

YOUR RADIO'S GOT SOMETHING IT WANTS TO TELL YOU pg9

# RC Helicopter

THE WORLD'S LEADING RC HELICOPTER MAGAZINE

## The PERFECT STORM

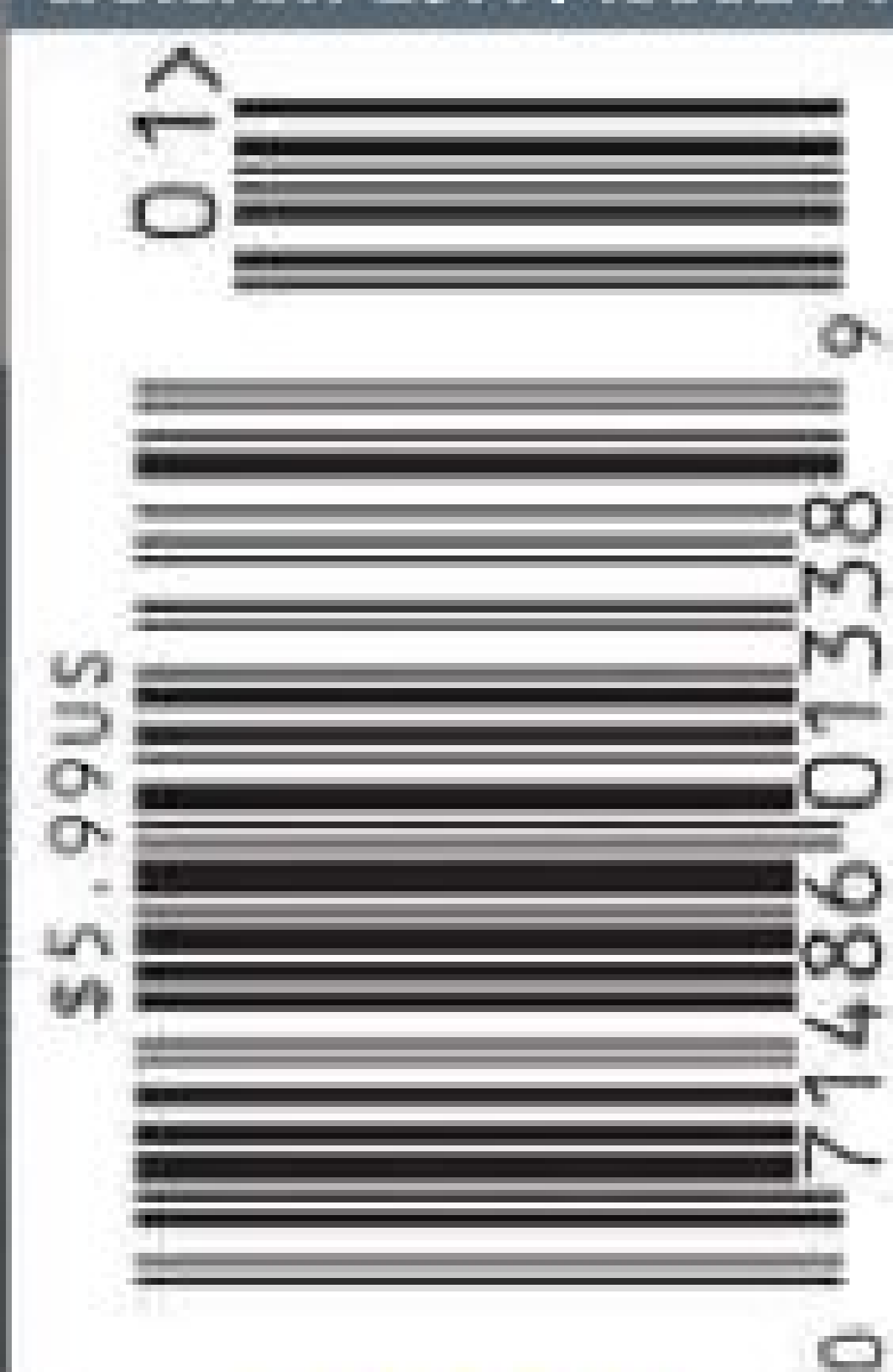
It all comes together  
with **Outrage RC's**  
NEW VELOCITY 90!

### TESTED:

- » **LA-HELI** SNIPER II
- » **VIPER** PROGAUGE
- » **KME** DIAMOND PRO .60
- » **ELEVATED RC** LPG

Do Flybarless  
Blades Really  
**Make a**  
DIFFERENCE?

JANUARY 2011 / ISSUE 54



www.RCHELIMAG.com

### HOW-TO:

- ▶ Calculate Headspeed
- ▶ Set Pitch & Throttle Curves
- ▶ Build a Perfect Flybarless Head
- ▶ Hover Flip & Hover Roll
- ▶ Fly The Flipping Hurricane

THIS GUY WILL  
HOOK-UP YOUR  
**TREX 550E**

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# Titan X50

## THE **ULTIMATE** 50-CLASS 3D HELICOPTER



### Titan X50B

-TTR4855-K10 Includes Kit & TT Y2 Carbon Blades  
-TTR4855-K11 Includes RL53i Engine, H-Race Motor  
and TT Y2 Carbon Blades

#### Specifications:

Full Length of Fuselage: 47.24" (1200mm)  
Full Width of Fuselage: 7.87" (200mm)  
Total Height: 15.75" (400mm)  
Main Rotor Dia.: 52.95" (1345mm)  
Tail Rotor Dia.: 10.24" (260mm)  
Gear Ratio: 8.5:1:4.56  
Total Fuel Capacity: 480cc  
Fully Equipped Weight: 6.63 lbs. (3150g)

### FEATURES:

- 1-piece Carbon Main Frames, Slim Profile Design (30mm Wide)
- New underslung Rotor Head for Ultimate 3D Performance
- High-quality Fiberglass Canopy Preprinted
- Main & Header Tanks Total Capacity: 480 cc
- Dual Radial, Single Thrust Bearings Metal Tail Grips w/95mm Blades
- Lightweight & Vented Clutch Bell/Metal Reinforced Ribs
- Lightweight & Vented Main & Tail Gear Set Design
- Lightweight Tail Boom Bracket & Landing Skids
- Carbon Base Plate & Carbon Fin
- Metal Tail Boom Clamp
- 10mm Hardened Main & 7mm Feathering Shaft
- Shrouded-fan for Efficient Thermal Dissipation
- Spacious 3-deck Tray for Electronic Devices
- Equipped with Lightweight Paddles for 3D (20g)

[ttamerica.com/101h](http://ttamerica.com/101h)



# TORQ

ADVANCED HIGH VOLTAGE DIGITAL SERVO

## BRUSHLESS DIGITAL SERVO

HIGH VOLTAGE



[WWW.OUTRAGERC.COM](http://WWW.OUTRAGERC.COM)



## BL SERIES

Size: 1.57"x0.79"x1.52" Weight: 2.15 oz

**BL 9088**

**BL 9080**

24 VOLT RATED  
(2 CELL LIPOS)

**BL 9088 TAIL Servo 760/560Hz**

*Speed / Torque*

6.0 v : 0.05 / 63.48 oz

7.4 v : 0.04 / 78.53 oz

8.4 v : 0.03 / 91.64 oz

**BL 9080 CYCLIC Servo**

*Speed / Torque*

6.0 v : 0.07 / 88.32 oz

7.4 v : 0.06 / 112.35 oz

8.4 v : 0.05 / 132.86 oz

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RC Heli (ISSN 1559-7903) is published monthly by Think Omnimedia LLC at 13401 Yorba Avenue, Chino, CA 91710, tel: 909-517-3366. Subscription rates are \$24.99 for 12 issues (one year), \$49.99 per year for foreign airmail, \$29.99 for Canada and Mexico. Periodicals Postage paid at Chino, CA, and additional mailing offices. Postmaster: send all address changes to RC Heli PO Box 469063, Escondido, CA 92046-9488. Printed and produced in the U.S.A.

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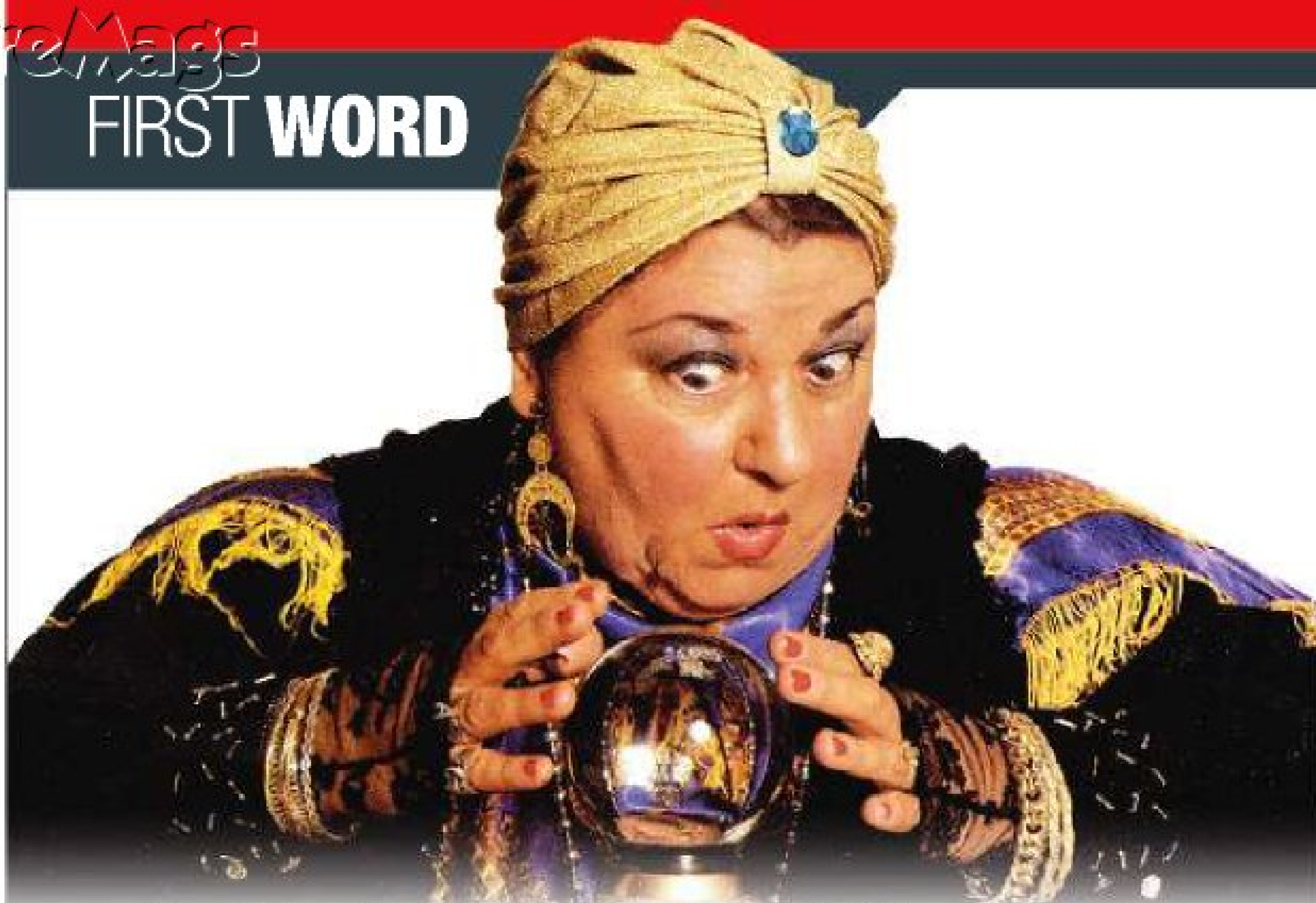
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## RESOLUTIONS and PROGNOSTICATIONS

**J**ANUARY IS A FUN MONTH. ONCE YOU GET PAST EVERYONE SAYING "I CAN'T BELIEVE IT'S 2011 ALREADY" YOU CAN FOCUS ON THE FACT THAT THE CALENDAR CHANGING SOMEHOW CAUSES US TO LOOK AT THINGS FROM A NEW PERSPECTIVE. For me it's a chance to once again make an effort to add organization into my life. By the 5th of the month or so I'm over it and I can get back to work. But this year I'm going to set some resolutions that will hopefully get carried out. The first thing I'm going to resolve to do is get organized. If you've read this column with any regularity then you probably know my thoughts aren't the most organized. I seem to be easily distracted, which reminds me of the time... Kidding. Aside from getting organized my other resolution is to get our website finished. Trust me when I tell you that it's 99% complete, it's just that last little bit that seems to take the longest. By the time you read this the new site "should" (said with fingers crossed, knocking on wood, etc.) be complete and on-line. Give it a look, if it looks new, awesome; If it looks like the same site we've had for 5 years, well then just give it another try in a day or two. Really - we're that close.

Along with making resolutions January is also a time that many like to make predictions about the year ahead. So with that in mind I've come up with a few predictions. We'll check back on these next year to see just how wrong or right I was. Prediction numero uno; flybarless will become the norm. Companies will begin to offer flybarless versions of their machines before the flybared version, and the prices on flybarless systems will continue to drop while features increase. Prediction number two; this year's IRCHA will be the biggest yet. No real stretch there, the trend has definitely been in the right direction. But I think more than ever this annual gathering will become more of a festival with more and more activities than what's been showcased so far. My third and final prediction; you're going to learn more than ever before reading *RC Heli*. We recently did a survey and gathered a ton of important information on what you want out of your favorite magazine. We're listening and will be stepping it up on the how-tos, flight instruction, and more videos.

Thanks for reading and supporting us over the years. We really appreciate it and hope that you and your family have the best year yet!

**Fly Safe,**

**Mike Velez**

Publisher/ Editor-in-Chief  
mikev@rchelimag.com

# RC Heli

m a g a z i n e

## CHATTER BOX

WHAT'S YOUR NEW YEAR'S RESOLUTION?



**MIKE VELEZ - Publisher/Editor-in-Chief**  
I just told you.



**RYAN KEPHART - Associate Editor**  
To finish off my pilots license and fly to IRCHA next year.



**JIM INNES - Editor-At-Large**  
To take care of my new baby girl while still giving time to my other two kids and my fantastic wife.



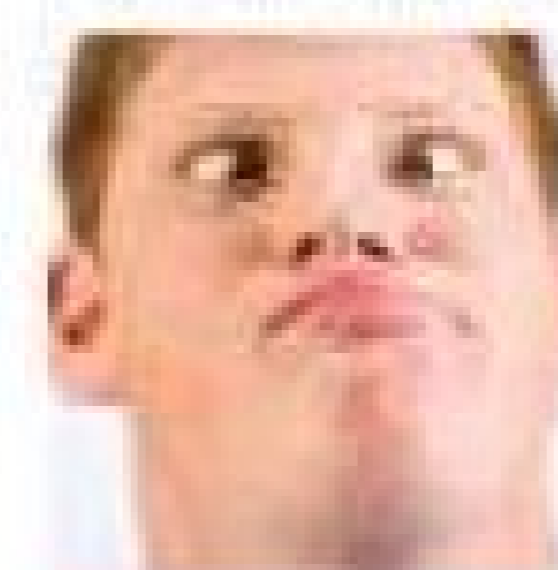
**SHAWN KITCHEN - Editor-At-Large**  
To not get hit with a flying helicopter.



**CHUCK BASSANI - Editor-At-Large**  
I learned to stop making them a long long time ago...



**ART KORAL - Contributor**  
Lose 30 lbs and not crash any Helis.



**AARON SHELL - Contributor**  
Be the best father I can be, and no more children...

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**Graphic Artist**  
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Phone: 1.800.406.4288

### BACK ISSUES/SALES INFO

Phone: 1.888.200.8299  
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### HOBBY SHOP SALES

Retailvision: 1.800.381.1288

### ADVERTISING RATES AVAILABLE UPON REQUEST, CONTACT:

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13401 Yorba Avenue, Chino,  
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# RADIKAL



## G30 PETROL ENGINE

\*Production model may differ slightly.  
Shown with optional items.

For Zenoah 23-30cc  
GAS POWERED R/C HELICOPTER

### Specifications:

- Length: 55 inch / 1397 mm
- Height: 17 inch / 432mm
- Main Rotor Diameter: 62.2 inch / 1580 mm (with optional RotorTech™ 710mm)
- Tail rotor diameters: 11.1 inch / 282.5 mm (with optional RotorTech™ 105mm)
- Engine: Zenoah™ Z-231, 26 or Modified Z-27 and Z-30 gasoline engine.
- Start method: Top Hex start or Optional pull start.
- Dry Weight: approximately 5 kg / 11 lbs. when full load tested with 5 Futaba digital servos, Futaba 611 Gyro, Futaba 2.4GHz receiver, Li-Po Receiver battery and Century 3D Torpedo Slim Muffler.

### CN1340 Radikal G30 kit: .....MSRP \$650

- Semi-metal rotor head with two types of hard dampeners. (for 690-710mm Main blades) For 3D maneuver.
- Aluminum triple bearing metal swash plate with zero-slop bearing design.
- Black modular G-10 side frames with aluminum ridge frame enforcements.
- Top quality ball bearings, thrust bearings and one way bearing.
- Aluminum bearing blocks with double upper main shaft bearing and extra thrust bearing.
- Heavy Duty double bearing supported and double NSK One-way bearing autorotation design with extra large aluminum lower bearing support.
- Advanced 4-point supported engine mounts for less vibration and highest rigidity.
- Adjustable gear ratios available: 6.0, 6.42 and 6.92.
- Designed to be powered by Zenoah G231, G26 or after market G27 and G30 modified gasoline engines. This side frame design accepts up to 4 BHP power output.
- Extra large clutch and clutch bell with Heavy Duty one way starter design.
- Advanced intake/exhaust cooling fan system and specially designed fan cover.
- Machined POM Main Gear and DuPont™ plastic parts.
- Automotive grade tail drive belt supported by aluminum timing pulley and idler pulley along with double bearing supported aluminum tail bearing coupler.
- Carbon adjustable tail pitch control rod.
- High Gloss white fiberglass painted canopy (Black windshield and white body).

### CN1340C Radikal G30 Carbon kit: .....MSRP \$750

- Fully carbon fiber side-frames, tail fins with rigid aluminum frame enforcements.
- Metal center hub along with two different hard dampeners. For hot 3D maneuvers.
- Aluminum tail gear box, flybar control arm set, seesaw control arms.
- Carbon tail boom supports with aluminum ends.

### CN1340CE Radikal G30 SE Carbon kit:.....MSRP \$850

- New Style Aluminum Metal Rotor head, mixing arms and metal blade grips.
- New aluminum flybar seesaw holder.
- New aluminum seesaw assembly.



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## WHAT GEEKS DO FOR FUN

When they're not eating granola and fixing their Birkenstocks the guys up at UC Berkley are merging two toys together. They've mounted the new Xbox Kinetic camera on top of a quadcopter and come up with a completely autonomous drone that can sense precisely where everything in front of it is and move through a predetermined path. If something should get in its way the camera sees it, pauses to a hover until the object is removed. We're sure they'll figure out a way to make the device figure out a way around obstacles, but it's a start. Check out the video here: [HTTP://TINYURL.COM/XBOXQUAD](http://tinyurl.com/xboxquad)



## BERT AND BOBBY ARE AT IT AGAIN

Have you been keeping up with Smack Talk RC? Well if you haven't Bert Kammerer, and Bobby Watts have some new videos up and running. Although this season of Smack Talk is over they finished it off with a bang with a "Going Flybarless" episode. If you are not sure you need the information these professional pilots are giving, check out their free Best of Season 1 video on YouTube. [HTTP://TINYURL.COM/SMACKTALKHELI](http://tinyurl.com/smacktalkheli)  
[WWW.SMACKTALKRC.COM/](http://www.smacktalkrc.com/)



## SHE ISN'T PRETTY

But she's pretty cool. Check this out; Eurocopter has begun test flights of the X3 demonstrator. It's a long-range, high-speed hybrid of sorts. It combines the ability to take off and land vertically like a conventional helicopter, while offering the speed of a turboprop-powered airplane. The idea is for missions where you need a heli, but you've got to be there fast. So far it's managed to clock a speed of 180 knots, which is about 207 MPH. They're hopping to get that bad boy up to 250 MPH sometime next year. That would make it one of the fastest helicopters in the world.



## BEASTX FIRMWARE UPDATES

Version 2.0 has been released to update your BeastX electronic stabilization gyros. This release brings a few new setup options available to fine-tune your system. Here are some of the features.

- **SWASHPLATE FREQUENCY SETTINGS:** 50, 60, 120, 165, and 200 Hz
- **TAIL SERVO FREQUENCY SETTINGS:** 50, 165, 270, 333, and 560 Hz
- **SWASHPLATE MIXERS:** mechanical, 90°, 120°, 140°, 140° 1:1, and a user-defined setting.

Also, note that this coming year BeastX electronics will be available in the United States through Horizon Hobby. This should make the controllers more readily available.

[WWW.BEASTX.COM](http://www.beastx.com)





## MCB ENGINES 3D .90-SIZED PIPE

Is carbon fiber your thing? Well if it is this new .90-sized pipe will surely make it on your helicopter one way or another. The convergent chamber is made from carbon fiber while the rest of the pipe is made from aluminum. Other than that not much is said about this new lightweight pipe, but it is being designed and built in Italy by a reputable company that works closely with Ferrari, Audi, and Lamborghini, so you know it will look cool. We'll see how performance goes once we get our hands on it.

[WWW.MCB-ENGINES.COM](http://WWW.MCB-ENGINES.COM)



## JUST WHAT DO YOU THINK YOU'RE DOING, DAVE?

It's Hal2000 for your radio. Hitec is really pushing things on this whole telemetry movement. Their latest offering is pretty cool. It's called the HTS-Voice. It's a module that attaches to your Hitec radio like the top-of-the-line Aurora 9, Optic 6 or Optic 6 Sport 2.4 GHz radios. When using their telemetric Optima 7 or Optima 9 receiver this system will announce your model's data via a built-in speaker or optional headphones. You can select which information to be read aloud. This is pretty cool, you'll know exactly what's going on up there without having to look down at your radio.

[WWW.HITECRCOD.COM](http://WWW.HITECRCOD.COM)



So when is a full carbon fiber head going to be produced?

## TITAN DISTRIBUTOR – A POWER BUS AND REGULATOR IN ONE

The Titan Distributor is an all-in-one regulator for your helicopter that can regulate up to five channels to 5.2 to 6 volts. You can also configure the Titan Distributor to supply raw voltage for your high voltage rated servos. Each channel is regulated using a linier regulator. The Titan Distributor was specifically designed to run a 2s LiPo, but can handle a maximum voltage of 10 volts. A built in battery monitor displays the current battery level using eight LED indicators. The Titan Distributor can output up to 10amps continuously.

[WWW.WESTERN-ROBOTICS.COM](http://WWW.WESTERN-ROBOTICS.COM)



## SMALLEST TREX YET!

The TREX 100 is coming. It's a tiny electric that's similar to the Blade MSr in size and uses a fixed pitch control system. The tail rotor is motor driven and early indication is that it uses a four-channel 2.4GHz radio. Here are some computer renderings that Align has released.

[WWW.ALIGN.COM.TW](http://WWW.ALIGN.COM.TW)



## WHAT DOES JR HAVE UP THEIR SLEEVES?

With their newest lineup of radios on the market JR decided to focus on the servo side of things and release some of their most exciting servos to date. JR's new High Voltage line of servos do not just cover the standard sized servos used for your bigger machines, but offer high voltage servos for your 450 sized helicopter and smaller. Each servo is designed to run directly off a 2s LiPo battery and offer faster speeds, and higher torque. These servos are not out quite yet, but be on the lookout.

[WWW.HORIZONHOBBY.COM](http://WWW.HORIZONHOBBY.COM)



## PILOT TO CO-PILOT WE HAVE A PROBLEM!

What does any good Co-Pilot do when the main pilot lets go of the controls? Well, fly the aircraft wouldn't you think. That is just what this new product does for you. The CPII LT flight stabilization system can be used in all flight modes including 3D. This unit is able to recover from inverted flight by rolling the helicopter over and leveling off into a hover. Although this type of electronic stabilization system seems like it would cost a fortune you will be surprised of the low street price under \$200 for a complete system. We're working on getting our hands on one of these units soon.

[WWW.REVOLECTRIX.COM](http://WWW.REVOLECTRIX.COM)



## RC HELI SHIRTS BACK IN STOCK AND NEW BOOK ABOUT TO SHIP

RC Heli shirts are back in stock in all sizes. Whether you're into scale of 3D you'll be the best looking fella at the field in one of these gems. Also on-sale now (Shipping in early January) is the Ultimate Guide To The Spektrum DX8. The new book is written by RC Heli Editor-At-Large Chuck Bassani and takes you on an in-depth trip into the features, functions, performance, programming, and use of the Spektrum DX8. You can order shirts and books at our new store site. [WWW.RCHELI.BIGCARTEL.COM](http://WWW.RCHELI.BIGCARTEL.COM)



**LET THE BATTLE BEGIN!™**

**YOU LIFT OFF. BANDITS  
SWOOP IN ON YOUR SIX.  
YOU JINK BEFORE THEY  
CAN GET A SHOT OFF AND  
CLAW FOR ALTITUDE.  
THEY MISJUDGE THEIR  
SPEED AND SCREAM BY  
UNDERNEATH YOU. YOU  
PIVOT AND DROP DOWN  
BEHIND THE NEAREST  
TARGET...**

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Pictured: FHX Strike Heli FCE2100 (Left) and MH-35 Strike Heli FCE2000 (Right).

FORCE is the revolution in RC that combines the fun of flying ultra micro helis with the thrill of aerial battle.

**Fly into Battle with the Best!**

FORCE™ ultra micro helis come assembled and ready for action with 4-channel control, a rugged airframe and a built-in battle module that fires and detects infrared shots. They're easy to fly too.



**Smoothed-Out Controls**

FORCE helis have been tuned to provide plenty of responsiveness for aggressive ABM (Air Battle Maneuvering) without making them too sensitive or difficult to control.



**SimpliFly**

FORCE rookies who've never flown before have the option of activating SimpliFly™, which reduces pilot workload to rudder, pitch and throttle so they can get in the fight right away.

**VDAS Keeps Score**

The FORCE Visual Damage Assessment System (VDAS for short) lets you know when you score a hit on another heli by making that heli involuntarily spin in either direction. Hit someone three times and VDAS will gently power down their motors, forcing them to land. But don't worry if you get shot down. VDAS will reset your heli's systems and let you back in the fight in seconds. There's even a range selector that lets you level the playing field by allowing FORCE rookies to take longer shots while RC battle aces have to get in closer to score a hit.



**Visual Damage Assessment System**

First hit: heli spins once. Second hit: heli spins once in each direction. Third hit: heli loses power and spins continuously.



**Adjustable Range Battle Module**

The FORCE battle module can register hits from as far as 15 feet away. You can cut the range in half if you're fighting in a smaller space or want to make battles more challenging.

**Go at it Alone or as a Team**

Battle one-on-one or with multiple teams in an aerial battle royale. Or hone your gunnery skills with the optional ground target. Because FORCE uses the proven precision and reliability of Spektrum™ 2.4GHz DSM2™ control, you can have large numbers of FORCE helis in the air at one time and never have to worry about signal interference.



**Multiple Team Battle**

**WITH FORCE THE BATTLE  
POSSIBILITIES TRULY  
ARE ENDLESS.**

**FORCE-RC.COM**



## FURION CONVERSION KIT

So you bought yourself a Fury 55 because you like MA, but really wanted an electric helicopter. Never fear, Miniature Aircraft has you covered with an all-new conversion kit to convert your Fury 55 into the brand new Furion 6. Everything is included to get your helicopter ready to go except the speed controller and motor. That means a canopy, frameset, motor mounts, gearing and more.

Street Price: \$300

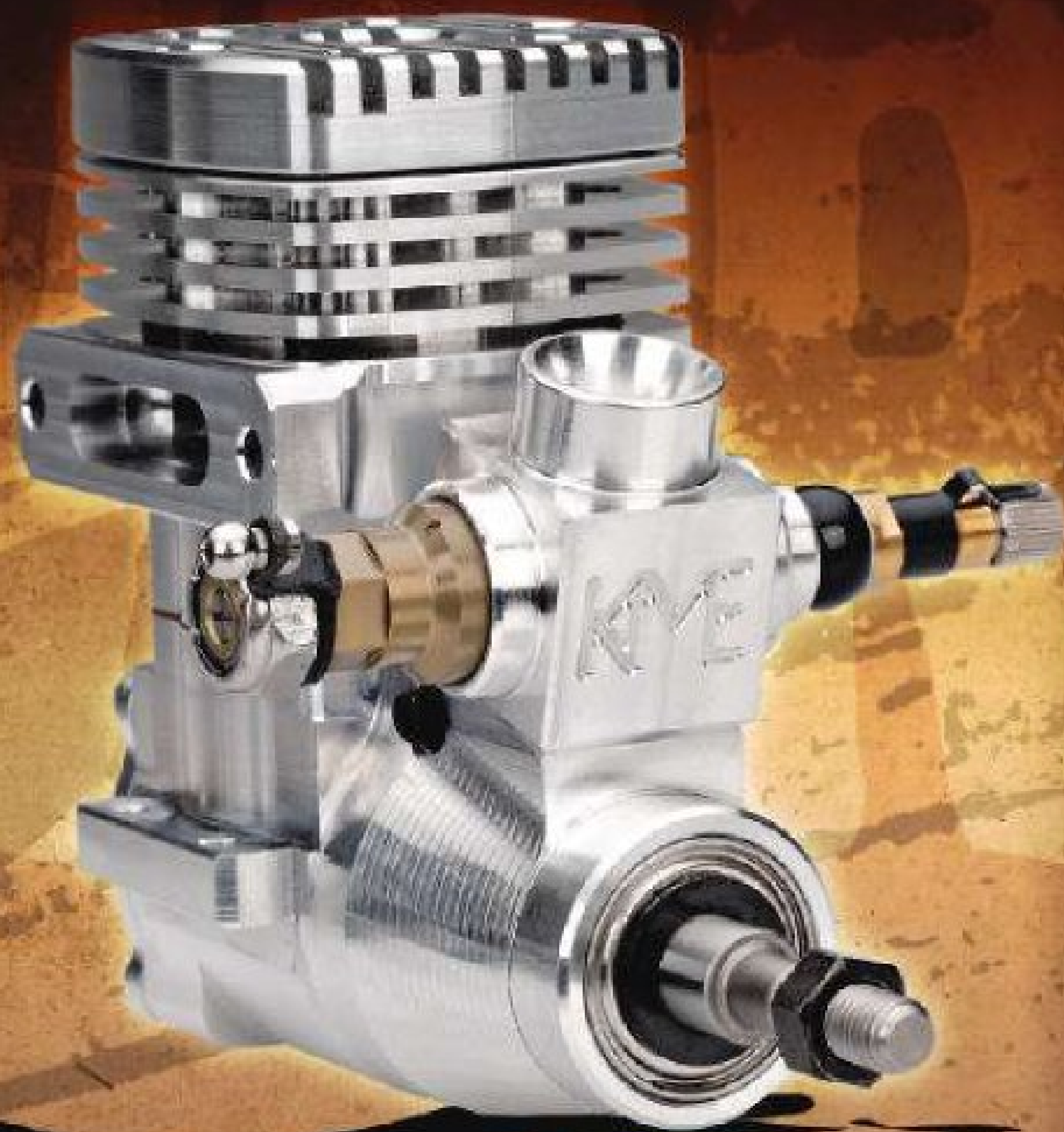
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Experience full .60 size power in your 50-size heli with **no modifications!**

- + Made from high grade Aircraft Billet Aluminum.
- + 30% more power than your existing .50 size engine.
- + 24mm piston!



# KME ENGINES

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# ALIGN

Conquer Your Heart



Awarded the Constructor Championship

# TREX 700E

## Defy Gravity with the 3G Flybarless system



### TREX 700E 3G Super Combo or Combo

- Specifications:
- Full length: 1328 mm
  - Total height: 408mm
  - Main rotor diameter: 690mm
  - Tail rotor diameter: 261 mm
  - Motor Drive Gear: 18T
  - Main Drive Gear: 115T
  - Autostat on Tail Drive Gear: 104T
  - Tail Drive Gear: 24T
  - Full equipped weight: 2000g
  - Drive Gear Ratio 1.9:58:4:33
- Ask your local dealer for KXD18E01(Super Combo) or KXD18E04 (Combo)

## 3G Flybarless System

### STANDARD FEATURES ON THE TREX 700E:

- All metal rotor head for durability and superior control response
- 15 +/- degree pitch control for Superior 3D performance and explosive power
- Innovative sliding battery tray rails that allow fast battery changes and protection
- CNC Module 1 gear pitch for improved power transfer from the 700MX motor
- Unique 3 Bearing fixed motor mount for direct motor shaft support
- FL760 3G Flybarless System
- Rigid 3K Carbon Fiber Frames
- 690mm Carbon Fiber Rotor Blades
- Digital Cyclic Servos DS 610 x 3
- Digital Tail Servo DS 650 x 1
- High performance 700MX (510kv) motor
- Castle ICE HV 120 Brushless ESC Included w/ (KXD18E01)
- Aluminum Tail Boom x 1
- 3K Carbon Fiber Tail Boom x 1



3Axis SMM 12bit Easy Energy Stable T-Rex 250-700 300Hz 3V-8.4V RoHS



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## LETTERS

### THANK MY LUCKY STARS

Here are a few photos of a crash I had with my 450. I was flying at a local soccer field on the out skirts of town. I was having the time of my life that day when wind started to come in from nowhere! I decided to keep flying, to no surprise the wind gusts were stronger the higher up.

I could not bring the heli back from a tail in flip. The wind took over as I fought to bring the heli back towards me. The farther it went away the harder it was to remain orientated the heli got smaller and smaller. The wind took it across the field, across the frontage road, across highway 99 and over to a upscale neighborhood. The total distance was about 1000 feet from where I started. As it went over the neighborhood all I could do was try to tell if it was nose in or tail in, I couldn't! So I hit throttlehold and watched it go down. I spotted a palm tree as a landmark and jumped into my car with my wife and drove over the bridge to the neighborhood, there we spent the next two and a half hours knocking on doors, looking on rooftops, bushes and trees to find the heli. At last I turned on my TX as I walked towards my car (feeling very down) moving the cyclic stick around trying to hear the servos moving the swash, nothing. So I moved the throttle up a bit and I heard the motor spin up! I walked to



### A ROYAL REPLY

This is my first scale build - a Century Swift with a A109E fuselage. I modeled it after what I think is a beautiful helicopter - One of the three RAN's (Royal Australian Navy) Agusta A109E's this one #510 they refer to as "Medusa"

I installed a full light/strobe kit and aluminum landing gear with suspension. It is 49" long and runs on a 6-cell Lipo battery. When I was building it I had a question about something and I emailed the unit. The Officer-in-Charge of the unit not only emailed me back but he also sent me a letter, tie pin, stickers and a squadron cap which my son is seen wearing, very cool! I live on a small island and there are no hobby shops around here, your magazine helps me tremendously!

Regards,

**Brendan Massett**  
Hilton Head Island, SC

■ Nice job Brendan, that's a great way to get some true scale documentation, go straight to the source. Congratulations on an excellent build. - Mike



the sound and there in a driveway near a shrub was my heli!

I have since rebuilt the heli. I was lucky there was not more damage to the heli than it sustained. I could go on about the day this happened; I don't think you want to read the whole story! In short, this of all my helis means the most to me because my son Daniel bought it for me, and I did all the upgrades to it. I was actually feeling sick at the thought of not returning home without this bird.

**Danny Juarez**  
Southern California

■ Wow Danny, you're a lucky guy. Not only could your helicopter have caused a lot of damage, it could have really hurt someone. Thankfully that didn't happen. I guess the lesson here is not to stay flying when the conditions change and you're the least bit uncertain about things. Also, you should be flying at a sanctioned AMA field. Not that that would have made a difference on this day, but your AMA card, along with flying at a sanctioned field does limit some of your liability. Thanks for sending the pics, and glad it worked out okay.  
- Mike



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*— David Messina, LaGrangeville, NY*



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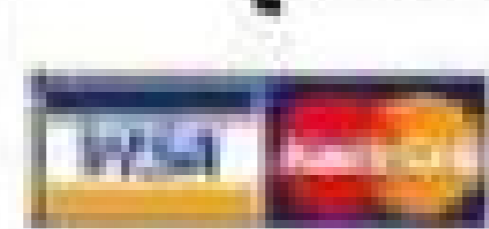
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## ROTOR HEAD

### ☑ FULL BLOWN FOUR HUNDRED

First congratulations to everyone of you for the amazing help that your magazine is to me and so many other readers around the world. Second, that's my heli, it's a Blade 400 with Heliartist bo-105 fuselage, HS65MG servos from Hitec, navigation lights from Heliartist, a 3-axis gyro GU-365 from Gaudi and a mini camera from E-tech. My transmitter is a Hitec Aurora 9 with the Optima 9 receiver and because of the three spare channels one is for the navi and landing light the second for the landing light retract and the third for the camera up and down! A DS75H from e-flite for the light and a Hitec HS225MG for the camera. Thanks to Hitec for the ability to slow down the servo speed, camera and landing light working on full-scale speed. Thanks again for the great help and keep on the great job!

