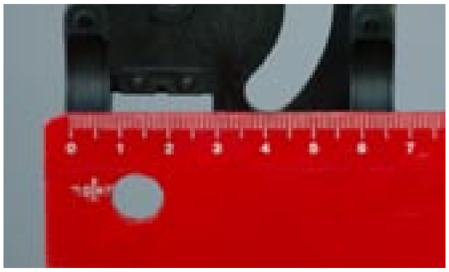
As a kid, did you ever ride in the back of a pickup truck? Or maybe you went for a ride in a boat, and even though you were told to sit, you stood up? If you have a memory like this, you probably also discovered that standing with your feet spread as you normally did meant you were affected by every bump and turn and it was harder to stand. But just by spreading your feet wider apart, you immediately were far more stable and able to maintain your place with greater ease.

Similarly, we spread the main shaft bearings further apart on the Tiger 50, this is called increasing the breadth. This is an elegant design improvement because it's via an engineering practice we instinctively know and understand. Thus, the main shaft is more stable since it is like spreading your feet apart!


This results in less frame deflection and thus, the maneuver is predictable so your Tiger 50 takes to 3D like a duck to water! The spread across the Raptor's main shaft bearings (from outside to outside) is a generous 59 mm.



The Raptor's 59 mm breadth compares well to that of the old Concept 30 and Shuttle 30 designs (which came before the Raptor), but the Tiger's spread of 66 mm is 12% greater and improves on the Raptor by increasing torsional rigidity!



Thus, a frame design with narrow bearings may lead to plastic compression and play. Play leads to frame creep while weak fasteners compound it. Before you know it, the bearings are loose as a goose resulting in bearing walk!

We think these issue are because the Raptor predates today's 3D maneuvers. For proof, look at the pitch indicator built into the Raptor side frame where the pitch center point isn't 0° but 6° instead.

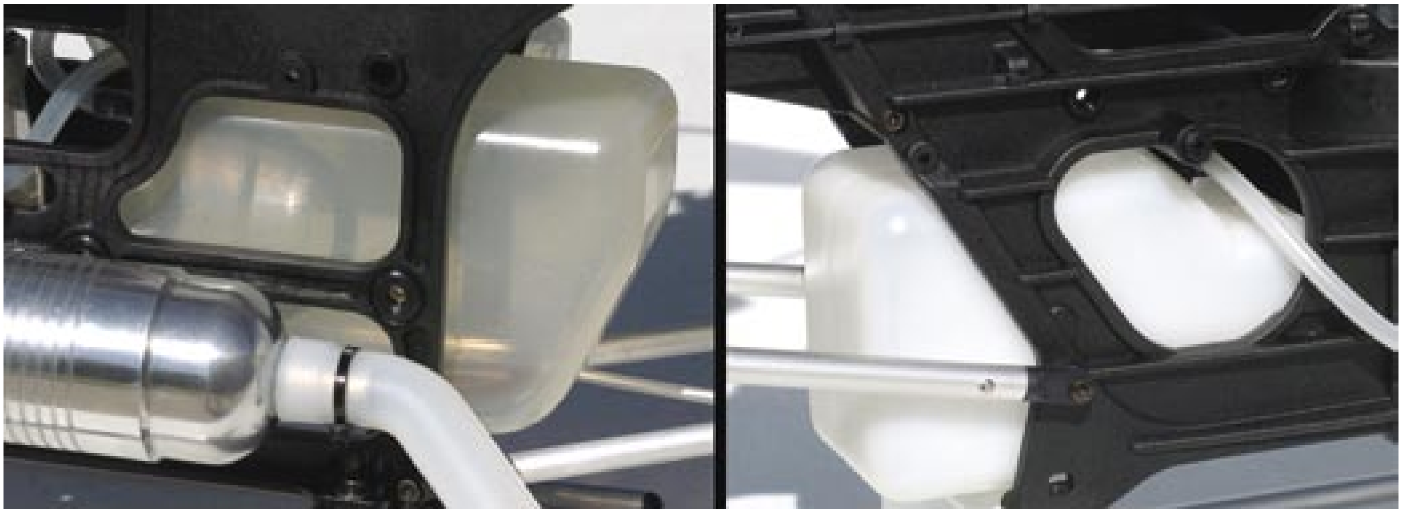
Sure, there are fixes for the Raptor 50, but by starting with a clean sheet design, we prevent trouble via guide pins, better fasteners, 40% bigger bearings, along with 12% greater bearing breadth!

In the next section, we address some nagging issues we experienced with our own Raptor's fuel sub-system.

In achieving the panit finish above, Tiger 50 owner Roy Applewhite explains . . .

*"I used automotive paints from DupliColor, PlastiKote and Rustoleum in rattle cans. They're available from automotive stores."*

**Details:**
1. I sanded "bleach bottle" canopy lightly with 400 grit, wet/dry sandpaper to remove sheen. I dulled all the glossy places I saw!
2. Next I washed canopy with warm soapy water. Then I sanded again the dull spots I missed. Then washed and checked again.
3. Spray DupliColor "Adhesion Promoter" on canopy (per instructions on the can about preparing the plastic for paint).
4. Then spray PlastiKote "Flexible Bumper Primer" - and make certain to follow their instructions for recoating!
5. I sanded with 400 grit paper (lightly) to remove airborne dust particles that adhered to the canopy.
6. Then I sprayed DupliColor "Acrylic Enamel White" as a base coat. A mist coat followed by a wet coat - per instructions on the can.
7. Then I saned lightly after it dried.
8. Next I sprayed a band of DupliColor Acrylic Enamel, "School Bus Yellow". This was applied "free-hand", i.e. no masking.
9. Again, sand lightly prior to a second coat.
10. Spray Rustoleum "Flourescent Orange" (for the visually challenged - like me), again make sure to follow the instructions.
11. Again, lightly sand it when dry.
12. Finally, I sprayed a light tack coat of DupliColor "Acrylic Enamel Clear" followed with a couple of wet coats. NOTE: Regular enamel doesn't work . . . the fuel eats it up!
13. *C'est Tout* for those who have time. If not, maybe try some Krylon "Fusion" paint.



The Raptor 50 has been our focus of comparison because it's an incredibly capable model that for years has set the standard for the 50-class – however, due to its age we found areas where we can make improvements. For example, while a rigidly mounted tank was acceptable back in the day of little 30-class engines, the thumping power of the 50-class engines creates an issue in the Raptor we sought to avoid.

Thus, by drawing on our own personal Raptor ownership experience, it led to us identifying three areas where we felt we could improve its fuel sub-system. These are in the areas of capacity, mounting, plus a little detail – an integrated fuel shutoff.

## 2) Fuel Sub-system

- **Capacity**
- **Mounting**
- **Shutoff**

Something that bothers me a little about my Raptor 50 is that just as I'm getting the old thumbs warmed up (but before I can give the heli a good workout) I'll notice it's low on fuel and then I'll become preoccupied with having to land soon – instead of just thinking of having fun. Frankly, the modest fuel capacity is absurd for such a capable machine. I resolved to do something about it.

### Capacity – 440 cc vs. 340 cc

The capacity of the fuel tank of my Raptor 50 is only 340 cc and while this may be OK for a 30, it's something of a joke for a 50-class helicopter because it means a mere 8 minutes of flight. The 440 cc Tiger's fuel tank is ample and gives about 11-12 minutes of hard flying.

The Raptor 50 has such a small tank because of its roots as a 30-class bird. While there are several places this heritage is evident, one of the places where it becomes comical is when you check the fuel capacity. You see, back when they stretched the Raptor 30, folks were sticking .46 engines in them (which didn't make lots of power and thus, didn't consume lots of fuel). But when folks started using really powerful engines like the 50SX in the airframe, the small tank became an issue as this is the equation; *more power = more fuel consumption*. But what was merely a bother quickly becomes absurd when you use a barnburner of an engine like a 50SX Hyper because the fundamental issue is a hairy 50-class engine is a heck of lot thirstier than a dinky 30-class engine.

