

# Beginner's Guide to turbine jets

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*Learn what it takes to join the turbine jet community Article and photos by Peter Goldsmith Featured in the June 2014 issue of Model Aviation.*

Jets are one of the most aspirational and biggest growing segments in fixed-wing RC. Ten years ago, the buzz at the field was about 40% International Miniature Aerobatic Club (IMAC) type aircraft. People would boast, "I own a 40 percenter." Today, the buzz is about jet turbines. Most of the larger segments of RC are seeing event attendance stabilizing or reducing, but the jet community is seeing substantial growth. This is largely because jets are just so cool, and are now heavily supported by the explosion of decent-quality, highly prefinished ARFs. Turbine operation has become easier and there are more options for the consumer. I see many of my old friends whom I competed against in F3A and IMAC gravitating toward jets. It's fulfills our need to immerse ourselves in the hobby. It's said that we are in tough economic times, but the jet community seems to still find a way to fund its projects and attend events.

## Choosing a Model

You first need to determine how much you plan to spend. Although the cost of entering the jet scene has reduced dramatically in recent years, it's still expensive. I use the term "emotional debt level," which means how committed you are to investing on your next aircraft. If you only want to experiment, your emotional debt is low and you have an exploratory limit that you're prepared to spend. If you want to immerse yourself, your emotional debt is high and you will be more willing to spend more. Based on my experience, you get what you pay for. There are no cheap shortcuts. Invest in the best equipment you can afford—whether it is the airframe, turbine, radio equipment, servos, etc.—and you will be assured of greater success. There are many airframe choices, so I will make suggestions based on my experiences. A great place to start for a first jet would be a BobCat or a KingCat. Both designs are great-flying, easy-to-set-up aircraft with basic systems incorporated for the entry-level jet pilot. They are in the higher price range, but are the pinnacle of jet engineering. If you're emotionally committed to getting into jets, this is a great place to start. For those of you who want to try before you commit, the balsa ARF models are a less expensive alternative, but you must be resourceful in organizing the support equipment for completion

and have savvy modeling skills. If your skill level is high and you're comfortable flying faster aircraft, then Bandits and Shockwaves are great choices. They are slightly more complex and fly faster, yet are well engineered and have good service and support and offer spare parts. If you want to try a Scale jet, I suggest most of the early jets or jet trainers. Scale jets are cool but they cost slightly more and are more complex. I currently own a Skymaster MB-339, a T-33, a BAe Hawk, and a Cougar. All of these jets are good aircraft with no bad tendencies and are supported by several worldwide distributors. If you're a good pilot who knows someone who can teach you the basics, I recommend any of these models. The basic airframe is generally 50% of the investment. Fuel cells, gear, tailpipes, radio equipment, and the turbine engine are additional expenses. The best jets have complete systems. They have their own gear, tanks, wheels, brakes, tailpipe and so on—all specifically designed for that aircraft. These manufacturers offer a "go fly package" which removes all of the guesswork and, in most cases, will save you some money. Popular jet brands have a good network of field support. If you need a landing gear component, setup advice, or even someone to test-fly an aircraft, the companies have representatives at most of the larger jet events and are happy to accommodate your needs.



**The author's Skymaster BAe Hawk 100. A JetCat P120-SX powers this 37-pound Scale jet trainer. A Spektrum DX18 with a full telemetry system is used for guidance. Trailing link landing gear makes the Hawk ideal for grass fields. The fuel system installed in the Hawk with an engine control unit, fuel pump, propane start bottle, fuel solenoids, fuel filter, and ground-support unit board are all visible. The aircraft has three 4,000 mAh LiPo battery packs. One is for the turbine and the other two are for the flight controls.**



The Skymaster F-9F Cougar's docile handling characteristics make it a fantastic first Scale jet. It is powered by a JetCat P140-RX and weighs 39 pounds. Photo by Barry Vaught.

## Importance of Waiver

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The AMA regulates turbine use by requiring that each pilot have a turbine waiver. Although the process may seem simple and rudimentary, please take it seriously. Jets are complex model aircraft—treat them with respect. Even if you're the most experienced, talented, and skilled RC pilot who has ever existed, you have some learning to do. You need to spend some time with an experienced jet pilot who can teach you the basics. I found this out the hard way. With my flying background, and perhaps an excessive amount of pride and lack of humility, I ventured into the jet community. I sought minimum assistance thinking, "I got this." Approximately six months into my jet career, with several torn-out landing gears, bad landings, and running out of talent, I decided to seek help. I called my local jet expert and arranged to spend some time with him on the basics of jet flying. Jets are not difficult to fly, they are simply different, and you need to be taught the difference. Takeoffs and landings are especially unique. In my entire flying career I have never traveled down the runway holding half to three-fourths up-elevator until rotation, and landing approaches at one-third to half throttle all the way to the flair. After you have touched down, you still have plenty of flying to do until the speed reduces. Jets also cover plenty of sky quickly so you will have to learn to use the throttle and understand energy management. After a day of enlightenment, ego adjustment, and close listening, my jet instructor signed me off and said I was officially a jet pilot! I gave

this same advice to people such as Mike McConville, Seth Arnold, Kyle Goodwine, Steve Stricker, and so on. These are pilots at the top of their game in skill and experience, yet they agreed that it was a necessary step to becoming a successful RC jet pilot.