**Costas Porichis**

**Toronto, Canada**



## WANT TO SEE YOUR HELI IN THE MAGAZINE?

Send us pictures of your heli along with a description of what it's got. We prefer digital files (no zip files please) in a **HIGH RESOLUTION**, so be sure to flip that switch on your camera to the "fine" setting. One submission per month will receive a full-year subscription to **RC Heli Magazine!**

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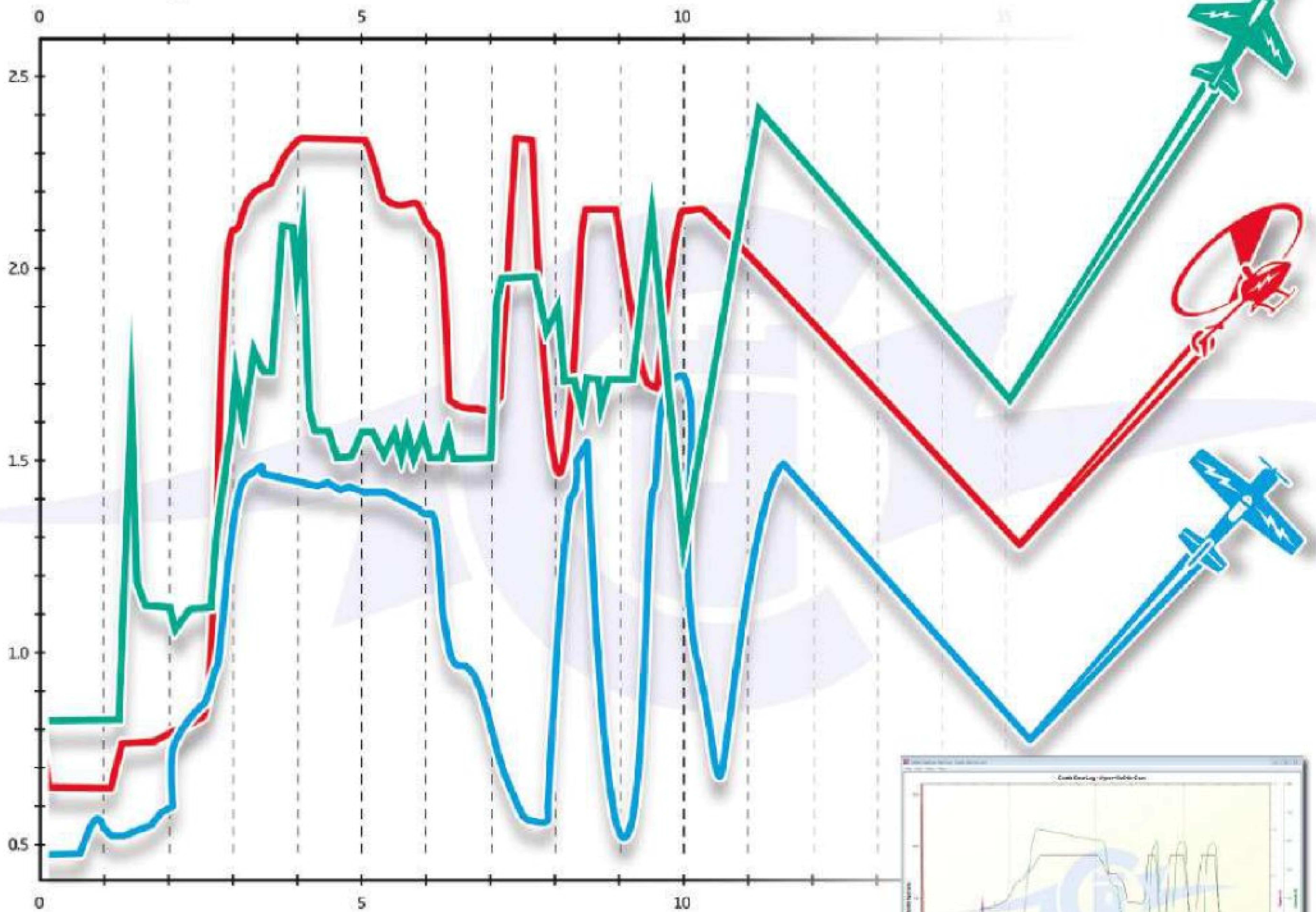
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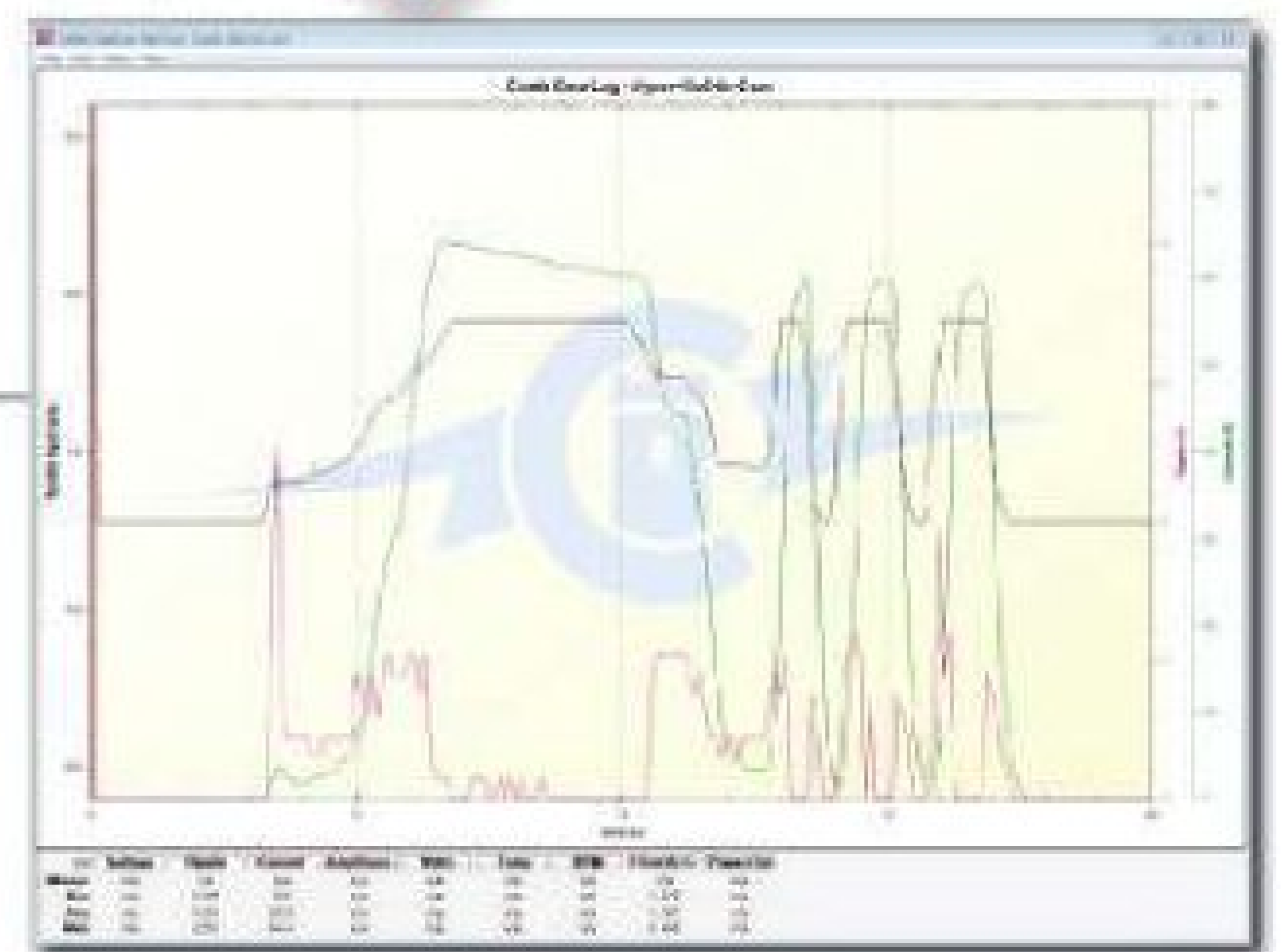
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## FREQUENTLY ASKED QUESTIONS

**Q:** I am a pilot who has been flying nitro helicopter for a long time, and I recently bought my first electric helicopter. I have noticed that a lot of electric pilots spool up their helicopters in Idle-up. Wouldn't this harm the motor with a 100-70-100 curve? How can this be good for the motor? Why not just spool up the normal way? -FlyDad

**A:** Hey FlyDad, these are very good questions that many die-hard nitro fans have questioned for years. Spooling up an electric helicopter is much different than a nitro helicopter. Which speed controller you use can change everything when you spool up. To answer your first question about spooling up in Idle-up, no electronic speed controllers are designed to ramp up the power to the motor over a set amount of time. This spool up program works any time the throttle is at or below 0% for a given amount of time. Some speed controllers can be set up using a governor mode and are set using the throttle curve, so in Normal mode you would have a straight throttle curve from 60-70%. You can, however, set up an electronic speed controller to spool up like any nitro. Just set your throttle curve so it's linear and go for it. -RKephart



**Q:** I am new to this hobby and recently purchased a used Blade 400 over the Internet. After receiving my helicopter, I noticed that the boom was angled towards the rotor blades. I was wondering what this angle should be, and how I should go about adjusting it. -Skinny

**A:** It sounds like you might have a bent tail boom. It's sometimes hard to see if the boom is bent when it is installed on the helicopter. Try taking the boom off by loosening the screws that clamp it to the boom. Pull the boom out and check for a bend. The boom should be completely straight. After installing a new boom, you will see that the new boom should be 90 degrees to the main shaft. -RKephart



**Q:** I have one of the best chargers on the market that can charge multiple packs at a time. My question is, if I stare at my batteries long enough will it help them to charge faster? -CaptainQuickCharge

**A:** Yes, if you stare at your batteries long enough they will instantly charge after about an hour. This is kind of like watching water boil. You know you got the job done when the job is done! -DDJ2347



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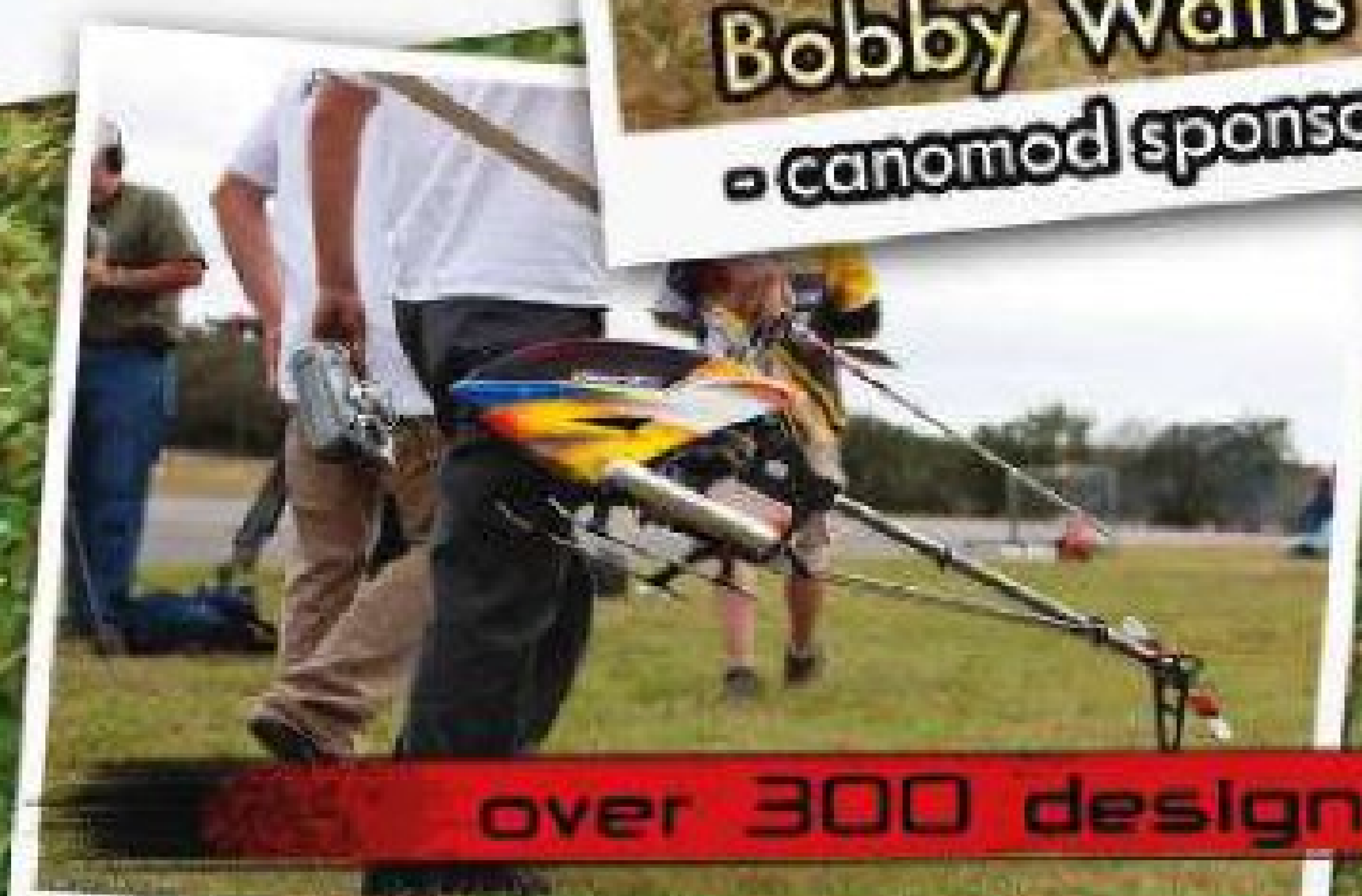
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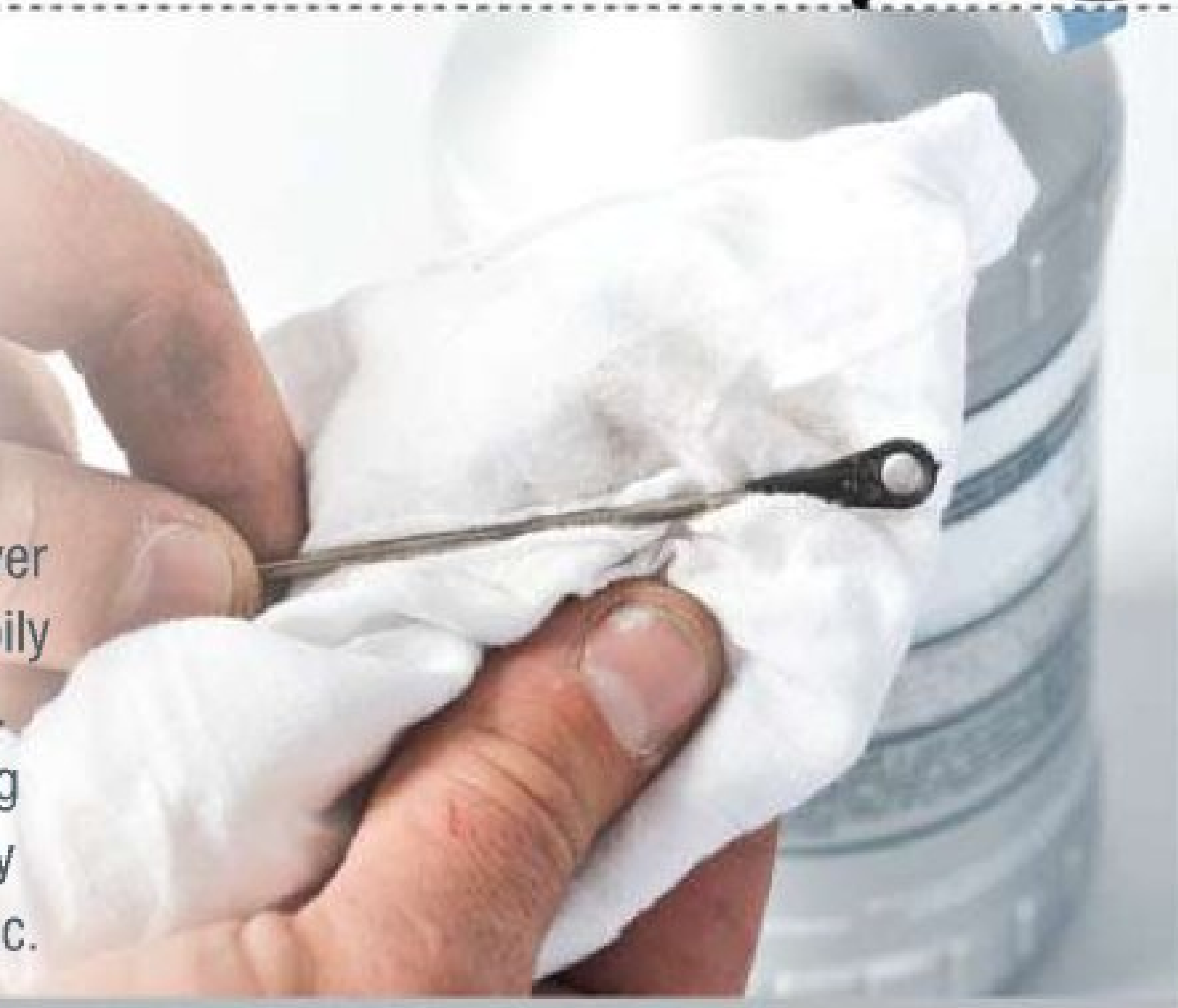
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## QUICK TIPS

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# KEEP A CLEAN LINKAGE

If you haven't noticed already, linkages are probably the most important part of your helicopter. Missing just one can wreak havoc on your flight and cause your helicopter to lose control. Over time, linkages can develop grime from dirt, dust, and wear. The oily residue from a nitro engine can also increase this contamination. Keep your linkages clean and dry by removing them and spraying some denatured alcohol and wiping them clean. This will not only keep your linkages clean, it will also improve the life of the plastic.



# REPLACE YOUR GLOW PLUG AFTER BREAK-IN

**NITRO ENGINE BREAK-IN IS SOMETHING EVERY PILOT MUST DO WHEN FLYING A NITRO POWERED HELICOPTER.** A brand new engine must be broken in as well as a freshly rebuilt motor. During the break-in process, the piston ring must seat to the piston sleeve. This process shaves microscopic pieces of metal left over from manufacturing. These metal particles can cling to the glow plug and cause it to either foul or simply burn up. It's always a good idea to replace your plug after break-in to ensure that your engine will run at its optimum performance.

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## BUT THE TRACKING TAPE MAKES MY BLADES **LOOK HORRIBLE!**

Once again, this tip was submitted by jimzpsd (this guy is a real whiz!) Instead of using tracking tape, try a "dry erase marker". Once you have your blades tracking, just wipe off the marker without the worries of an out-of-balance rotorhead caused from the tracking tape.



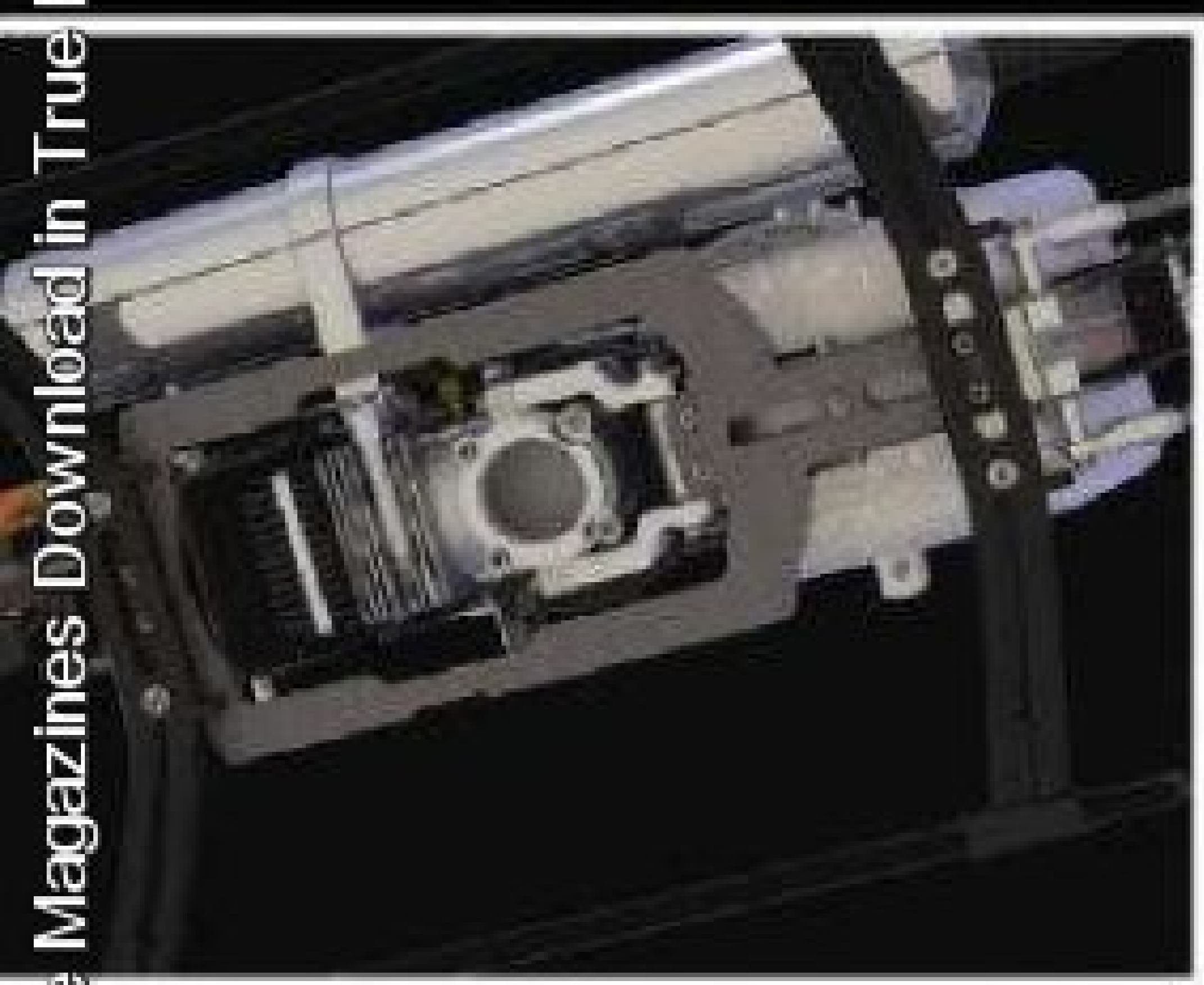
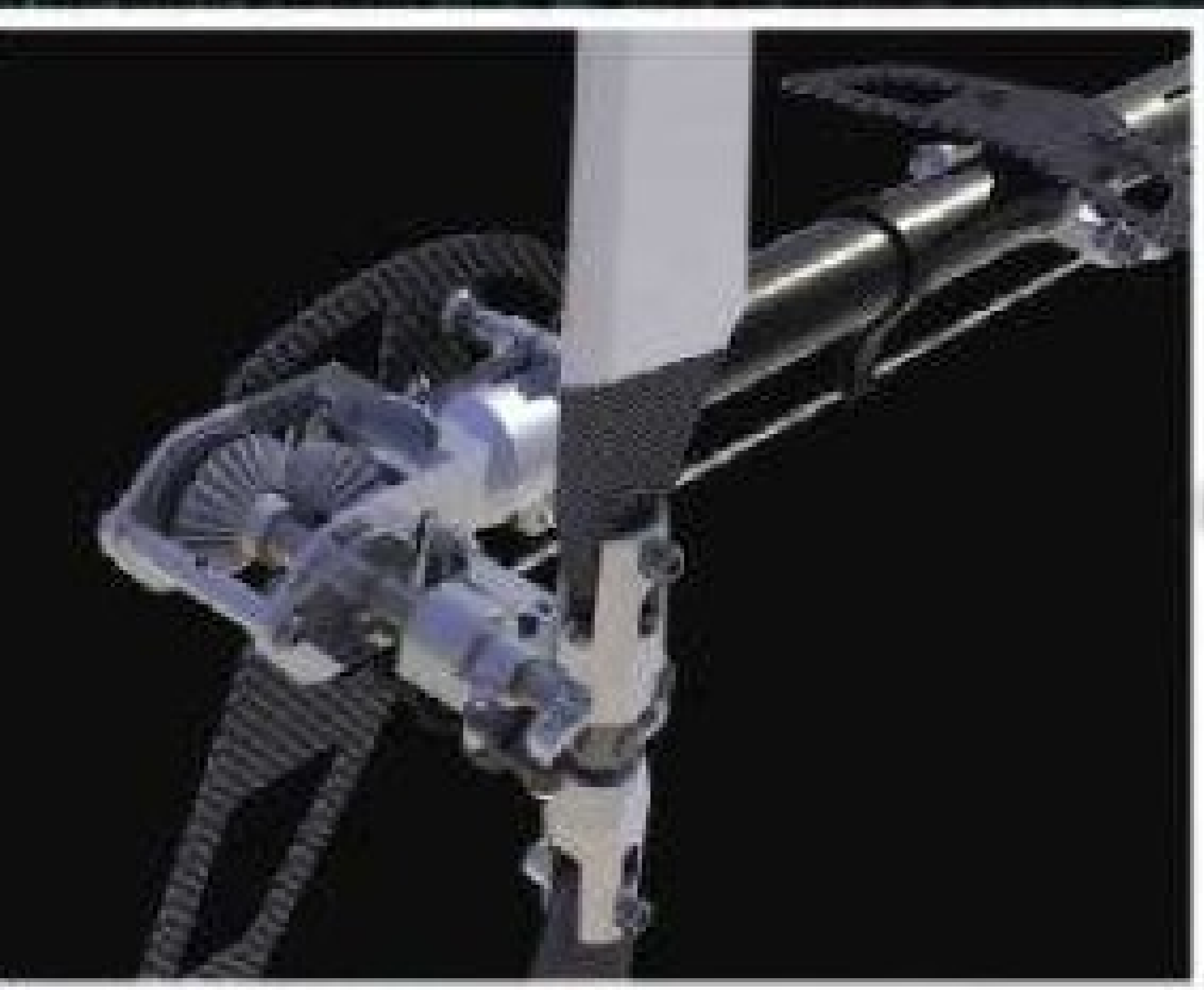
## **HELP!** I CAN'T FIND MY HELI

This tip was submitted by Jim, better known on our forum as "jimzpsd". Apply reflective tape to a few places on your heli (boom, frame, canopy, etc.). If you crash into a tree or dense field or any foliage and you cannot find your heli, go back to the crash site at night with a bright flashlight. The reflective tape will glow once hit with the light (and don't forget to look up into the trees). The tape can be cut to look factory (like a logo).



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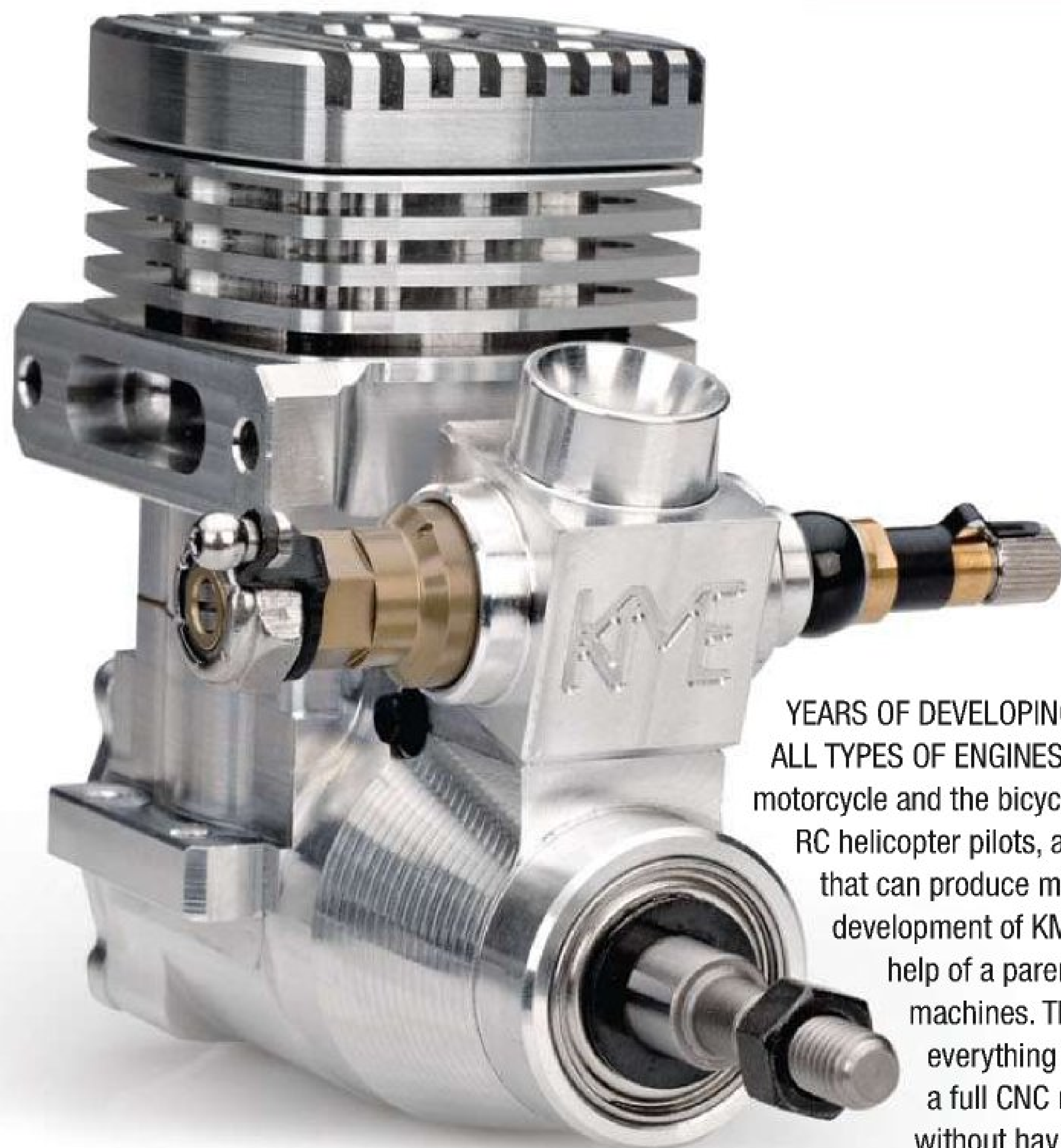
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# KME DIAMOND PRO .60

More Power  
WORDS: Ryan Kephart

**K**ME ENGINES, ALTHOUGH NEW TO THE HELICOPTER INDUSTRY, THEY HAVE OVER 19

YEARS OF DEVELOPING AND ENGINE MODIFICATIONS FOR ALL TYPES OF ENGINES. KME has over seven patents in motorcycle and the bicycle industry. Like one of your local RC helicopter pilots, an individual that wanted an engine that can produce more power than standard lead to the development of KME. This business was started with the help of a parent company that manufactures CNC machines. These machines allowed KME to create everything they needed to build and produce a full CNC machined aluminum engine locally without having to outsource. 98 percent of all

KME products are manufactured here

in the United States, which include the Diamond .60 engine, Powerhouse .60 pipe, and the Diamond Pro 110, which will be released shortly. KME is here to stay with plans to have five engines out by the end of next year. Let's take a look at the engine that started it all and see if KME has what it takes to compete.

## FEATURES

The KME Diamond .60 Pro features a completely new engine case design made from billet aluminum. The case is CNC machined in one piece and allows this engine to fit most 50-size nitro helicopters. Every part of the KME Diamond .60 is polished, giving it that extra bling we have always wanted in a nitro engine. KME also designed and built their own carburetor, piston, and sleeve to achieve the close tolerances they were looking for. The carburetor is a simple two-needle adjustable mixture control that allows the high end and the low end to be adjusted. The head of the KME Diamond .60 is also made from aluminum and machined to match

the rest of the engine. Four cooling fins are located on the side of the head and 10 fins are located on the top. This engine also uses standard muffler mounting, which allows you to connect a standard 60 or 90-size muffler.

To match the KME .60, we opted to use the KME Powerhouse .60 Pipe which was specifically designed for the Diamond .60. KME claims that the Diamond .60 provides up to 30% more power than most .50 size engines, but we couldn't just take their word for it. Let's see how the Diamond performed and see if we get the power we have all been looking for.



### + THE GOOD

- Beautiful CNC machined aluminum
- Extra power
- Quality you can see

### - THE BAD

- No printed manual
- Needles are not factory set

### CONNECT

MANUFACTURER:	KME
WEBSITE:	www.kmeengines.com
PART NUMBER:	KME1240-60
STREET PRICE:	\$319

The rappers engine choice for BLING!

## INSTALLATION/ TESTING

Installing the KME Diamond .60 is no different than installing a normal 50-size nitro engine. We opted to use the Outrage Velocity 50 as a test bed due to the increased rotor size and extended tail boom. This helicopter already flew well with the Y.S. 56, but we wanted to see how much more power this helicopter could handle by using the Diamond .60. Basically, swapping out was as simple as removing the four motor mount bolts, sliding the old motor out, and sliding in the KME Diamond .60. The Diamond sat perfectly on the engine mount and nothing had to be modified for this engine to work.

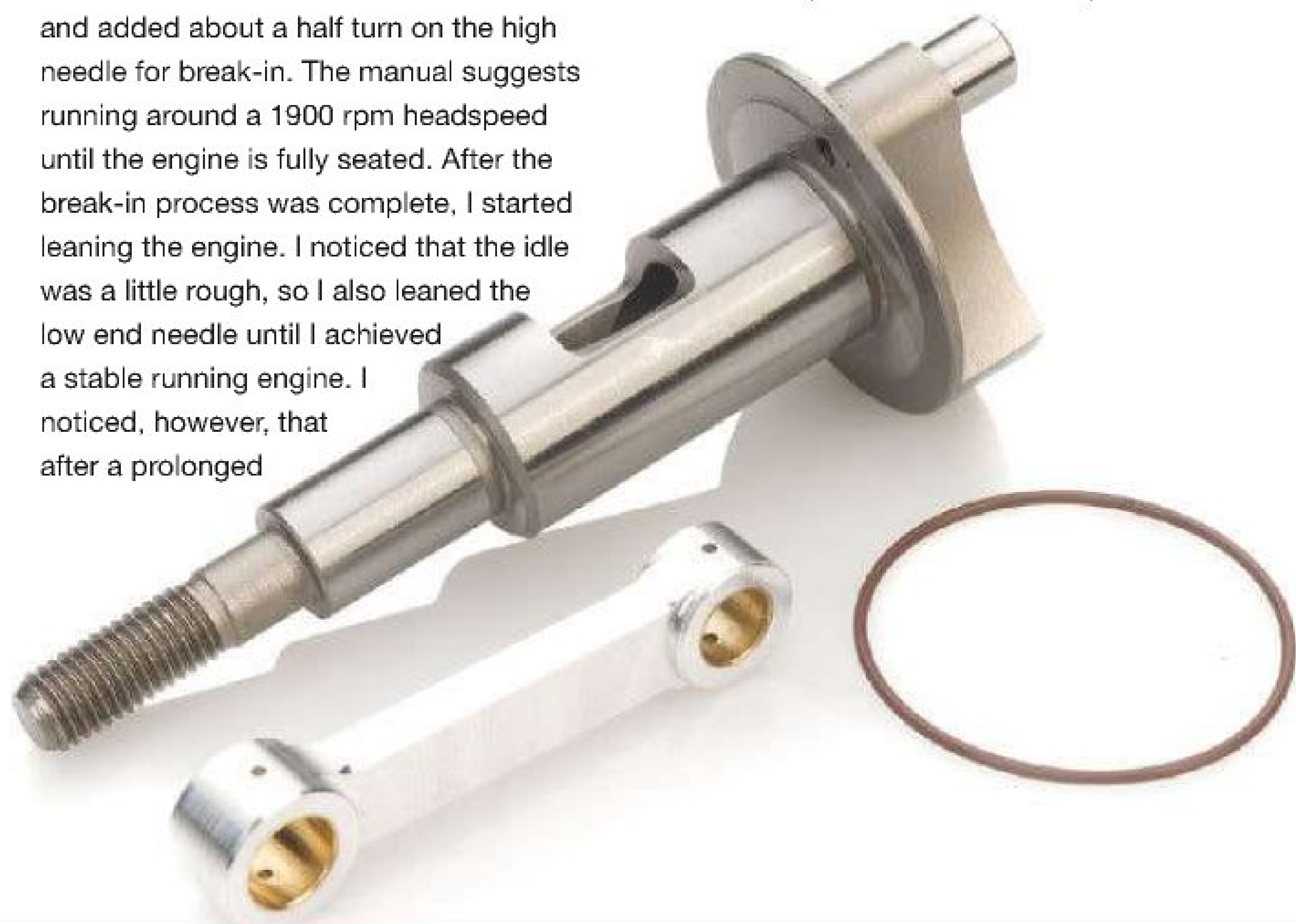
The KME Diamond .60 comes almost ready to run, with only a few steps to complete before the initial start. The needle valve must be set for break-in, as they are not set from the factory. When you open the box you'll find that no printed manual is included, but thankfully

an online manual is available that can be downloaded from [ww.kmeengines.com](http://ww.kmeengines.com).

After installing the engine and setting the needle valves, a break-in process must be completed. I used 30% nitro and added about a half turn on the high needle for break-in. The manual suggests running around a 1900 rpm headspeed until the engine is fully seated. After the break-in process was complete, I started leaning the engine. I noticed that the idle was a little rough, so I also leaned the low end needle until I achieved a stable running engine. I noticed, however, that after a prolonged

period of time at idle the engine would load up and quit.

During the first flight after break-in the engine ran extremely well. The power was definitely there, as the Velocity



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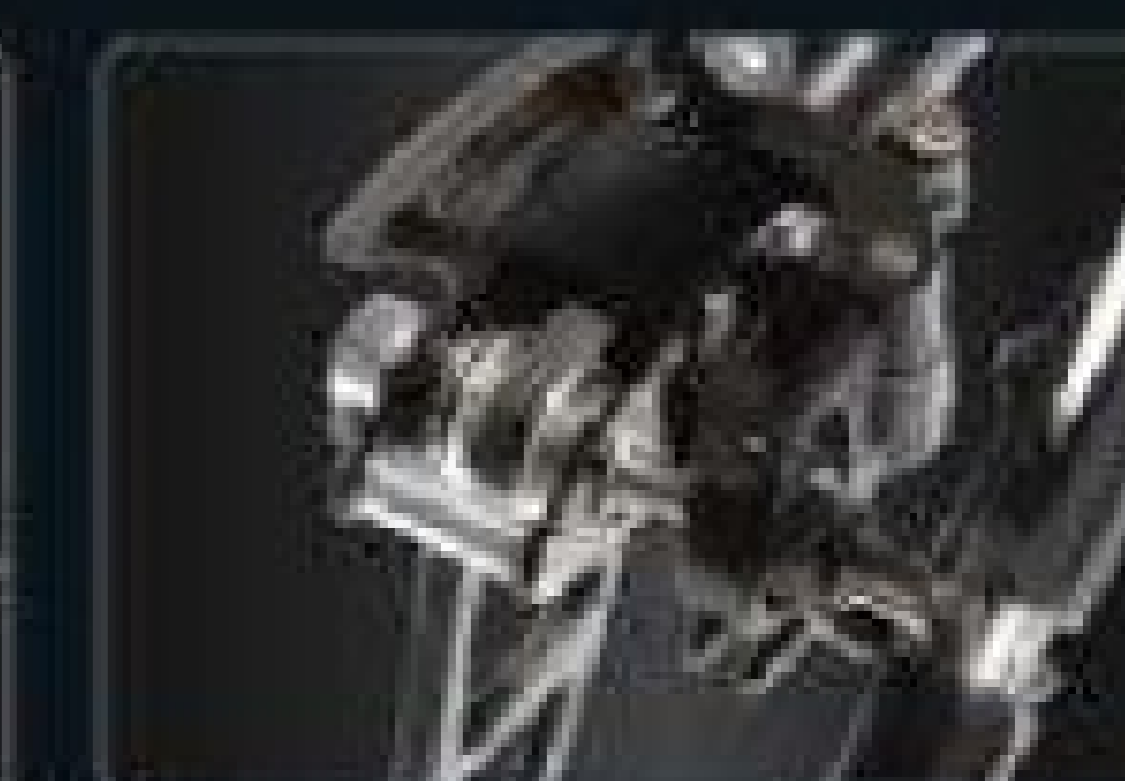
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- Main Rotor Diameter: 305 mm
- Tail Rotor Diameter: 85 mm
- Overall Length: 293 mm
- Brushless Motor: WK-WS-15-001
- BSC: WK-WST-20A-L
- Battery: 7.4V 850mAh Li-Po
- Gyro: three-axis-gyro
- Transmitter: WK-2803
- Receiver: RX-2815V
- All-up Weight: 106g (Battery included)



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soared through the air with no bogging tendencies. Even with the pitch maxed out, the KME Diamond .60 took it with ease. Towards the end of the flight I noticed the engine leaning out a bit and decided to land and adjust the mixture for the last portion of the tank. This allowed me to run a little rich during a full tank, but perfect as it gets to empty. Overall, the engine performed well and I did not experience any abnormal operation. We'll see how well this engine performs in the long run, and we'll post our results in a long-term test sometime in the near future.

## CONCLUSION

If you're looking for some more power (or you simply have a heavier-than-normal helicopter), the KME Diamond .60 might just fit your needs. The engine has great looks and amazing quality inside and out. We ran the engine with about a gallon of fuel and so far we have yet to see any problems. Although KME is a relatively new company, it looks as if

they have done a great job from the beginning. KME has also started to work on a new engine for 90-size helicopters that promises the same great features, coupled with the power of 1.10 engine in a 90-size case. Keep an eye out for a review in the near future as well as the long-term review of the Diamond .60. **TRE**



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# Viper PROGAUGE

Everything including the kitchen sink!

WORDS: Daniel Colby

**V**IPER RC HAS DEVELOPED A REVOLUTIONARY INNOVATION THAT GIVES YOU EVERY FUNCTION YOU NEED IN ONE POCKET-SIZED BOX. It's called the VIPER PROGAUGE. It has an easy to read user interface and straightforward operational logic. The PROGAUGE offers the most all-in-one functions, easiest setup, and is the smallest size device of its nature on the market.

## FEATURES

Some of the other features include a 2x16 character LCD screen that shows you all of the information you need for each of the many functions. There are four buttons located at the bottom of the screen that make it easy to enter information, make adjustments, and find the proper selection. The PROGAUGE also has two connectors. One is a battery connector with seven pins that allows you to connect up to a 6S pack using the balance leads, and the other is an I/O connector that has a three-pin plug that allows you to connect a servo, receiver, or a V-Port when using it as a programming card with any Viper device.

### THE PROGAUGE CAN BE USED AS A:

- Li-Po battery monitor
- Servo tester
- Input PPM signal monitor
- Propeller RPM tachometer
- Viper device programming card

## TESTING

We tested every feature that the PROGAUGE offers, starting with the battery monitor. We tested several battery types from a 2S to 6S Li-Po, and it worked very well. It tells you the number of cells in the pack, the total voltage of the pack, the voltage of the highest and lowest cells and the difference between them, and also gives you the voltage of each individual cell. This comes in handy after balance charging a pack; it allows you to double check each cell and make sure that it's at the correct voltage.