So like many guys I promptly added a 2-oz header tank to my Raptor 50. Then, in an effort to increase the fuel capacity, I soon tried a 4-oz header (mounted to a home-brewed bracket). This was enough fuel, but it was too unwieldy – plus it unbalanced the helicopter to one side. Then, going from bad to worse, next I tried a pair of 2-oz header tanks, which made for a plumbing nightmare!

Anyway, depending on a header tank to increase capacity wasn't a smart thing, and frankly was really a dumb solution to a fundamental problem because that's not what they're for! That's because the real term for a header tank (technically correct) is *air-fuel separator*.

The real reason we mount a header tank to our helicopter is to prevent the introduction of air into the fuel line leading to the carburetor. This is due to how violent maneuvers may momentarily uncover the fuel clunk (the pickup) thereby letting air into the fuel line. Air bubbles can make an engine unexpectedly quit running – which is real bad news when your model is too low for a successful autorotation, and especially bad if it's inverted and only a couple of inches off the deck! So using the header tank (some guys call it a hopper tank also, which is the same thing) to increase the fuel tank's capacity is the wrong way to go about rectifying the situation!

Interestingly, the Raptor 50V2 includes a 2-ounce header tank. Curiously, it's not included with the Raptor 30V2. Regardless, if aggressive 3D flight is in your Tiger 50 future, then we offer a header tank as an inexpensive option.

Why is it an option? Because we don't think it's fair to make everyone pay for something only the 3D-guys need – after all, just because it's included doesn't make it free! Anyway, until you're flying forceful 3D maneuvers, a header tank simply isn't necessary.

But there's more to the story than an undersized fuel tank. There's also an issue with how the Raptor fuel tank is mounted to the frames . . . you see, it's prone to leaks!

### Mounting – Dampers vs. Rigid

One day I was flying my Raptor 50 and the engine went lean. Before I could make it back to land the engine died. Fortune smiled on me and my practice paid off because I pulled off a successful autorotation! When I checked the glow plug I discovered it was toast. I put a new one in, filled the fuel tank, and then wandered off to chat with a friend while I waited for the frequency pin. When I returned, there was a big puddle of fuel beneath my Raptor. Turns out the fuel tank had developed a leak during the last flight and of course, lost muffler pressure (which is why the engine had gone lean). Naturally, this was hindsight, which like most of us I'm really good at! Anyway, a little research on the Internet revealed this wasn't that unusual an event and was due to the Raptor's softer plastic fuel tank being rigidly mounted to the hard plastic of the frame!

It turns out rigidly mounting the softer plastic fuel tank directly to the harder

plastic side frames leads to accelerated wear because of the engine vibrations. The engine, running at 17,000 RPM, creates significant vibrations throughout the frame – and something has to give! But what stinks is folks have complained about this for years and instead of them fixing the problem, they just keep selling replacement fuel tanks!

As a result of my experience, I figured soft mounting the fuel tank was something of a no brainer. And yes, it's more expensive, but ending a flying day early due to this isn't how I want customers to experience the Tiger 50 – plus imagine crashing instead of executing a successful auto! For all I know, it's hardmounted because a bean counter says it's more important for a company to shave a tiny little bit off the cost – who knows?

Anyway, the Tiger 50 sports four soft rubber dampers. They gently support the fuel tank in the side frames and help isolate it from the engine's vibrations. A additional advantage is they help isolate the fuel from blade-induced vibrations (which further helps minimize any issues with fuel foaming).

### Shutoff – Integrated vs. Add-on

A nifty feature on the Tiger 50 is the integrated fuel shut off. It's part of the side frame. Now let me step up to volunteer that molding this into the side frame cost practically nothing to incorporate into the design. After all, it's simply a keyhole molded into the side frame that can be used to pinch the fuel line shut.

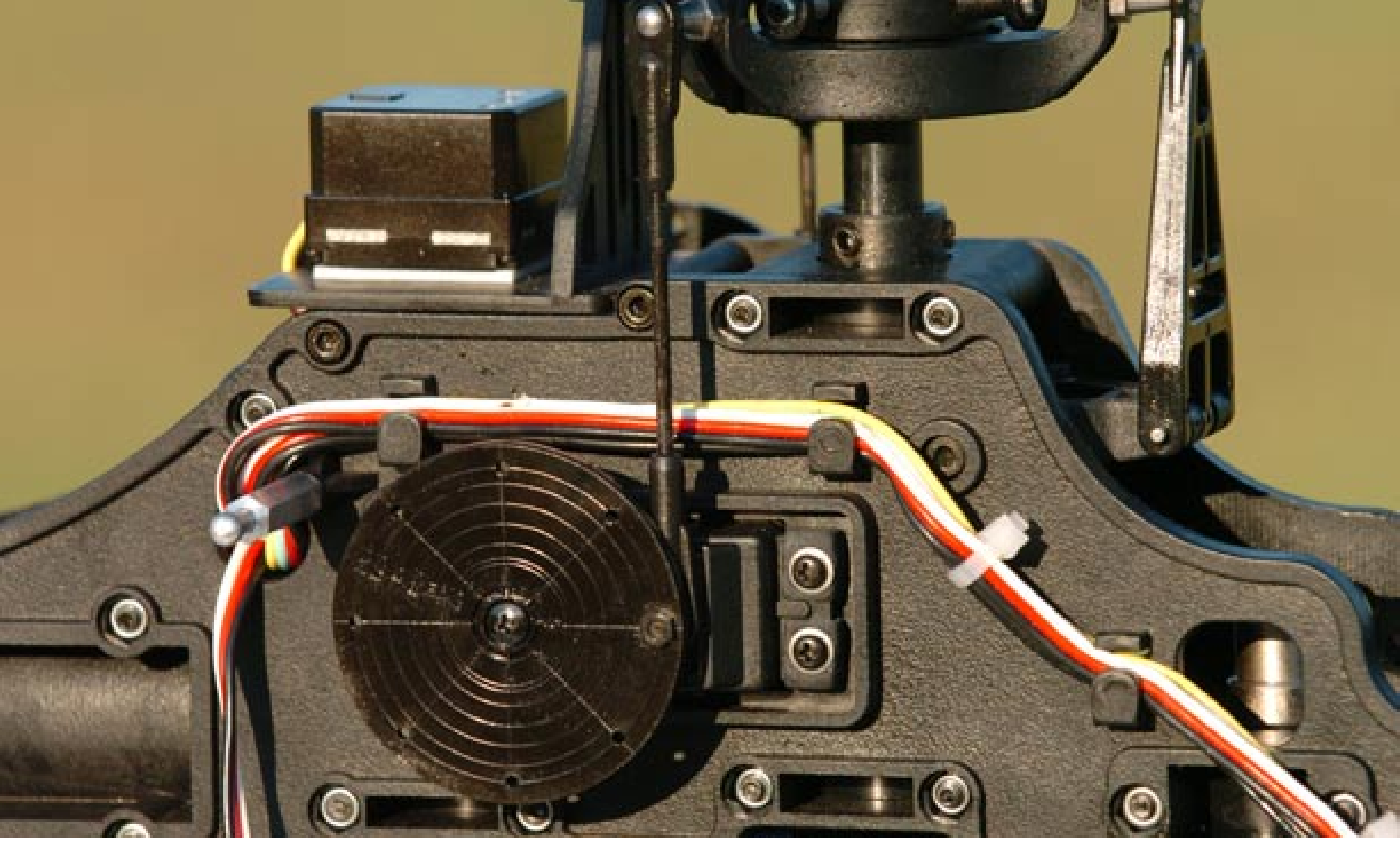
But what is especially nice is how it makes running the engine dry at the end of the day very easy. All you do is slide the fuel line into the pinched-position (like in the picture) and the engine shuts off. After that, with the ni-start battery attached, hit it with the electric starter a few times until it won't start and run any more. Finally, dribble a little after-run oil in through the carb throat and turn the engine over again. This prolongs the life of engine bearings. But best of all, it means one less piece of gear (an add-on fuel line clamp) on the helicopter!