## Keep Your Eyes on Your Model

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When I first became interested in jets, I attended a seminar at the Toledo R/C Expo hosted by the “Grandfather of Jetsb” Bob Violett. If you have a sliver of jet interest, you likely have heard of Bob Violett. He is a legend in the jet community. Not only is he an excellent pilot, he knows everything there is to know about jets. Bob’s business has been around at least 25 years to my knowledge and was the first in the industry to make successful high-performance RC jets. His company, Bob Violett Models (BVM), makes jets, accessories, and supports the modeling community. I set through Bob’s Toledo Show lecture twice because there was so much to learn! I remember one specific diamond of information that Bob discussed. He spoke at great length about the importance of knowing where your switches are. Never take your eyes off of your jet or any model. The only way to achieve this is to know transmitter mechanics blind folded. I’m not referring to programming, but switch locations, trims, brake locations, where the speed brakes are, canopy release, gear switch, etc. Bob suggested that modelers put their transmitters in a black bag then have a friend call out various functions while the pilot imagines flying the jet. Have your jet in front of you and simulate a flight, retract the gear, apply speed brakes, wheel brakes, landing circuit, and so on. Keep doing this until you’re fluent enough to do everything without looking down at the transmitter. Repeat this process until you can subconsciously do it.

## Which Turbine Type to Use

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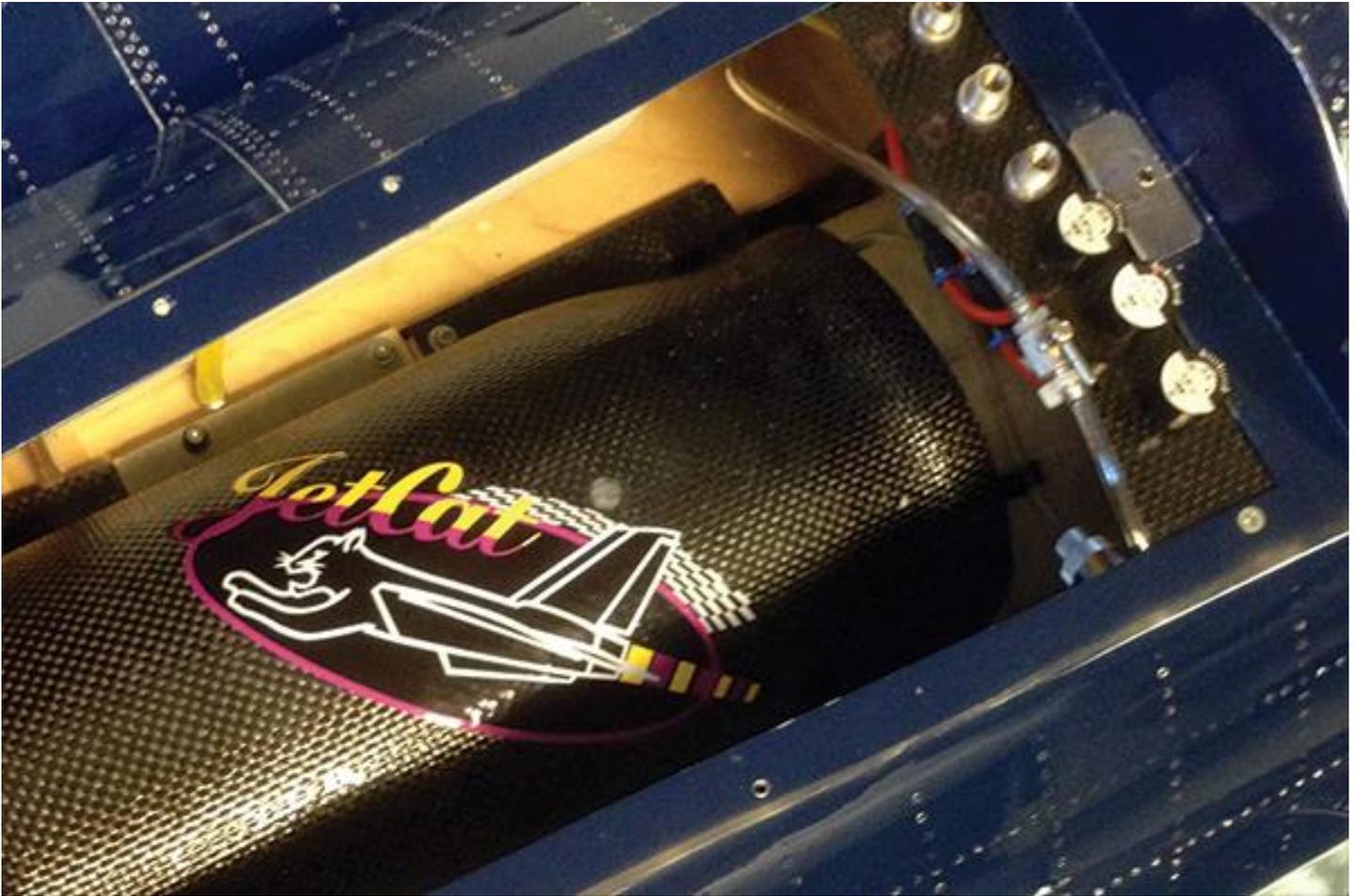
This topic is subjective and controversial, but do some basic market research. Watch out for misleading information on the forums (or anywhere). Forums are helpful and entertaining, but they typically only represent a small percentage of the segment base. If someone states that he or she is an expert, run in the opposite direction. There is no such thing as a humble opinion. I’m not bashing the threads, but it’s often difficult to validate information, especially if you’re new and don’t know with whom you’re corresponding. I suggest that you attend a jet event as an observer. Take notes on which turbines are popular, which appear to have the least number of problems, and which have the most problems. If you attend a few events you will begin to see a pattern of who is using what and why. After you have decided which brand to use, find out how good the manufacturer’s service is. You can’t fix your turbine, so this is important. In nine years of flying, I have sent two turbines to the manufacturer for general maintenance. They were repaired in a few weeks and the bill was a few hundred dollars. To me, that’s excellent. Most of the newer brands are well represented and appear to run well. JetCat, Jet Central, Wren Turbines, and King-Tek are the brands that I see the most at the field. These companies also give back to the community by donating products and field support, which is appreciated and a good sign of the manufacturers’ commitment level. Many ask me what size turbine engine they should purchase. That’s up to your emotional debt. If you’re all in, I suggest one in the 120 to 140 range. Jets are measured by their static thrust in kilograms. A 120 is 12 kg, or slightly less than 27 pounds of thrust. This size will give you the option to fly nearly anything and its operating costs won’t break the bank. If you want to try jets but are not sure if you will like them, the smaller 60 to 100 range may be a better route. You can always get a bigger engine later. Most kits will give you a range of turbine sizes