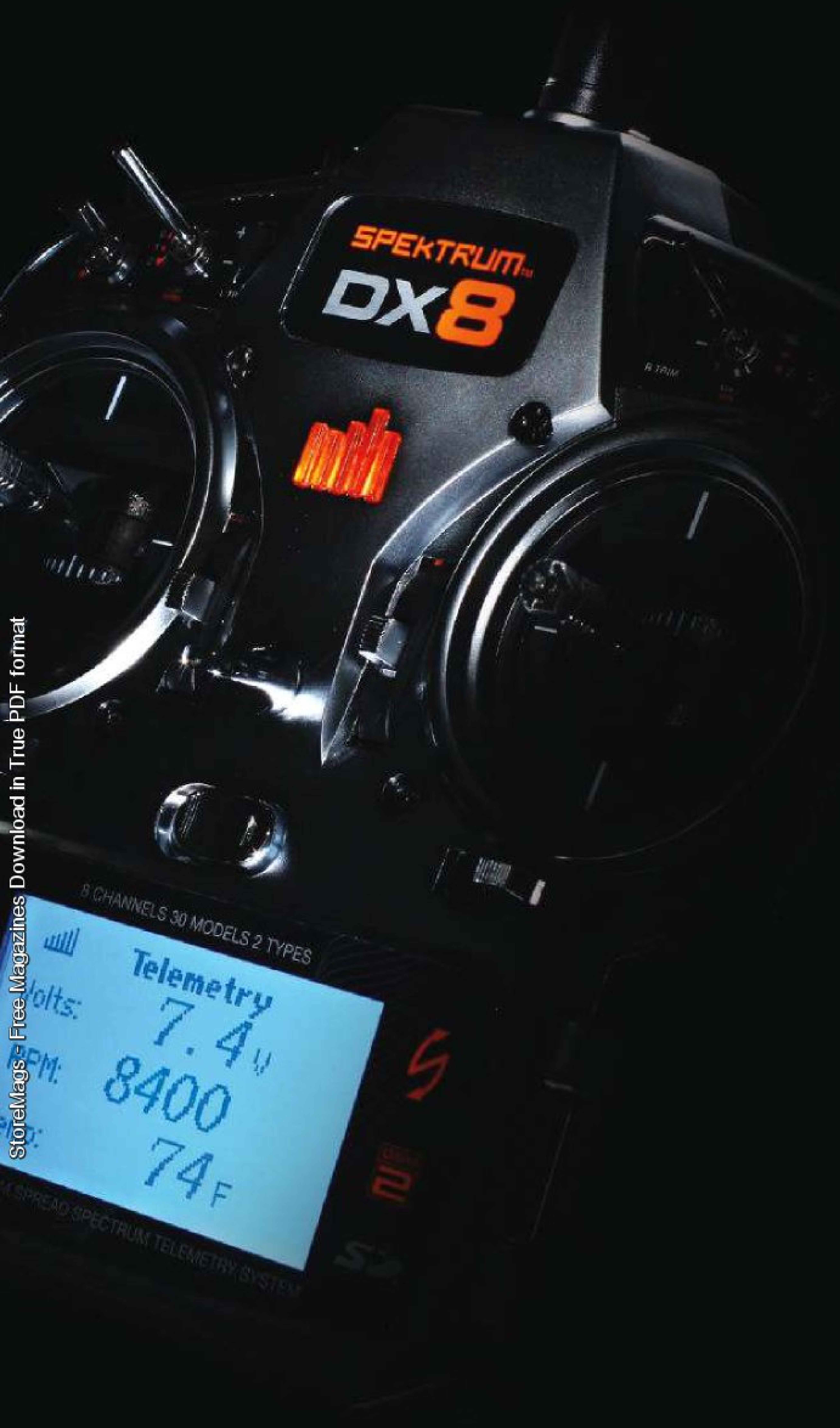
Next we tested the servo tester. This PROGAUGE automatically regulates the output voltage to 5.5V so you don't have to worry about burning up your servo. This function has three settings: swing/normal mode, wide/narrow band mode, and normal/extra range mode. The swing/normal mode allows you to make the servo swing automatically or manually by turning the PPM signal knob.

The wide band mode will allow you to test and center both digital, and analog servos, while the narrow band allows you to test and center high end tail servos such as the Futaba 9256. The normal/extra range mode is used to send out and extended PPM signal range. This lets you simulate going over your 100% endpoint value on your radio. When using any of these functions, the LCD screen will also display the servo swing time, voltage, servo travel position, and peak current draw.

Now to the input PPM signal monitor. This allows you to monitor the output voltage from your receiver, the receiver's PPM signal width, and the frequency. For example, while using a Spektrum AR7000 and a 6V battery, the PROGAUGE gave me a reading that my RX output voltage was 6.45V and that my PPM was 1507 microseconds. As for the radio frequency, it only works with non-2.4 GHz receivers for now, but Viper states that Version 2 will be coming out

# The World's Most Advanced 8-Channel.

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When it comes to flying securely, nothing maximizes performance like the DX8. This innovative radio comes with built-in telemetry and a full range telemetry module (shown below). While you're flying, it will display real-time battery voltage, signal quality, temperature and rpm on a large backlit LCD screen.



If any telemetry values exceed the parameters you set, the DX8 will alert you with audible or vibrating alarms. You can even review telemetry data for the flight after you land.

After the DX8 arrives in stores, more telemetry sensors will become available. If you want a more compact module, a smaller fly-by module will also be available separately. Both the fly-by and full range modules are compatible with any DSM2™ receiver that has a data port.

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and should be compatible with current 2.4 GHz systems.

The propeller RPM tachometer feature can't safely be used to get the headspeed of a helicopter, so instead we tested the feature using an airplane. We compared the RPM reading we got from the PROGAUGE against another tachometer and got the same reading, so if you're also an airplane enthusiast this feature will work great for you.

The last feature is the Viper device program card. Unfortunately, it will only

work with Viper electronic products such as speed controllers and helicopter gyros which we have yet to acquire, so keep an eye out in a future issue to get the feedback on this feature.

### CONCLUSION

This is a great little gizmo for anyone in the hobby, as it's loaded with plenty of handy features. If you're in the market for a complete package, gauge don't be afraid to try the PROGAUGE out. *(THL)*

#### THE GOOD

- Compact
- Easy to use
- Affordable

#### THE BAD

- Only puts out 5.5V; would be nice to have a 6V and 7.4V option for those using HV servos

#### CONNECT

<b>MANUFACTURER:</b>	VIPER-RC
<b>WEBSITE:</b>	Viper-rc.com
<b>PART NUMBER:</b>	6VSCARD001
<b>STREET PRICE:</b>	\$49

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# nano-tech

**HIGH DISCHARGE LI-PO BATTERY**

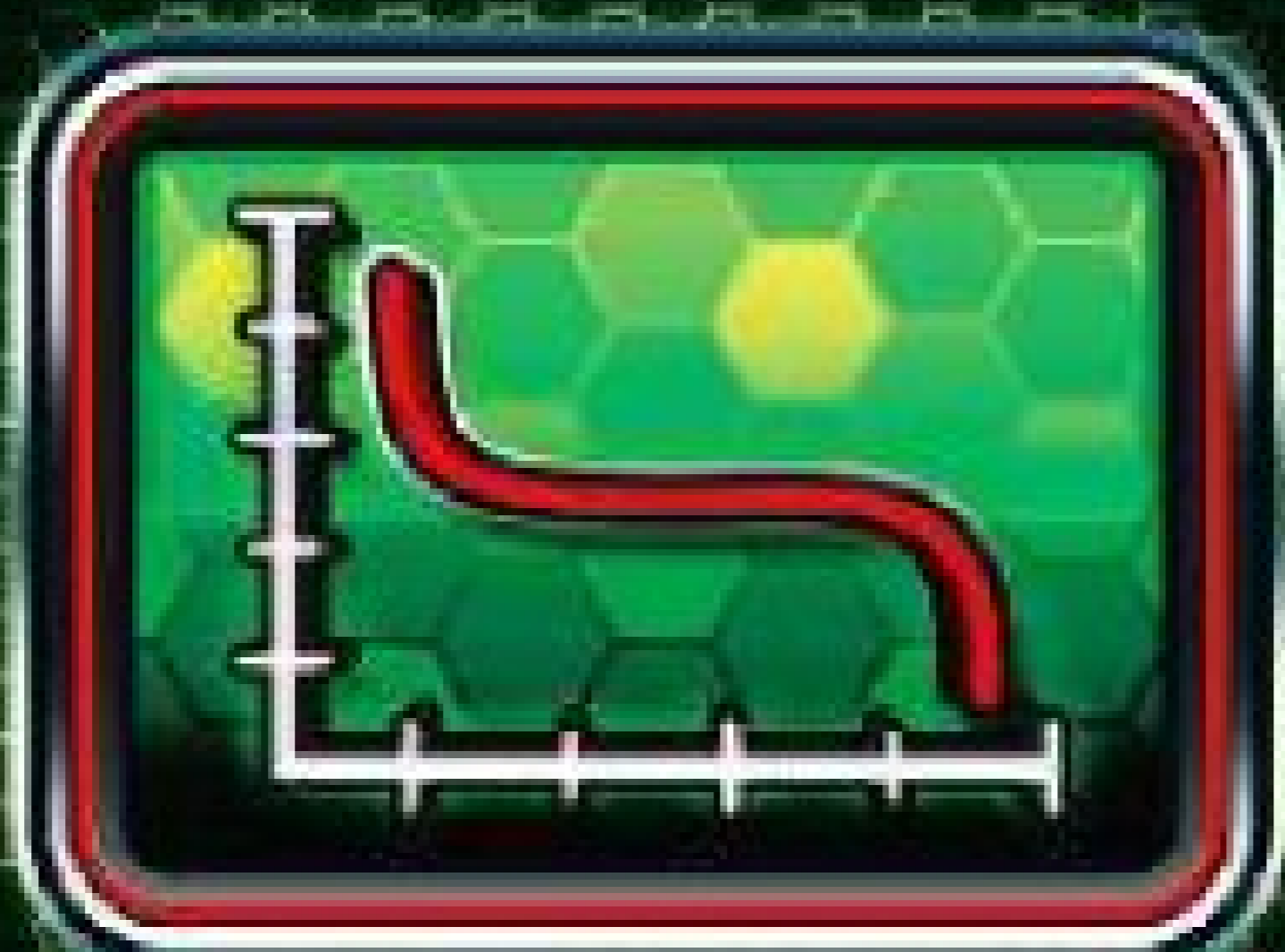
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**CELL MATCHED**



**FAST CHARGE RATE**

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- ② These additives create a superstrong ability for imbibition in the carrier liquid to supply more ion channels. This improves the ability of ion transmission and ion diffusion. Through improving electronic conductivity and ion transmission, the impedance is reduced and the polarization of high rate discharge decreases greatly.

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- Power density reaches 7.5 kw/kg.
- Less Voltage sag during high rate discharge, giving more power under load.
- Internal impedance can reach as low as 1.2mΩ compared to that of 3mΩ of a standard Lipoly.
- Greater thermal control, pack usually doesn't exceed 60degC.
- Thickness swelling during heavy load doesn't exceed 5%, compared to 15% of a normal Lipoly during heavy load.
- Higher capacity during heavy discharge. More than 90% at 100% C-rate.
- Fast charge capable, up to 15C on some batteries.
- Longer Cycle Life, almost double that of standard lipoly technology.

★ OF THE SAME WEIGHT



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# Elevated RC LASER PITCH GAUGE

Ultimate in Precision

WORDS: Ryan Kephart

**S**O YOU'RE SITTING THERE, PONDERING HOW TO ADJUST THE PITCH ON YOUR NEW FLYBARLESS HELICOPTER. "If there isn't a flybar, how am I supposed to reference pitch?" Elevated RC has the answer in the form of a tool that works with laser accuracy. The new Laser Pitch Gauge can accurately measure your flybarless rotorhead pitch angle and even level your swashplate.



## FEATURES

The Laser Pitch Gauge offers a new high-tech way to precisely measure the pitch of your blades and level the swashplate on a flybarless helicopter. Although this product is designed for a flybarless helicopter, it can easily be used with a flybarred helicopter with the use of a flybar lock. The gauge is constructed of two main parts: a standard laser pointer and a machined aluminum base. Adapters are included to fit a variety of blade grips. The laser pointer is installed on the base and activated by a thumbscrew.

## TESTING

The Laser Pitch Gauge installs on your blade grips using aluminum adapters that can fit 10mm, 12mm, and 14mm grips. To install the Laser Pitch gauge you first select the correct adapter and install it inside the blade grip using the original blade bolt to secure it. The laser clamp is then installed over the adapter using a single setscrew. Next, you slide the laser into the clamp and activate the diode by turning the thumbscrew. The thumbscrew also secures the laser to the main body of the Laser Pitch Gauge.

This pitch gauge requires a solid surface towards the center of a room with a clear view of a wall. The model can be placed on a sturdy table toward the edge to prevent the laser from hitting the table when checking the negative pitch range.

The Laser Pitch gauge uses reference points that are established by the laser. To establish the reference points a level the swashplate the model must be placed 60 inches away or greater from a wall. Leveling the swashplate was somewhat easy, but seemed to take longer than with a conventional pitch gauge. We also tested how easily and accurately the Laser Pitch Gauge could perform pitch adjustments. This process was a tedious, but by following the directions closely the Laser Pitch Gauge gave an extremely accurate reading.

## CONCLUSION

If you're obsessed with perfection, the Laser Pitch Gauge from Elevated RC will be perfect for you. The Laser Pitch Gauge is probably overkill for a flybarred model, as it takes longer than with a conventional pitch gauge, but for a flybarless model the Laser Pitch Gauge is a great option and is much more accurate than what your eyes can judge. **TRM**



### THE GOOD

- Accurate
- Unique
- A viable option for pitch adjustment on a flybarless helicopter

### THE BAD

- Tedious process
- Laser mount and activator uses same thumbscrew

### CONNECT

<b>MANUFACTURER:</b>	Elevated RC
<b>WEBSITE:</b>	www.ronlund.com
<b>PART NUMBER:</b>	LaserPitchGauge
<b>STREET PRICE:</b>	\$35



# Mavrikk, Really? Yeah Really!

# AGAIN!

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MAVRIKK G5 PRO

MAVRIKK G5 PRO

## Maximum Performance, Maximum Value



## REGULAR GUY


## REGULAR GUY INTERVIEW

with

**STEVE  
BAHR**

**W**ELCOME TO THIS MONTH'S "REGULAR GUY" INTERVIEW. EACH MONTH WE INTERVIEW A RELATIVELY UNKNOWN PILOT THAT IS ONE OF THE "GOOD GUYS" AT THEIR LOCAL FIELD. We hope to shed some light on what we consider the lifeblood of this hobby: those pilots who day-in and day-out train and help new pilots succeed, and who do so with no fanfare or payment. We're always looking for more of the unsung heroes in the hobby. If you know of such a person we could interview in your area, please email Jim Innes at [rchelijim@gmail.com](mailto:rchelijim@gmail.com).

**PILOT INTRO**

 Our pilot this time around is Steve Bahr. His long-time flying buddy, Anthony Avallone, told me about Steve's dedication to the hobby. Anthony specifically talked about how Steve took him and his teenage son under his wing five years ago and has been a mentor to them ever since. Steve has also spent much of his own time to teach seminars and setup classes at their local hobby shop. Let's find out more about Steve!

**RCH: SO, TELL US A LITTLE BIT ABOUT YOURSELF. WHAT DO YOU DO? WHERE DO YOU LIVE?**

**STEVE:** I was born and raised in Bemidji, MN. I joined the Marines right after graduating from high school and spent seven years in the Corps. After discharge, I remained in southern California and worked for Northrop Grumman on the B2 program until 1993.

After that, I relocated to Grand Rapids, Michigan with my beautiful wife of 22 years and two children. Currently I work in the plastics industry. We supply parts and components for many different vehicles around the world. I am also the President of West Michigan RC, a flying club here in Grand Rapids.

**RCH: HOW DID YOU GET STARTED IN RC HELIS?**

**STEVE:** I was getting tired of RC cars and an opportunity came up to trade a car for a Concept 30. I had never seen an RC helicopter before. It took me a few weeks just to figure out how things were supposed to go together, and another 2 weeks to get it adjusted correctly before I could finally hover.

**RCH: WHAT ARE SOME OF THE MANEUVERS YOU ARE CURRENTLY WORKING ON? WHAT ARE YOUR FAVORITES?**

**STEVE:** Lately I have been working on piro funnels and piro snakes. As for favorites, I would have to say funnels and Tic-tocks are the ones I like to do most.



**RCH: WHAT ARE YOUR TOP TIDBITS OF ADVICE FOR NEW PILOTS?**

**STEVE:** Research flying clubs in your area and find someone who can help answer your questions before you buy your first helicopter.

Be patient. Master the basics first before moving on to more advanced maneuvers. Burn fuel or electrons. Simulators are great but they are not the real thing.

Pass on what you have learned to future pilots. Have fun!

**RCH: WHY DO YOU FLY HELIS NOW AND WHAT ARE YOUR FUTURE PLANS?**

**STEVE:** I love the "risk versus reward" feeling of flying helicopters. Learning a new maneuver carries a lot of risk, but accomplishing it is a great reward!

I also strive to continue helping the helicopter community grow in any way I

can. It makes me feel good when I see a pilot who I mentored pay it forward by helping another future pilot. That's what it is all about.

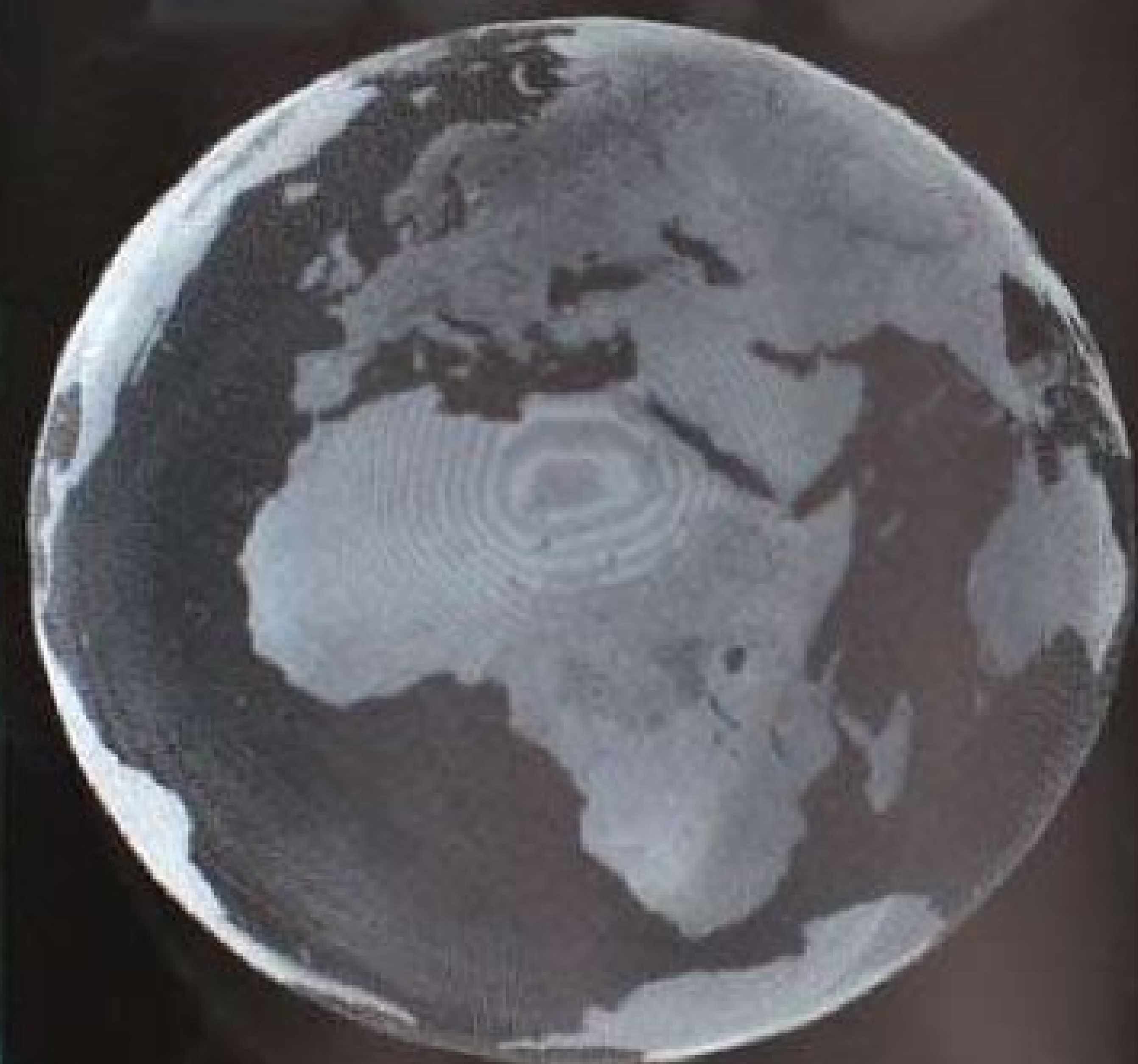
**RCH: THANKS SO MUCH FOR TALKING WITH US STEVE, ALSO A BIG THANKS FOR YOUR YEARS OF SERVICE TO YOUR COUNTRY AND FOR TAKING ON LEADERSHIP ROLES IN YOUR LOCAL CLUB.**

**CONCLUSION**

Steve Bahr represents a lot of what is good in this hobby. His going the extra mile by holding setup classes at the shop and aiding in the repair of a recently broken helicopter speaks volumes about his dedication to the hobby. He also takes an active role in his local club, which has helped make it more heli friendly. Like all our "normal guys", Steve is willing to give up his own flying time to get someone else up in the air. Thanks Steve for being one of the good guys in our hobby! **TBI**



3D MASTERS  
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1


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# FLYBAR PADDLES

Get your paddle on

WORDS: Daniel Colby

I'VE HEARD THE QUESTION, "WHAT DO FLYBAR PADDLES DO ANYWAYS?" Shoot, when I first started out in the hobby I wondered the same thing. This month we'll explain to you what exactly a fly bar paddle does.

## BELL HILLER HISTORY

WHEN DESIGNERS FIRST STARTED MAKING MODEL HELICOPTERS, THEY HAD TWO TYPES OF ROTOR HEAD CONTROL SYSTEMS TO INTEGRATE FROM THE FULL SIZE COUNTERPARTS. The "Bell" system used either weights or hydraulics on the head to create a form of damping. The controls directly controlled the main rotor blades with the weights/hydraulics making the responses sensible. The "Hiller" system used mixing levers and paddles much like our models to create the damping effect. The controls connected directly to the paddles/flybar and in turn controlled the main rotor blades. The designers realized that using a full Bell system on such a small scale wouldn't work, but wanted the fast response the Bell system offered and the stability of the Hiller system, and soon ended up with the system we have today which is a mix of Bell and Hiller.

Now that you have some history lessons let's move on. As mentioned above, when cyclic inputs are put in, that affects the paddles and the paddles affect the main blade disk. Therefore, paddles play a huge roll in how our helicopters fly.



Not your moms whipping paddle!

## » PADDLE FACTORS

There are three major factors of paddles that will affect the way your helicopter performs. I would have to say that weight is the biggest factor of a paddle in how your helicopter performs—if you want a more docile response then use a heavier paddle; if you like to toss your helicopter around or just want a fast response rate then use a light weight paddle **(1)**.

Next is size (and yes, it does matter). The length of the paddle contributes to control feel. In general terms, a longer paddle will have more control force than a small paddle due to its larger surface area **(2)**. Another important consideration when shopping for different paddles is the shape. If you look at the paddle edge, you will notice that it has an airfoil shape very similar to an airplanes wing or the rotor blade. There are two things to consider

when it comes to the shape of paddles: the roundness and the thickness. A more rounded edge tends to give a paddle a very soft response to small inputs around center stick, compared to a paddle with a very sharp edge which will give the helicopter a much more aggressive feel. A paddle with a thicker airfoil tends to create a softer overall feel compared to a thinner paddle **(3)**.



Some paddles have removable weights inside.



## CONCLUSION

When considering buying aftermarket paddles, put into consideration all the variables of different paddles and how they will affect the flight characteristics of your helicopter. If you're a beginner I would suggest using a heavier, long length paddle with a large airfoil. If your looking to move into the 3D side of the helicopter spectrum I would suggest using something lighter, shorter in length and with a thin airfoil. I hope this article shed some light on how to properly choose the paddle for your flying style. **RPL**

# 2011

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### Align Trex 700E

The BIGGEST and BADDEST e-heli from Align. Strap a couple 6-cell LiPos to this baby and LOOK OUT! You'll be doing 3D maneuvers you never thought possible. Available in either a Flybar Combo or 3G Flybarless Combo.

T-Rex 700E 3G Super Combo... **\$1,268<sup>99</sup>**  
T-Rex 700E Flybar Combo..... **\$1,220<sup>99</sup>**



### Align Trex 550E

The latest and greatest offering from Align, the new T-Rex 550E. All the power of a 600 size heli, but in a smaller package. Like the 700E, The 550E is available in either a Flybar Combo or 3G Flybarless Combo

T-Rex 550E 3G Flybarless Combo.. **\$848<sup>99</sup>**  
T-Rex 700E Flybar Combo..... **\$698<sup>99</sup>**



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### Blade mSR

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### Blade mCX2

The next generation of ultra micro coaxial helicopters! The new Blade mCX2 adds a user-selectable swash sensitivity and flashing LED, wrapped in a sleek, full fuselage. Available Ready-To-Fly with 2.4GHz radio, or Bind-N-Fly, ready to bind to your own 2.4GHz radio.

Ready to Fly **\$119<sup>99</sup>**  
Bind-N-Fly **\$89<sup>99</sup>**



### Blade 120 SR

The sub-micro Blade 120 SR is the perfect next set up from a coaxial to a fixed pitched heli. Small enough to fly indoors, but since it's larger than most micro heli's, it's big enough to fly in your backyard. Available Ready-To-Fly with 2.4GHz radio, or Bind-N-Fly, ready to bind to your own 2.4GHz radio.

Ready to Fly **\$179<sup>99</sup>**  
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### Video Tx/Rx Combos

We've tested this very system on both the EasyStar and TwinStar airplanes. Great FPV system! Check your local regulations for power output. You may need a Ham license to operate.

900 MHZ Video Transmitter/ Receiver combo **\$89<sup>99</sup>** w/CCD Camera.....



### Multiplex EasyStar & TwinStar II

Multiplex EasyStar and TwinStar II RR (receiver ready) are easy to fly and provide stable platforms for mounting video equipment. Even Larry can fly these planes, just keep your car away from the landing strip! Both are receiver ready requiring transmitter, radio and battery.

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# ON THE PLANET



The HeliProz Crew (left to right): Kayla, Larry, Mandi, Kurt & Poncho, Rick, and JR



## Thunder Tiger Titan X50

This may look like a Raptor, but it's a whole new beast. Completely redesigned to deliver the ULTIMATE 3D experience, yet smooth and stable to build confidence with beginning pilots. New features include 1-piece carbon main frames with slim profile design, underslung rotor head, and ±15° collective & ±25° cyclic travel.

Titan X50 Kit w/Blades..... **\$439<sup>99</sup>**

Titan X50 Kit w/Blades, Motor, Muffler **\$659<sup>99</sup>**



## Raptor 50 & 30 2.4GHz Super Combos

Thunder Tiger has put together the perfect combos for fliers who are just starting out. These are all inclusive combos built around the solid and reliable Raptor 50 & 30. Raptor 50 & 30 Super Combos includes a 2.4 GHz radio system, engine, muffler, heading lock gyro, digital servos, and blades. To top it all off, the Super Combos come 95% assembled!

Raptor 50 Super Combo..... **\$949<sup>99</sup>**

Raptor 30 Super Combo..... **\$689<sup>99</sup>**



## Thunder Tiger Mini Titan V2

Performance has gone ballistic with the latest Mini Titan E325 V2. Tons of very impressive features have been injected to create the ultimate 3D machine in its category: lightweight Carbon/ Aluminum main frame, full metal rotor head, lightweight 3D paddles, carbon fin, reinforced main shaft and a totally-redesigned fiberglass canopy.

### HAD A CRASH?

*Mother Puss Bucket!*

At some point we all must face the inevitable. Don't worry, we have full parts support for every heli that we sell.

We'll get your heli back in the air!

**FLY HARD! HeliProz has the parts!**



## Model Avionics Link Maker 9000

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## Futaba GY701 Gyro/Governor

Gyro/Governor... **\$269<sup>99</sup>**

Gyro Only..... **\$219<sup>99</sup>**

Governor Only.... **\$149<sup>99</sup>**



## XPS Platinum Plus LiPo Batteries

XPS Platinum Plus batteries are the next generation of LiPo technology. Incredible 65C/90C continuous/burst ratings. Max 8C charge rate! We've tested these batteries and they outperformed every other LiPo battery, and you can't beat the price!

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## Hirobo SRB Quark SG RTF

**\$748<sup>99</sup>**

You'll really *FLIP* for this one. Second Generation SRB Quark from Hirobo features a new Bell/Hiller collective pitch rotor head, direct drive tail motor, larger and thicker main blades, control unit with idle up mode, high performance gyro and sensors, and 3-cell lipo battery. Comes ready-to-fly with transmitter, battery and charger. Matt flew his upside down for at least a few seconds.

## Spektrum DX8 2.4 GHz Transmitter



The world most advanced 8-channel radio system. Don't let the fact that it looks similar to the DX6 fool you. As soon as you pick one up you'll know that this radio is something completely different. The all new Spektrum AirWare Software makes this radio easy to use and also easy to update.



## Phoenix RC Flight Simulator/ E-Flite Blade mSR BNF Combo

This combo just seemed like a no-brainer! The VERY best way to get started flying RC helicopters. Phoenix Sim already includes a Spektrum DX5, so we combined it with the Blade mSR Bind-N-Fly micro helicopter. One transmitter for both heli AND sim.



## Imax B6 Duo Charger

With the new lipos that are capable to charge rates at 5C, you need a charger that can keep up with them. No more waiting up to an hour to charge a battery. This charger can charge up to two 6S lipos at a time at 200W each.



## Miniature Aircraft USA X-Cell Fury 55

The BEST flying 50 size heli on the PLANET. PERIOD. When you get sick of replacing cheaply made parts, step up to Miniature Aircraft.

Flybar or Flybarless Versions Available



## Miniature Aircraft USA X-Cell Fury 55

The BEST flying 50 size heli on the PLANET. PERIOD. When you get sick of replacing cheaply made parts, step up to Miniature Aircraft.

Flybar or Flybarless Versions Available



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# Wireless VIDEO LINK

Like a remote eye in the sky

**WORDS:** Aaron Shell

**F**LYING YOUR MODEL HELI WITH AN ONBOARD WIRELESS VIDEO LINK CAN OPEN UP A WHOLE NEW PERSPECTIVE FOR YOU. Whether you just want to be able to frame pictures of your back yard or fly your heli as if you were taking a ride, the heart of any wireless video system is the actual video link itself. A camera on the model picks up the image and a monitor or video goggles display it, but the ability to see the video in real time on the ground without any wires depends on a video transmitter and matching receiver.

## » ANALOG WIRELESS VIDEO

**W**hile we haven't quite crossed the bridge to having a digital video link which works without noticeable lag, analog video systems are simple and proven for wireless video on model aircraft. The links themselves will work with either common analog video format (NTSC or PAL), but your camera, monitor(s) and recording device need to all operate on the same format. Almost all of these products offer an SMA connector for the antenna, but a few units may have RP-SMA (reverse polarity SMA), Type F connectors, or just have a hard wired antenna.

**NOTE:** Antennas with high gain offer longer range but have a narrow "viewing angle." Low gain antennas get as close as possible to omni directional coverage, but don't offer as much range.



FPV is a great way to fly with the birds!



## VIDEO TRANSMITTER

**A**nalog video transmitters accept a composite video signal (a combination of three channel signals which make up the video signal) generated by the video camera, and transmit the video signal along with audio. Most of these devices operate at either five or 12 volts, and power output can range from 10 mw to over one watt. Some video transmitters simply have a four-pin connector for video, audio, power and ground, and it's up to you to make a wiring harness. Others are more purpose built to include a filtered power supply and onboard microphones. Some of these systems offer plug and play simplicity; a power connector for your battery, and another connector, which carries both power and Audio/Video signals for the camera., such as the transmitters from Immersion RC. Antennas for the transmitter should be 2-3 dBi to be omni directional; a dipole or inverted V is generally considered to be the best option. Most of these transmitters will require an Amateur Radio (HAM) license to operate, but you don't have to learn Morse Code anymore, and the lessons you learn help you understand what frequencies you can use and some of the basics of RF (radio frequencies).

### What is Diversity?

It's important to respect people who are different... Oops, sorry, wrong diversity. "Diversity" in our video systems is a protocol, which can select between two or more video sources for the cleanest signal. Unfortunately, it's not as simple as connecting two antennas to one receiver; diversity systems employ separate receivers and antennas for each incoming signal. This allows the user to take advantage of a combination of antennas to provide a solid video signal the entire time by constantly hopping to the cleaner video source.

### A FEW BASIC RULES

- Don't use 2.4 GHz video transmitters on the same model with 2.4 GHz control. Regardless of your radio, if you put a transmitter on the same frequency right next to your control receiver you can swamp it and cause it to lose your control link.
- If you use 2.4 GHz for control, you must keep direct line of site during the ENTIRE flight. Even flying behind a group of trees or behind your body can block the signal enough for you to lose control.
- 5.8 GHz is a great option for video if you are using 2.4 GHz control because you are less likely to venture into an area where you will have good video but lose your control, plus you'll have up to eight channels available on 5.8 GHz system to play with your friends!
- If you use a lower frequency video transmitter (910 MHz or 1.28 GHz) than your 2.4 GHz control system, a low pass filter can help prevent harmonics from disturbing your control link.

These are all antennas for 1.28 GHz.  
From left to right; A dipole, a "whip," and a home-made Inverted V



### VIDEO RECEIVER

**O**n the ground, the video receiver picks up the signal and converts it back into a composite video signal and audio channel(s) for your monitor and speakers. These units commonly operate on 12 volts and sometimes offer dual Audio/Video outputs to simplify your ground setup. One new receiver on the market from Cercom Technology simplifies ground station wiring by integrating a patch antenna with the receiver, and uses Cat 5 cables to provide power to—and get the Audio/Video signals from—the receiver. Beam antennas such as patches or yagis with a gain of 6-10 dBi can be put to good use on the ground without having to worry about being too directional. Beam antennas rated at 12-18 dBi can be put to good use if combined with either a diversity system or an antenna tracker. Avoid using high gain omni directional antennas, as these have a "flattened doughnut" radiation pattern that would be fine for ground vehicles but are not good for flight.



Someone call the Geek Squad, we have a dirty power supply!

# NEED HELP?

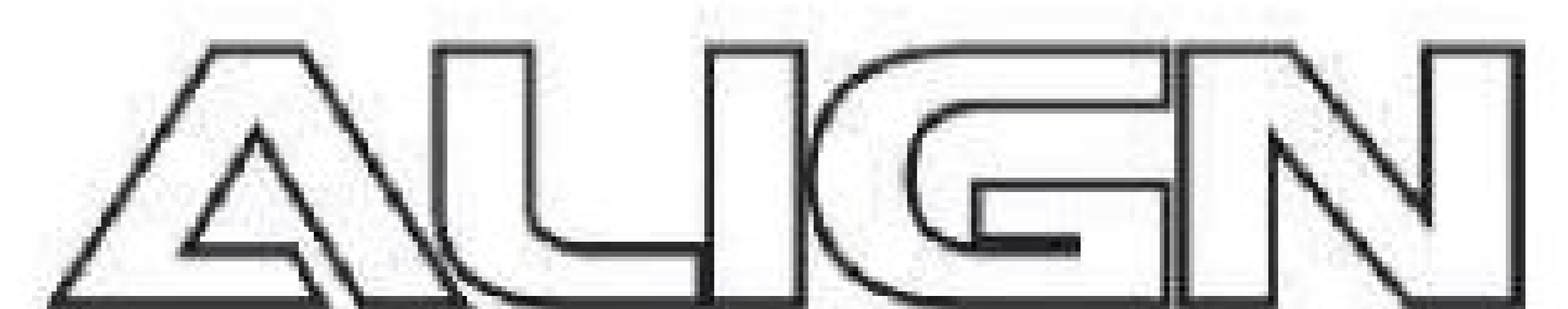
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Dave P. is a great cartoonist, can't you tell?



$$\left( \frac{3500 * 11.1}{150 / 13} \right) * 9 = A$$



# Calculate HEADSPEED

The need for Headspeed

WORDS: Daniel Colby

**I**F YOU'RE NEW TO THE ELECTRIC HELI WORLD THERE ARE SOME THINGS YOU NEED TO KNOW. A major one is to know your headspeed, whether your building a new heli and want to know the correct pinion to go with your power plant or you want to change your head speed to accommodate your flying style. Having the correct head speed for your style of flying is crucial. If you're wanting to move into aerobatics and your head speed isn't sufficient or too high it could end up costing you a trip to your local hobby shop.

## » SKILL LEVEL

SCALE RATING: 1=EASY 5=ADVANCED

**1.0** **RC-Heli**

## » TIME TO COMPLETE

**10** Minutes

## » TOOLS NEEDED

- Calculator
- Brain
- Tach

## THE FIVE FACTORS TO CALCULATE YOUR HEADSPEED

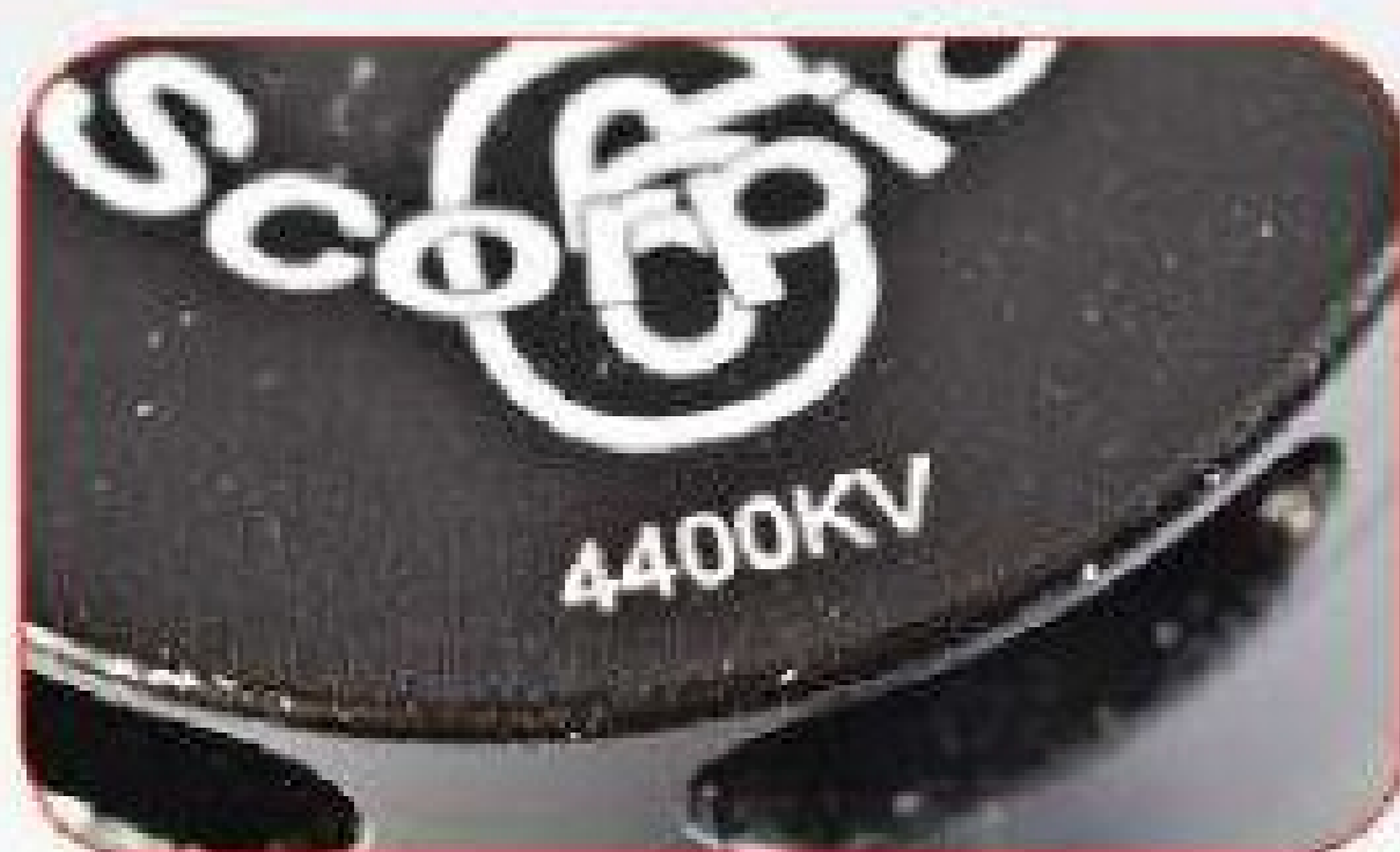
**B**elow I listed 5 things you need to calculate your head speed, or get a rough estimate of what it will be with different size gears.



• **THE NUMBER OF TEETH ON YOUR MOTOR PINION:** If you set up your RC helicopter yourself, you should know that figure by heart. If you bought the RC Helicopter RTF (ready to fly) or someone set it up for you, just count the teeth of your motor pinion.



• **THE NUMBER OF TEETH ON YOUR MAIN GEAR:** This is easy to find—just look in your manual. If you cannot find it there, then you're going to have to count them.



• **THE KV RATING OF YOUR MOTOR:** This is the RPM produced by a motor per volt applied. You should be able to get the motor KV rating from the motor specification sheet.



• **EFFICIENCY RATE:** This is the percentage of your RC helicopter's motor efficiency when you're flying with your setup. Even though you may be running 100% on your throttle curve, the efficiency rate will normally around 80% (.8) or 90% (.9); this is due to energy loss caused by friction and heat.

• **VOLTAGE:** This is the voltage of your battery. You may get this information from your battery specification sheet or label.