As an engineer, this really floats my boat because I cut my teeth on KISS (Keep It Simple Silly). Thus, any time we can do the job with less parts means it's less expensive, more reliable, lighter, etc.

In summary, the Raptor 50 fuel tank is good for about 8 minutes of flying and thus, so small it doesn't cut the mustard for a 50-class helicopter. Furthermore, it's been rigidly mounted which means it may leak. And if you want a fuel line shut off, you have to add it to the model.

The way I figure it, by making the Tiger's fuel tank big enough for a hot 50, combined with mounting the fuel tank on soft rubber dampers just make sense. And the innovative little keyhole in the side frame is a nice touch of Yankee ingenuity!

Next, when we discusee the radio subsystem, we'll touch on other innovations.



The radio sub-system consists of mounting and organizing the servos, receiver, gyro, governor, battery, switch, and wiring harness. The Raptor, long recognized by astute modelers as the best in class absolutely dominates and thus, we've chosen to compare and contrast it to the Tiger 50. If we can improve on the Raptor, then folks might give the Tiger serious consideration. There are three areas where we match up well to the Raptor's radio sub-system. These are component installation, the switch mount, and wiring harness organization.

### 3. Radio Sub-system

- **Component Installation**
- **Switch Mount**
- **Wire Harness**

Interestingly, despite our emphasis on 3D performance, scale modelers quickly fell in love with the Tiger 50. It's because many find it better suited for a scale application than a Raptor. One reason is how the radio equipment is laid out. For example, if you mount a Raptor into a scale fuselage, the servo-frame of the mechanics intrudes into the cockpit area. With the Tiger, because the servos are mounted in the side frame and the radio platform only holds the receiver and battery pack (which are easy to hide inside the fuselage, you can just leave it off. Hence, the Tiger mechanics won't protrude into the cockpit area and to a dedicated scale modeler; this is nirvana

because you can detail the cockpit to your scale lover heart's content! After all, the cockpit is where everyone's eyes are drawn on a scale bird!

#### Component Installation – The Gyro, Governor, and Servos

A gyro mount is nice. Believe it or not, there are models where the gyro is an afterthought. However, the Tiger's is mounted aft, similar to where the Raptor mounts a gyro. The only thing we felt we could improve over the Raptor was by mounting the gyro higher (thus helping raise the CG to help improve rolls), but it's a really minor issue. There's also a theory that mounting the gyro closer to the main shaft helps gyro performance, but frankly, we can't tell a difference though just in case, our gyro mount is closer to the main shaft also! A nifty idea was to incorporatie an anti-rotation guide for the swashplate directly into the gyro-mount!

Unlike some helis, The Tiger 50 has a nice spot to mount a governor like the Futaba GV-1. It fits in nicely and the side frames protect it – plus it's easily visible while you are programming it. In fact, it's even visible through the windscreen

for reading flight pack voltage right off the LCD. In general, it's very neatly tucked away.

An aspect we diligently worked to improve vs. the Raptor was mounting the servos. For example, instead of mounting them in the vulnerable nose, the Tiger's


servos are well protected because they're mounted directly to the side frames. Also, the Raptor's TR (tail rotor) servo is mounted up front so the pushrod snakes all the way down the length of the side frame – which can easily add drag as it rubs on the guides. The Tiger, however, features a shorter connection due to the superb aft placement of the TR servo.

Interestingly, the Tiger's aft-mounted TR servo can be mounted either of two ways. The regular way is to mount it from the outside of the side frame. Then there's the the inside-mount – which is directly due to a customer's suggestion!

You see, shortly after receiving his Tiger, a fellow named Tony Vomfell (that's him below) e-mailed us a photo of how he'd mounted his TR servo (the photo above). I tried it and immediately concurred his way is very cool.

Modelers are the kind of folks who think around corners. What do I mean? In the more than two years it took to bring the Tiger to market, we never thought of mounting the TR servo from the inside, but after getting his Tiger, Tony thought it was obvious. We think this is a perfect example of why a company would be dumb to ignore its customer's ideas and suggestions! By the way, Tony ended up becoming a field rep.

### Switch Mount – Vibration Isolation

While I don't get too upset if I crash because I dumb-thumbed my model, it drives me bonkers is if I crash because equipment failed. For example, switches fail due to vibrations transmitted directly through the frames into the delicate switch. Most, including the Raptor, mount the switch directly to the side frame. The Tiger 50, however, affords additional protection to this critical bit of radio gear by using little rubber dampers.

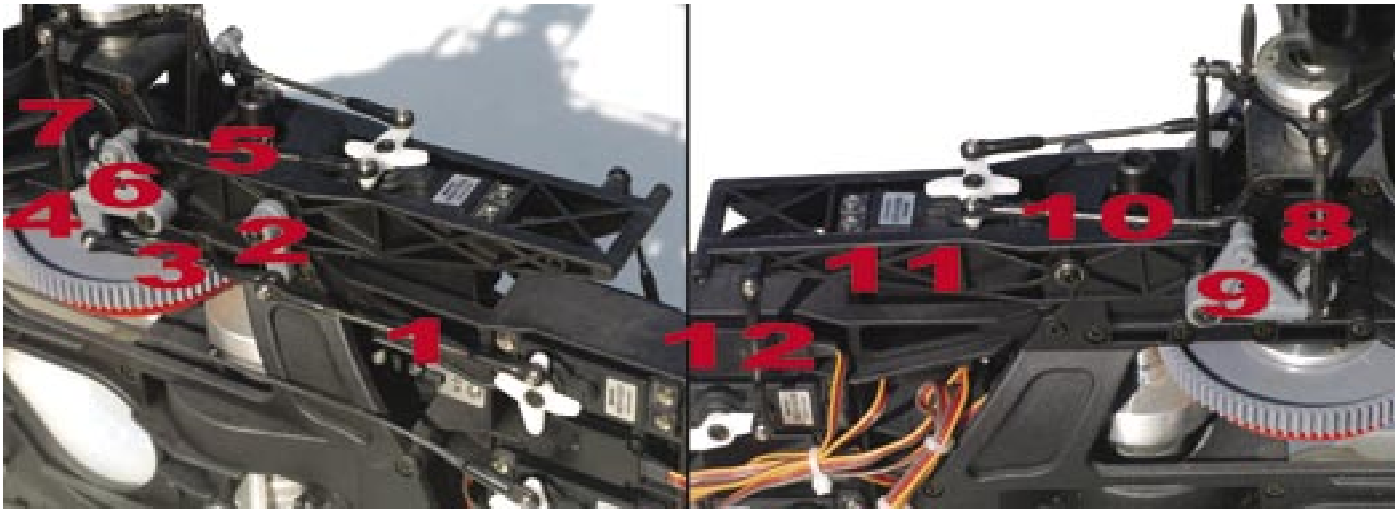
These dampers are similar to (but much smaller than) those used to isolate the fuel tank for mounting the switch. It's a small touch, but it's the kind of thing I believe makes owning a Tiger different than the experience with any other heli.

### Wire Harness – Wiring Clips

In most helis, the wiring harness often resembles spaghetti breeding! The nifty clips we had molded into the side frames are designed to group and guide the wiring harness on its way to the receiver. Since every model has to contend with servo wires, it only took a little bit of forethought on our part to figure the best way to route them (along with a little fancy molding). This results in wires not exposed to sharp edges, rotating bits, or clumsy fingers!

Thus, scale modelers love the Tiger 50 because less of the mechanics protrude forward into the cockpit area of their scale masterpiece. Also, Tiger 50 servos are protected due to being mounted in the side frames, the TR servo is closer to the tail, and there's a neat place for mounting the governor. Add to this the switch is rubber mounted for vibration isolation and the organizing the wiring hasrness is made easy!

Next, when we discuss the control sub-system you'll learn why mounting the cyclic and collective servos closer to the swashplate meant a huge increase in precision – plus eliminating a bunch of linkages and pushrods!