## HOW IT IS DONE

**N**ow that you have all your numbers, let's find your headspeed. Here is the formula for a estimated headspeed:

$$\left( \frac{\text{Motor kv} \times \text{Battery Voltage}}{\text{Main Gear / Teeth of Pinion}} \right) \times \text{Efficiency Rate.}$$

For example, I set up my 450 Pro with a 450M brushless motor (KV: 3500) with a 13 T pinion. I'm using a 3-cell LiPo battery that produces a nominal voltage of 11.1V. The main gear is 150 T and running a motor efficiency rate around 90% (.9) Now I want to know what my headspeed is.

$$\left( \frac{3500 \times 11.1}{150 / 13} \right) \times .9 = A$$

headspeed of approx. 3,040 RPM

*I broke down the formula here one step at a time for you to understand it.*

1. Main Gear/Teeth of Pinion = Main rotor gear ratio
2. Motor kv \* Battery Voltage = Maximum motor RPM
3. Motor RPM/ main rotor gear ratio = Headspeed Without Efficiency Loss
4. Headspeed Without Efficiency Loss
5. Efficiency (either .9 or .8) = Targeted Head Speed

I was checking the in line girder belt.....

## CONCLUSION

**B**eing able to calculate your headspeed is important. Using the formula above won't give you an exact headspeed, but it will be close enough to tell you, which pinion you, should use to get the headspeed you want. **REEL**





# Pitch & Throttle CURVES

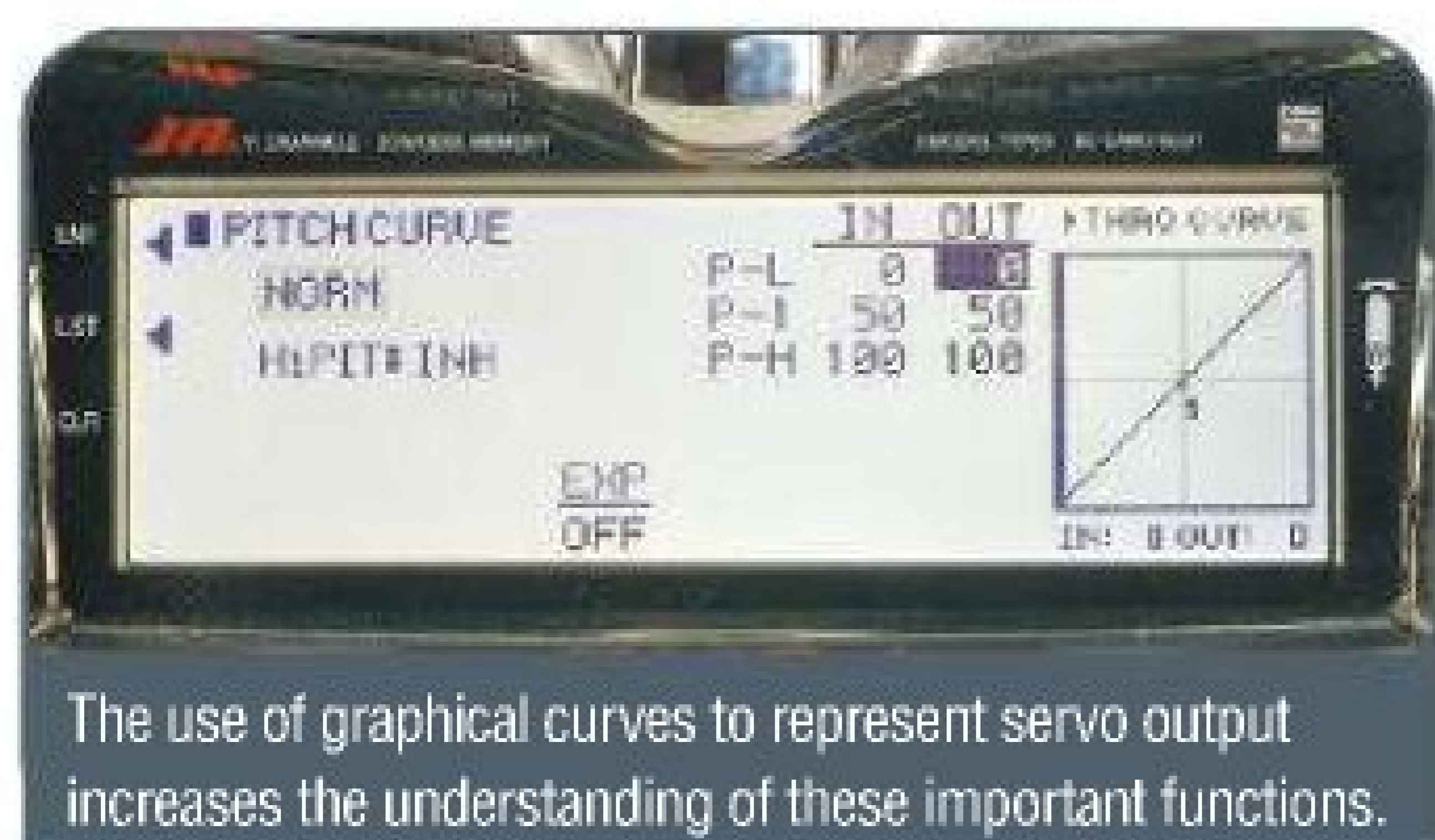
Ok, you've read it, now get it done!

WORDS: Jim Innes

**C**ONSISTENT AND PREDICTABLE HEADSPEED IS A CRUCIAL PART OF A PROPERLY SET UP HELICOPTER. The simple rotating disc at the top creates all of the lift and most of the directional control of the bird. In a modern helicopter, controlling the rotor speed is done through the use of throttle and pitch curves. Radio curves are quite simple to program and adjust as long as you have a goal in mind in regards to flight attributes.

## WHAT ARE RADIO CURVES?

Before we dive into setting up throttle and pitch curves, we should briefly discuss what they are. A radio curve can be simply defined as an editable graph or set of points that determine the output level of a function for any given input position. For example, a throttle curve with a percentage of 70% at the middle point in the graph would mean that when the throttle stick was centered in its travel, the throttle servo would move to 70% of its total travel.



The use of graphical curves to represent servo output increases the understanding of these important functions.



### » SKILL LEVEL

SCALE RATING: 1=EASY 5=ADVANCED

# 2.0



### » TIME TO COMPLETE



# 45

 Minutes

### » TOOLS NEEDED



■ Pitch gauge



■ Radio



■ Tachometer

Throttle and pitch curves are usually represented on the radio display by a simple graph, and most radios have five or more points that can be moved along the curve. A user can fine tune throttle and pitch settings using any one of these points.





Always keep in mind that the goal of throttle and pitch curves is to work together to maintain a desired headspeed.

## THROTTLE AND PITCH CURVES ARE ONE

The first thing to understand about throttle and pitch curves is that they really are two parts of the same system.

As mentioned above, these two curves have one simple goal: to achieve a desired headspeed at any given stick position. Editing one of these curves will have an effect on the other curve. In my opinion, if you can go into programming your radio curves with the idea of them being intertwined, it will help greatly throughout the process.

## NITRO VERSUS ELECTRIC

One of the largest differences between a nitro and electric helicopter during radio setup is found in the throttle curve arrangements. Because of this we will discuss the setup process for both model types separately.

## ELECTRIC MODELS

It's safe to say that electric models are now the majority in this hobby. Most hobbyists are now starting with 450 or 500-size models, where just a handful of years ago the 30 or 50-size nitro birds were the most popular beginner platforms. The first step to doing curves on an electric bird is to select the appropriate motor, cell count, ESC, and gear ratio to get the desired headspeed. You can use a headspeed calculator such as the one by "Mr. Mel" found on [www.readyheli.com](http://www.readyheli.com) for help. After this, setting the throttle and pitch curves is a very simple process.

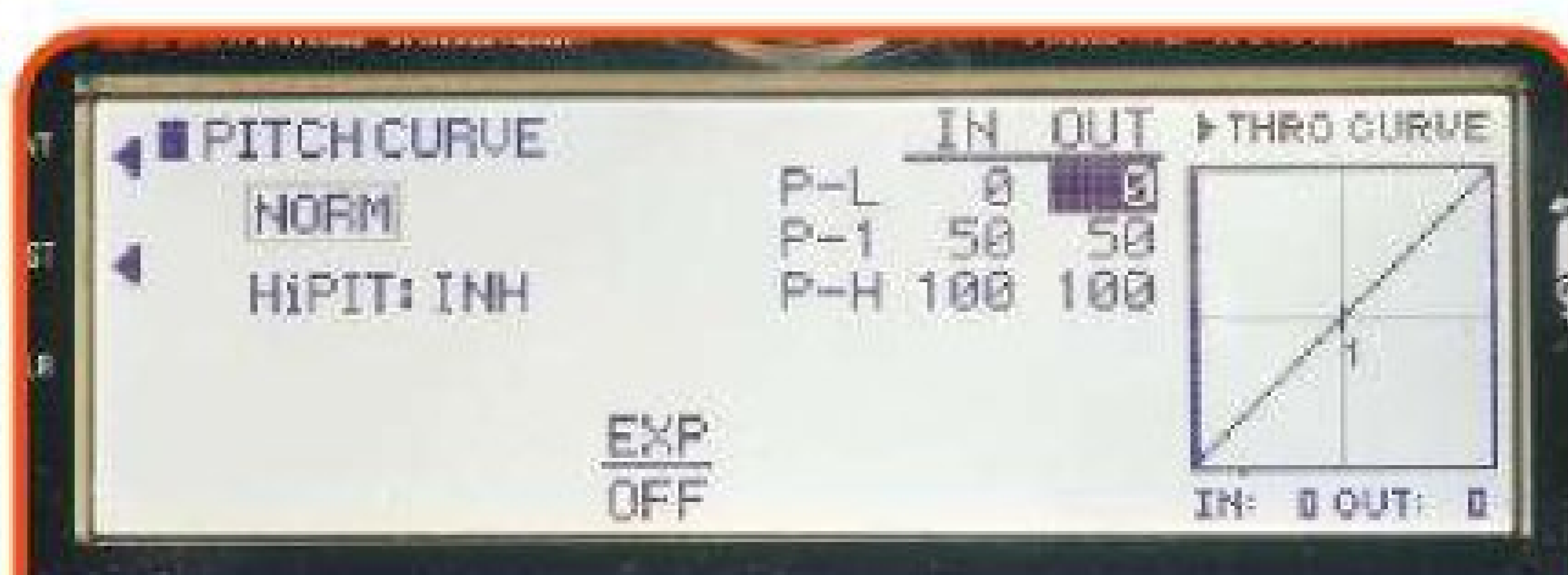


Once you have calculated what is needed to attain the desired headspeed and set the heli up accordingly, the rest of the process is quite simple.

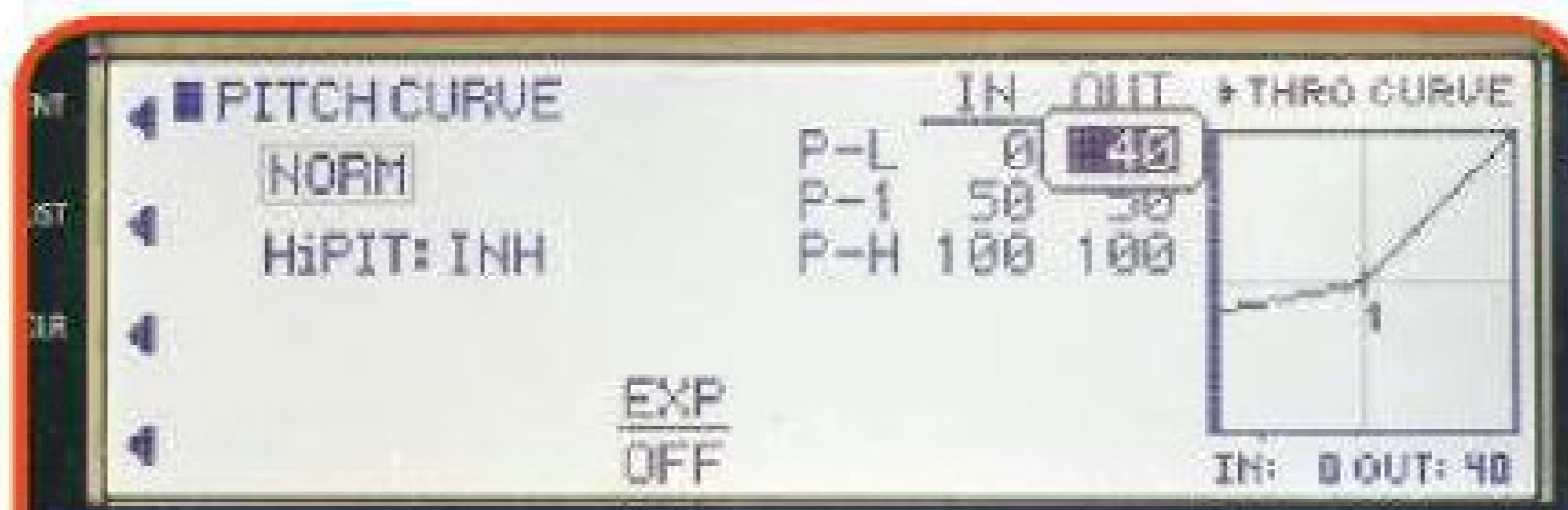
## Electric pitch curves

Pitch curves have become less and less talked about during recent years, as many have adopted using a linear pitch curve in all flight modes. A "linear" pitch curve is set by simply setting low stick to zero, mid-stick to 50%, and high stick to 100% on the graph and inhibiting the other points if applicable. This is assuming that the rotor head is mechanically set to have zero degrees at mid-stick and equal positive and negative pitch values for 3D maneuvers.

This method of pitch curve is quite prevalent, but there are many variations from this norm. I would recommend that a new pilot set their machine up so that it's mechanically the same as a 3D machine, but then modify the low point of their normal mode pitch curve to somewhere around 30% or 40%. What this will result in is a maximum negative pitch setting between -1 and -3 degrees without adjusting any of the positive pitch.



In the modern era, you will find that most sport and 3D pilots end up using a basic, linear pitch curve for all of their flight modes.



If you are just starting out, you can take the low point of your pitch curve in normal mode and just bump it up a bit until you get between -1 and -3 degrees of pitch. Curves allow you to make these changes in the radio with no need to modify linkages or make mechanical adjustments.

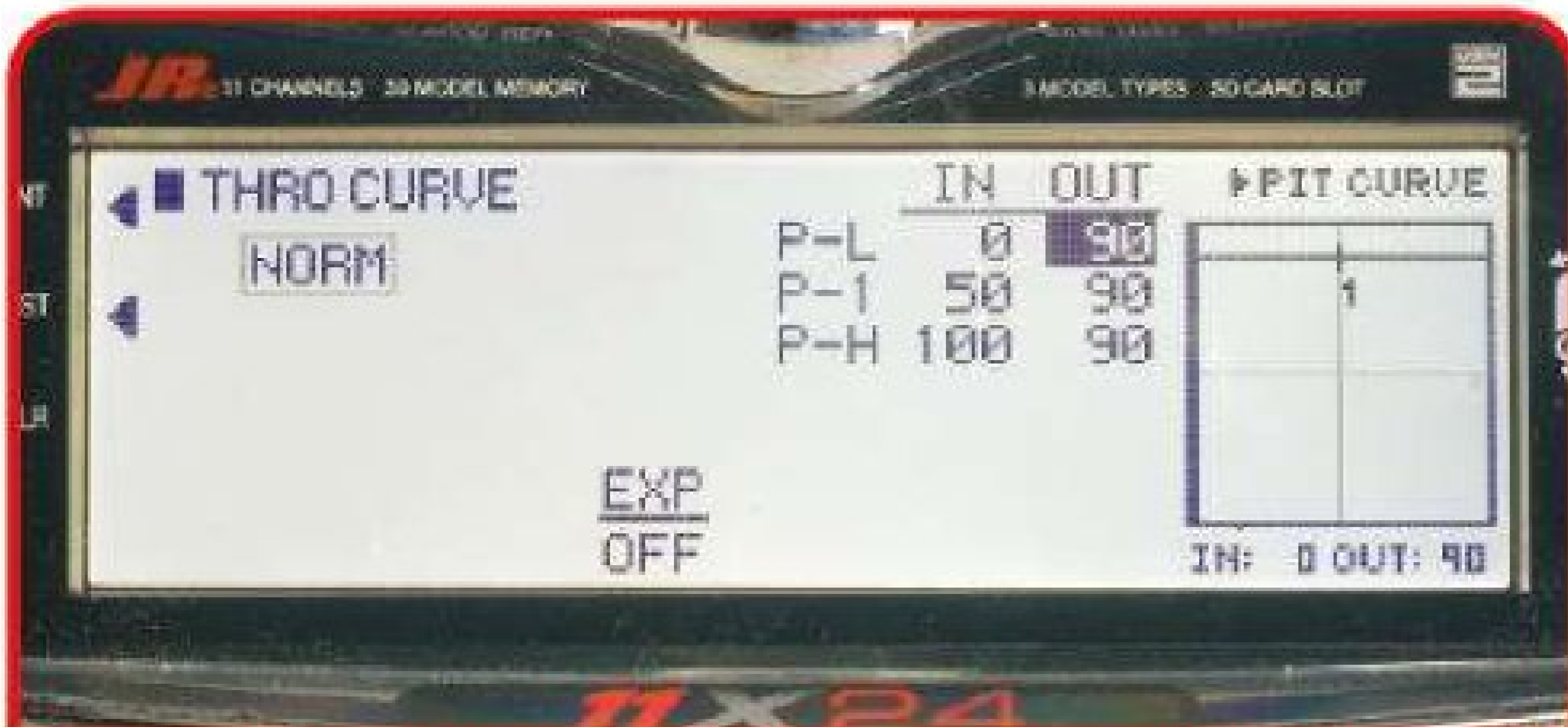
## GOALS

Too often, a modeler will go into the programming phase of a new build without deciding what they want from the model. Decisions on flying style, response, stability, headspeed, and other concerns should be made early on in the process so that adjustable areas on the bird can be tuned appropriately. Sit down early on and decide what kind of headspeed you will want from the helicopter in each flight mode. This will help when you start to program the radio curves.

Performance is only as good as the programming will allow.

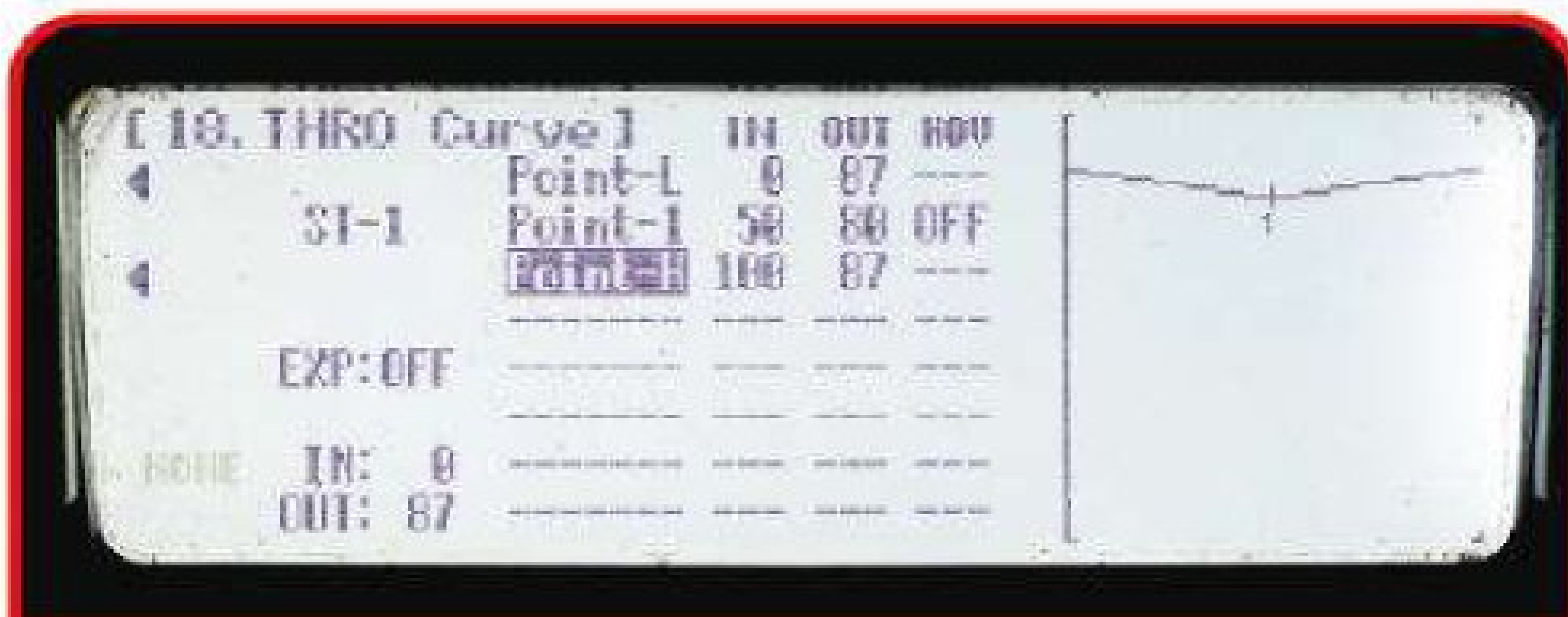
## ELECTRIC THROTTLE CURVES

Electric motors do have an advantage over their IC (internal combustion) counterparts in that they generally run at full torque and across their RPM range. This means that the throttle side of the radio curves can be very simple to program for an electric model. Many modern ESC's utilize an internal governor function that maintains rotor speed at all pitch settings. When you are using the ESC



For many electric birds, a simple straight-line throttle curve is all that is needed.

governor you will generally use a throttle curve that is the same value all the way across (except in Normal mode, where the low point will be set to zero). For example, on my Logo 500 with a Kontronics Jazz ESC, I set my throttle curve between 85% to 90% at all points. This results in the 2000 rpm that I want at the rotor disc using the ESC's governor function, and leaves 10%-15% headroom in the throttle in case the ESC needs it during extreme maneuvers.



Some ESC's perform better using a slight V-curve as pictured here. The drop in the middle is to simply lower the RPM a little bit when the pitch is nearing zero, maintaining headspeed as the load decreases.

A slight V-curve setup in the Idle-up throttle curves is often used when the installed ESC does not offer a governor mode. What the V-curve offers is a slightly lower throttle output as you near zero degrees pitch to avoid overspeeding the head as its load is reduced. On many electric machines, a simple 95% low, 80% middle, and 95% high will work great when combined with the linear pitch curve. The normal mode throttle curve can start at 0% at low and ramp up to whatever percentage is needed to hover and fly around at the desired headspeed. We will discuss figuring that out later on.

Obviously, those using more complex pitch curves may choose to tweak these settings a bit, but the nice thing about electric models is that the motors run very consistently, even under load.

Here comes the pitch.

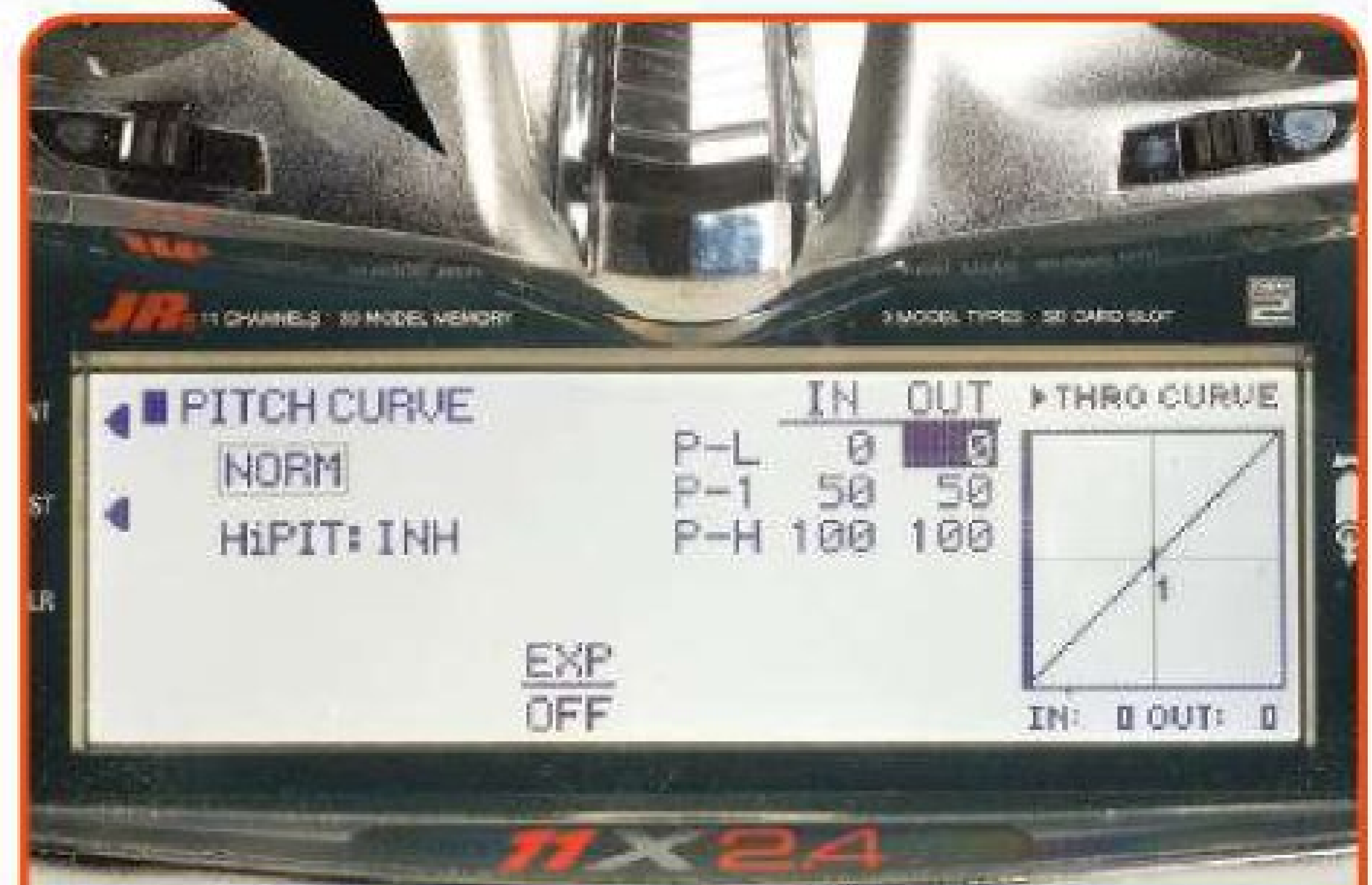
## NITRO MODELS

There is something gratifying about the sound, smell, and smoke trail from a nitro bird. Fuel powered engines offer a completely different set of advantages and needs when compared to their electric counterparts. Radio curves are a lifesaver for a nitro engine and they can play a big part in how well the engine can transfer its power.



### Nitro pitch curves

Like electric models, nitro models also are generally set up using a linear pitch curve. In fact, all the same pitch curve rules and conditions that we discussed earlier also apply to nitro machines.



Linear pitch curves are as common in nitro birds as they are in electric models. This type of setup allows full pitch range at the heli.

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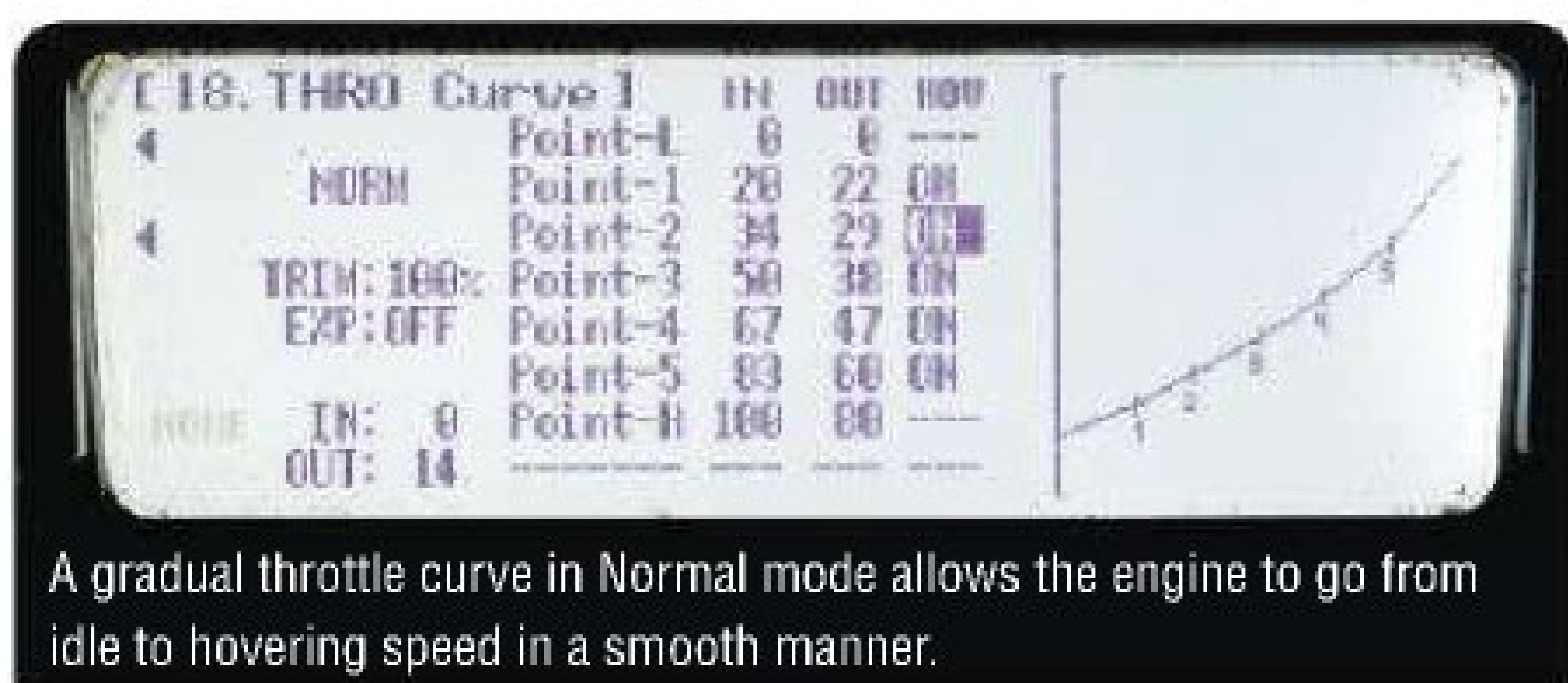


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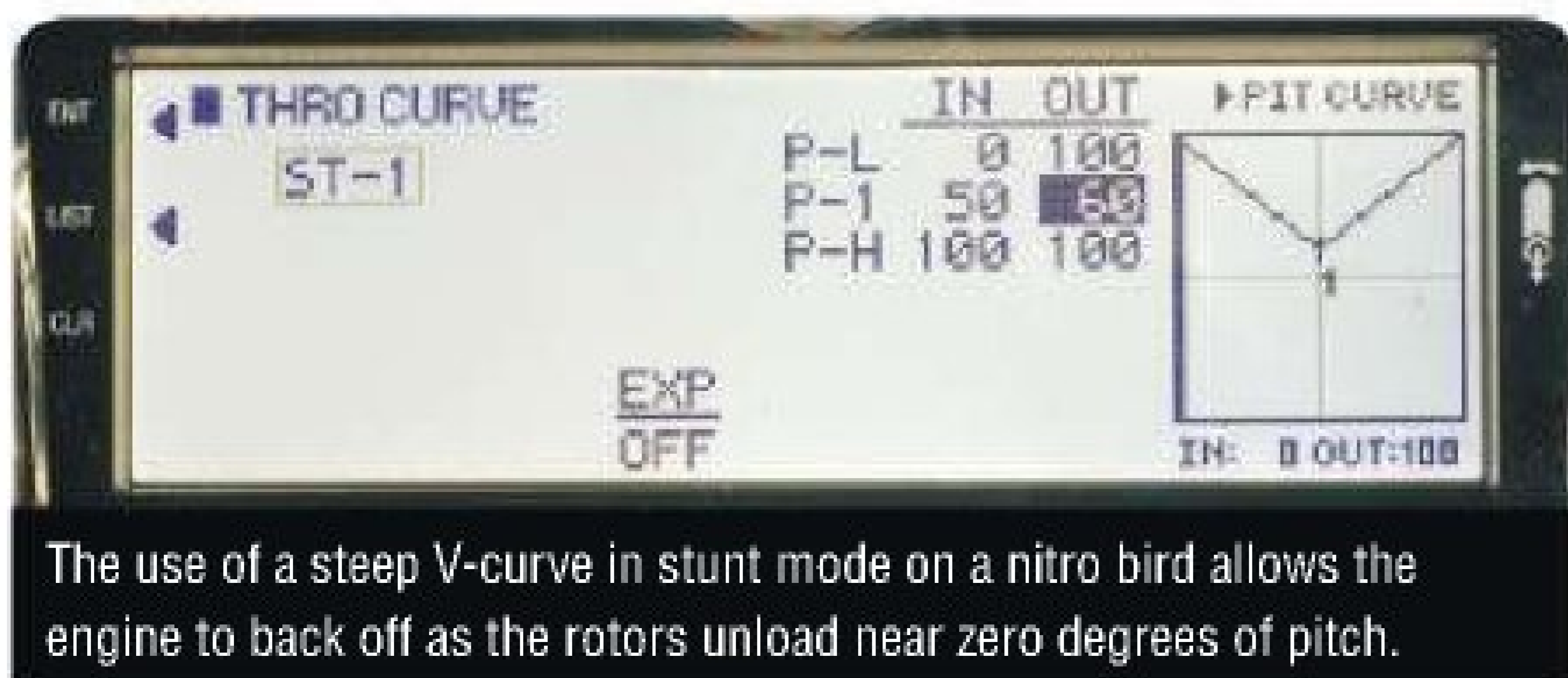
# NITRO THROTTLE CURVES

Nitro birds utilize throttle curves more intensively than their electric counterparts. Unlike an electric motor, IC engines have a ramped powerband. At low RPM, the engines are far from their peak power and torque. A nitro engine needs to be running in its powerband RPM range in order to deliver peak power. You can help your engine

run in this range using throttle curves.



A gradual throttle curve in Normal mode allows the engine to go from idle to hovering speed in a smooth manner.



The use of a steep V-curve in stunt mode on a nitro bird allows the engine to back off as the rotors unload near zero degrees of pitch.

A nitro bird needs to be steeper than those in an electric because the engine could over-rev drastically when unloaded at zero pitch. A good place to start would be with 100% at bottom, 60% in the middle, and 100% at the top.



The use of governors and rev-limiters has changed the way many view the process of setting up throttle curves. My advice would be to set your throttle curves up as if there were no governor, then enable the governor. The curves will always be there as a backup.

For a Normal mode curve I usually set the low point to zero and the high point to 80% or so. This allows a lower headspeed for hovering and takeoff. The points in between are set at a gradual curve, a gentle slope up to the 80% mark. For the Idle-up modes, a simple V-curve works well. The V-curve in a

Of course, governors are in high use with nitro birds as well. A governor will try to adjust the throttle to maintain the headspeed. Some governors or limiters call for straight line throttle curves, but it's a good idea to still set your throttle curves properly so that if you have a governor fail in flight, the curves will still allow you to fly.

## FINE TUNING

The last part of throttle curve setup happens at the field while using a tachometer. You will need another person for this step unless your ears are really tuned to correlating the noise of your model with the RPM range it's running. Simply put the model into a hover and have the person check the RPM of the main rotor using the tach. If the head is spinning too quickly or slowly, lower or raise the throttle curve points a little to get to the proper speed. The same should be done in stunt modes as well. Go through some maneuvers and be sure to go to zero pitch at times to listen for overspeeding. If you notice overspeeding when near mid-stick, lower the middle point of the throttle curve and try again. It's at this stage that you can enable other points in the curve to fine-tune the points between the middle and end points if needed.

The only sure way to know if your throttle and pitch curves are doing their part in maintaining the desired headspeed is to fly the heli and check. The use of a tachometer makes this an easy job.



## CONCLUSION

The process of setting pitch and throttle curves can be quite simple, but is crucial to predictable headspeeds. Look at your throttle and pitch curves as two parts of one cohesive unit. Adjustments to one will affect the other. Throttle and pitch curves are a fantastic part of the modern radio that allow pilots to fine tune both these important functions to their liking. The result of a few minutes on the bench and taching the model at the field will result in a nice and consistent heli. See you at the field! **TRH**

... and it's outta here!

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# GOVERNOR USE

Eh Govna?

WORDS: Aaron Shell

**“T**O GOVERN OR NOT TO GOVERN?”, THAT IS THE QUESTION. If you are new to RC helis you may not be familiar with governors, but do you even need one? For many fliers the answer to that question is a resounding “Yes!”, and thankfully the market has responded in recent years with a wide variety of governors providing great performance. The reality is, if you don’t have a governor and your heli flies well, you don’t “need” a governor. But depending on your demands and your skill level, a governor will help unleash your heli’s full potential.

## WHAT DOES A GOVERNOR DO?

**G**OVERNORS ARE AN ELECTRONIC ACCESSORY, WHICH MEASURES YOUR HELI'S HEADSPEED AND ADJUSTS THE THROTTLE TO KEEP THE RPM CONSTANT. Governors are often integrated into the speed control for electric helis, and the speed control is able to use the switching circuitry, which makes the motor operate to measure the motor speed. For nitro and gasoline helis, governors may be a separate unit or a function of an integrated system. For instance, there are a few governors on the market integrated with a gyro, and others that offer flybarless stability control, a tail gyro, and accept satellite receivers! Measuring the RPM for a fuel powered heli is usually done on the cooling fan with a magnet and a hall effect sensor, but there are some setups on the market which use the hall effect sensor right on the backplate of the engine to pick up the crankshaft, and at least one which offers an optical sensor.



## » WHEN YOU SHOULD STEP UP TO A GOVERNOR

If your flying has progressed to the point that you can notice the headspeed changing during your maneuvers, it's probably time to step up to a governor. It's almost impossible with throttle curves alone to achieve the consistent headspeed, which is paramount to getting great performance, even if you are really aggressive and quick on the sticks. If you prefer gentle flying or you are still in the hovering and forward flight stages, a governor may complicate your setup unnecessarily. If you have an advanced flier who knows governor setup and can help you, a governor can be employed at any skill level, but you really don't need it until you start noticing your engine sagging or over-speeding during maneuvering.



Did you know electrics can use a governor too?

## Governors AREN'T A CRUTCH

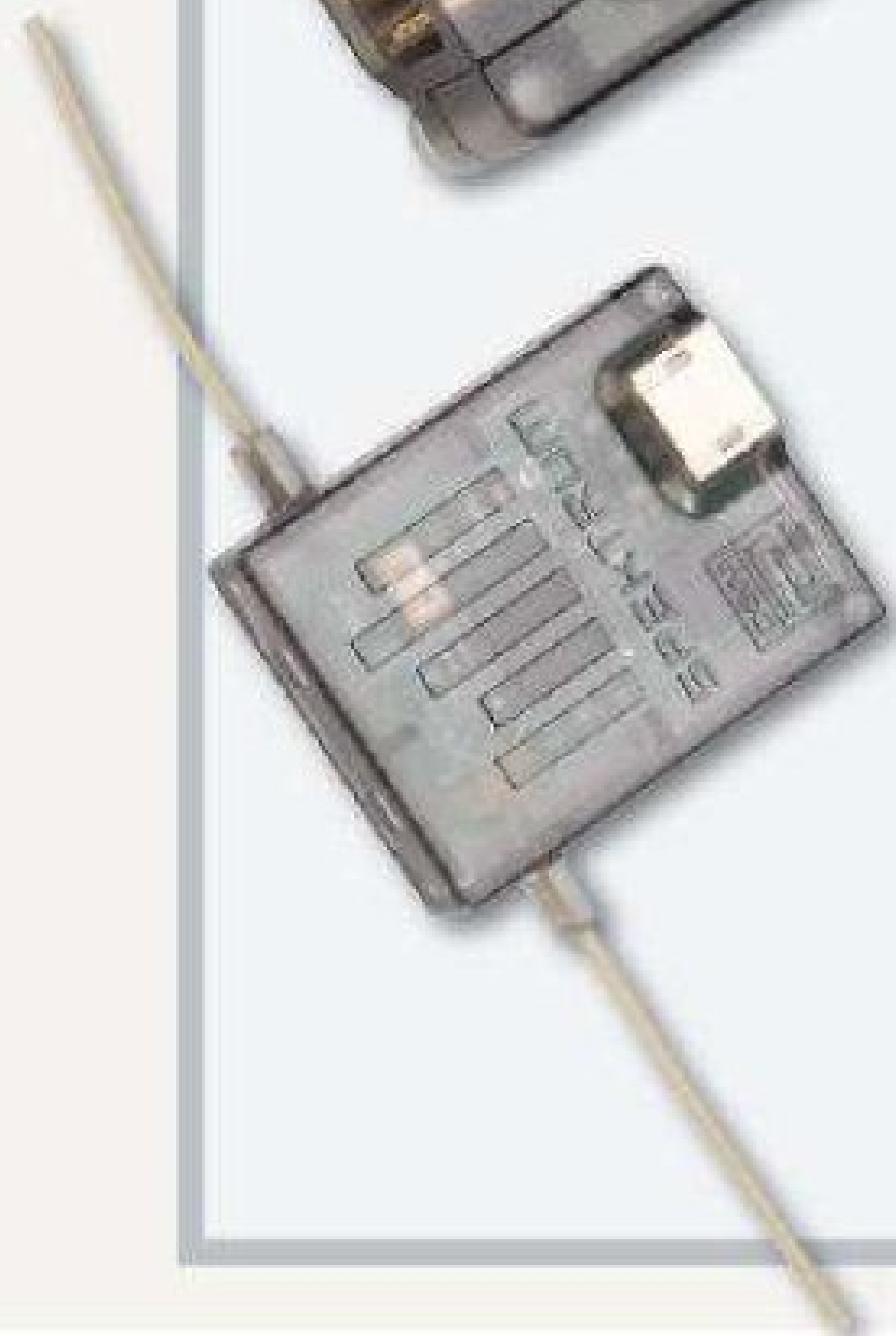
It's important to understand your governor if you intend to rely on it. A governor does not maintain your engine's tune, and it's possible to do more harm than good with one if you don't pay attention to your engine's needles. It's important to get your heli flying as well as possible before turning on the governor. Make sure that your engine is running just on the rich side of its peak, never lean.



## WHAT IS A REGULATOR?

Not to be confused with voltage regulators, throttle regulators offer a similar function to governors. You still have to use your throttle curve, but the regulator will prevent your heli from over-speeding. Because of their reliance on the throttle curve to fine tune the response, they may require a little more tweaking than a governor. The advantage of a regulator is the reduced chance of a governor overworking a poorly tuned engine. Because all a regulator does is limit the headspeed, it could be said they offer easier engine tuning, but you should always set your needle valves without the governor enabled first anyway.

Governors should always be used.



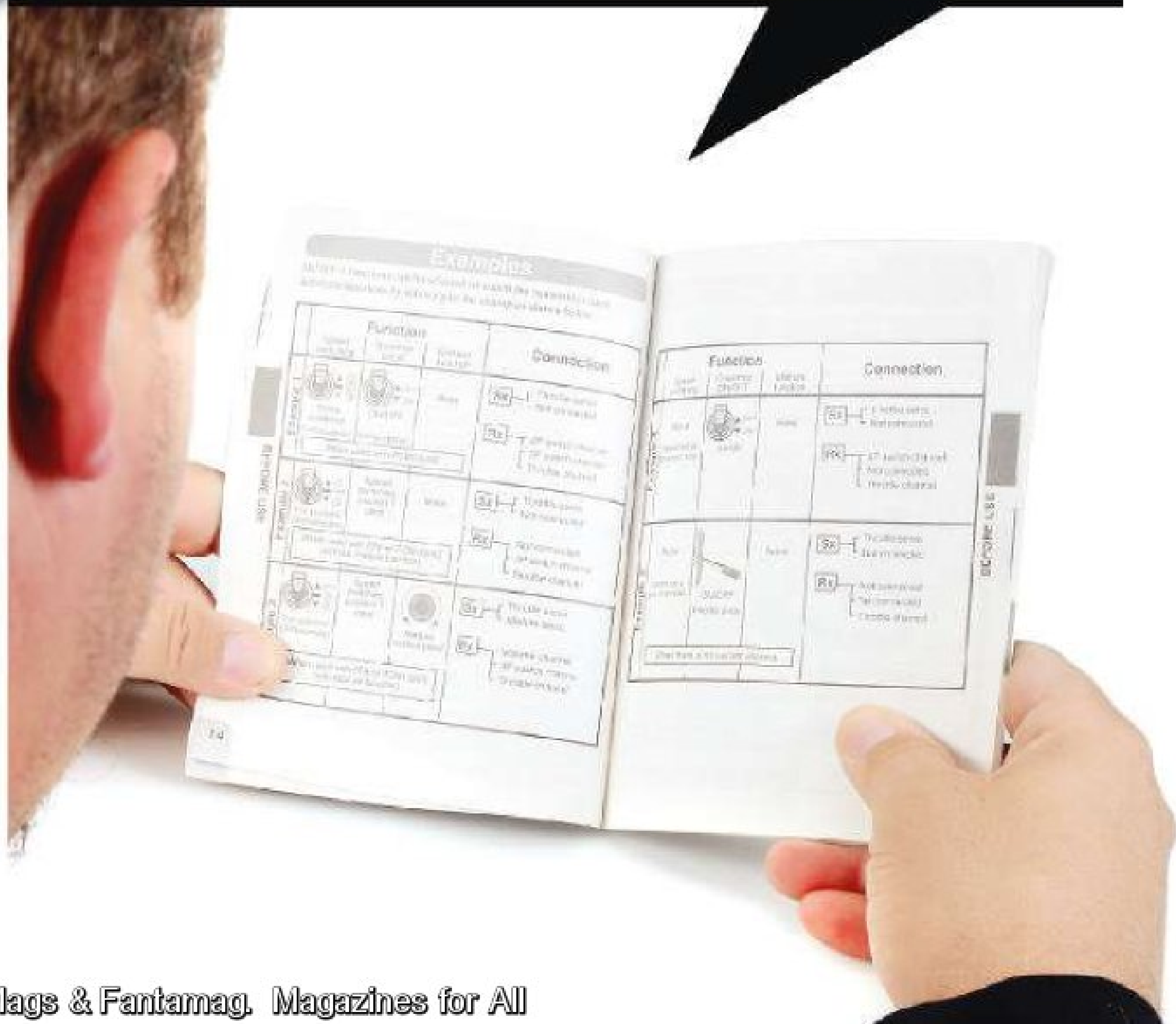
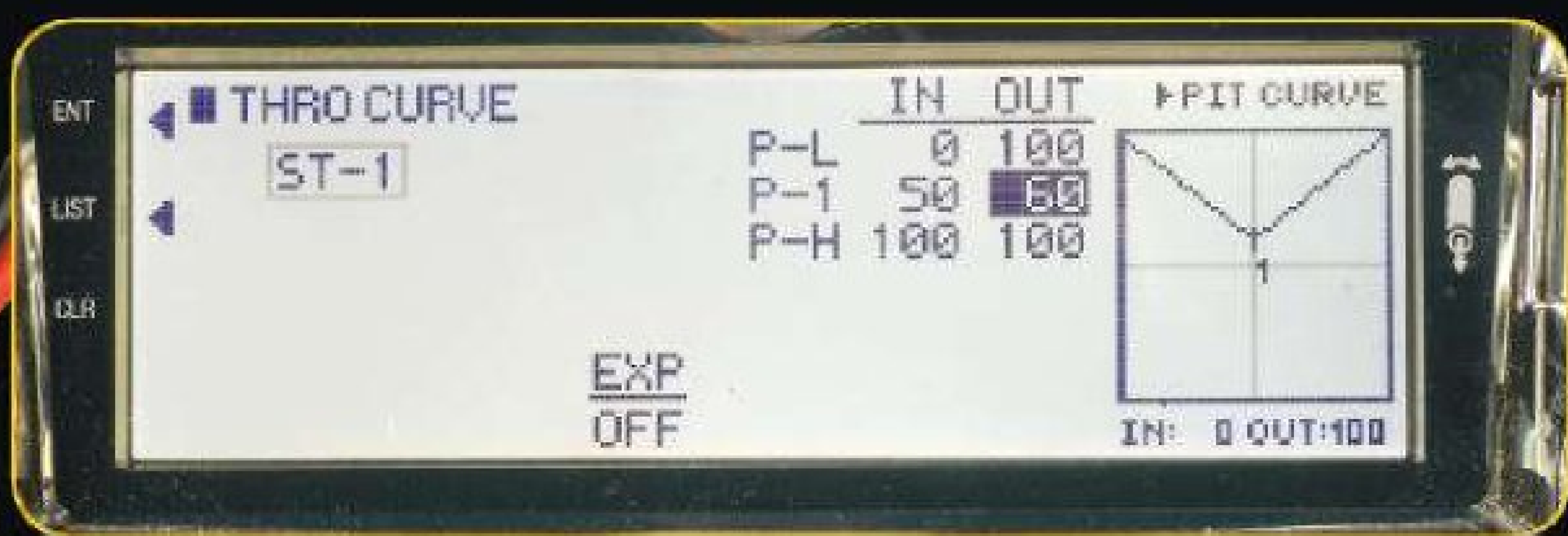
## GENERIC GOVERNOR SETUP

Most governors employ similar setup routines. First, it's important to make sure that the sensor is picking up the magnet properly without touching anything. You want the magnet as close as possible without any rubbing. Most governors will indicate when it senses the magnet with a light turning on. Then you set the headspeed (or engine speed, depending on the manufacturer). Some governors have you preset the desired headspeed, and



take into account your heli's gearing. With these, you can toggle between the preset headspeeds with your Auxiliary input. Other governors use the Aux channel to select the headspeed; with these you just use the value of the Aux channel to set the engine speed.

It's important to understand your governor's settings before using it. Most governors vary somewhat with their setup, and this can be one of the most critical aspects of using a governor. Not only do you need to do your setup correctly to get the governor to work, but also you want to make sure it won't kick on when you don't expect it to. Governors usually won't engage unless the engine speed is above a certain level and your throttle stick is above a certain point (usually 25%). If you don't go through your setup correctly, it's possible that your governor could engage when you don't want it to, which could be a dangerous situation.





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## » A FEW NOTES ON A FEW POPULAR GOVERNORS

### FUTABA GY 701

One of the first to bring a governor to market with the original GV-1, the engineers at Futaba have brought us the GY 701, featuring an integrated gyro and governor. Using Futaba's S.Bus technology, it's possible to further simplify your setup with an S.Bus compatible receiver; you only need one servo lead to the GY 701 to handle your throttle servo, tail servo, and auxiliary channels for both the gyro and governor!



### ALIGN RCE-G600

Included with many of the nitro helis Align offers, the simple yet proven RCE-G600 is about as basic as a governor can get, but still works very well. If you buy one for a heli other than an Align, be prepared to come up with your own mount for the hall effect sensor. Align's nitro helis have a clever location on top of the clutch, putting the sensor right on the frame.

### CASTLE CREATIONS PHOENIX HV 45

Certainly one of the most evolved governors offered in an electronic speed control, Castle Creations offers governor software, which can be programmed through a Castle Link USB connection. Taking full advantage of the software requires knowing your heli's motor specs and gear ratio, but you can program the speed control to deliver an exact RPM and the software will tell you if the settings are in the ballpark.



This is how you do it Daniel!

### SPEKTRUM AR7100R

Integrating the regulator directly into the receiver has proven to be another great concept from the folks at Spektrum. Using a Hall effect sensor directly on the backplate of the engine to pick up engine RPM without an additional magnet, the AR7100R further simplifies setup.



### CY ATG

Curtis Youngblood's CY ATG offers both a regulator and governor function and you can switch between them in flight, allowing you to find what works best for you and your comfort zone. The ATG is limited to 2000 RPM, so if you're trying to spin your head a little faster you'll have to trick the governor by fibbing a little on the gear ratio.



## CONCLUSION

Governors are one accessory hardcore 3D pilots love almost as much as their heading hold gyros. If you aren't demanding the highest level of performance from your heli then you may not need one, but if you take your time getting your setup done correctly, a governor is a great addition. If you have a speed control with a built-in governor feature, turning on the governor should help make your heli more consistent. Experienced pilots familiar with governors can confirm if your setup is correct and help you decide if your flying is at a point where it will help you or just over-complicate things to add one. **TCH**

### Statement of Ownership, Management, and Circulation

1. Publication Title: RC Heli 2. Publication Number: 1559-7903 3. Filing Date: October 1, 2010 4. Issue Frequency: Monthly 5. Number of Issues Published Annually: 12 6. Annual Subscription Price: \$24.99 7. Complete Mailing Address of Publication: 13401 Yorba Ave, Chino, CA 91710 8. Complete Mailing Address of Headquarters or General Business Office of Publisher: Same 9. Publisher: Michael Velez 13401 Yorba Ave, Chino, CA 91710 Editor: Michael Velez, Same, Managing Editor: James Revilla, Same 10. Owner: Michael Velez, 13401 Yorba Ave, Chino, CA 91710 11. Known Bondholders, Mortgagees, and Other Security Holders Owning or Holding 1 Percent or More of Total Amount of Bonds, Mortgages, or Other Securities: None 12. Tax Status: Not Applicable 13. Publication Title: RC Heli 14. Issue Date for Circulation Data: October 2010 15. Extent and Nature of Circulation, Average No. Copies Each Issue During Preceding 12 Months, No. Copies of Single Issue Published Nearest to filing Date 15a. Total Number of Copies Printed (Net Press Run): 33,160, 32,800 15b. (1) Paid Subscriptions, 6929, 6517 15b (3). Sales Through Dealers and Carriers and other Non-USPS Distribution, 14,980, 14,624 15b (4). Paid Distribution by Other Classes of Mail Through the USPS, 770, 747 15c Total Paid Distribution: 22,679, 21,888 15d (1). Free or Nominal Rate Distribution Outside Country: 110, 102 15d (3) Free or Nominal Rate Copies Mailed at Other Classes Through the USPS: 240, 240 15d (4) Free or Nominal Rate Distribution Outside the Mail: 125, 120 15e Total Free or Nominal Rate Distribution: 475, 462 15f. Total Distribution 23,154, 22,350 15g. Copies not Distributed: 10,006, 10,450 15h. Total: 33,160, 32,800 Percent Paid: 97.9%, 97.6% 16. Will be printed in the January 2011 issue of this publication 17. Michael Velez Publisher, 10/1/10

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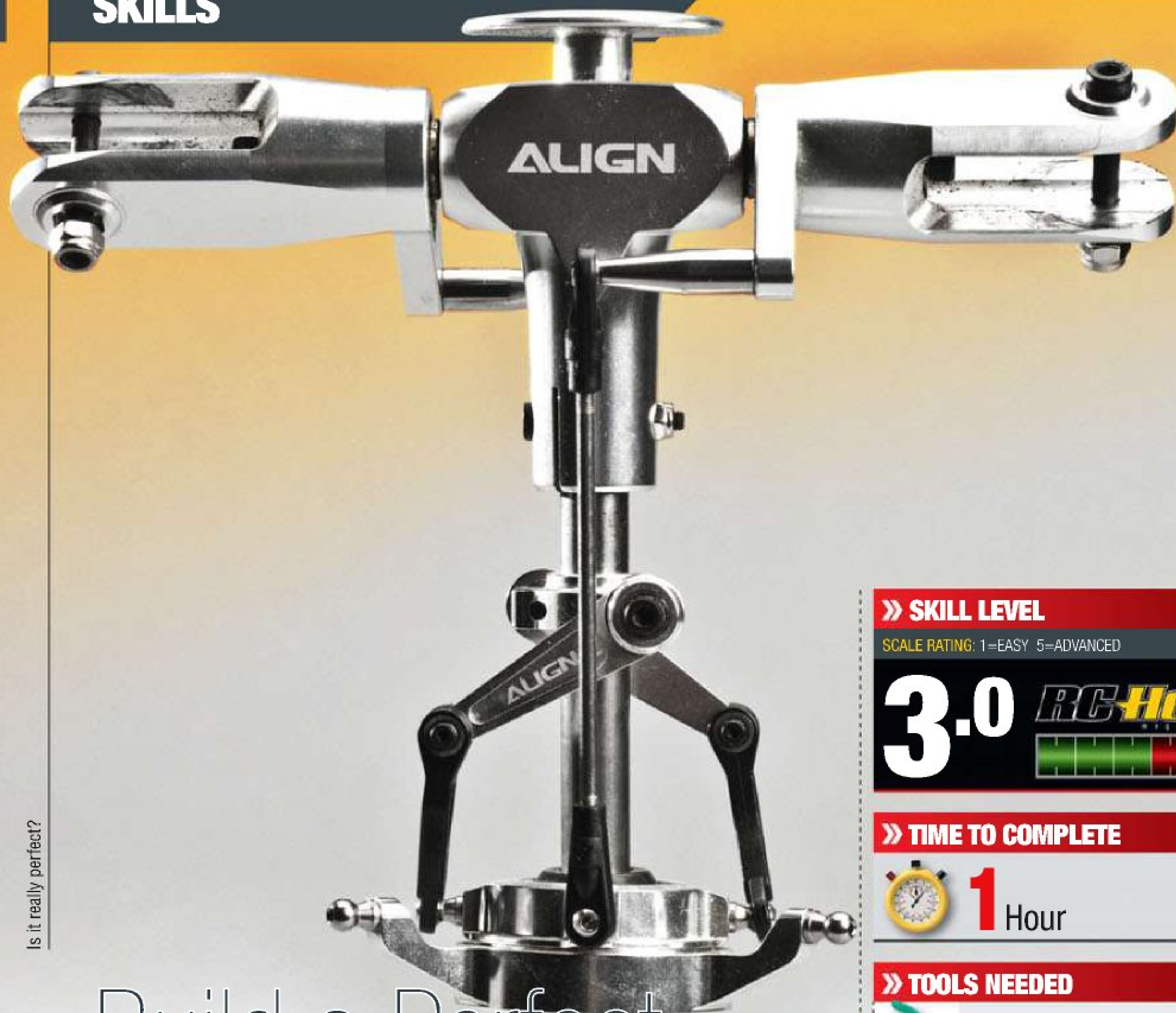
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Is it really perfect?

# Build a Perfect FLYBARLESS HEAD

Taking the Guesswork Out of the Equation.

**WORDS:** Ryan Kephart

**W**ITH THE NEW AGE OF FLYBARLESS HELICOPTERS, MANY ARE MAKING THE SWITCH TO THEIR FIRST FLYBARLESS HEAD. Although building a flybarless head is somewhat easier than building the flybarred version, there are some key points that must be completed to achieve a perfect setup. We'll walk you through the details and show you what it takes to have an accurate, smooth running head that will make your electronic stabilization system perform at its peak.

## » SKILL LEVEL

SCALE RATING: 1=EASY 5=ADVANCED

# 3.0



## » TIME TO COMPLETE



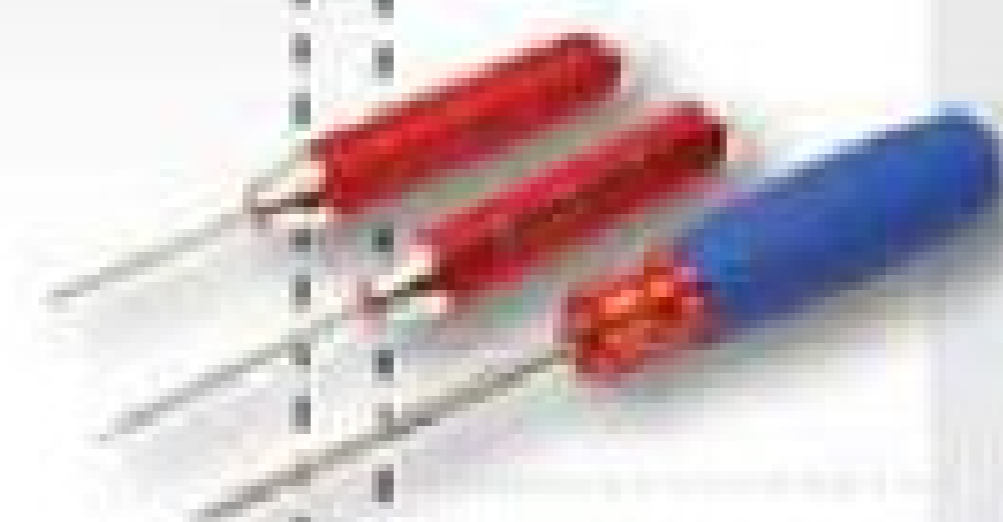
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## » TOOLS NEEDED



■ BALL LINK PLIERS



■ ALLEN DRIVERS



■ PITCH GAUGE



■ HIGH POINT BALANCER



■ BLADE BALANCER



■ GREASE



■ LIGHTWEIGHT OIL



■ THREAD LOCKING COMPOUND

## » BUILDING THE HEAD

The components of a flybarless rotor head must work flawlessly with one another to perform the functions of controlled flight. If one component fails then the whole head can fail, causing the inevitable crash.



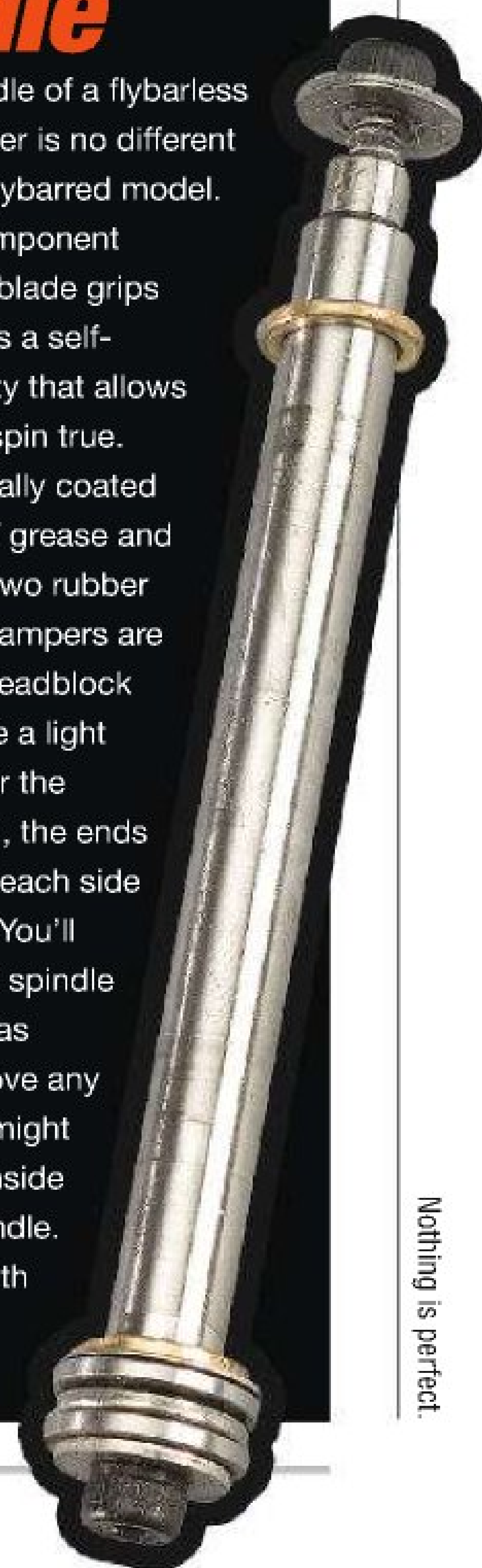
### HEADBLOCK

The headblock is the main component of a flybarless head. You'll notice that the head is similar to a flybarred head, but without the extra machining needed for flybar operations. This means that the phasing pins are eliminated, as well as the cutouts and bearing blocks for the flybar and seesaw, and also a mount for the Bell/Hiller mixing arms. The headblock houses the damping system and allows a connection from the main shaft to the rotor blades. The headblock is secured to the main shaft in the same way as a flybarred head, by use of either a single Jesus bolt or a Jesus bolt in combination with two clamping screws.

### Spindle

The spindle of a flybarless helicopter is no different than a flybarred model.

This component connects the two blade grips together and offers a self-centering capability that allows the rotor head to spin true. The spindle is usually coated with a thin layer of grease and then slid through two rubber dampers. These dampers are pressed into the headblock and usually require a light coating of oil. After the spindle is installed, the ends will protrude from each side of the headblock. You'll want to center the spindle by hand as much as possible and remove any grease or oil that might have coated the inside threads of the spindle. You can do this with a Q-tip and some rubbing alcohol.



Nothing is perfect.

## BLADE GRIPS

The blade grips on a flybarless head are similar to a flybarred model, but they do have some minor differences to accommodate the new control system. Most flybarless blade grips are controlled from the leading edge of the blades. Depending on the manufacturer, the grips will be made from either aluminum or plastic. Attaching the pitch arm, or ball link to the main body of the grip is the first assembly step. These arms are slightly different from a flybarred model, as the ball link is usually centered with the main shaft of the helicopter. This allows for a straight connection from the blade grips to the swashplate.

Bearings are then installed inside the blade grips. This usually consists of two radial ball bearings and a thrust bearing. The radial bearings are lubricated by the manufacturer and do not need any additional oil or grease. The thrust bearing must be lubricated before installation; use a high quality grease such as Tri-Flow or similar product. Place a small dab of grease on the palm of your hand and work the ball bearing race into the grease. Make sure that the cup of the race is filled with grease. Next, apply a thin layer to both the inner and outer race of the thrust bearing. After that, measure both the inside and outside race with a pair of calipers to determine which inner diameter is bigger. The larger inner diameter race must go towards the center of the helicopter, then the ball race is installed with the cup facing the center, followed by the last race.



After the bearings are installed in the blade grips, they can be installed on the spindle followed by the retaining screw. Apply a drop of thread locking compound to the screw and carefully install the screw without touching the bearings, as the thread lock can penetrate and cause the bearings to become notchy. Two correctly sized Allen wrenches must be used to secure the blade grips to the spindle.

# SWASH FOLLOWER

**U**nlike a flybarred helicopter, a flybarless helicopter uses a swash follower instead of a washout

base. This component is locked to the main shaft and usually has one or two links that attach to the inside race of the swashplate. This allows the inner ring of the swashplate to spin at the same rate as the main rotor blades, thus keeping the control system in phase.

Phasing is always adjustable on a flybarless helicopter by rotating the swash follower and then locking it down. To install this part, slide it over the main shaft and use the retaining screws to hold the follower in place. Final adjustments are made after the entire head and linkages are installed. To make the final adjustments, turn on the radio and center the collective stick. Rotate the main rotor until one of the blades is parallel to the tail boom. Next, position the swash follower until the arms are 90 degrees to the main shaft, and then rotate the swash follower until the arms are parallel to the main rotor blades. This will phase the rotorhead and give you linear throw from positive to negative collective.

## » SWASHPLATE

**T**he swashplate of a flybarless head is exactly the same as a normal flybarred helicopter. If you're working on a scale project with a multi-blade rotor head, then a different swashplate must be used to accommodate the extra rotor blades. The only difference is an inner swash ring with more ball links. For a two bladed rotor head, four linkage balls are used; two are attached to the swash follower and the other two attach directly to the blade grips. The linkage used to connect to the blade grips are usually made from thicker stainless steel rod and bigger plastic ball links. This is to accommodate the extra load placed on these



linkages during flight. When installing the swashplate, turn on your radio and keep the collective stick centered. Adjust the linkages until the swashplate sits level. This can be done by eye, or a swash leveling tool can be used.

## Servos

**U**nlike a flybarred helicopter, the servos on a flybarless rotor head should be of high quality. Higher torque servos are required because with a flybarless head the rotor blades are controlled directly, which places the entire flight load directly on the servos. When choosing servos for your flybarless head, make sure they are high quality with enough torque for your size of machine. Metal gear servos are also a plus.



The better the servo, the better the performance.

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## BALANCING THE ROTOR HEAD

Keeping your rotor head in balance is the key to a smooth running helicopter. No matter if it's electric or nitro, vibration can cause issues with not only the electronics of the helicopter but the frame as well. A small vibration can lead to component failure, loose screws, and unwanted gyro corrections. To balance your rotor head, remove the main rotor blades from the blade grips and slide the whole rotor head assembly and main shaft off of the helicopter. Place the blade retaining screws back on the blade grips and then proceed to the following steps.

**1.** Place the rotor head and main shaft on a High Point balancer. The balancer will have to be secured to a table or weighed down to prevent the balancer from tipping over. The High Point balance will have to be configured to accept the main shaft. Look at the picture closely and configure your balancer the same way.



**2.** Rotate the rotor head so that the blade grips are parallel to the table.

**3.** Observe the rotor head and look for movement. It will rotate in the direction of the heavier side. Double check the results by rotating the rotor head 180° so that the heavy side is on the opposite end. If the heavy side drops after rotating the head, then you know for sure that side is heavier.



**4.** Balance the rotor head by adding weight to the lighter side. This can be done with a washer on the outside of the blade bolt or with weighted tape.

**5.** Next, you'll want to balance the main rotor blades. The use of a blade balancer is required for this and you should follow the manual included with your balancer. Make sure to balance both the C.G. and overall weight of the blades.



Balancing is the key.

## Adjusting Pitch

Some flybarless rotor heads come with a way to adjust the pitch of your blades by adding a temporary bar to the top of the head. This allows you to use a standard pitch gauge to adjust the pitch range. Other rotor heads depend on an eyeball approach. This is not always that accurate, but when combined with flight testing can yield accurate results. Another option is to use a pitch gauge designed for flybarless rotor heads. The Laser Pitch Gauge from Ron's Heliproz South is a great example of this. This tool allows you to adjust the pitch range, level the swashplate, and equalize the two main blade grips.

Regardless of what option you choose, make sure that each blade has the same pitch. To do this, center your collective stick and check the pitch of

one of the main rotor blades. At center collective stick the blade should read 0 degrees. If it doesn't, adjust the link until it does. Next, remove the pitch gauge from that blade grip, spin the head 180 degrees, and check the other rotor blade pitch. Adjust the link until it matches the opposite blade pitch.



## CONCLUSION

With the proper steps taken to ensure your rotor head is perfectly built and balanced, your helicopter will surely look and fly better than ever before. Vibration is the number one cause of helicopter failure and tail issues. The rotor head is the business end of the helicopter, so taking your time and building this section of the helicopter perfectly will pay off. Get out your tools and build your flybarless rotor head right, and don't forget the thread lock. **TTR!**

Outrage... In Your Face!





# Outrage RC VELOCITY 90

It is Outrageous!

WORDS: Ryan Kephart | PHOTOS: Jason Boulanger

**D**URING IRCHA 2010 YOU MAY HAVE NOTICED A HUGE FOLLOWING OF OUTRAGE RC FLYERS. This following doesn't just happen overnight, nor does it happen without a quality product. Outrage RC is known for their quality, performance, and innovation in 3D helicopters. Outrage designs their helicopters to not only impress you with the visual aesthetics, but also with the performance gains from smooth, quality parts.

3D helicopters are not the only product Outrage produces. They also focus on designing and building high-end servos, fuel, and helicopter accessories. This month we'll take a look at the new Outrage Velocity 90 that boasts the same great looks as the previous Velocity 50, but with more key features that will surely make this 90-size helicopter a hit.

The canopy has some great looking colors.

## » AT A GLANCE

<b>SIZE:</b>	90
<b>POWER:</b>	Nitro
<b>TYPE:</b>	Pod & boom
<b>BUILD TYPE:</b>	Kit
<b>TAIL DRIVE:</b>	Torque tube

# FEATURES

The Velocity 90 features an ultra rigid and compact frame design made from carbon fiber with aluminum bearing blocks and spacers. The head is made completely from aluminum and offers plenty of mixing options for both hardcore 3D pilots and beginners. I don't want to spoil all the great features in this intro, so let's take a closer look at the individual sections of the helicopter.

## » MAIN FRAME

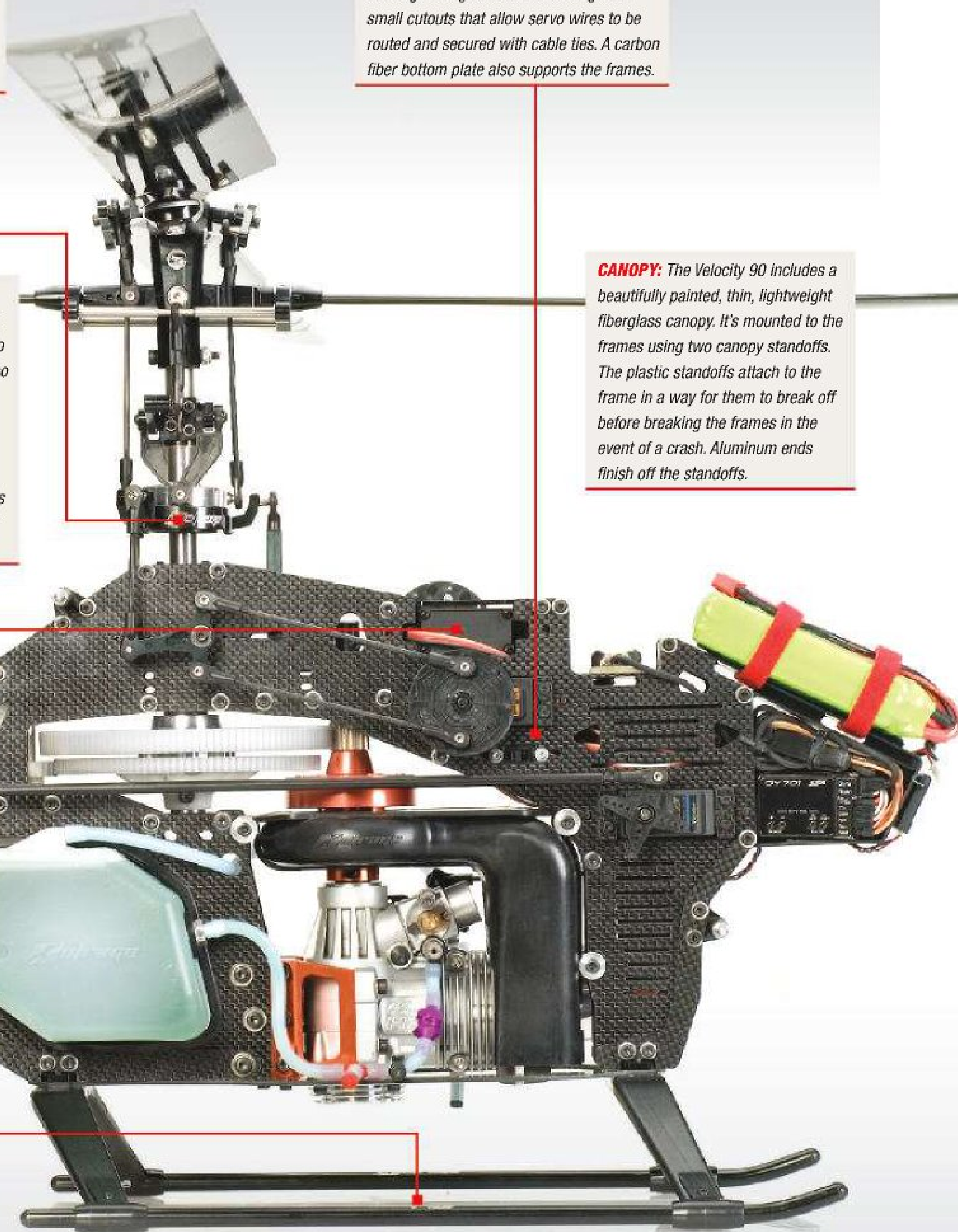
**SWASH CONTROL:** The swash is controlled by a push-pull system with a series of bellcranks. The bellcranks are all dual ball bearing supported and have multiple input options that allow you to achieve perfect 90 degree connections from your servos to the bellcrank.

**DESIGN:** The frames are designed as a two-piece plate that sandwiches the bearing blocks, spacers, and radio tray. The frames have lightening holes cut out along with small cutouts that allow servo wires to be routed and secured with cable ties. A carbon fiber bottom plate also supports the frames.

**COMPONENT LAYOUT:** Component layout is something Outrage knows how to do and does it right. The Velocity 90 has a small, yet useful radio tray at the front of the frames, and this tray is also molded with a gyro mount that sits just behind the receiver battery. The plastic tray has slots to allow Velcro straps to hold down all of your key components. Every servo is located up front for added protection by the canopy. The fuel tank sits just behind the engine and is mounted off center to counter the weight of the exhaust pipe.

**CANOPY:** The Velocity 90 includes a beautifully painted, thin, lightweight fiberglass canopy. It's mounted to the frames using two canopy standoffs. The plastic standoffs attach to the frame in a way for them to break off before breaking the frames in the event of a crash. Aluminum ends finish off the standoffs.

**LANDING GEAR:** The landing gear is a four-piece design comprised of plastic struts and aluminum skids. The struts are mounted to the frames by aluminum braces and the carbon fiber bottom plate. The skids slide through the struts and are secured using a clamping method tightened by machine screws and nylon lock nuts. Plastic end caps finish off the skids.



## » DRIVE TRAIN

**ENGINE MOUNT:** The engine mount alone is a work of art. The whole mount is made from orange anodized aluminum. The mount consists of three aluminum parts. The center section is mounted to the frames using (3) four millimeter bolts on each side and an additional three screws that mount to the bottom plate. Two side plates are then attached to the center section using four millimeter bolts. These plates can be slid up and down to accommodate future engine upgrades.

**CLUTCH:** The clutch bell on the Velocity 90 is made from aluminum and anodized orange to match the engine mount. The clutch bell is machined with lightening/cooling holes and two governor magnet recesses. The pinion is threaded onto the top of the clutch bell. The clutch is mounted to the fan and has a one-way bearing to allow the starting shaft to spin freely after the engine is running.

**COOLING FAN AND SHROUD:** The molded plastic cooling fan mounts to an aluminum hub that is anodized orange to match the engine mount and clutch bell. The hub slides over the engine crankshaft and uses a clamp to keep the fan from pressing too hard when the crankshaft nut is used.

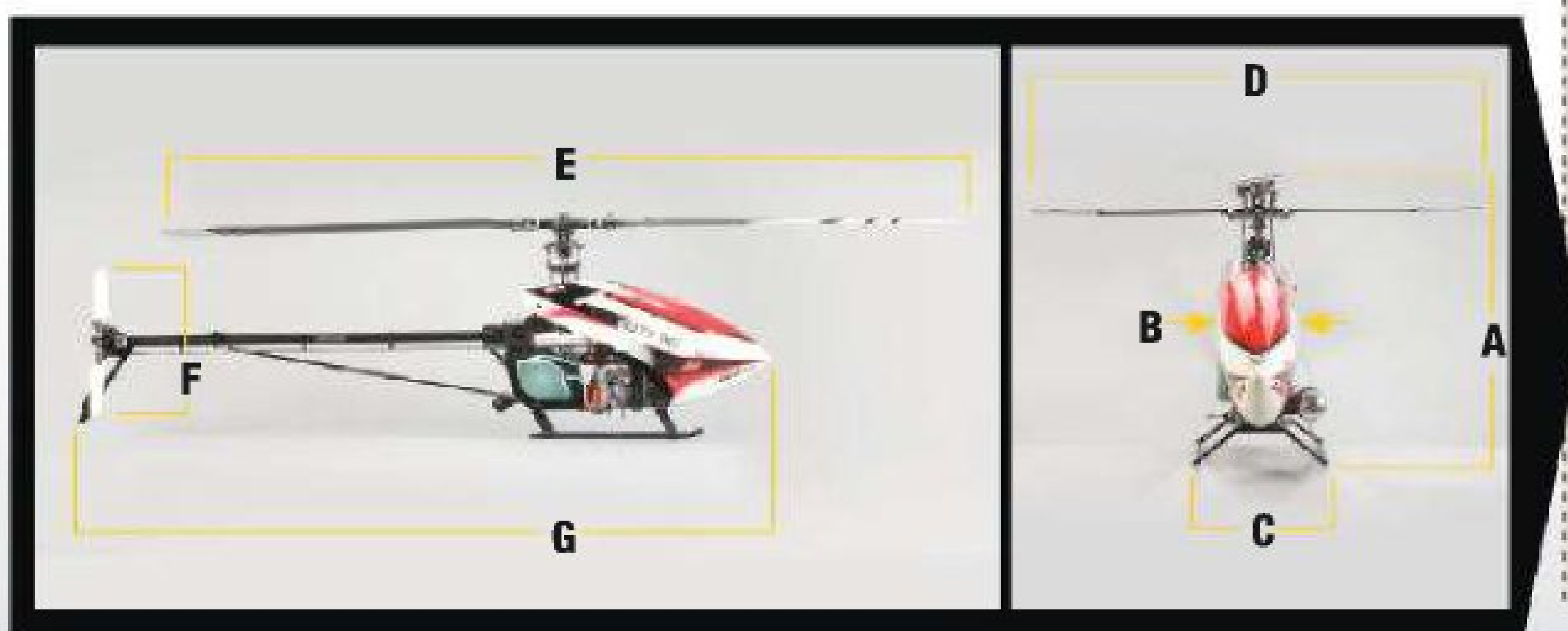
**MAIN GEAR:** The lightened main gear is molded from Delrin and mounts to an aluminum hub that houses an oversized clutch bearing. The bearing is supported by two radial bearings. The hub uses six machine screws that pass through a metal top plate and thread into the hub.

**AUTOROTATION DRIVE:** The oversize clutch bearing uses a steel race that is held in place by a one-way hub end plate. A steel sleeve is passed through the clutch bearing and locks the tail drive gear to the main shaft, allowing the tail rotor to be driven during an autorotation.

**TAIL DRIVE:** A molded Delrin main tail gear and secondary gear system drives the tail rotor. The secondary system is supported by two ball bearings. A Delrin bevel gear drives the torque tube.