So far we've discussed the Frame, Fuel, and Radio Sub-systems as we've looked at things we've done to make the Tiger 50 into a worthy competitor to the Raptor 50. We discussed issues resulting in a manufacturer opting for cheaper Phillips-head fasteners instead of quality Allen-head fasteners, or not using soft rubber dampers for the fuel tank and the system switch. We also looked at how the Tiger main shaft bearings are 40% wider than those in the Raptor and how the bearings are spread further apart. We've also seen how a rigid-mounted small-capacity fuel tank becomes an issue, plus we've looked at how the Tiger 50 may also be more suitable for scale modelers.

### 4. Control Sub-system: CCPM

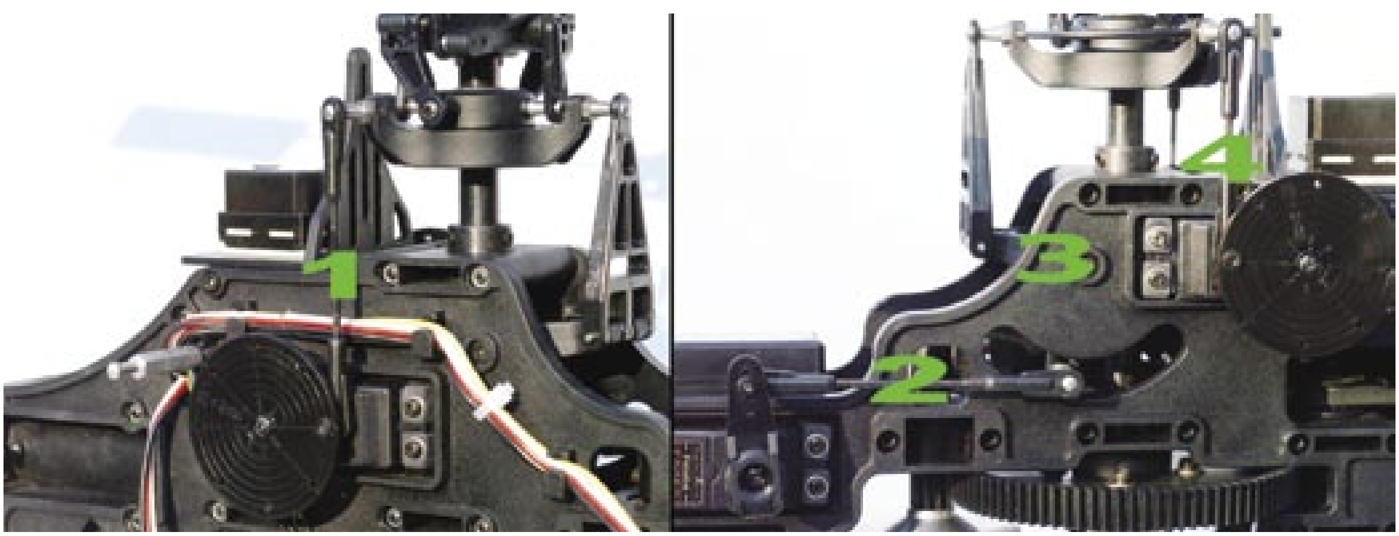
**(or why in the new math, 12 is less than 3)**

If doesn't take a genius to figure we have to make up for these extra expenses somewhere! As you'll soon see, with regards to costs, we've had an ace up our sleeve all along! So let's take a look at the Control Sub-system, an area where computer technology is what let us make up the ground!

Growing up an Army brat meant I learned a thing or two from my US Army Sergeant major stepfather – for example, how knowing your adversary is smarter than cruising along fat, dumb, and happy, or primed for being bushwacked! As a result, our Raptor is one of several models we keep around just because it pays to know your competition. We've got lots of experience with it and thus, just like Santa Claus knows when we've been good or bad, we know where the Raptor excels and where it doesn't. But to really understand how we got to where we are now, you need to know a little history. I'll try to keep this brief.

When I got into R/C back in 1972, my first radio, an Orbit 5-channel unit cost about 500 bucks. Yet present day units kick butt in features, and cost ¼ the price (considerably less if we account for inflation). In those days American radio manufacturers like Kraft, Orbit, and Proline dominated, and Du-Bro (who now is a hardware manufacturer) offered several helicopters (in fact, I still have one new in the box called a Whirly-Bird). Anyway, just as American television manufacturers like RCA and Magnavox lost out to Japan Inc. (in the form of Sony and Panasonic), our radio and heli manufacturers lost out to the foreign competitors in the form of Futaba and JR (Japan Radio) on the radio front, and Hirobo and Kyosho on the helicopter front.

Interestingly, European companies led the way in the development of model helicopters (this was the '70s, and '80s before they too lost out). Anyway, there was this brilliant European technology called CCPM (cyclic, collective pitch, mixing) for controlling the swashplate directly by using the transmitter to perform the mixing functions. Unfortunately,back in the old days when the Raptor was released, radios sophisticated and powerful enough to offer CCPM were not just rare, but also rather expensive. Consequently, another method won out. The method was to mechanically mix the servo outputs with levers and rods so that cheaper radios could stand in for more expensive ones.



The downside to mechanical mixing of course, is the increased complexity and parts count. Naturally, more parts are the antithesis of good design! But a more pernicious problem exists, which is due to the play inherent in having more moving parts. You see, mechanical play ultimately leads to slop because play increases as the parts wear – and sloppy helicopters don't fly as well.

Anyway, with more parts involved manufacturing costs increased, which due to a much lower prevailing wage in the Orient opened the door to Europeans losing out as had happened in America. On top of this, Japanese manufacturers were really smart at refining the complex models and by making them in plastic, they made them cost effective to boot!

The leader in all this was Hirobo when they came out with the Shuttle 30 (back in 1984, or so). Heck, even the Shuttle's clutch shoes were plastic! So where am I going with this? Simple, fast forward to 1998 (during mechanical mixing's glory days) to when the Raptor was introduced (with mechanical mixing, of course). Keep this last point in mind.

Meanwhile, digital transmitters like the Futaba 8U Super introduced in the '90s were readily available and relatively inexpensive. With computers inside they could easily handle the requirements of mixing the servos inside the transmitter instead of by using levers and pushrods.

But frankly, CCPM didn't get much press then because manufacturers were desperately trying to appeal to our cousins, the fixed-wing pilots – so cost was paramount, i.e. the Holy Grail. In fact, for a real giggle, eyeball an old heli manual, you'll be laughing when you see schemes for using 4-channel airplane radios! Hence, nobody had an interest in saying, "Hey, these computer radios do away with all the slop and extra parts in a mechnically mixed heli!" Now enter Moore's Law.

Gordon Moore, one of the founders of Intel, postulated that computer power doubled roughly every 18 months; this became known as Moore's Law. What's important to realize is how we in the world of R/C also benefit. Remember my mentioning my old Orbit 5-channel radio was easily outclassed by any modern day radio for ¼ the price? Computers are the reason. Today's computers, which even very inexpensive radio transmitter have inside not only weigh far less, cost less, are more reliable, have more features, etc, but could smoke my ancient Orbit 5-channel by any objective performace measure as well. So where am I going with this?

Simply this . . . electrons are far more reliable than mechanical gadgets. It's why fly-by-wire has replaced cables and pulleys for moving ailerons or elevators in our jet fighters. Which brings us back to CCPM. Presently, even 5 to 10-year old radios offer CCPM mixing.


In fact, very inexpensive units like the Futaba 6EXH (above) have 5-point pitch and throttle curves and CCPM mixing, and so, naturally, do radios like the Futaba 7C, 8U, 9C, 9Z, and 14MZ (below) along with JR, Hitec, and Airtronics equivalents. There's one last point.