WHILE FLYING THE VELOCITY 90, THE CYCLIC PITCH RESPONSE HAD A PERFECT BALANCE OF STABILITY AND RESPONSE TO PERFORM ANY 3D MANEUVER IN THE BOOK.



Outrage RC

## VELOCITY 90

MODEL SPECIFICATIONS

<b>CLASS:</b>	Velocity 90
<b>BUILD:</b>	Kit
<b>BLADE SIZE:</b>	690-710mm
<b>LEVEL:</b>	Beginner, intermediate, or advanced

### FRAME

<b>MATERIAL:</b>	Carbon fiber
<b>TYPE:</b>	Two-piece
<b>SERVO TO SWASH LINKAGE:</b>	Push-pull to bellcrank
<b>SERVO SIZE:</b>	Standard

### ROTOR HEAD

<b>GRIPS:</b>	Aluminum
<b>HEAD BLOCK:</b>	Aluminum
<b>LINKS:</b>	Ball
<b>SWASH:</b>	Aluminum
<b>CONTROL:</b>	CCPM 120° (140° opt.)

### TAIL

<b>DRIVE SYSTEM:</b>	Torque tube
<b>AUTO DRIVEN:</b>	Yes
<b>TAIL PITCH SLIDER:</b>	Dual-point
<b>TAIL BLADE GRIPS:</b>	Aluminum
<b>TAIL CASE:</b>	Aluminum
<b>BOOM STRUT MATERIAL:</b>	Carbon with aluminum ends

### GEARING

<b>MAIN ROTOR TO PINION RATIO:</b>	1:8.2
<b>MAIN ROTOR TO TAIL RATIO:</b>	1:4.62

### WEIGHT

<b>EMPTY:</b>	8 lbs, 1 oz (3,651g)
<b>WITHOUT FUEL:</b>	10 lbs, 9 oz (4,808g)
<b>FULLY LOADED:</b>	11 lbs, 13 oz (5,352g)

### DIMENSIONS

<b>HEIGHT (A):</b>	17.64 in (448mm)
<b>CANOPY WIDTH (B):</b>	4.25 in (108mm)
<b>LANDING GEAR (C):</b>	8.25 in (209mm)
<b>PADDLE TO PADDLE DIA. (D):</b>	29 in (736mm)
<b>MAIN ROTOR (E):</b>	63 in (1,600mm)
<b>TAIL ROTOR (F):</b>	11.5 in (292mm)
<b>LENGTH (G):</b>	50.5 in (1285mm)

# FEATURES CONTINUED

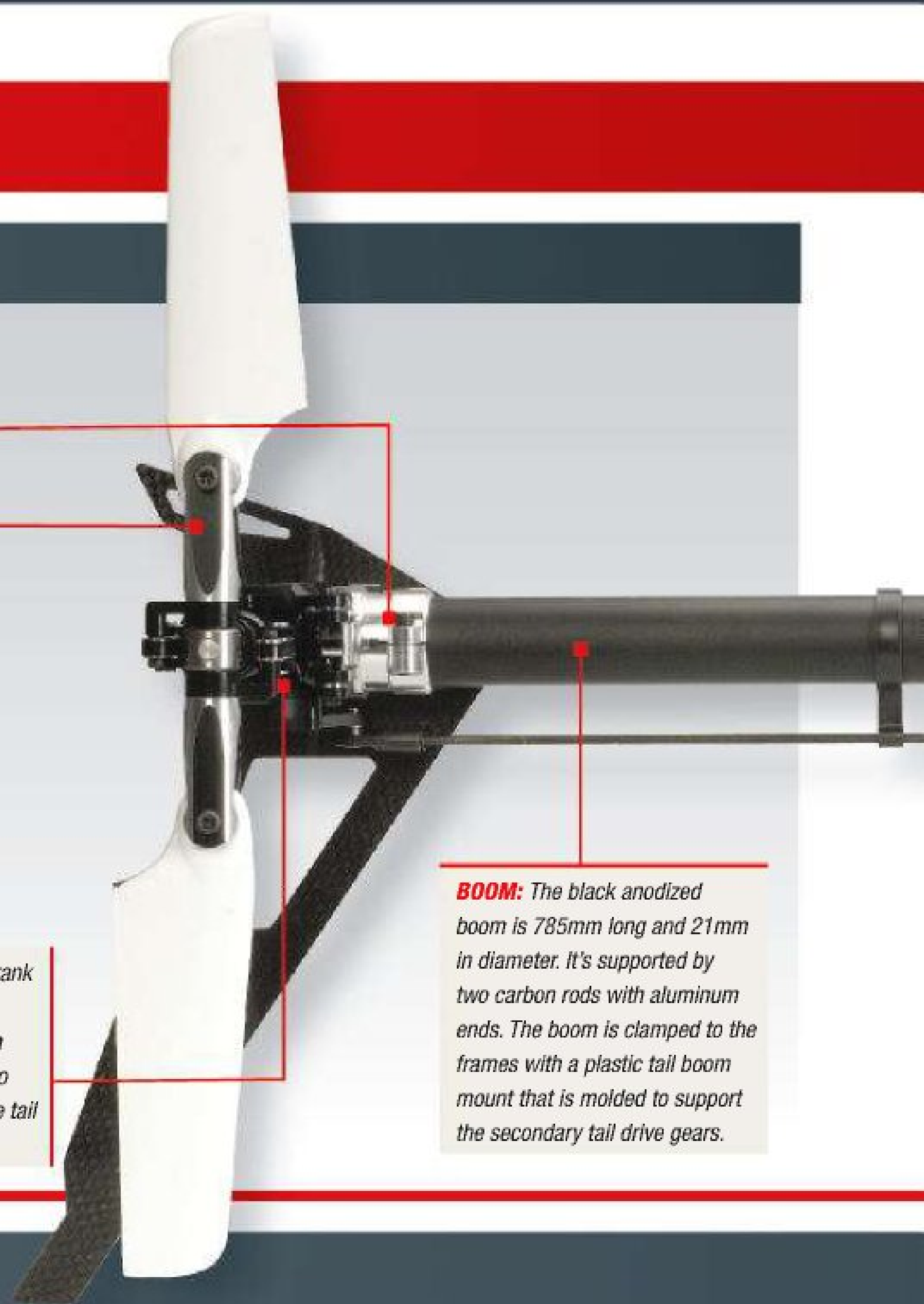
## » TAIL & BOOM



**TAIL CASE:** The tail case is a three-piece aluminum design. The clamp section is secured to the rear hub section by four screws that also thread into the boom. A single machine screw tightens a clamp to the boom. A side plate can easily be removed to quickly switch out the tail shaft or gears.

**TAIL BLADE GRIPS:** The aluminum tail grips are mounted to a steel hub that is machined with the spindle. Two ball bearings and a thrust bearing support the grips.

**PITCH ACTUATOR SYSTEM:** The tail is controlled using a pushrod from the servo to a bellcrank just below the tail boom clamp. From this dual ball bearing supported bellcrank to the tail bellcrank lever, a steel pushrod is routed through three plastic guides that clamp to the boom using a single screw. A dual-point tail bellcrank arm is used to achieve a smooth transition to the tail shaft. This arm is quad bearing supported and attached to the clamping section of the tail case. The links are all bearing supported and attach to the blade grips with machine screws.



**BOOM:** The black anodized boom is 785mm long and 21mm in diameter. It's supported by two carbon rods with aluminum ends. The boom is clamped to the frames with a plastic tail boom mount that is molded to support the secondary tail drive gears.

## » ROTOR HEAD

**HEADBLOCK:** The headblock is made from aluminum and anodized with two-tone accents. It attaches to the main shaft using two screws that thread into the main shaft and a single Jesus bolt that clamps the bottom of the head block to secure the whole assembly.



**BELL/HILLER MIXER:** The Bell/Hiller arms are attached to the main blade grip pitch arms. The arms are dual ball bearing supported and anodized to match the rest of the head. Three mixing options are available from both the swashplate and the flybar. Three output options are also available on the flybar, and even more with a dual position ball link.



**PHASING:** Two steel pins permanently pressed into the bottom of the headblock accomplish the phasing. The washout base slides over the main shaft and phasing pins with ease. The phasing pins ride through four ball bearings attached to the washout base on each side. This feature eliminates any slop and works smoothly.

**WASHOUT ARMS:** The washout arms are made from aluminum and supported by dual ball bearings. The arm accents are anodized black to give it a nice two tone look. Two output options are available.



## » INSTRUCTIONS & BUILDING TIPS

**WHEN YOU OPEN THE BOX:** With so many high quality kits on the market, Outrage decided to one-up the competition by supplying one of the most unique and functional forms of packaging. Every aluminum part was delicately placed into a laser cut foam board packaged with the hardware needed to install that part. The canopy is well wrapped and protected in a separate box. The main frames were separated by foam and placed towards the bottom of the box.

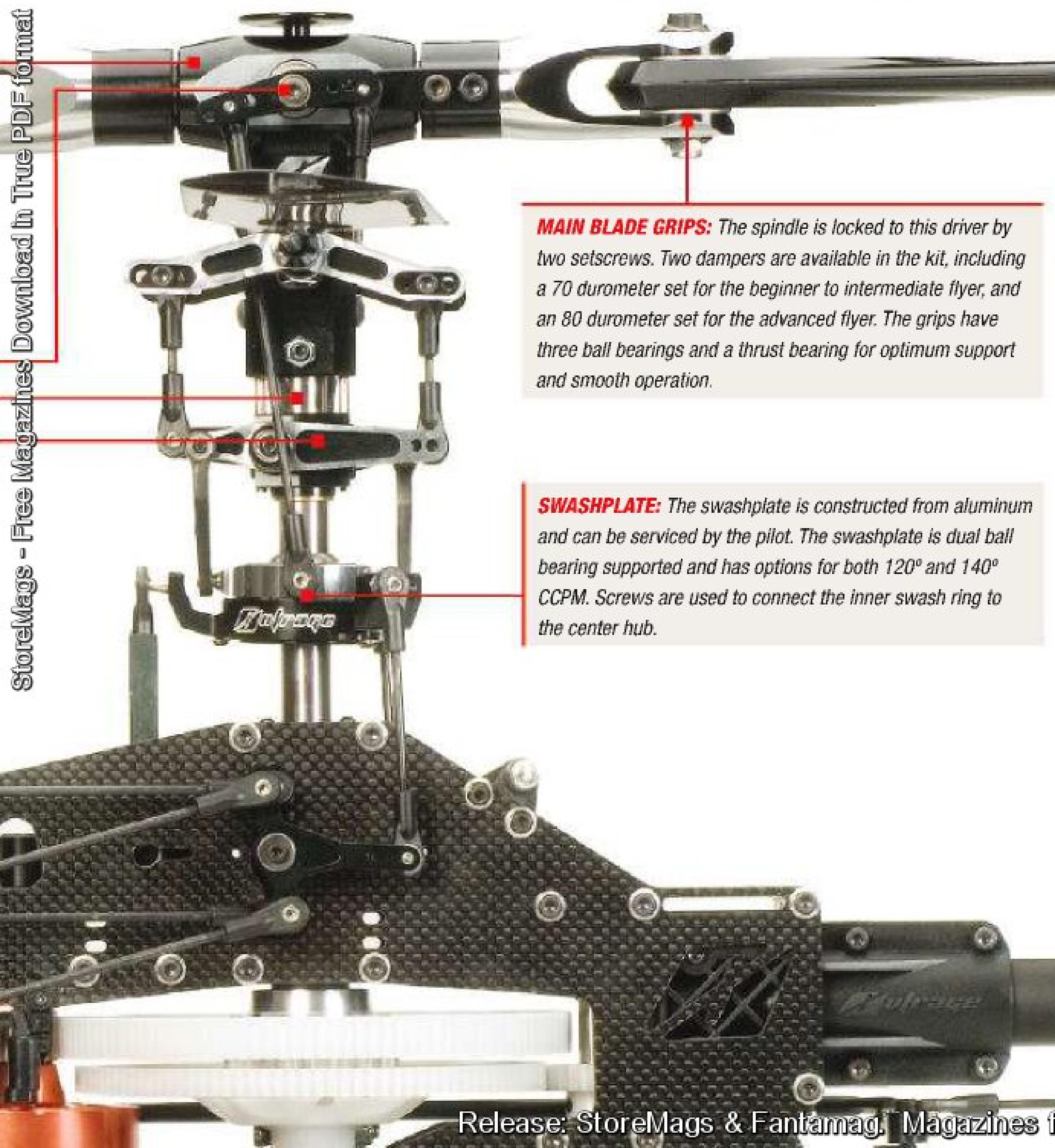
### MANUAL AND BUILD:

Building the Outrage Velocity 90 was similar to other high-end 90-size helicopters. Some

parts were completely built for you and others required assembly. The build was smooth and the manual did a good job showing how the parts fit together. Every screw had labels indicating the size and type used to install a specific part. Overall, the build was intensive yet fun. Some beginners might have a little trouble building this helicopter, but with a little studying of the manual they should be able to build the kit without too much trouble.



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**MAIN BLADE GRIPS:** The spindle is locked to this driver by two setscrews. Two dampers are available in the kit, including a 70 durometer set for the beginner to intermediate flyer, and an 80 durometer set for the advanced flyer. The grips have three ball bearings and a thrust bearing for optimum support and smooth operation.

**SWASHPLATE:** The swashplate is constructed from aluminum and can be serviced by the pilot. The swashplate is dual ball bearing supported and has options for both 120° and 140° CCPM. Screws are used to connect the inner swash ring to the center hub.

## Outrage RC VELOCITY 90

RTF & TEST GEAR

### » TEST GEAR



■ **RADIO:** JR, 12X, JRP12X, \$1250



■ **RECEIVER:** JR, R921 2.4, JRPR921, 0.8 oz (23g), \$170



■ **CYCLIC SERVOS (3):** Savox, SC-1258 TG, SAV-SC-1258TG, 1.84oz. (52.4g), \$70 ea.



■ **THROTTLE SERVO:** Savox, SH-1290MG, SAV-SH-1290MG, 1.98 oz (56.4g), \$70



■ **TAIL SERVO:** Futaba, BLS251, FUTM0521, 2.1oz. (59.5g), \$(included with gyro)



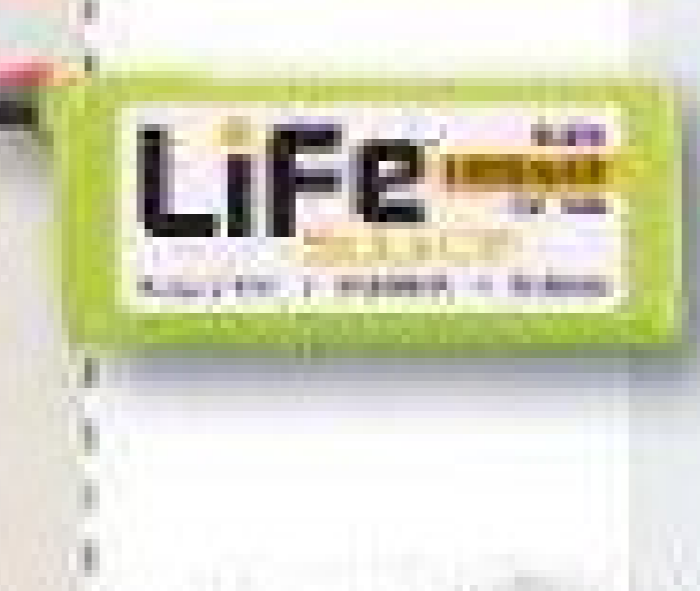
■ **ENGINE:** O.S., 91HZ, OSM18600, 1.36lbs (618g), \$400



■ **FUEL:** Outrage Formula, 30% Nitro



■ **GYRO:** Futaba, GY701 Gyro/Governor Combo w/BLS251 Servo, FUTM0823, 1.128oz. (32g), \$400



■ **RECEIVER BATTERY:** LiFe, LiFe 6.6V 3200mAh 10C, HCAM6445, 7.4 oz (210g), \$59.99



■ **BLADES:** Curtis Youngblood, 710mm Radix, YEI-YB-710, \$125

Great gear for a great heli.

# TESTING

After building the Velocity 90 I decided to take a little test hop out back. Several things I noticed that I didn't catch in the build suddenly appeared in flight. The pitch actuator for the tail control was sticking on the tail shaft, causing the helicopter to respond erratically. I also experienced the torque tube shaft spline coming off in flight even when using red thread lock on the retaining screws. I took the helicopter apart and applied JB Weld to the splines and smoothed the inside of the pitch actuator using fine sandpaper. This smoothed the action and allowed the tail to operate smoothly.

**HOVERING** • Even with the aggressive settings on the head, the Velocity 90 felt stable and very accurate in a hover. Minimum input was required to keep the helicopter rock stable in a hover. Overall, the Velocity 90 is a heavier helicopter that locks into a hover just like an FAI machine would.

**Rating: 5**

**FORWARD FLIGHT** • The Velocity 90 is a good fast-flying helicopter that can keep up with the best of them. The helicopter tracked well through the sky, but I did notice that the Velocity 90 wanted to pitch the nose up ever so slightly during high speeds. Overall it wasn't abnormally bad, as only a slight amount of forward cyclic was required to keep the helicopter flying at full speed.

**Rating: 4**

**CYCLIC PITCH RESPONSE** • The cyclic pitch response and rate were extremely fast on the Velocity 90. With the adjustable head this setting can be customized to your liking. I went with the aggressive settings in the manual, and it was perfect for both big air and fast smack-style flying. While flying the Velocity 90, the cyclic pitch response had a perfect balance of stability and response to perform any 3D maneuver in the book.

**Rating: 5**

**COLLECTIVE PITCH RESPONSE** • Another strong point for the Velocity 90 is the collective. With a large pitch range and quick response, the Velocity 90 was quick and overall fast. Big air maneuvers were easily performed with 11° of pitch, while the quick response allowed smack flight in tight flying spaces. Although the collective was very responsive, the Velocity 90 seemed to handle precise maneuvers very well. Every little input was felt through the

transmitter, allowing me to be extremely precise during hovering photos and consistent flight maneuver shots.

**Rating: 5**

**TAIL ROTOR RESPONSE** • Older Velocity 90 kits were supplied with a shorter tail shaft, which led to under-correcting tail issues. We received the newest updated kit, which includes a longer tail shaft that increased the overall pitch range of the tail blades. I was pleased to find that the tail performed flawlessly on the Velocity 90 after I smoothed the pitch slider using some steel wool. The tail was responsive and accurate in all flight orientations. The slop-free tail and perfect tail ratio allowed the Velocity 90 to perform with the best of them.

**Rating: 4**

**AUTOROTATION CAPABILITIES** • Like most 90-sized helicopters, the Velocity can auto-rotate very well. The oversized

one-way bearing was smooth and allowed the main rotor to retain enough energy to float for an extended period of time before landing. Overall I was able to perform aerobic autorotations and normal autos from any height.

**Rating: 5**

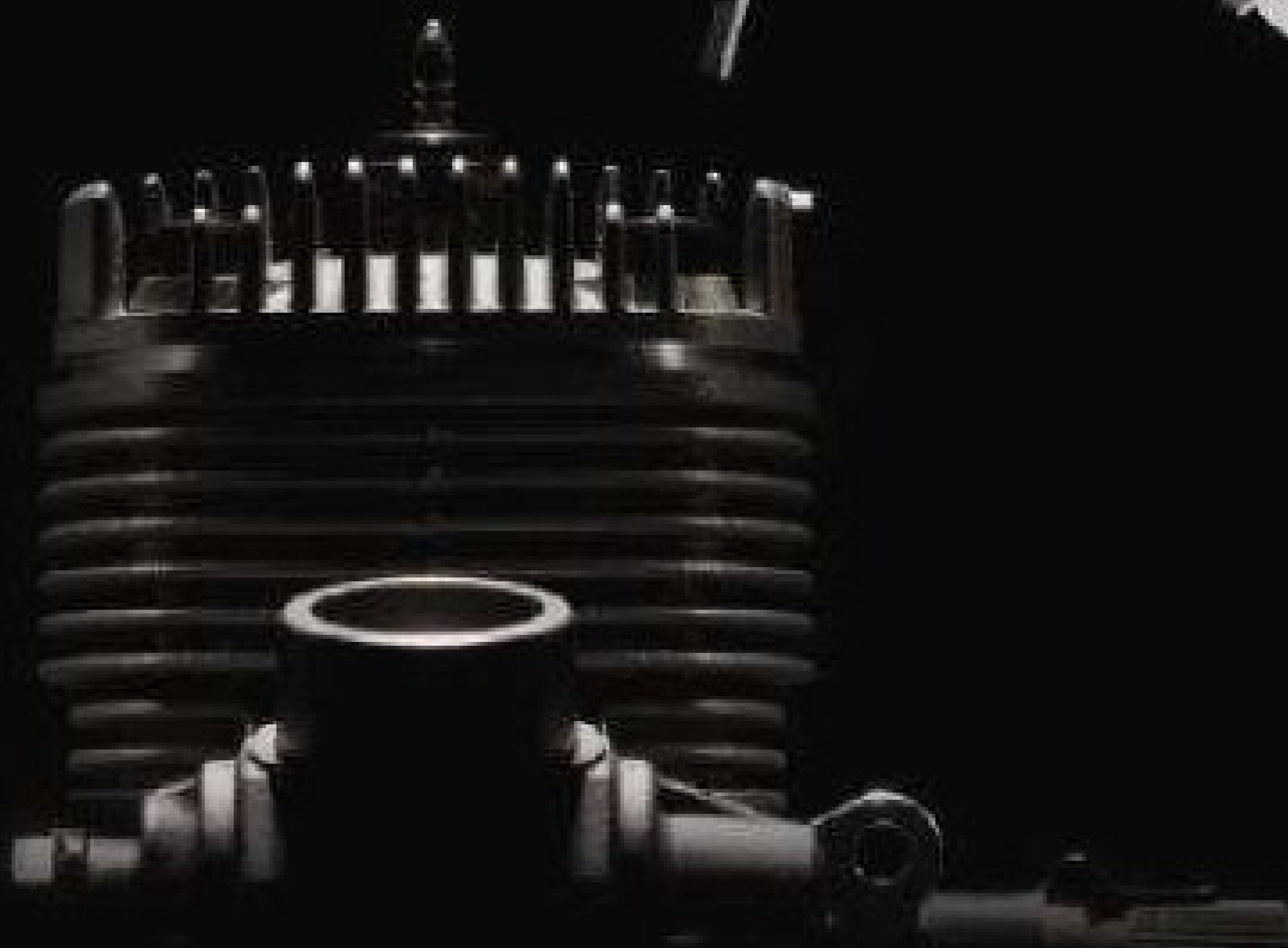
**POST-FLIGHT INSPECTION** • Going over the helicopter and inspecting the linkages and screws, I was pleased to see the Velocity 90 was wearing in perfectly. The linkages were setting in and moving freely, which gave the helicopter a smoother feel. After fixing the tail problem, I didn't notice any abnormal wear. I did add a few drops of lightweight oil to the tail shaft to make sure the tail would not lock up, and this seemed to do the trick. Overall the helicopter had a rough start, but with a little patience and persistence the Velocity 90 is one of my favorite 90-sized helicopters to fly.

**Rating: 4**





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# TESTING SPECS

## Outrage RC **VELOCITY 90**

**Part #:** KR90N01

**Distributor:** Heli Direct

**Web:** www.outragerc.com

**Street Price:** \$799

**Price as Tested:** \$3,084

**Build/Setup Time:** 18 Hours

### PERFORMANCE

**MODE FLOWN:** Normal, idle up 1, idle up 2

**RPM OF EACH** Normal: 1800

**MODE:** Idle Up 1: 1925

Idle Up 2: 2000

### ENGINE TEMP

(after flight): 185° F

**FLIGHT TIME:** 8 minutes

**CRASH COST:** \$62\*

### TEST CONDITIONS

**WEATHER:** Partly Cloudy

**TEMP / HUMIDITY:** 70 °F/15%

### BAROMETRIC

**PRESSURE:** 29.92 in

**WIND SPEED:** 8 mph

**VISIBILITY:** 10 mi

**ALTITUDE:** 875'

### PITCH CURVES

**NORMAL:** -4, 0, 11

**IDLE-UP 1:** -11, 0, 11

**IDLE-UP 2:** -11, 0, 11

\* includes main shaft, tail boom, spindle, landing gear, flybar, torque tube

### REQUIRED TO FLY

Radio, receiver, battery, engine, pipe, three matching cyclic servos, gyro, throttle servo, tail servo, thread lock (medium and strong), lightweight oil, and grease.

### WHO'S IT FOR?

With the fully adjustable head, the Velocity 90 can be set up for a beginning, intermediate, or advanced flyer, although the build was a little more difficult than a beginner should tackle without help.

### » SCORECARD

SCALE RATING: 1=POOR 5=EXCELLENT

**4** Instructions

**4** Parts Quality/Fit

**4** Durability

**5** Tunability

**4.5** Overall Performance

**5** Value

### +

 THE GOOD

- Great design
- Fully adjustable head
- Great flight characteristics

### -

 THE BAD

- Tail needed deburring
- Torque tube ends should be JB Welded

## CONCLUSION

Overall, the Velocity 90 performed very well after a few tweaks to insure proper operation of the tail components. Although this helicopter was not perfect out of the box, a true builder will be impressed with the quality of the parts and the beautiful finished product. If you are looking for a new 90-sized helicopter that can hang with the best of them both visually and in performance for a fraction of the cost, then the Velocity 90 would be a great choice. *TJH*





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Beginner-friendly – competition-ready.



Shown larger than actual size.

## GY701 – Heading-Hold Gyro & Governor

The Futaba GY701 combines a gyro and governor in one unit, representing a quantum leap forward in technology\*. Ultra high-speed processing rates make it the most sophisticated system on the market. Basic and Expert menus make it easy for novices and pros to enjoy latency-free performance and virtually instantaneous set-ups. The GY701's OLED (Organic Light Emitting Display) is easy to read indoors or out. Add the Governor, and you have a system that's optimized for even the most extreme helicopter competitions.

\*Also available in separate gyro or governor units.

*"The Futaba GY701 rocks! Like the GY520, it offers superior gyro performance, with an easy-to-use programming interface featuring Basic and Expert modes. Piro rate consistency is unmatched.*

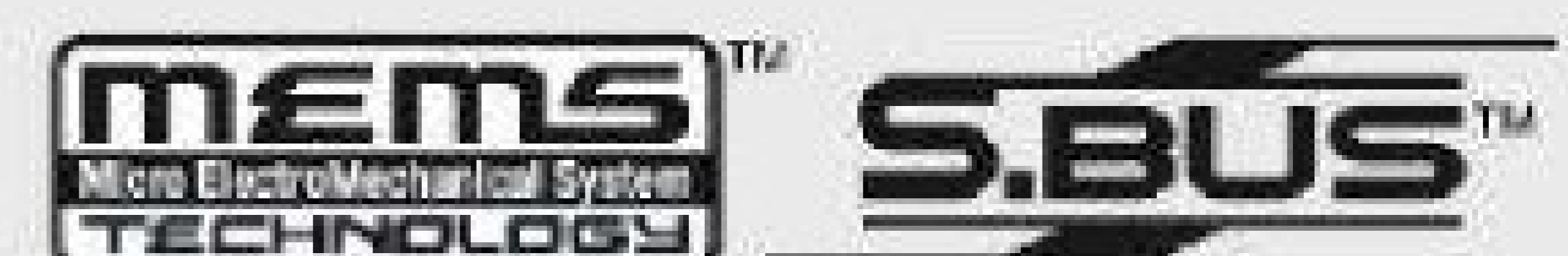
*The governor is just as phenomenal, reacting to tail rotor demands even before the engine does. The GY701's compact size, user-friendly interface and S.Bus support result in a winning combination that's tough to beat!"*

– Ray and Kyle Stacy, Futaba Team Members

# Futaba

Get the full scoop on the GY701 Gyro and Governor at [futaba-rc.com/98h](http://futaba-rc.com/98h).

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Snipe...Snipe

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# LAHeli SNIPER II

One shot, one thrill.

WORDS: Dan Goldstein | PHOTOS: Jason Boulanger

**T**HIS SNIPER II 500-SIZE MODEL HELI HAILS FROM THE CZECH REPUBLIC. It has a minimalist design for the sole purpose of being a precision instrument for performing heart-stopping 3D with pinpoint accuracy.

You think you have what it takes soldier?

## » AT A GLANCE

<b>SIZE:</b>	500
<b>POWER:</b>	Electric
<b>TYPE:</b>	pod and boom
<b>BUILD TYPE:</b>	kit
<b>TAIL DRIVE:</b>	torque tube

# FEATURES

The Sniper II, like any precision instrument, comes with only the best underpinnings the heli world has to offer. The airframe consists of a strong, lightweight array of carbon fiber and CNC aluminum bits. Out of the box, this model is capable of swinging 470mm main blades for reduced disc loading and increased performance. Aiding in the simplified design is a 120° CCPM direct-to-swash cyclic servo arrangement. This model also accepts a wide range of power systems, ranging from a frugal 4-cell Li-Po for cheap fun flying, on up to an 8-cell Li-Po setup for manic 3D.

## » MAIN FRAME

**SWASH CONTROL:** 120 degree CCPM direct-to-swash cyclic servo arrangement. The plastic anti-rotation guide is secured to the main frame.

**DESIGN:** The main frame consists of a 2-piece upper set and 2-piece lower set. The lower frames then tie to the landing gear using a unique plastic block that also secures two carbon fiber mounting rails for your electronics and the plastic landing gear struts and aluminum skid pipes. All of the bearing blocks are carved by CNC out of aluminum.

**COMPONENT LAYOUT:** The flight pack battery is located at the front of the frame and secured with included Velcro straps. The cyclic servos are installed in a vertical fashion in the upper carbon frame surrounding the main shaft. The tail servo is boom mounted. Your gyro unit can be mounted on a plastic plate that sits atop of the tail transmission. Your receiver and speed control are mounted to the CG-adjustable plastic plates at the bottom of the airframe.

**CANOPY:** The canopy is made from fiberglass and painted yellow. Vinyl decals are included for a carbon-fiber-look windshield and the model name. The canopy is secured to the airframe with four stand-offs; the upper-pair utilize thumbscrews for retention of the canopy during hard flights.

**LANDING GEAR:** The model is equipped with a four-piece landing gear with separate plastic struts and aluminum skid pipes.

## » DRIVE TRAIN

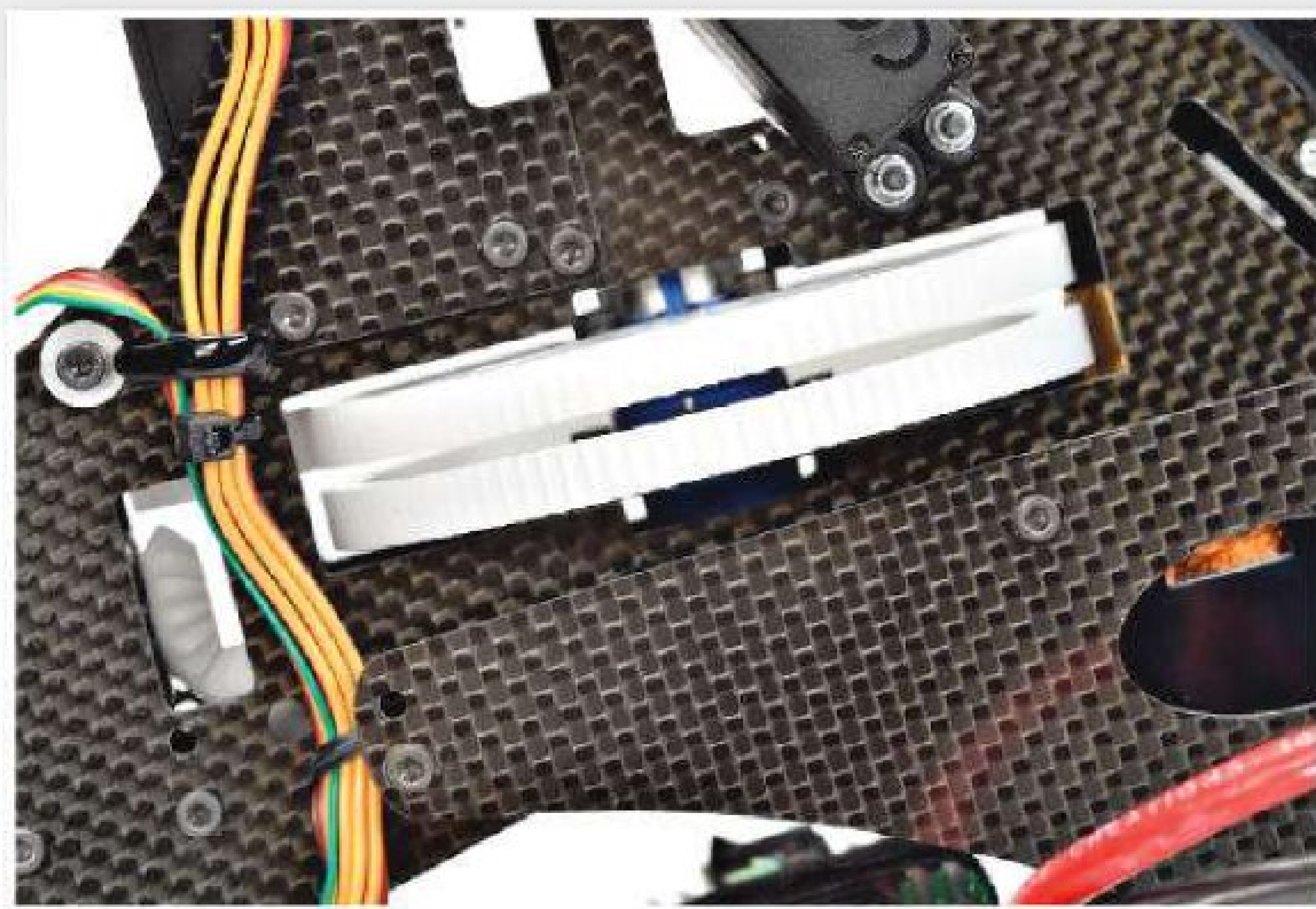
**ENGINE/MOTOR MOUNT:** The motor mounts just aft of the battery and is underslung in a CNC aluminum motor mount.

**CLUTCH/PINION:** The pinion supplied with the model is made of brass, has 13-tooth, and 0.7-modulus

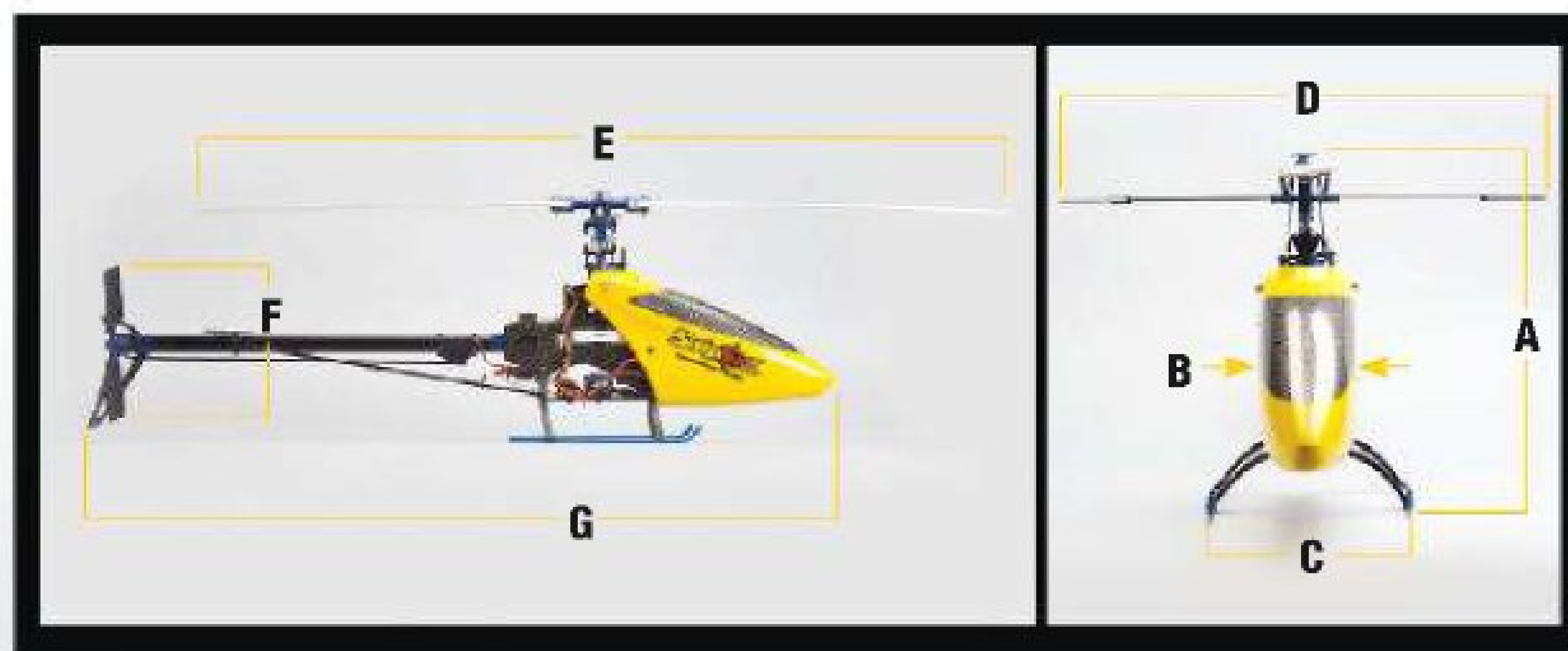
**MAIN GEAR:** The main gear is made from Delrin, 110-tooth, 0.7-modulus

**AUTOROTATION DRIVE:** There are two one-way bearings pressed into an aluminum hub that is secured to the main gear. The tail is driven during autos.

**TAIL DRIVE:** A bearing supported torque tube drives the tail.



“A PRECISION INSTRUMENT FOR PERFORMING HEART-STOPPING 3D WITH PINPOINT ACCURACY.”



LAheli

## SNIPER II

MODEL SPECIFICATIONS

**CLASS:** 500 Electric

**BUILD:** kit

**BLADE SIZE:** 425-470mm

**LEVEL:** Advanced

### FRAME

**MATERIAL:** Carbon fiber

**TYPE:** Stacked

**SERVO TO**

**SWASH LINKAGE:** Direct

**SERVO SIZE:** Mini or micro

### ROTOR HEAD

**GRIPS:** Metal

**HEAD BLOCK:** Metal

**LINKS:** Ball

**SWASH:** Metal

**CONTROL:** CCPM, 120°

### TAIL

**DRIVE SYSTEM:** Shaft drive

**AUTO DRIVEN:** Yes

**TAIL PITCH SLIDER:** Dual point

**TAIL BLADE GRIPS:** Metal

**TAIL CASE:** Metal

**BOOM STRUT**

**MATERIAL:** Metal

### GEARING

**MAIN ROTOR TO**

**PINION RATIO:** 1:6.56

**MAIN ROTOR TO**

**TAIL RATIO:** 1:5

### WEIGHT

**EMPTY:** 1.9 lbs 30.5 oz (865g)

**WITHOUT BATTERY:** 2.8 lbs 46.2 oz (1312g)

**FULLY LOADED:** 3.8 lbs 61.2 oz (1738g)

### DIMENSIONS

**HEIGHT (A):** 12.6 in. (322mm)

**CANOPY WIDTH (B):** 3.1 in. (80mm)

**LANDING GEAR (C):** 7.1 in. (182mm)

**PADDLE TO**

**PADDLE DIA. (D):** 17.75 in. (451mm)

**MAIN ROTOR (E):** 41.3 in. (1050mm)

**TAIL ROTOR (F):** 7.75 in. (197mm)

**LENGTH (G):** 38.1 in. (970mm)

Does an accurate paintball shot qualify me as a sniper?