If you look at the top of the food chain; the high-dollar model helicopters are overwhelmingly controlled by CCPM. Top-of-the-range American models from MA (Miniature Aircraft) use it, as do the best European manufacturers like Henseleit and Vario. In fact, whilst researching the subject you may soon come to the conclusion that the quaint and old-fashioned mechanical mixing (as used in the Raptor series – yes, even in their top-of-the-line 90SE) is something of a dinosaur . . . an endangered species if you will. And with this class of pilot (accustomed to top-of-the-line) it's absolutely not a matter of lower cost, it's all about higher precision!

You see, CCPM is better because there are fewer parts (lower cost is a byproduct). Fewer parts mean increased precision (because of a decrease in play between the parts), plus reliability. Play is the anathema of precision. The extra parts in the various pushrods, links, bellcranks, bearings, screws, and lever in a mechanically mixed heli like the Raptor means the difference between having the extras – or not!

Hence, the ace up our sleeve is not having the extra parts of a mechanically mixed heli means our manufacturing costs are lower. We counted up every single bolt, washer, bearing, linkage, lever, linkage rod, and ball link end and arrived at this comparison . . . and these are parts just to control the swashplate mind you!

## Thunder Tiger

**Raptor 50V2 – 62 total parts**

## Audacity Models

**Tiger 50 Mk 2 – 21 total parts**

Folks, if ever there's a time a picture is worth a thousand words . . . this is it! Proponents of mechanical mixing will usually respond with smoke and mirrors. But for the clearest of proof, we only have to look as far as the ultimate proving ground, the competition records.

Search for the answer to these simple questions; "How many years has it been since a mechanically-mixed helicopter won the United States Nationals?" Why is this? The answer is simply that the top pilots want to win regardless of costs. For them, the higher precision of CCPM far outweighs being sponsored by a manufacturer whose best product features mechanical mixing.

In short, this is a situation where less is more. It's not algebra, but in helicopter math, 21 is more than 62 (the number of rods and links a Raptor 50 V2 has). From a manufacturing point of view this is a huge difference. And don't forget, the Raptor 50 Titanium has even more parts! This is our ace, it's how we compete effectively (cost-wise) against a 30-class helicopter like the Raptor 30V2!

Next, in section 5 we'll discuss areas where we make huge strides vis-à-vis the clutch and cooling fan.


It's been said that power makes the world go round. With our helicopters, this task is the engine's domain. The Raptor became the dominant player in the market because it did things better than the competition – which were slow to recognize how great the Raptor was and thus, became road kill. As we worked to make the Tiger 50 a genuine contender to the Raptor 50, we approached things one sub-system at a time. With the power sub-system we've thought there were a couple of places where we could make substantive improvement, these are with the clutch and cooling system.

**5. Power Sub-system**

- **Clutch**
- **Cooling Fan**

It's usually a surprise to learn the clutch and fan in the Raptor 50V2 are the same as in a Raptor 30V2. A little more history may be in order. Whereby the Raptor defeated the Concept and Shuttle, the engine wars had a different result. Offered as a package with the Thunder Tiger .36 engine, the Raptor 30 more frequently sported the better running and more powerful OS Max .32 engine. Not surprisingly, TT then bored the .36 out to create the .39 and OS responded by extending the .32 to create a .37 ci (easily taking back the horsepower crown) and thereby delivering the awesome little OS37ZX engine. After all, there's no substitute for cubic inches!

Anyway, while Kyosho responded with a Convept 46VR, and individual efforts to shoehorn a 46 into the Raptor became popular, TT released a version suitable for .46 engines too. Naturally, the tail boom and belt had to be stretched since the 46-class engines weren't being loaded sufficiently by the 550 mm blade used by 30-class models. Adding insult to injury, just as with the smaller engines, the OS Max .46 was again more powerful than the TT .46, so it was more popular. The Chinese response was the TT .50-class helicopter engine. See the trend?

Meanwhile engineers at OS crafted an entirely new and truly delightful engine, the OS Max 50SX-H. What folks really love (other than the rush of power) is the superb carburetion – plus the 50SX fits where the OS .46FX-H engine does. Both the TT .46 and .50 are scrawnier across the beam and require a smaller engine mount . . . which is of little consequence in the real world because pilots opt for the higher power of the OS engine! By the way, it's common knowledge the Chinese Thunder Tiger company hired a top OS engineer away from the Japanese OS Max Engines, but while it appears he knew quite a bit about designing engines, it's also seems he didn't know everything OS Max knew about making them!

Anyway, perhaps realizing the stateside release of the YS50ST helicopter engine posed a threat to their domination, OS got the jump on the competition and sucker punched not just TT but also YS by quickly following up the 50SX with the awesome OS Max 50SX-H Hyper (before the YS engine was released stateside).

The Hyper is a nasty junkyard dog by comparison to the TT .50, (and probably the YS .50 as well). But come to think of it, there's really no comparison . . . it's not even close because the 50SX already whipped the TT .50 and YS declined to bring their 50 to our market (draw your own conclusions of why that is).

Yes, the Hyper is a bad boy! It differs from the standard 50SX-H in that it has a 1 mm larger diameter carb throat, plus an anodized aluminum head (reminiscent of that encountered on R/C cars). The idea is to shove more fuel in and run the mixture leaner for more power (using that huge head to keep it cool). It works and the Hyper makes beaucoup horses! The problem with this is 600 mm blades aren't enough load for a Hyper. So the more aggressive Tiger 50 pilots turned to 620 mm blades! Which brings us back to clutches again (in a roundabout way).

**Clutch – Way bigger**

First of all, let me assure you that's not a typo in the above picture . . . yes, the Tiger 50 clutch really is flanked by the Raptor 60 and Raptor 90 clutches!

Here's the background. While the Raptor 30 clutch was large enough for a .46, when you stuff a Hyper in it there may be an issue. Maneuvers the models are being called upon to perform are the reason. Popular maneuvers like a Tick-Tocks (thus named because the heli describes an arc similar to inverting the pendulum of a grandfather clock) and Chaos (piro-flip) greatly stress the clutch as the rotor disk is repetitively loaded, unloaded, and loaded over and over again.

In fact, upon landing, a really good pilot's clutch bell may be hot to the touch (a sign the clutch is slipping). This means pilots have to buy replacement clutches because they're wearing them out via the abuse they dish out – which is expensive. And this is with 600 mm blades (and we already know the 3D hotdogs want longer blades) which makes the situation worse!

So yes, the Tiger 50 clutch is huge. And it is easily sufficient to handle the power of the OS Max 50SX Hyper – or whatever follows, whether you're using 600 mm, 620 mm, or even 630 mm blades (if that's what's required to absorb the horsepower). And yes, it's definitely overkill . . . but as an engineer I firmly believe in Murphy's Law;