# FEATURES CONTINUED

## » TAIL & BOOM

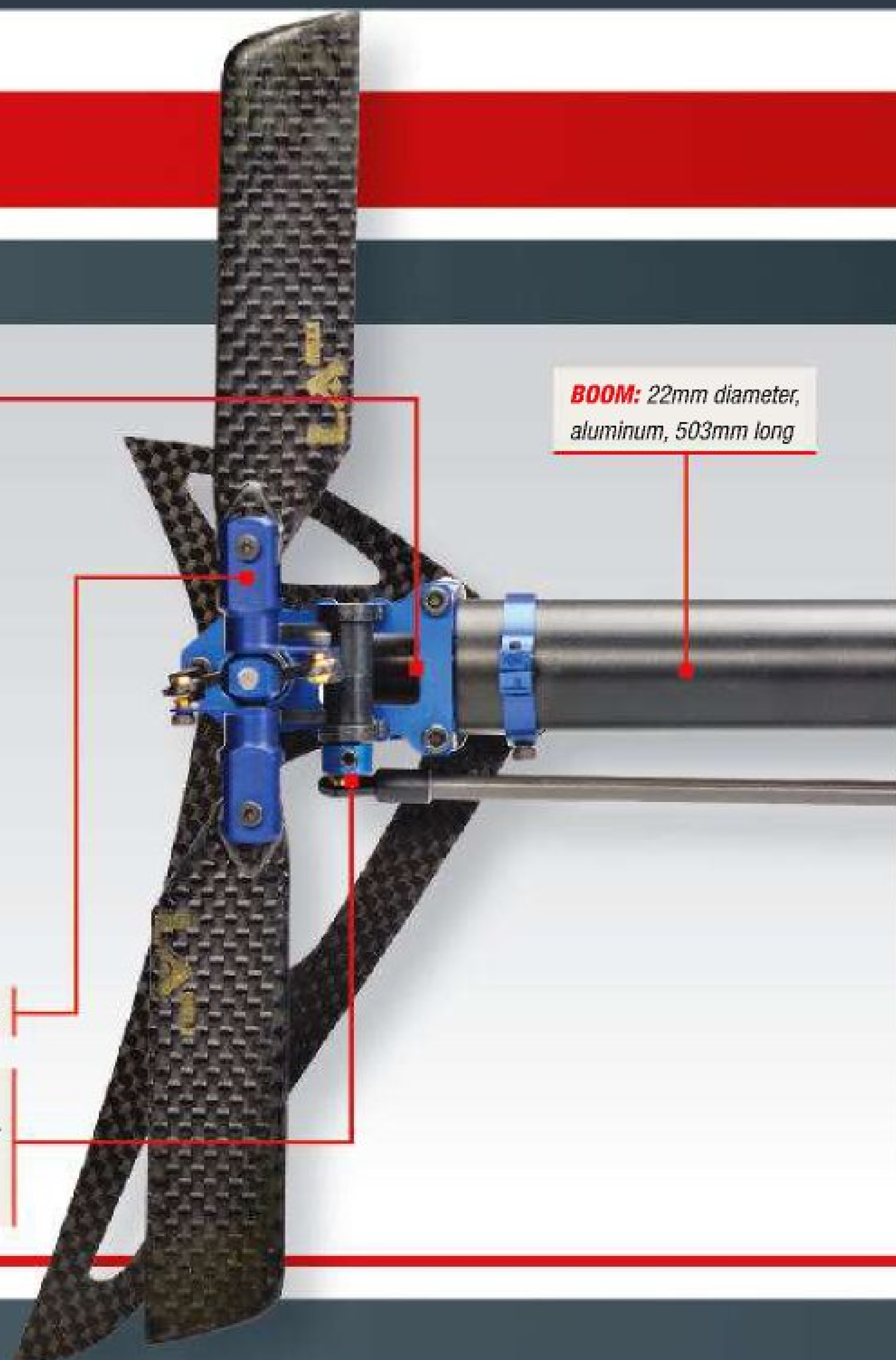
**TAIL CASE:** The torque tube output bevel gear interfaces with the tail output shaft bevel gear in an open aluminum tail case.



**TAIL BLADE GRIPS:** Aluminum, two radial bearings, blade bolt threads into a locknut.

**PITCH ACTUATOR SYSTEM:** The tail pitch is controlled via servo-driven, direct carbon fiber pushrod to a bellcrank that moves the pitch slider. The bellcrank attaches to the pitch slider with two radial bearing supported screws in recessed plastic arms. The tail blade grips are actuated via plastic ball link secondary arms.

**BOOM:** 22mm diameter, aluminum, 503mm long



## » ROTOR HEAD

**HEADBLOCK:** The headblock is an aluminum piece and is attached to the main shaft with both a Jesus bolt and clamping force. The dampers are solid rubber pieces.

**WASHOUT ARMS:** The washout arms are supported by two radial bearings and the radius arms are pinned to the washout arms. The ball link attachments are non-adjustable.



**BELL/HILLER ARMS:** The Bell/Hiller arms are mounted to the main blade grips and are supported by dual radial bearings. These are made of aluminum and are non-adjustable.

**PHASING:** The phasing is non-adjustable and there is negligible slop between the washout guide pins and their notches in the washout base.



## » INSTRUCTIONS & BUILDING TIPS

### WHEN YOU OPEN THE BOX

The canopy is bagged, the tail boom and carbon fiber rods are tucked in against the long side and a separate box contains the remainder of the parts. All of the parts are bagged and labeled to correspond with steps in the manual.

### MANUAL AND BUILD

The included instruction manual is printed in Czech with a loose English translation. The instructions are relatively brief and assume that the builder already has experience with many of the methods of typical model assembly. The manual also includes CAD drawings to aid in understanding the assemblies. Unfortunately, the print quality of these images leaves a bit to be desired when it comes to ascertaining certain parts of the assembly process. Isometric drawings, photographs or more descriptive copy would be welcomed.

While installing the tail drive's bearing blocks into the main frame, I discovered that the lower mounting holes were not properly positioned. When assembled, this caused the gear train to bind. I took measurements, photos and added an illustrated diagram to convey the problem to LAHeli. Their response was less than inspiring. They sent me a new set of side frames with these particular holes elongated. I wasn't impressed with their handling of the problem, since I could have performed this tweaking myself. Given the perceived class of this model, I would have expected a more finished resolve.

I'd also suggest installing the servos and setting up the servo horns before putting the upper frames together or by removing the main shaft. Otherwise, it's extremely difficult to access the servo horn screws and properly set them up to ensure that you wind up with zero subtrim.

## LAHeli SNIPER II

RTF & TEST GEAR

### » SUPPLIED GEAR

- **BLADES:** LAHeli, Blades Symmetrical 47cm GFK, N0670, 1.71 oz. (48.5g)

### » TEST GEAR

- **RADIO:** Futaba, T8FG 2.4GHz radio system, FUTK8001, 28.75oz. (815g), \$450

- **RECEIVER:** Futaba, R6106HF 2.4GHz receiver, FUTL7650, 0.24 oz. (6.7g), \$60

- **CYCLIC SERVOS (3):** Mark Star Servo-tech Co., Ltd., DS-9670 A+ mini servo, DS-9670 A+, 0.97 oz. (27.5g), \$58 ea.

- **TAIL SERVO:** Mark Star Servo-tech Co., Ltd., DS-8910 mini servo, DS-8910, 0.99 oz. (28.2g), \$68

- **SPEED CONTROL:** Castle Creations Inc., Phoenix ICE 100, 010-0061-00, 6 oz., (170g), \$140

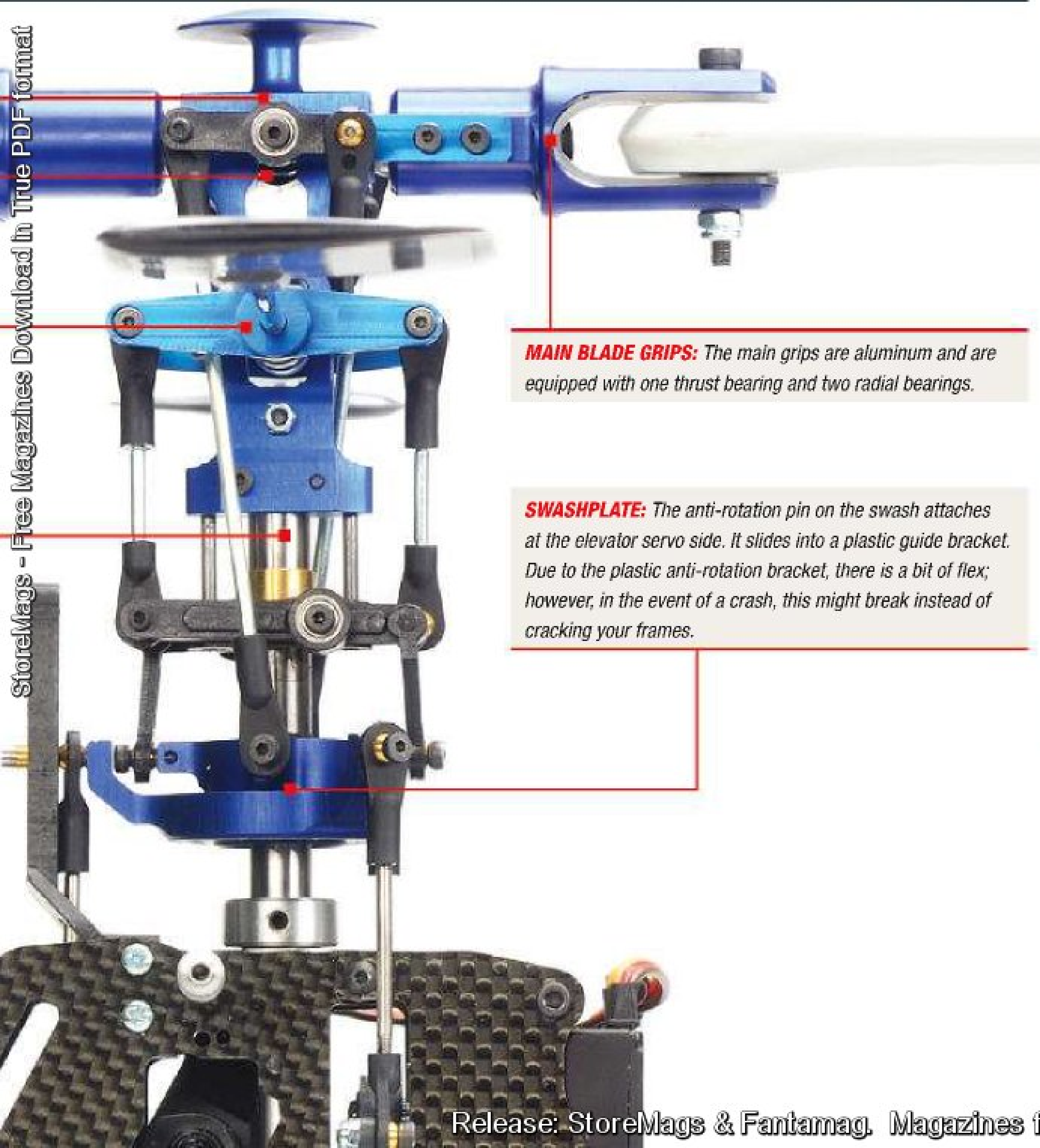
- **MOTOR:** Neu Motors, 1706/1.5y, 1706/1.5y, 5.6 oz., (158.75g), \$145

- **BATTERY:** Outrage RC, NRG 6S1P-2500 25C, NRG25-25006, 15.02 oz. (426g), \$100

- **GYRO:** Spartan RC, Quark, SRC-QKB, 0.28 oz. (8.2g), \$165

- **CHARGER:** Shenzhen Junsi Electronic Co., Ltd., iCharger 106B+, 106B+, 12.34 oz. (350g), \$100

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**MAIN BLADE GRIPS:** The main grips are aluminum and are equipped with one thrust bearing and two radial bearings.

**SWASHPLATE:** The anti-rotation pin on the swash attaches at the elevator servo side. It slides into a plastic guide bracket. Due to the plastic anti-rotation bracket, there is a bit of flex; however, in the event of a crash, this might break instead of cracking your frames.

Where is the ghillie suit?

# TESTING

Despite it being a bit windy out, with gusts nearing 15mph, it was time to get this model loaded up and ready to abuse some air molecules. I opted for very conservative pitch and head speed settings. I expected a relatively sedate first flight, followed by some tweaking to see how wild I could get it before it started to show any bad tendencies. My expectations were about to be shot to pieces!

**HOVERING** • Despite a moderate wind, the model didn't balloon significantly, nor did I feel I had to chase after it. When I gave input, the model reacted and demonstrated a very precise, direct response. The stability was quite good considering the model's wild capabilities. In a calm wind, I'd fully expect this model to sit for a few seconds before needing much corrective input.

**Rating: 4**

**FORWARD FLIGHT** • Staying true to its point-and-shoot theme, the model tracked straight and true through upright and inverted flight. There was no hint of pitching up or down by the nose through elongated, fast circuits. The model really inspires confidence and goes exactly where you want it, without complaint or any strange behaviors.

**Rating: 5**

**CYCLIC PITCH RESPONSE** • During my setup, I thought I'd start by being somewhat conservative on the cyclic pitch range by setting it to 6°. Once I got the model in the air, I was awestruck by the

rapid rolls and flips on such a typically dull amount of pitch. This really illustrated the low disc loading ideology that this model emphasizes. All I could think of was, "Wow! This thing is crazy, it must be psychotic on 8°+!".

**Rating: 5**

**COLLECTIVE PITCH RESPONSE** • As with the cyclic response, with a conservative 20° pitch range the model had explosive collective pop! The only thing conservative was the amp draw, peaking briefly at 64 amps during some Tic-tocks. Again, I presumed that with more pitch I could likely get this model to leap off the ground like a bee stung jack rabbit and ripple time and space while doing it!

**Rating: 5**

**TAIL ROTOR RESPONSE** • Regardless of direction or loading, the tail performed flawlessly. This may be due in part to the buttery smooth tail pitch mechanism which allowed the gyro system to do its job. The tail authority performed as commanded with no blow-outs or other strange tendencies during piro or tail slides. When

the stick was centered after a fast piro, the tail stopped without any bounce, jitter or complaint. It just simply worked.

**Rating: 5**

**AUTOROTATION CAPABILITIES** • The low weight of this model, combined with the low disc loading and larger main rotor disc, allowed for substantially less teeth clenching on autos. With a slight wind, the model seemed to float down, the main blades giving enough inertia to flare, but you still need to be more conservative than a more auto-friendly larger model. Unlike many other models in this class, this one does not drop like a rock, so working the collective in an emergency is much less of a "How much can I not make this hurt?" kind of experience.

**Rating: 4**

**POST FLIGHT INSPECTION** • After a dozen or so flights I found no significant points of wear. The links were wearing in quite well, the gear train was clean, and if anything the model seemed to be flying even more smoothly.

**Rating: 5**



If the Sniper II was actually a gun, what would it load like?



**SYMA**  
RADIO-CONTROLLED PRODUCT

**S032**

3 Channel RTF Co-axial Electric Helicopter w/ Gyroscope

Specification:  
 Product Size: 305mm x 72mm x 150mm  
 Flight Time: Approx. 12 min  
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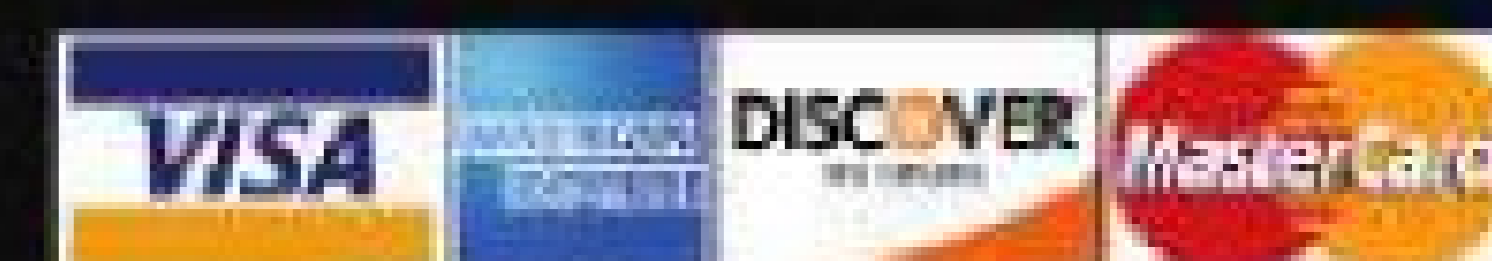
Ready-To-Fly 2.4Ghz 4 Channel Electric Remote Control Co-Axial Helicopter

Specification:  
 Main Rotor Diameter: 450mm (17.7 in)  
 Length: 450 mm (17.7 in)  
 Height: 250 mm (10 in)  
 Flying Weight: 350g (12.5 oz)  
 Driven system: 2x 370 carbon brushed motor  
 Servo: 2x 9g servos  
 Battery: 7.4v 1000mAh Li-polymer  
 Control system: 2.4Ghz RC Transmitter  
 Radio Control Range: 2500 ft (762m)

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# TESTING SPECS

## LAheli SNIPER II

**Part #:** LA-N2000

**Distributor:** ElektroRC

**Web:** www.elektrorc.com

**Street Price:** \$379

**Price as Tested:** \$1,682

**Build/Setup Time:** 8 hours

### PERFORMANCE

**MODE FLOWN:** Normal, idle up 1, idle up 2

**RPM OF EACH** Normal: 2100

**MODE:** Idle Up 1: 2600

Idle Up 2: 2800

#### MOTOR TEMP

(after flight): 112° F

#### BATTERY TEMP

(after flight): 82° F

**FLIGHT TIME:** 4 minutes

**CRASH COST\*:** \$55

### TEST CONDITIONS

**WEATHER:** Party Cloudy

**TEMP / HUMIDITY:** 64° F/77%

**BAROMETRIC PRESSURE:** 29.89 in

**WIND SPEED:** 8 mph

**VISIBILITY:** 7 miles

**ALTITUDE:** 69 ft (21m)

### PITCH CURVES

**NORMAL:** -0, 0, 0

**IDLE-UP 1:** -10, 0, 10

**IDLE-UP 2:** -10, 0, 10

\* includes main shaft, tail boom, spindle, landing gear, flybar, torque tube

### REQUIRED TO FLY

Radio transmitter, receiver, gyro, servos, brushless motor, motor pinion, electronic speed control, battery, battery charger

### WHO'S IT FOR?

While this model flies perfectly well for a beginner, the build requires a bit more experience and capacity for dealing with small parts to assemble it properly. If you're a more advanced pilot, this model's flight performance is only inhibited by your piloting abilities.

### SCORECARD

SCALE RATING: 1=POOR 5=EXCELLENT

<b>2</b>	Instructions
<b>3</b>	Parts Quality/Fit
<b>3</b>	Durability
<b>2</b>	Tunability
<b>4</b>	Overall Performance
<b>4</b>	Value

### + THE GOOD

- Parts issues addressed quickly by manufacturer
- Lightweight airframe compared to peers
- Smooth, precise controls

### - THE BAD

- Manual not up to par, poor English translation
- Performance-minded design compromises ease of setup and service
- Parts quality control issues

## CONCLUSION

The precision and explosive agility this model demonstrates really does justice to its name. Even with conservative settings, the model performed above par for its class and could be, if you so desired, detuned to a gentle sport flier and provide substantially more flight time and maintain the spirited nimbleness. However, when fully maxed out this model flies like a supernatural hummingbird and will quietly take out nearly everything else at your field without breaking a sweat. **FHM**



# HK-500CMT TT 3D Torque-Tube Helicopter Kit Full Carbon Fiber & 6061 Alloy

**\$99.48**

Light weight design provides awesome flight performance and extreme 3D capability  
Rotor Head/Tail With Thrust Bearings  
Direct-To-Swash CCPM Linkage  
Fully Driven Tail Auto Rotation System  
Tail Servo Boom Mount

**Specification**  
Main rotor diameter: 970mm  
Motor pinion gear: 13T  
Weight (without power system): 1370g  
Flying weight: Approx 1700g  
Length: 840mm  
Tail rotor diameter: 200mm  
Main drive gear: 162T  
Drive gear ratio: 1:12.46:4.68  
Tail drive gear: 31T  
Height: 310mm



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# ALIGN TREX 550E

with **MICKEY JOHNSTON**

**WORDS:** Mike Velez

**U**NLESS YOU'RE LOCAL TO THE SOUTHERN CALIFORNIA FLYING SCENE, YOU HAVE NO IDEA WHO MICKEY JOHNSTON IS. But if you're a local and have any TREX running the 3G Flybarless setup, the guy you want setting up your machine is Mickey.

His electronics and mechanics background made him a no-brainer when we asked Align USA who would be a good pilot to help us with our 550E Hook-Up. Not only is Mickey a genius on the setup, he's a pretty darn good pilot to boot.

7th St. Rockstar

**AGE:** 40

**RESIDENCE:** ONTARIO, CA

**FLYING SINCE:** JUNE '08

**SPONSORS:** ALIGN USA,  
ASSURANCE RC

## THE MACHINE

The Align TREX 550E is a great machine. It's bigger than a 450 so it's easier to fly for most, yet smaller than a 600 or 700 which is easier on your wallet. This platform was built around Align's 3G Flybarless System.

## THE MODS

Aside from the general setup specs, Mickey's running a number of different parts on his machine that aren't stock.

**600 TAIL SERVO MOUNT** • To give the tail a more locked-in feel and to help the CG, Mickey went with the tail servo mount from the 600; it's mounted about 1.5" from the frame. When running 5000 mAh packs prior to making this mod, Mickey mounted a quarter ounce weight to the tail frame to help with the helicopter's CG. This mod is safer and has more benefits than adding any weight.



**CANOPY SUPPORTS** • Although not photographed on his 550E (the 500 is shown instead), Mickey runs the 600 canopy supports to the sides of the main frame using the screws for the battery support. These supports help to put a little pressure on the canopy to increase the clearance between the canopy and the main gear. This also helps with reducing vibration, something that Mickey considers a problem.



**600 BOOM SUPPORTS AND TAIL FIN** • Mickey traded in the stock boom supports for those found on the 600. The longer supports are stiffer, sturdier, and help with the CG of the machine (the tail servo mount is responsible for that). When mounting these, be careful of the clearance between the tail rotor and the horizontal stabilizing fin. For rough landings, Mickey opted for the 600-size tail fin as well; this is a little thicker than the stock fin and proves to be more durable. For 3D flight he's ditched the horizontal stabilizing fin, but for pattern flight he recommends keeping it intact.



**DOUBLE UP FRAMES** • One thing that's not easy to spot when you see Mickey's 550E is the fact that the side frames are doubled up. This does add a little weight, but the cost of weight is easily made up for by the added rigidity. Also, when running larger than stock motors like the Scorpion 1100kv shown in the photos, you'll only have to cut away the inner frame and the outside frame will stay intact.



**MOVING THE 3G SENSOR** • The 3G sensor is extremely important; in fact, there's more on this further in the article. Mickey has experimented with running the sensor in a number of different positions on the machine, including the two recommended in the manual. He found that mounting it to the very bottom of the center frame offered the least amount of vibration and made the sensor more accurate. To mount the sensor Mickey likes 3M double-sided tape. The tape is stuck directly to the sensor, that's stuck to a thin piece of metal, and then the plate is mounted to the frame using a Futaba or Align gyro mounting pad. This setup offers excellent vibration isolation from the frame.



## THE SETUP

### THE HEAD

Unlike flybarred helicopters, the mechanical setup of the head is fairly simple. He runs everything at 90 degrees. The washout base arms are at 90, and everything from the cyclic servos up are set at 90 degrees when the blades are at zero degrees. For collective throw Mickey runs +/- 13 degrees on the collective and +/- 12 degrees on the cyclic.



For now Mickey's been running the stock dampers, they have a pretty good all-around feel; he's going to be testing harder dampers shortly and expects them to provide a more crisp feel.

### HEAD SPEED AND BLADES

Although the machine's a 550, Mickey likes running the standard Align 520mm blades. The smaller blades are more responsive than the 550's and tend to load the head less. Running 550's uses more battery power at a 2450 rpm head speed. Using the Align 600M motor, he runs a 17-tooth pinion on the 170-tooth main gear. This is a great power setup that's not too demanding on the batteries. His throttle curve is set for a flat 100%. Currently he's testing a Scorpion 1100kv motor using a 19-tooth pinion on the 170-tooth main gear. It provides a ton of power but yields 4-minute flight times, which leaves greater than 20% left in his battery. With this motor, he's running a 95% flat throttle curve. With this setup, he's set for 2650 rpm on the head speed.

### GEAR MESH

With most molded gears the size of the main gear on the 550E, you'll see a variance in manufacturing that causes tight spots. Always set your gear mesh so that there's a tiny bit a play on the tight spots. If the mesh is too tight on the tight spots it will create a vibration.



### 3G TUNING

With flybarless setups like the 3G, most of the adjustment is done on the computer instead of the mechanics. Mickey's recommended 3G settings are as follows: On the Lock gain, run it in the low 40's for aileron and elevator. By running these on the lower side you'll give the helicopter a more neutral feel and will help to eliminate bobbles. On the Total gain, the range should bet between 65 and 80 for aileron and elevator. Adjust these gains for a stable hover and locked-in feel. On the Stop gains, he's set at 0. He's also had good luck running them at 5. But don't go higher than 5, because can cause the servos to run warmer than normal.

One setting that's important, yet difficult to describe in flight, is the Swash Return Speed. He recommends that the range on this is between 50 and 70; currently he's running at 65 and likes the feel. This is one to experiment with and see how you like it. You'll notice a difference in feel doing piro moves. When you have access to a PC to set the parameters, all of the adjustment pots on the 3G should be set at 12 o'clock.

Don't mesh with my hell fool.

## GEAR

**TRANSMITTER** • Mickey flies all his machines on a Spektrum DX7se. This radio provides all the needed features and then some, along with enough model memory to fly multiple machines.



**CASTLE CREATIONS 100 ICE** • All the power goes through this bad boy and it can definitely handle it. Mickey loves to use the Castle Link to monitor motor performance and to keep track of key information like current draw. If he sees lots of current spikes, he goes down a tooth on the pinion.



### ALIGN SERVOS

The stock servos that come with the Super Combo suit Mickey's aggressive flying style just fine.



### ALIGN 3G FLYBARLESS SYSTEM

This is the stock system and it provides excellent performance for any flying style (see Vibration Reduction Sidebar).



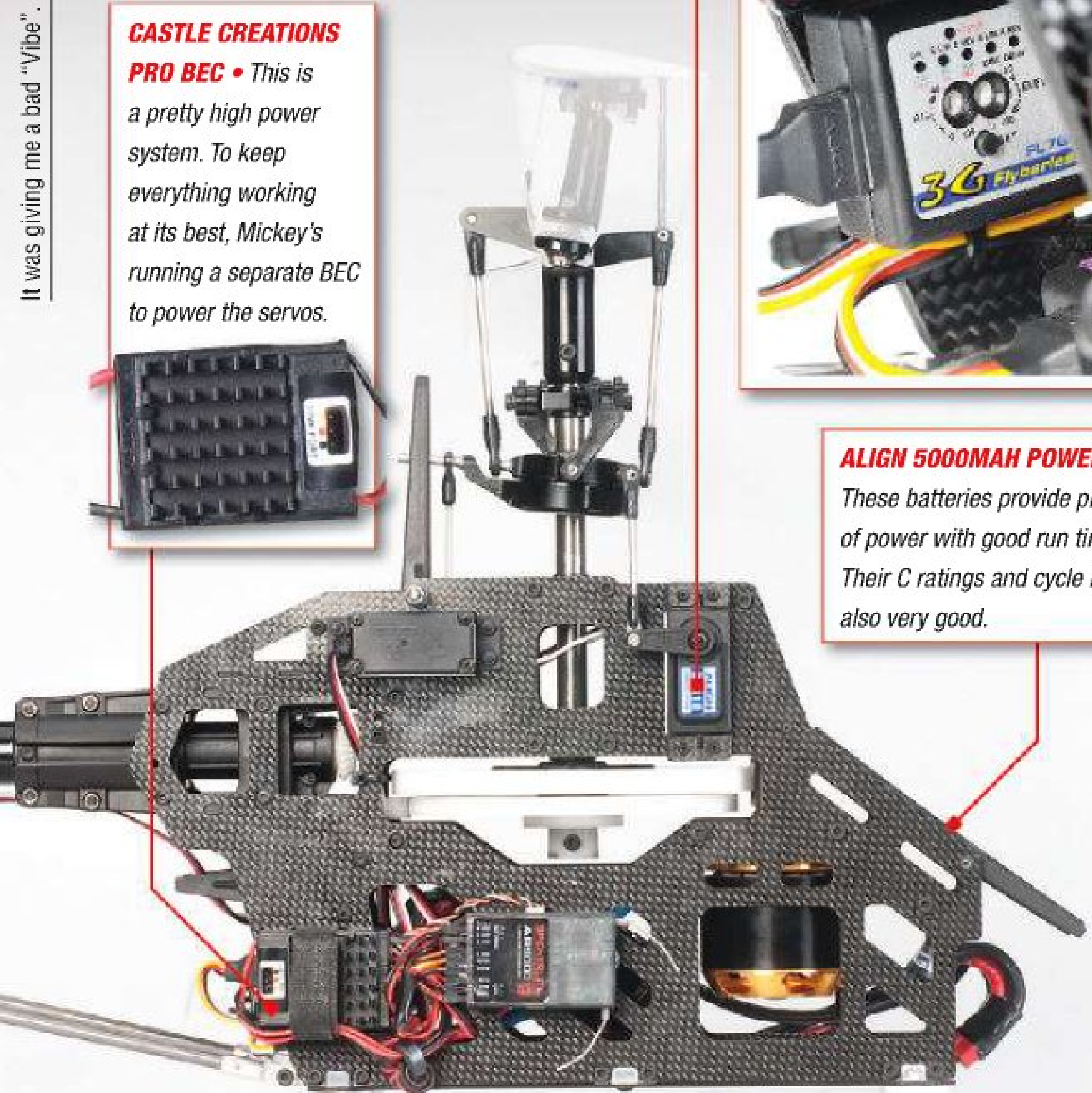
### CASTLE CREATIONS

**PRO BEC** • This is a pretty high power system. To keep everything working at its best, Mickey's running a separate BEC to power the servos.



### ALIGN 5000MAH POWER

These batteries provide plenty of power with good run time. Their C ratings and cycle life are also very good.



# VIBRATION REDUCTION

On any flybarless system (or any helicopter, for that matter), vibration is the enemy. Reducing vibration is extremely important. Along with the tips you've already read about, most Align factory pilots are using a little tip that's simple and easy for anyone to perform. The tip comes from Leon Luke, and new 3G sensors coming out of the factory are being produced with this added amount of vibration reduction.

**STEP 1** Remove the cover that the 3G sensor is housed in.

**STEP 2** Take some clear, electronics safe, anti-corrosive, silicone RTV and apply it to the center of the sensor. The silicone should make a bridge between all three sensors inside the unit.



**STEP 3** - Slowly and gently fit the cover back onto the unit, wipe off any excess RTV that extrudes out the sides. Make sure that no silicone is on the pins of the sensor.

**STEP 4** - Check the cure time on the RTV and allow plenty of time to cure before re-mounting.

Performing this tip helps to allow the three separate sensors to work as designed and improves system performance.

## CONCLUSION

There you have it, an inside look at a 550E setup you'll definitely want to duplicate in your machine. Thanks to Mickey for helping us out with this article. Look for more RC Heli Hook-Ups in the months to come. **RH**



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# FLYBARLESS (FBL) BLADES

What the heck is the difference?

WORDS: Art Koral | ILLUSTRATIONS: Dave Palacios

**M**UCH OF THE RECENT BUZZ IN THE RC HELI UNIVERSE HAS BEEN ABOUT FBL (FLYBARLESS) SYSTEMS. Now that FBL technology has been out for a while, it makes sense that blade designers such as EDGE, Curtis Youngblood Enterprises, and others are focusing their attention on how to better FBL systems by providing a FBL specific blade. It's not as though the FBL systems don't already work with traditional blades, it's just that FBL blades may improve flight characteristics even further. If you're having problems with trim, moving in unwanted directions during maneuvers, and porpoising in fast forward flight, FBL specific blades may lessen or eliminate these unwanted tendencies. In this Heli IQ we plan to explain the design characteristics of FBL blades so that you can make a choice as to whether your current blades are worth exchanging.



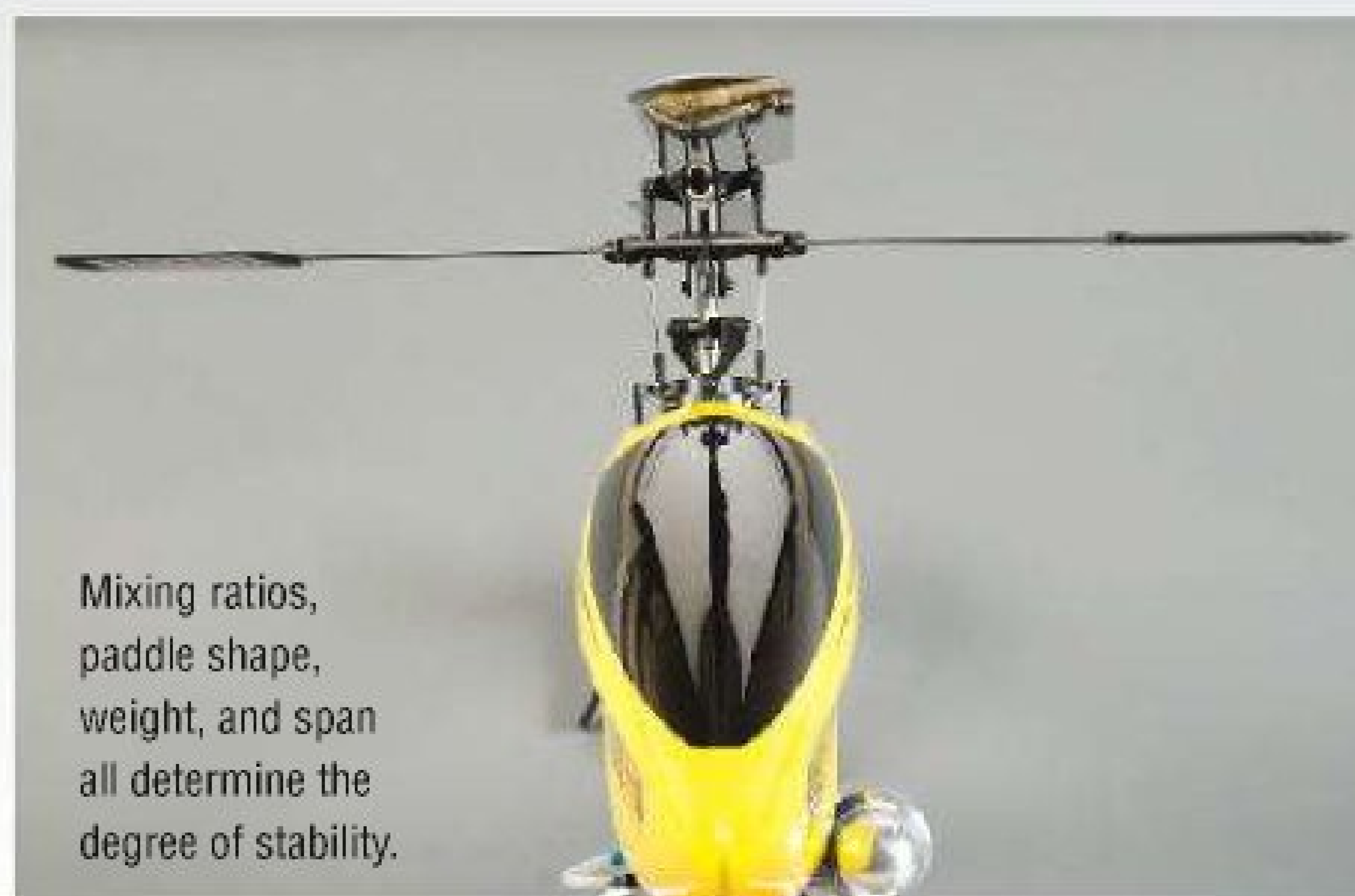
Are flybarless blades that different?

## » DIFFERENCES BETWEEN FBL AND FB SYSTEMS

Before discussing FBL blade design it's worthwhile to review the fundamental difference between FBL and FB systems. The purpose of a helicopter's stability system is to maintain solid track (direction) and orientation in all modes of flight unless commanded by the pilot to change direction. Whether upside down, knife edge, or in fast forward flight, once you take your hands off the sticks the helicopter should remain in the last orientation it was placed in, tracking in the last direction it was commanded to go. When maneuvering, the stability system should keep the helicopter from rotating about any other axis other than the one intended.

With a flybar system, locked-in orientation is accomplished by infinite input from the gyroscopically stable flybar. Any disturbance - such as a wind gusts - would be counteracted to a degree by the flybar. If the pilot wants to maneuver, a mixed control input from the servo and flybar, along with the paddle's washout controls, would cause the flybar to fly to a new reference plane and the helicopter would instantly follow, maintaining orientation in the non-rotating axes along the way.

During fast forward flight, dissymmetry of lift causes the helicopter to pitch up and slow down. The flybar aligns itself with the relative wind and thus actuates the rotor disc to keep tilting forward without additional stick input. Stabilizing control input is immediate. To change the degree of stability, paddle weight, aspect ratio, and span can be adjusted along with mixing ratios.



Mixing ratios, paddle shape, weight, and span all determine the degree of stability.

Like the flybar, flybarless systems have the same goal of locked-in orientation. Instead of using a mechanically coupled flybar to do the trick, state of the art gyro sensors, electronics, and control algorithms are employed. The sensors, programming, and servo performance determine the system response characteristics. It's important to note that even though FBL systems have many advantages, they do add additional work on the servos. Unlike a flybarred helicopter that uses the flybar for stability and servos for maneuvering, the FBL system uses the servos for everything. Servo loading becomes a more critical factor and may affect the FBL system's capabilities.

Electronics and tuning determine flight characteristics.



What else can you balance on your finger? Perhaps a broom!

## FBL VS FB BLADE DESIGN DIFFERENCES

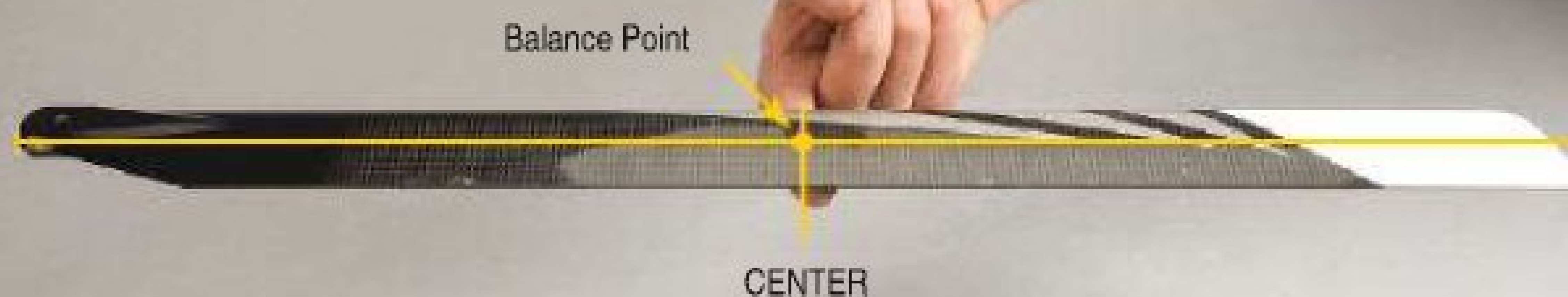
# PURPOSE BUILT BLADES

I was fortunate enough to discuss FBL blade design with Radix blade designer and World Champion Curtis Youngblood. When I asked Curtis what the key flight characteristics of FBL specific blades are, he explained they provide added gyroscopic stability and are less aggressive or "pitchy". He explained that a blade is typically more stable if it locates more of its mass towards the tip than the root. This outward weight increases the rotor disc's gyroscopic stability. (Incidentally, this increases rotational inertia, providing the ability to store more energy for autorotations.)

More gyroscopically stable blades tend to be heavier and balance closer to the tip.



Less gyroscopically stable blades tend to be lighter and balance closer to the root.



Curtis then explained that an aggressive blade tends to pitch up, assisting the servos while increasing pitch angles and resisting commands that bring the pitch to zero. A non-aggressive blade wants to return to zero pitch, resisting the servo when maneuvering. Blade aggressiveness is determined by a number of factors including airfoil shape, chord length, and blade thickness.