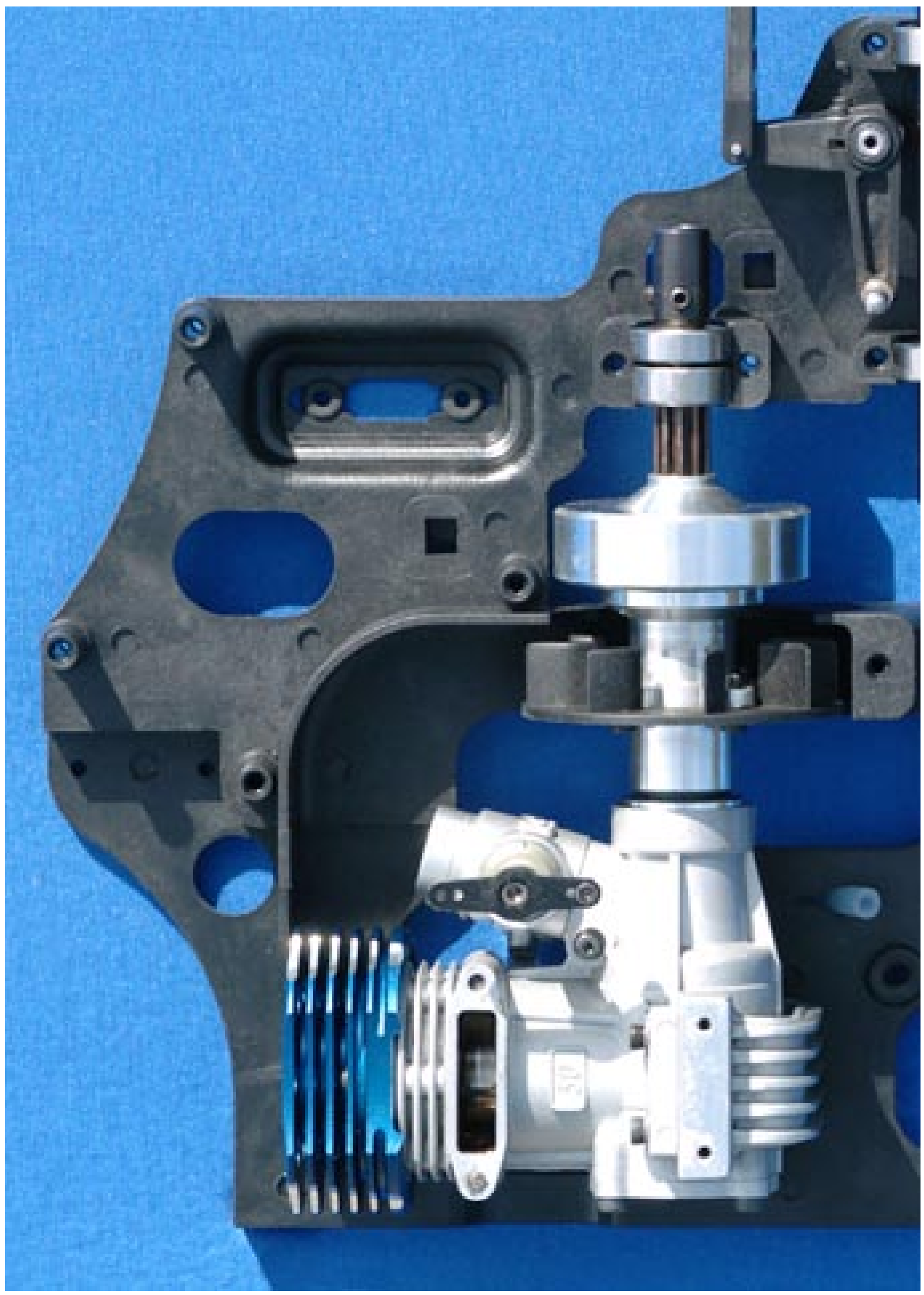
*"Anything that can go wrong will go wrong."*

Frankly, the Tiger's beefy clutch lets me sleep well – real well. And it should give you that warm fuzzy feeling too since there are three things you can take to the bank. First, the engine guys will continue their horsepower wars. Second, the most aggressive 3D pilots will always invent horsepower sapping maneuvers to use the extra power. Third, the Tiger 50 clutch will handle it with ease.

**Fan – Flat-plate vs. Airfoil Blades**

We flight tested the Tiger in the blazing heat of Nevada in July and Oklahoma in August, i.e. when it was really, really hot! Compared to the rudimentary flat-plate blade design with which the Raptor is equipped, even a cursory glance at the above photos demonstrates the extent to which we've gone in our efforts to use state-of-the-art technology in the Tiger. The fan is an example of the superb attention to detail with which we've endeavored to grace the Tiger 50. Each individually airfoiled blade is the result of our world-class molding operation.

Up next, we continue comparing and contrasting Tiger vs. Raptor by delving into the main rotor blade sub-system. We feel we make huge strides through our offering an aluminum head block instead of a plastic one – plus we discuss gear ratios, blade length, and more!



While blades are what make a heli fly, there's more to it than that. For example, we've been making comparisons to the Raptor since it was so much better than helicopters, which preceded it like the Shuttle and Concept that folks switched in droves. The goal has been to improve on the Raptor in hopes of making the Tiger 50 into a genuine contender.

In the main rotor sub-system we felt we could improve on four areas. The head block, adjustable seesaw ratios, main rotor blades, and main gear ratio.

### 6. Main Rotor Sub-system

- **Head Block**
- **Adjustable Seesaw Ratio**
- **Main Rotor Blades**
- **Main Gear Ratio**

The main shaft is what the main rotor rotates on and thus, is part of the main rotor blade sub-system. Both the Raptor and the Tiger use a 10 mm hollow main shaft . . . the same diameter as used by high-end, expensive, 90-class models from MA like the Stratus. I mention this not to slight the superb MA models but to point out how beefy the 50-class heli main shafts actually are.

### Head Block – Aluminum vs. Plastic

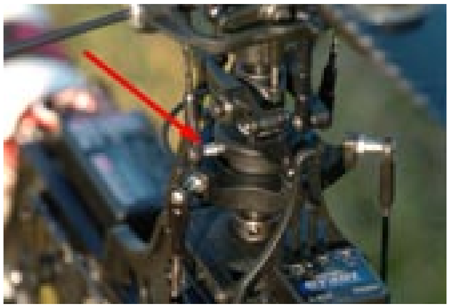
While flying my Raptor one day, I noticed a vibration. Since I couldn't find what was wrong I turned to the Internet forums and discovered I wasn't alone because it was a persistent complaint. Surprisingly, most advised replacing the plastic head block with an aluminum head block. A new plastic one resolved the vibration. If money's no object, there's a roaring Raptor aftermarket for aluminum head blocks. Surprisingly, the Raptor 50V2 still has a plastic head block.

Then there was the time I was out flying my Raptor and the head sailed off. The post mortem revealed the plastic head block had a crack where the Jesus bolt passes through it (which had failed again). By the way, despite landing on grass (vs. concrete), because it impacted nose first (like an expensive lawn dart), the model was basically a total loss. Damage included four crushed servos, a pricey PCM receiver, the battery, a new 50SX, and a Hatori muffler (which tore off the engine thereby breaking the crankcase), plus the canopy, frame, servo carrier, landing gear, etc. The blades weren't hurt at all.

Anyway, if you go online and search the TT forums for "broken Jesus bolt" you'll find we're not unique. What did we do to keep this from becoming an issue with the Tiger 50? Simple really, the Tiger 50 is equipped with an aluminum head block CNCed from a solid billet!

### Adjustable Seesaw Ratio - 3D Tuning

The Tiger 50 has both a 1:1 seesaw ratio and a 3D friendly .7:1 mixing ratio at the seesaw. This is a very nice feature, and you can't get adjustable ratios with the Raptor line until you spend for the Raptor 90. We thought it a good enough feature to include in our 50. What's more, the Tiger has adjustable swashball lengths for even more fine tuning options than a Raptor 90. It's all about tuning!



**Main Rotor Blades – 620 vs. 600mm**

The 600 mm main rotor blade came about soon after folks started flying the Raptor with a .46 engine because the 550 mm blades of a 30-class bird simply weren't enough load. With the release of very powerful 50-class engines like the Hyper, it became apparent to top pilots that a similar plateau had again been reached – 600 mm blades weren't long enough either.

The Raptor 50 v2 (and SE) as well as the Tiger 50 are supplied with 600 mm wood blades. For learning to hover and general flying around they're fine. The Raptor 50 includes decent 600 mm carbon blades. They're nice if you like them and not so nice if you don't because they weren't free. Plus for beginners, there are better places to spend money than carbon blades!

Our position on blades is they're a personal choice and we don't shove our choice down your throat, i.e. by making you buy something you may not want. Further to this, we already know the best pilots require something longer than an ordinary 600 mm long blade, so why include expensive blades that are too short for the very people who can use this caliber of blade? TT knows it too; witness the Raptor 50 Titanium!

Interestingly, the better pilots quickly discovered putting longer blades on a Raptor 50 meant interference with the TR blades – with predictable results! Before long, ever resourceful modelers started fitting their Raptor 50V2 models with longer custom tail booms (and tail drive belt, of course). As usual, custom is never inexpensive. Then again, if you're good enough to take advantage of longer blades, why waste time with something you already know doesn't cut it for your flying style?