# CURTIS YOUNGBLOOD

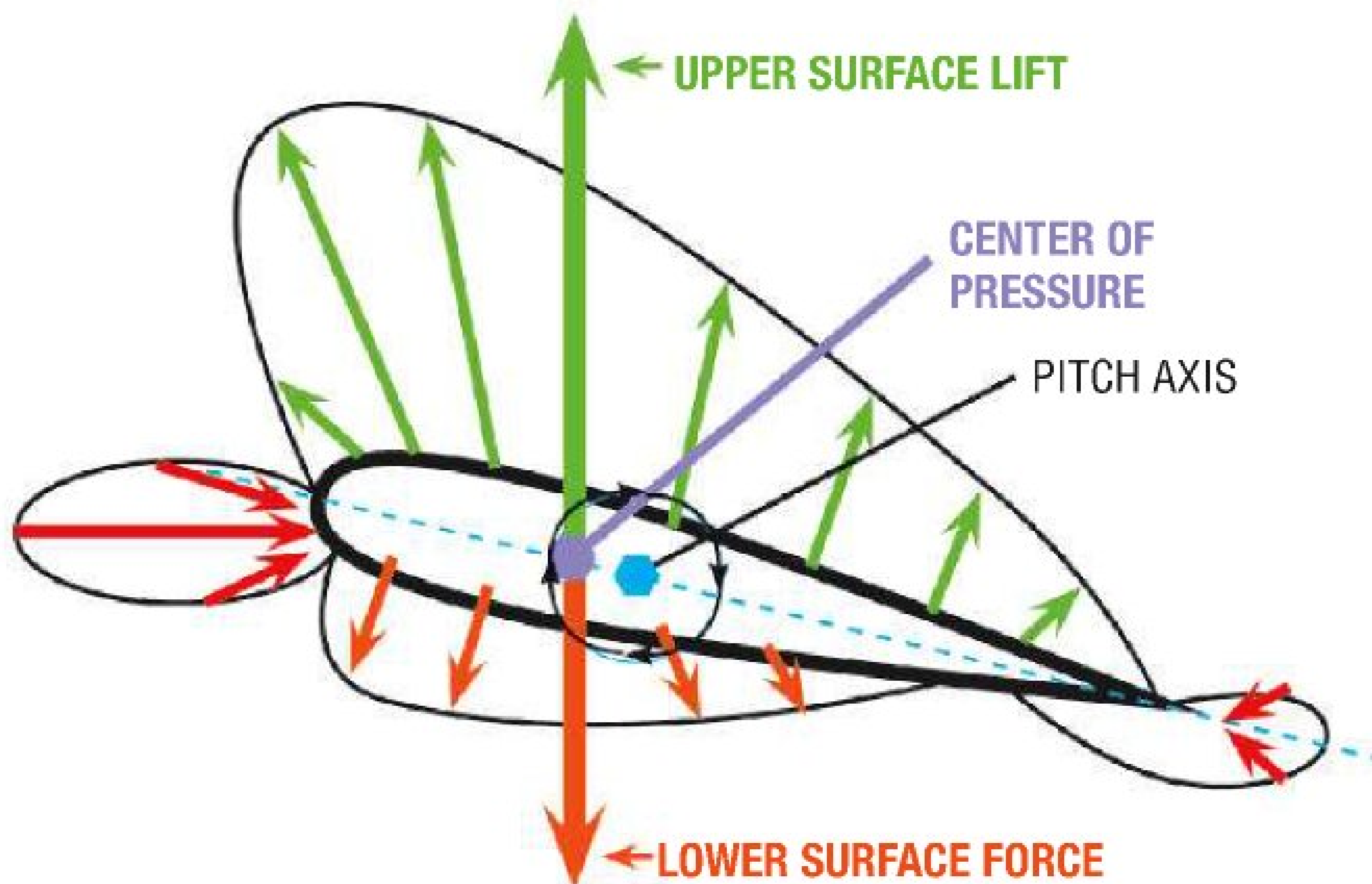
To help write this article I had the privilege of interviewing Curtis Youngblood, who has over 30 years of RC helicopter experience. He has achieved several 1st place rankings in 3D and FAI World championships. Curtis is also the designer of Radix blades and the Total G FBL system. He has a rich understanding of how blade design affects helicopter flight performance.



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## FLYBARLESS (FBL) BLADES

According to Curtis, there is one common factor among all the variables that directly affects the blade's aggressiveness – the location of the center of pressure relative to the blade's pitch axis. Center of Pressure (CoP) is the location where all of the lift force would act if it was concentrated in one spot. If the blade's CoP is located in front of the blade's pitch axis, it will create a moment about the pitch axis that will assist the servos to increase pitch and resist the servos to decrease pitch, causing the rotor system to be "pitchy". *Blade flutter is a symptom of an aggressive blade and is often exacerbated by excessive blade flex and loose pitch change links.* If CoP is located behind the pitch change axis, the opposite would occur and the forces would assist the servos in restoring the blade to zero pitch.



The position of the CoP relative to the pitch axis is determined mostly by how the blade balances relative to the bolt hole at the root. When suspended by a string and the blade swings toward the leading edge, the center of pressure will move forward. If the blade swings toward the trailing edge the center of pressure will move backward. During flight, centrifugal forces are the dominant forces acting on the blade aligning the center of pressure as though it was statically balanced from the bolt hole.

FBL blades are designed to be leading edge heavy, swinging the blade toward the trailing edge and moving the CoP backwards. This is why you'll see that FBL specific blades have no lead and maybe just a little bit of lag.

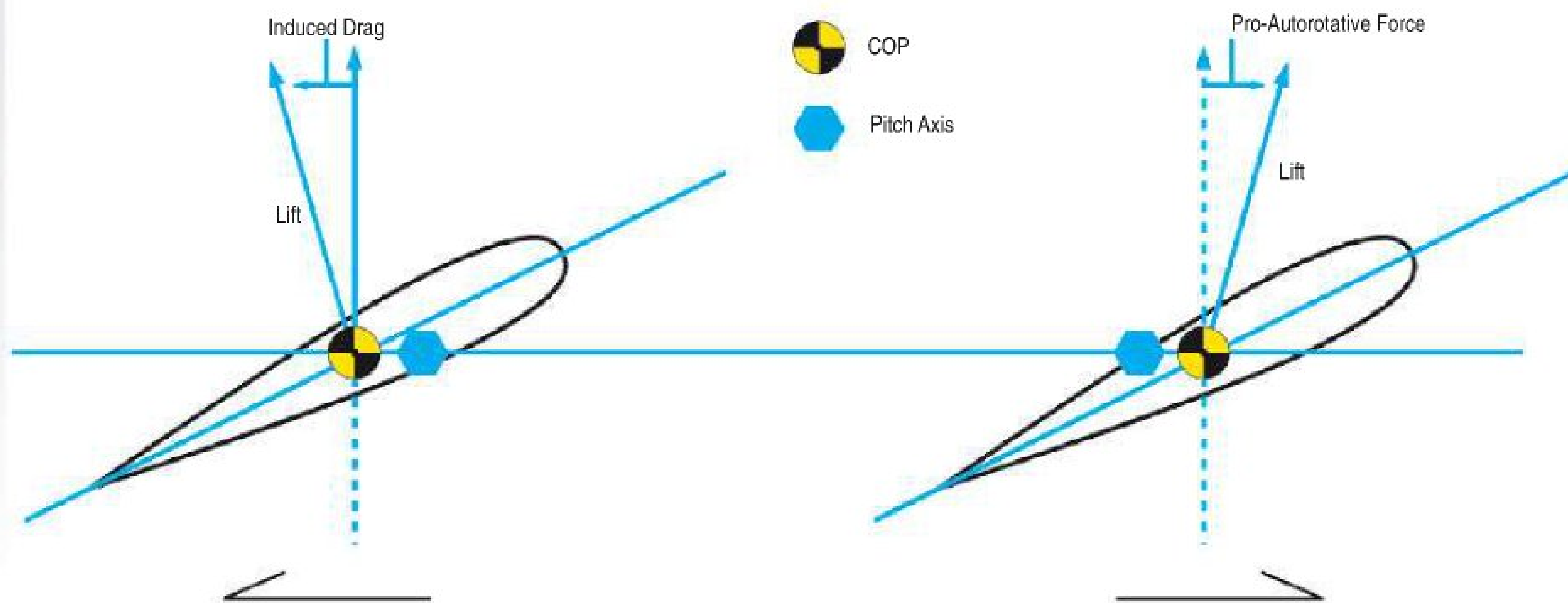


When balanced by the bolt hole, less aggressive blades tend to have more lag (right) and more aggressive blades tend to have more lead (Left).

A forward CoP relative to the pitch axis creates a moment that wants to increase pitch angle. Moving CoP aft relative to the pitch axis will create a moment that decreases pitch angle.

Class is in session.

If centrifugal force was the only force acting on the blade it would be easy to lock in the CoP relative to the pitch axis. Drag forces and pro-autorotative forces also influence lead and lag. During pitch maneuvers, drag forces will cause the blade to lag in flight, moving the CoP backwards. During autorotation, pro-autorotative forces cause the blade to lead ever so slightly. This variation in the location of CoP causes servo loading to change constantly.



During thrusting flight (left), drag forces move the CoP rearward relative to the pitch axis. During autorotation, pro-autorotation forces drive the blade forward relative to the pitch axis. The exact positions are not as indicated in the drawing. The illustration is for relative movement only.

## FLYBARLESS (FBL) BLADES

Because of all the different variables that contribute to blade performance and the relative position of the CoP, Curtis goes through an extensive trial and error process to find the right blade for the right application. There are currently four types of CY Radix blades on the market: FAI, FBL, Standard, and Stick Banger (SB). In that order, the FAI blades are the most stable and least aggressive and the SB are the least stable and most aggressive. For FAI flight, stable, less aggressive blades are desirable to limit the effect of system disturbances and unwanted stick inputs. In contrast for flybarless helicopters in 3D flight, SB blades are often desirable to have the most rapid maneuvering capability possible. In the case of FBL helicopters, a more stable blade does not limit maneuvering capability in any way. FBL systems simply offer better control characteristics when using a FBL blade.

According to Curtis Radix FBL blades were optimized with added gyroscopic stability and a balance in mind to limit the aggressiveness of the blade for more predictable servo loading through flight. The CoP is not set forward, causing the FBL system to work hard in overcoming blade flutter and added servo load when restoring the blade to zero pitch. The CoP is not set too far behind the pitch axis, either. A far aft CoP would unnecessarily increase the servo load when adding pitch and thus slow the system response to a disturbance. Instead, FBL blades are designed just right to limit any adverse control interaction with the FBL system.

FAI



Radix



FBL



SB



From top to bottom the FAI blades are the most stable and least aggressive and the SB are the least stable and most aggressive.

## CONCLUSION

I hope what you take away from this article is that there isn't any real magic to flybarless blades. They simply give you another option in fine tuning your FBL system. Your stock blades may already have just the right level of stability and aggressiveness to complement a FBL system perfectly. Before making the switch, make sure that your blades aren't already providing what you need. You can see how they statically balance by a string and compare their relative weight and length-wise balance point to other blades you might try. If you see you already have blades that may support FBL stability, I would keep trying to fine tune your system. If you know you're using a less stable and aggressive blade and the FBL system is struggling to maintain orientation and track, give FBL blades a shot to see if they help out. *(T.H.I.)*

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# HOVER FLIP & HOVER ROLL

Tuck and Roll

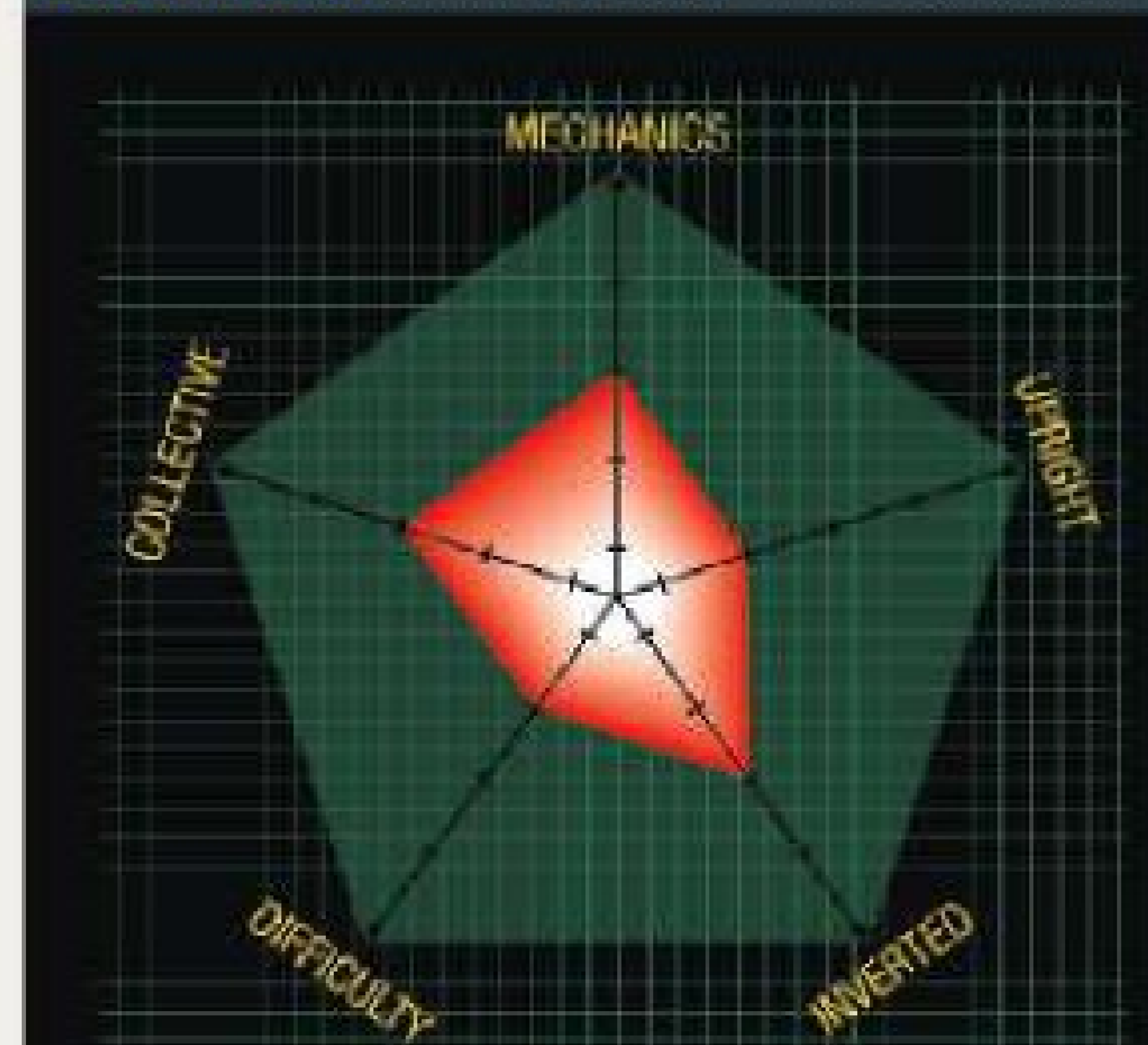
WORDS: Daniel Colby

**T**his Flight School is directed to the beginner who is transitioning into basic 3D. Hovering is everyone's first step; every pilot has to know how to hover in order to move up to the next level, which in this case will be learning how flip and roll your helicopter while hovering. It can be intimidating at first—new orientation and stick inputs will take some getting use to, but once you have accomplished this many doors will open for you.

## Flight School Training

### » SKILLS NEEDED

SCALE RATING: GREEN = Easy / RED = Advanced



**WARNING:** Only perform these maneuvers under safe conditions and in a large open area or designated flying field away from power lines, building, traffic and populated areas. Make sure you are familiar with your helicopters controls and can perform basic flight maneuvers.

### SETUP:

When you're ready to go from basic hovering to more advance moves, you want to make sure that you have your helicopter set up to do so. Make sure that you have an even pitch range of at least +/- 10 degrees at the top and bottom and zero degrees at center stick. Also, make sure that all servo arms are 90 degrees to their designated pushrod

when at mid stick. If your helicopter is a nitro machine, make sure to have a V-curve in your throttle curve setting; for example, 100 percent at high stick, 65 percent at mid stick, and 100 percent at low stick. For those of you running electric, a 70% to 80% straight throttle curve will work. For both setups, don't forget you need to be in Idle-Up to achieve this maneuver.

### HOW TO PREPARE:

■ **BEFORE TRYING** either a flip or roll, you always want to make sure that you have sufficient altitude to recover from mistakes. This is important especially if you don't have a simulator to practice on. Also, be sure to fly in a safe area away from people. An out of control helicopter can get nasty really fast.

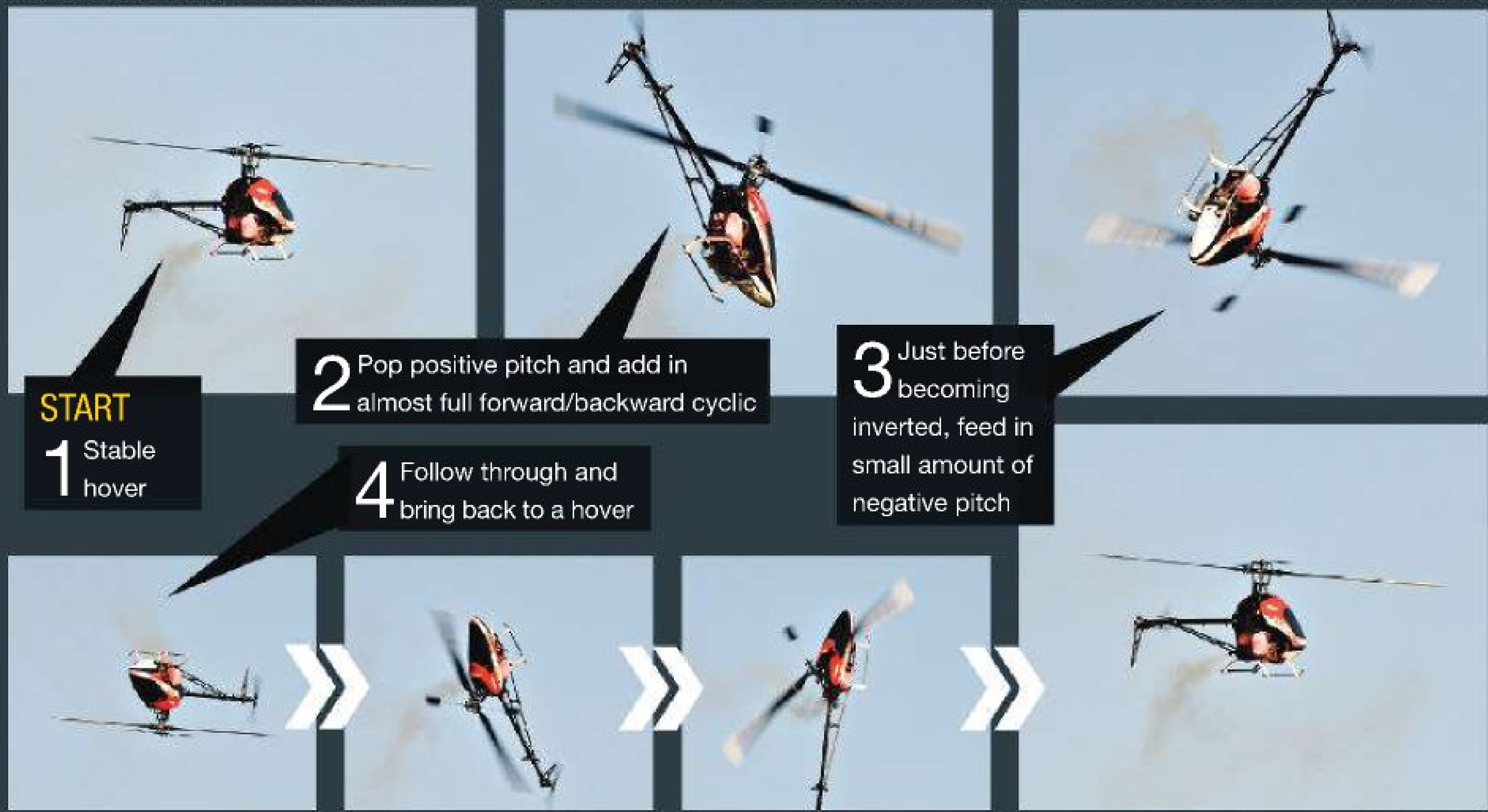
■ **THE BEST WAY** to get ready for this maneuver is to be confident in your skills. Figure out witch inputs will feel more natural to you. We'll start with a front flip. Once at a safe altitude, get your machine into a stable hover. Pop in a little positive collective and feed in a decent amount of forward cyclic. Once inverted, feed in a

small amount of negative pitch to sustain altitude while continuing to feed in forward cyclic. As the helicopter comes back around, put it back into a hover. Remember this all happens with in a second, so try to keep both the collective and cyclic sticks centered as possible; this will help keep the helicopter from moving left or right and making you lose orientation. If you want to roll it's almost the same exact inputs, but instead of forward cyclic you will feed in either left/right cyclic.

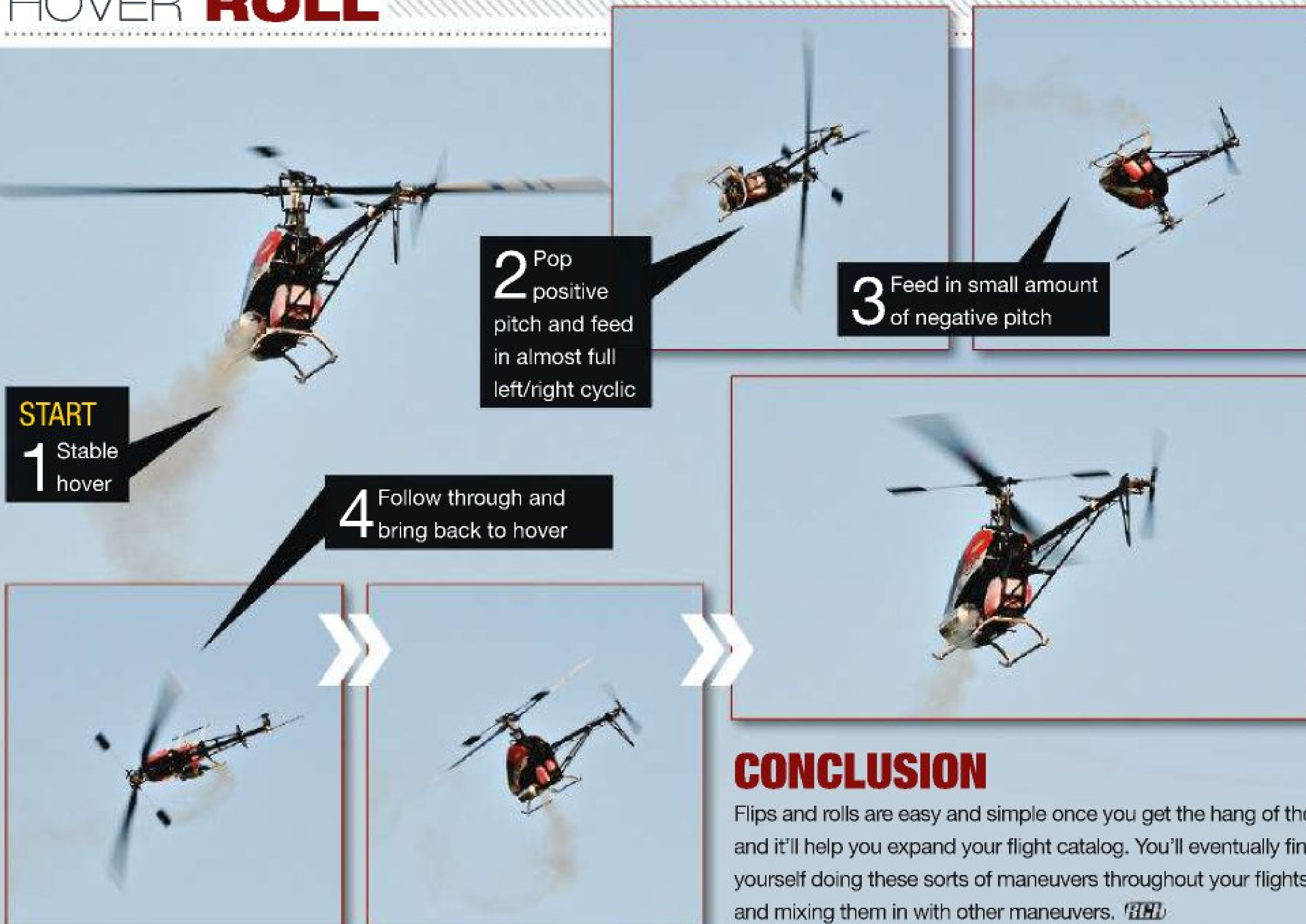
### WATCH OUT FOR:

■ **WATCH YOUR ORIENTATION**—Even though you will only be inverted for a split second, that's all it takes to loose your heading. Remember that once you're inverted your collective is reversed, meaning your positive becomes negative and vise versa. When inverted with the nose towards you, the cyclic is reversed but the tail stays normal. When inverted with the tail towards you, the cyclic is normal and the tail is reversed.

## HOVER FLIP



## HOVER ROLL



Flip that bird.

# FLIPPING HURRICANE

Storm Chasing

WORDS: Ryan Kephart

**H**ow do you mix a normal forward Hurricane with an inverted backwards Hurricane? Welcome to the world of transitions and the Flipping Hurricane. This maneuver is one of the most dramatic moves performed by top pilots when accomplished correctly. It's a matter of timing, speed, and precise control. The Flipping Hurricane is basically two different styles of Hurricanes mixed into one maneuver. While whipping around the field in a big circle, a quick transition transfers the forward motion into a reverse motion and the maneuver is continued around for another full rotation. Some pilots like to make several transitions throughout the Hurricane to increase the difficulty, but for this article we will show you the basics and only use one transition per revolution.

**3** Add a little more collective to gain a little elevation before your transition. Then quickly center your collective and apply full elevator cyclic to rotate the helicopter 180 degrees.

## START

**1** Start by gaining some speed in forward flight, then roll the helicopter over and add some additional collective to hold the elevation while turning.

**2** Add some additional cyclic roll if needed to get your helicopter as close to 90 degrees to the ground as possible before your transition.

Ryan thinks he's the Reed Tinner of the Flipping Hurricane.





**4** Now, quickly add some negative collective and back cyclic to continue the maneuver with a backwards inverted Hurricane.

## » Flight School Training

### » SKILLS NEEDED

SCALE RATING: GREEN = Easy / RED = Advanced



**WARNING:** Only perform these maneuvers under safe conditions and in a large open area or designated flying field away from power lines, building, traffic and populated areas. Make sure you are familiar with your helicopters controls and can perform basic flight maneuvers.

### BASIC SETUP:

**MUCH LIKE ANY 3D MANEUVERS**, the Flipping Hurricanes requires a helicopter set up for 3D with quick cyclic response, linear pitch curves, and Idle-Up throttle curves. You'll also want to use some sort of expo to soften the control feel around center stick. This allows you to lock in your Hurricane and keep you from over-correcting. If you're comfortable with a fast response, then expo does not have to be used. Try flying a few standard Hurricanes and see if you can keep the same altitude and diameter without expo. If you find it hard, you may want to add a little just to get that locked-in feel required for this maneuver.

### HOW TO PREPARE:

**PREPARING FOR THE FLIPPING HURRICANE REQUIRES A LITTLE WORK** and stick time to perfect. The first thing you'll want to get down is the upright forward and inverted backwards Hurricane. Keep practicing

these maneuvers until you can remain at one altitude while the helicopter is locked in. This will require smooth cyclic corrections while maintaining enough collective to keep the maneuver moving and locking in the altitude.

Once you have these two maneuvers down, you'll be set up for the transition. To practice this type of transition you'll want to gain some altitude and hold a hover about three mistakes high. Perform a half roll so that your helicopter is laying on its side. Now, apply full elevator cyclic until the helicopter is facing the opposite way. This is much like a Death Spiral. After getting a feel for the cyclic requirements for the transition, try flying in a straight line at a high altitude and performing a half roll, then half flip and flying out backwards inverted. This will prep you for the forward movement transition during a Hurricane. Now, mix everything you have learned into one and give it a try at a high altitude. Once you have mastered this at a higher altitude, work on bringing it down until you are performing this maneuver at eye level. This may take some time, but practice makes perfect.

### WATCH OUT FOR:

**YOU'LL WANT TO BE CAREFUL WITH THIS MANEUVER**, especially if you're transitioning close to yourself. You may want to try to transition when you are moving away from yourself in case you lose orientation, or in case the helicopter has a mechanical failure. Keep this move high at first and always look around the area to make sure that you will not hit any trees or obstacles.

## CONCLUSION

The Flipping Hurricane can add excitement to any flight routine. "Big air" maneuvers are getting bigger and bigger at competitions and the Flipping Hurricane fits into this category. Its giant high-speed circle can be performed low to the ground or high in the sky and still wow the crowd, especially if you "flip the bird" right in the middle of the maneuver. **TIP!**

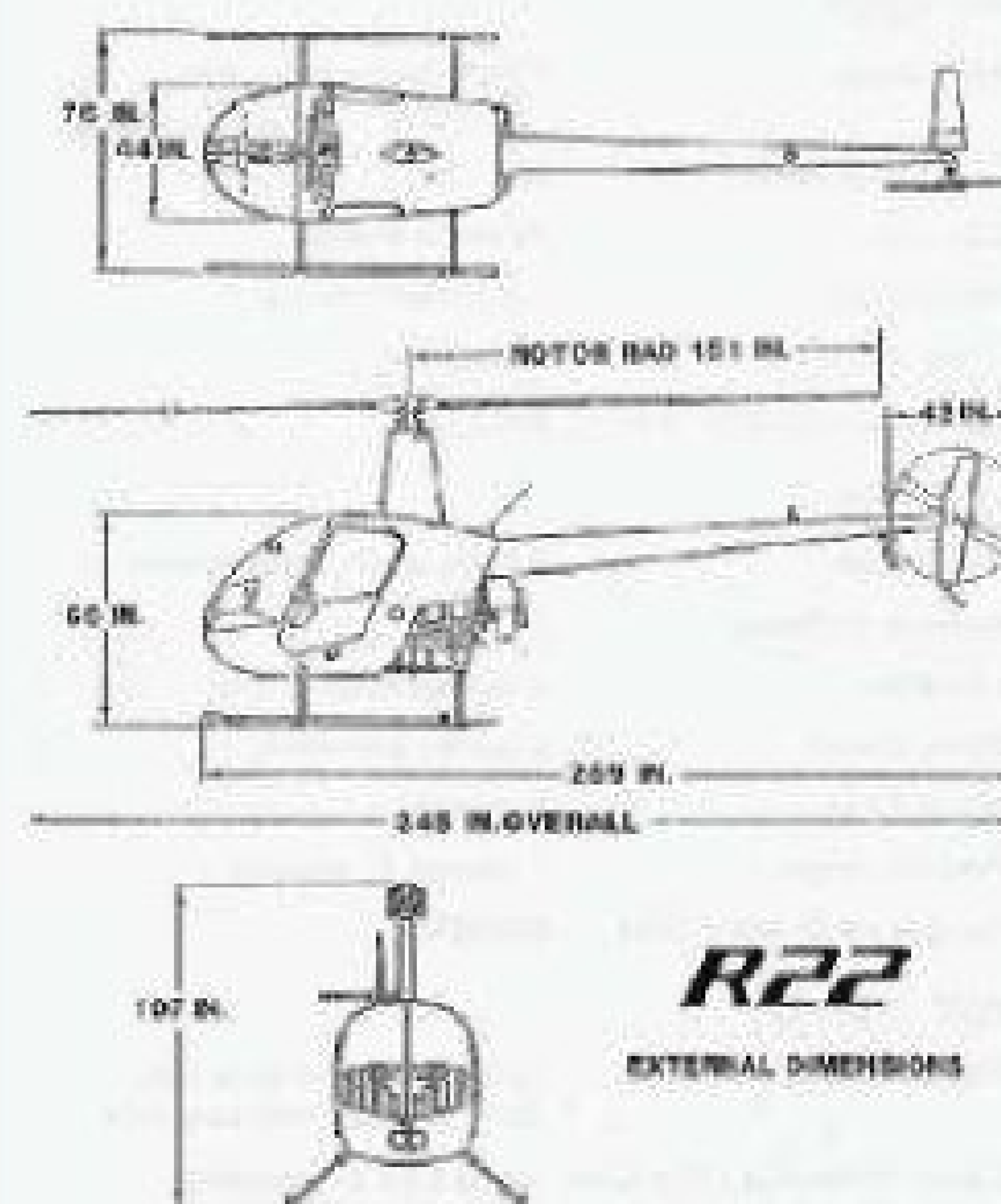
Ryan refers to his Scion TC as the TIV.

## SPECS

**CREW:** 1  
**LENGTH:** 28 ft 8 in (8.7 m)  
**ROTOR DIAMETER:** 25 ft 2 in (7.7 m)  
**HEIGHT:** 8 ft 11 in (2.7 m)  
**DISC AREA:** 497 ft<sup>2</sup> (46.2 m<sup>2</sup>)  
**EMPTY WEIGHT:** 796 lb (389 kg)  
**MAX TAKEOFF WEIGHT:** 1,370 lb (635 kg)  
**POWERPLANT:** 1Y Lycoming O-320-A2B or  
 -A2C flat 4 piston engine, 124 hp (93 kW)  
**MAIN TANK TOTAL CAPACITY:** 19.8 US  
 gallons (75 liters)  
**MAIN TANK USAGE CAPACITY:** 19.2 US  
 gallons (73 liters)  
**OPTIONAL AUX TANK TOTAL CAPACITY:**  
 10.9 US gallons (41 liters)  
**OPTIONAL AUX TANK USAGE CAPACITY:**  
 10.5 US gallons (40 liters)

## PERFORMANCE

**MAXIMUM SPEED:** 117 mph, 189 km/h, 102 kts  
**CRUISE SPEED:** 110 mph, 177 km/h, 96 kts  
**RANGE:** 240 mi (386 km)  
**SERVICE CEILING:** 14,000 ft (4,267 m)  
**RATE OF CLIMB:** 1,200 ft/min (6.1 m/s)  
**DISC LOADING:** 2.61 lb/ft<sup>2</sup> (13.7 kg/m<sup>2</sup>)  
**POWER/MASS:** 0.095 hp/lb (0.147 kW/kg)  
**ENDURANCE:** 2 hours, with 30-minute reserve



# ROBINSON R-22

## The Favored Trainer

**WORDS:** Ryan Kephart

**F**RANK ROBINSON FOUNDED ROBINSON HELICOPTER COMPANY IN 1973. This small yet popular company employs about 1,200 people and produces more helicopters annually than every North American manufacturer combined. What makes this company so popular? It's the helicopter that started it all, the Robinson 22 or R-22. This small, two person, normally aspirated helicopter is used around the world as the all around favorite training helicopter. The low operating and acquisition cost make this helicopter the primary rotorcraft trainer liked by many. Let's take a look at the R-22 and find out why this helicopter is so popular.

### BACKGROUND

The R-22 has a single engine, semi-rigid two bladed main rotor, and two bladed tail rotor. The main rotor is designed with a teetering hinge and two coning hinges that are controlled by a unique "T-Bar" cyclic stick. This design allows passengers and pilots to enter the R-22 easily. The R-22 does not use any form of flight assist, and instead is controlled using direct linkages combined with a series of pushrods. This makes the R-22 more sensitive than most helicopters and requires a light touch on the controls. Much like this hobby, if you can fly a small conventional helicopter then you can fly anything.

The R-22 is built with a basic structure made from chro-moly steel tubing with fiberglass and aluminum panels. The canopy is made from Plexiglass, allowing a curved windscreen to increase the visual area outside of the helicopter. The cabin doors can be removed for photography flight and hotter temperatures. Several versions of the R-22 are in production, including the R-22HP (bigger engine), R-22 Alpha (extended rear struts), R-22 Beta (added an engine governor, rotor brake, and auxiliary fuel tank), and the R-22 Beta II (revised Lycoming engine). Many other versions of the R-22 are made for special

operations such as a Police helicopter, Mariner for off-shore work, and an IFR trainer to achieve an instrument rating. The R-22 is also used as a platform for several unmanned flight systems, including the Maverick UAV for the military marketed by Boeing, and the Renegade UAV built for DARPA.

### CONCLUSION

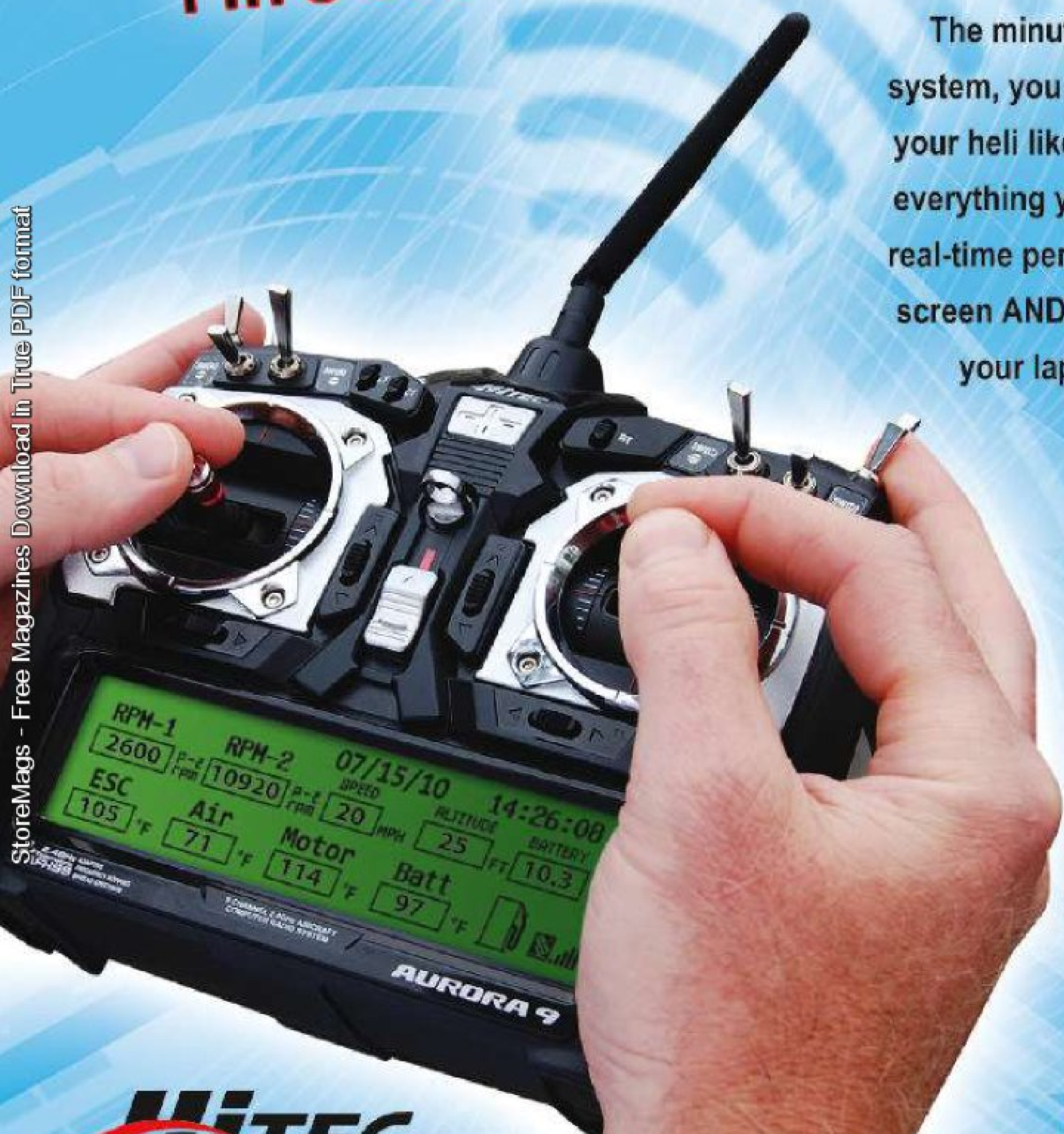
Needless to say the Robinson R22 is a great training helicopter that has brought many professional pilots from the beginner stage to the career they have today. Do you want to be a helicopter pilot? Take a discovery flight today! **RH**



# Get Smart!

## Plug Into Your Heli With Hitec's New Telemetry System

The minute you plug into our new telemetry system, you will feel empowered and in charge of your heli like never before! This system tells you everything you need to know. You can view your real-time performance data on the Aurora 9 touch screen AND capture the information stream with your laptop using our HPP-22 interface.



Purchase an Aurora 9 between now and December 31st and we'll throw in the HPP-22 for FREE!  
For complete details, go to [www.hitecrd.com/auroraoffer](http://www.hitecrd.com/auroraoffer)

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# FLIES BIGGER THAN IT LOOKS

**SPEKTRUM**  
Patented Spektrum™ 2.4GHz  
technology included.



## 120 SR

While the new 120 SR is certainly small enough to fly inside, Blade has optimized its power, size and control authority so that it feels like a bigger heli when you fly it outside, even if there's a little wind. At the heart of this impressive performance is a Bell-Hiller head design that gives the 120 SR the kind of speed and agility you would expect from a single-rotor heli plus some of the "hands off" stability of a coaxial heli. It also features adjustable swash sensitivity that lets you tweak it for more aggressive control response when you're ready.

Check out the Blade 120 SR at your favorite Blade retailer or get details, video and more at [bladehelis.com](http://bladehelis.com).

AVAILABLE IN:	<b>RTF</b> BL120SR	<b>BNF</b> BL120SR
LENGTH:	12.5 in (318mm)	
HEIGHT:	5.0 in (130mm)	
FLYING WEIGHT:	3.75 oz (106 g)	
ROTOR DIAMETER:	12.5 in (318mm)	
MAIN MOTOR:	Brushed (installed)	
TAIL MOTOR:	Coreless (installed)	
ON-BOARD ELECTRONICS:	5-in-1 receiver/servos/mixer/ESC/gyro (installed)	
BATTERY:	1S 3.7V 500mAh Li-Po (1 included)	
CHARGER:	Celectra™ DC Variable Rate Li-Po with AC adapter (included)	
TRANSMITTER:	MLP4DSM 2.4GHz DSM2™ 4-channel (included with RTF only)	

# BLADE

## #1 BY DESIGN