So if you're a good pilot and decide a Raptor 50 is for you, then either reach deep for a Raptor 50 Titanium, or plan to spend extra to upgrade an SE or V2 with a longer boom and belt. But this leaves you with a curious situation where the Raptor 30 has superior tail performance to the entire Raptor 50 family! That's because there's more to this business of stretching the tail than merely making the boom and belt longer, but we'll get into this later.

Thus, knowing the horsepower wars will continue, we made sure the Tiger 50 accepts longer blades right from the get-go! In fact, if your skills are of the level to really make use of them, you can fit 620 mm main rotor blades right now (with plenty of clearance too)!

**Main Gear Ratio – 8.9:1 vs. 8.5:1**

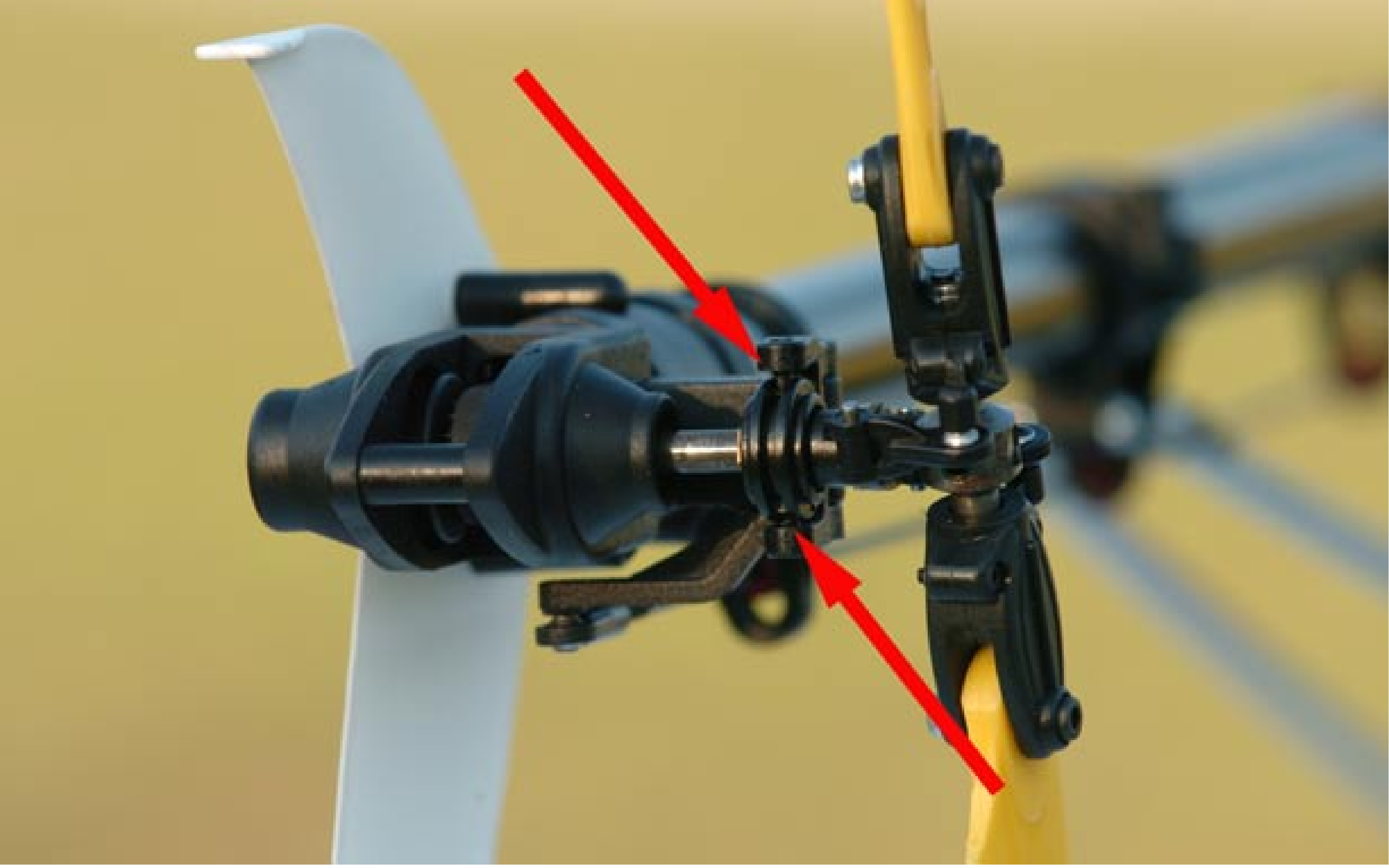
The Raptor 30 and 50 have different main gear ratios. The Raptor 30 gear ratio is 9.56:1 while the gear ratio of the Raptor 50 is is 8.5:1 – which just means 8.5 turns of the engine = 1 turn of the main rotor sub-system.

Since the OS Max 50 engines like to run in the 17,000-RPM range, the main rotor is running at 17,000/8.5=2000 RPM). While this is fine with composite 600 mm blades, our testing reveals this gear ratio is too low to handle 620 mm blades (with authority).

This is the reason we opted for a slightly higher 8.9:1 gear ratio. By the way, the gear ratio is easily calculated by counting the teeth on the pinion gear (10) and dividing them into the teeth on the main gear (89) and hence, 89/10=8.9 or expressed as a ratio, 8.9:1.

In summary, we've addressed some of the areas we felt we could improve on the Raptor 50. These are areas like using an aluminum head block instead of a plastic one, equipping the Tiger with adjustable seesaw ratios, accepting 620 mm main blades, plus having a gear ratio better suited to longer blades.

In the next section we discuss the tail rotor system. We'll delve into several areas including, once again, gear ratios.



A helicopter's tail rotor exists because it's needed to counteract the torque from the main rotor. A Sikorsky invention, without it a single-rotor helicopter would spin opposite the direction of the main rotor blades. So far we've been using the Raptor 50 as a point of comparison because it's such a great helicopter we figured any areas we could find to make improvements meant we'd be on the right track. When we examined the Raptor's tail rotor sub-system we hit on two areas we felt could be improved, the single point pitchfork and the tail gear ratio.

## 7. Tail Rotor Sub-system

- **Pitchfork**
- **Gear Ratio**

The pitchfork is used to transfer a linear motion 90° – from parallel to the tail boom to transverse to it, or parallel to the tail output shaft. It links to the pitch plate.

### Pitchfork – Dual-point vs. Single

The Raptor 50 uses a single-point pitchfork. Due to the range of motion, a single point of control may cock the mechanism slightly due to mechanical play. Naturally, this may result in wasted motion and less precision.

More expensive helicopter models tend to use a dual-point pitchfork mechanism primarily because it reduces the cocking tendency – this is exactly why they're more expensive in the first place (better features). As we know, add a little here plus a little there and before you know it, these costs add up quickly. Our answer to this is pretty simple . . . the Tiger 50 has a dual-point pitchfork anyway!

### Gear Ratio – 5.24:1 vs. 4.56:1

The tail gear ratio of a Raptor 50 is 4.56:1 which means one turn (revolution) of the MR (main rotor) results in 4.56 turns of the TR. Conversely, the Tiger 50 TR gear ratio is 15% faster at 5.24:1. Why does it matter? Simply this, to produce the same amount of side thrust, a Raptor 50 tail blade has to deflect more because it's turning slower. Hence, as a result, all things being equal, this also means the Raptor tail blades will stall sooner since they have to pitch more to accomplish the same result!

Interestingly, the power absorbed to counter the torque is equal between the two machines because all the tail rotor is doing is balancing out the MR torque.

Thus, identical main blades (both at 10° of pitch and 2000 RPM), use the same amount of TR power to counter the torque . . . regardless of which heli you're flying! However, since the Raptor requires higher TR blade pitch to do the same job (because the blades spin slower), they stall sooner as well!

For example, while performing a high-speed funnel, as the model transitions from upwind to downwind, i.e. back and forth over and over again, there's a point in the maneuver when the speed of the funnel on the downwind leg exceeds the holding power of the TR blades (because the blades stall) and thus, the tail blows out. Due to the Tiger requiring a lower blade deflection (angle), the TR blades on the Tiger don't stall as soon. Hence, the Tiger 50 performs the maneuver faster than the Raptor 50. Furthermore, this means the Tiger can achieve a higher pirouette rate than a Raptor 50! Also, because it features the same 4.56:1 gear ratio as the V2, the Raptor 50 Titanium has a slower pirouette rate still (because of its longer tail boom). Yes, Raptor 50 Titanium is slower in pirouette than a 50 or 30 . . . isn't that absurd?

Thus, for the good pilot, a dual-point pitchfork and higher TR gear ratio results in the Tiger having a faster and

Perhaps you've arrived here because you're impatient and wanted to cut to the chase. If that's the case I understand because this quickly turned into a longer document than I'd envisioned when I started – conceivably due to the years during which my ideas were bottled up! Anyway, this is the nickel tour.

The Raptor, long recognized by astute modelers as the best in class absolutely dominates and thus, we've thought it prudent to compare and contrast the Tiger 50 to the Raptor. After all, the Raptor dominates because it did things better than the competition – which were slow to recognize how great the Raptor was and thus, became road kill.

Our methods have been to improve on the Raptor's individual sub-systems in hopes the Tiger 50 would be a legitimate contender. Hence, we approached things one issue at a time figuring if we could find things to improve we'd be on the right track. These seven sub-systems are what we focused on:

1. **Frame**
   - **Rigidity**
   - **Fasteners**
   - **Bearings**
   - **Breadth**
2. **Fuel**
   - **Capacity**
   - **Mounting**
   - **Shutoff**
3. **Radio**
   - **Component Installation**
   - **Switch Mounting**
   - **Wiring Harness**
   - **Control**
5. **Power**
   - **Clutch**
   - **Fan**
6. **Main Rotor**
   - **Head Block**
   - **Adjustable Seesaw Ratios**
   - **Main Rotor Blades**
   - **Main Gear Ratio**
7. **Tail Rotor**
   - **Pitchfork**
   - **Gear Ratio**

1. The Raptor 50 has narrow main shaft bearings, which may lead to plastic compression and play. Play leads to frame creep (where the side frames shift relative to each other). Cheap fasteners compound this. Before you know it, the bearings are loose as a goose and you get bearing walk! While the Raptor 50 V2, SE, and Titanium fixes improve the original Raptor design, the Tiger 50 is a brand new clean-sheet design and thus, we had an opportunity to resolve many absurd issues ahead of time!

For example, the Tiger 50 ditches the old insert-based frame union in favor of precise guide pins, and uses Allen-head bolt and Nylocks instead of cheesy Phillips-head sheet metal screws thereby eliminating frame creep. Bearings in the Tiger 50 are 40% wider than the Raptor's and are spread 12% further apart!

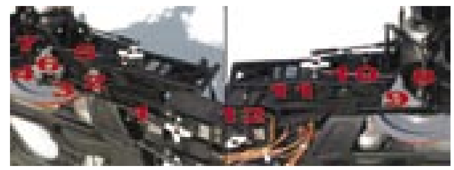
This results in the Tiger having a rigid foundation upon which 3D pilots can create maneuvers . . . perhaps maneuvers never before invented! It's worth noting we don't think our engineers are smarter that theirs, it's simply a matter of the basic Raptor design predating present day 3D maneuvers!

2. The Raptor 50 fuel tank is so small it results in 8-minute flights – absurd for a 50-class helicopter! Also, the rigidly mounted fuel tank of the Raptor 50 may soon leak. Thus, by making the Tiger's fuel tank large enough for a hot 50, along with mounting the tank on soft rubber dampers, we avoid both these issues. Finally, by incorporating an integrated fuel shutoff into the side frame, it means one less part to depend on – which per Murphy's Law is a good thing!

3. Scale mavens especially like the Tiger 50 because the mechanics slip into scale fuselages more cleanly without them protruding into the cockpit area. As a result, you can detail the cockpit with seats, instrument panel, pedals, and more, for a greatly enhanced and far more realistic appearance!

The reason is because unlike the vulnerable nose-mounted servos of the Raptor, the Tiger 50 mounts the servos directly in the side frames. Best of all, this results in servos mounted closer to the controls thereby ensuring shorter, less flexible pushrods and fewer parts. The radio switch is rigidly mounted in a Raptor while the Tiger's (for better vibration isolation) is a rubber mounted. Also, to facilitate organizing the wiring harness of the Tiger 50, wire guides are molded directly into the side frame.

4. Due to CCPM's fewer parts, the result are not just greatly increased reliability and precision due to the elimination of play between the part, but lower costs as well. While play is the anathema of precision, the many extra parts in a Raptor may mean the difference between having nice extras like Allen-head bolts and rubber dampers vs. Phillips-head screws and rigid mounting. By way of



comparison, to control the swashplate, a Raptor 50V2 uses 62 parts versus 21 for (counting every single bolt, washer, bearing, linkage, pushrod, ball link, etc.) and 50 Titanium has even more! The fact is CCPM is better, but to rile them up, ask opponents, "How many years has it been since an old-fashioned mechanically-mixed heli won the US Nationals?" Frankly, this is a case where less is more!

5. The Tiger 50 clutch, when flanked by the Raptor 60 and 90 clutches, reveals its outsized proportions! The Tiger 50 clutch is huge (and easily sufficient


to handle the power of the Hyper, or whatever follows), and whether the Tiger 50 is equipped with 600 mm or 620 mm blades (required to really absorb a Hyper's horsepower), the clutch can handle the power! Is it overkill? Yes, but as an engineer I firmly believe in Murphy's Law, *"Anything that can go wrong will go wrong."* Frankly, the Tiger's beefy clutch lets me sleep well and it should give you that warm fuzzy feeling too since there are three things you can take to the bank. First, the engine guys will continue their horsepower wars. Second, aggressive 3D pilots will invent horsepower sapping maneuvers to use the extra power. Third, the Tiger 50 clutch will handle it with ease!

6. In the Main Rotor sub-system we improve on the Raptor 50 plastic head block. The Tiger 50 features a head block CNCed from a solid billet of aluminum! What's more, the Tiger 50 has serious tuning advantages over the Raptor 50 to include a choice of either 1:1 or a 3D-friendly .7:1 Bell-Hiller mix ratio (which is a feature usually found in high end 90-class helicopters that the Raptor 50 doesn't have). On top of this, you can adjust swashball lengths to easily tune direct Bell input, which the Raptor 50 doesn't offer (nor the Raptor 90)!

Furthermore, the standard Tiger 50 accepts 620 mm blades while the Raptor 50 V2 can’t – so pony up for the Raptor 50 Titanium, or plan to spend extra for upgrading a R50 V2!

In addition, we feel the Tiger’s 8.9:1 main gear ratio is actually better suited to 620 mm blades than the Raptor's 8.5:1 ratio – this is great since the OS Max 50SX Hyper is begging for more blade!

7. If you’re a good pilot, there's a big advantage in the Tiger 50 having a dual-point pitchfork like the high-end 90-class helicopters vs. the Raptor 50 with a single-point. Plus the Tiger 50 TR gear ratio at 5.24:1 is much faster than the Raptor 50 (at 4.56:1) resulting in the Tiger having a distinctly faster (while simultaneously) more precise feel, and there's less likelihood of stalling the Tiger's TR blades – which is something a good pilot can take advantage of during aggressive 3D maneuvers like a Funnel or Chaos (piro-flip).

Like all engineers, we solve a big problem (making the Tiger a worthy competitor to the Raptor) by breaking it down into smaller problems. Thus, our concentrating on the small details meant we left the big picture to sort itself out and – in short, this resulted in chipping away at the problems one sub-system at a time.

But importantly, unlike a monolithic business which ignore you (like shouting at a wall), we're accessible to you since I happen to think we can learn a thing or two by listening to you!

*John Beech*
**GM (and janitor)**