# Maintenance

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For most of us, a jet—no matter what its type or size—will be the most expensive aircraft we will ever own. Jet maintenance is critical. Turbine engines have zero vibration, so if you take care of them, they will last a long time. I've lost two jets in nearly 10 years—both were preventable mechanical failures. One was caused by poor battery maintenance, and the other was a loose tailpipe. I learned my lesson and want you to know the importance of maintenance. My guideline is a 1 to 1 ratio—1 hour of flying equals 1 hour of maintenance for the first 50 flights. After this you can settle into a 2 to 1 ratio. Check your fuel system regularly—fill lines and clunk lines need to be in perfect operating condition. Jets need a lot of fuel and one air bubble can shut them down. Use a good-quality header system and frequently check it. I use the Ultimate Air Trap system, which works great. You must use a header tank with all turbines to prevent air bubbles in the fuel system. Pressure-check your fuel tanks after every flying season. High-pressure filling and emptying can weaken the tank seams and fittings over time. Check your landing gear because gear failures can destroy your aircraft. Test your air systems—they should be able to hold air for a long time. I shoot for no more than a 2 to 3 psi drop per hour. Check your batteries. I use either LiPo or LiFe batteries in my jets so there is not so much need for battery conditioning as there is with NiMH or Ni-Cds. I still, however, constantly check their capacity and discharge rate. Inspect your wheel brakes. The wheel brakes are the primary control on a RC jet and without them you could be in a lot of trouble. I check the brakes before I take off on each flight.





**TA turbine bypass gives greater cruise performance with slightly less acceleration at takeoff. This JetCat P140-RX powers the author's Skymaster F-9F Cougar. Note the fuel shutoff valve, which is important.**

## Telemetry

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I flew jets before telemetry systems were available, and had the out-of-sight, out-of-mind mentality. I always had a subconscious level of anxiety when flying these expensive aircraft. When telemetry came along, I was quick to adopt it and would never fly a jet without it. No matter what brand of radio you choose, most have telemetry systems. Please learn how it works and use it. Know what conditions your batteries are in during the flight. I have turbine information as well. If using a JetCat turbine and DX18 transmitter with the TM1000 telemetry module, you can set several warnings for pump voltage, exhaust gas temperatures, and so on. It also tells me what's going on in the starting sequence. I also have information for signal fades or holds being communicated back to the transmitter. All of this information is invaluable and I would question why someone would ever fly an expensive model without it. My jets have three primary warnings. The most important is low battery voltage, second is holds, and the third is turbine rpm. If the rpm drops below 30,000, it's likely not running. This information is critical. After the day's flying, I often download the flight data to my computer and review it. There is aftermarket software that allows you to download individual flights to your PC called ROBO Software. It's cost effective at roughly \$19.99. On one occasion after downloading my flight, I noticed on my Cougar that when I lowered my flaps, my battery voltage dropped. It was still in the safe voltage range, but it was a variation of normal. I investigated the mechanics and they appeared okay. I then put an amp meter on each of the flap

servos and discovered that one of the servos was drawing excessive current in one direction. I changed out the questionable flap servo and proceeding flights showed more normal voltage. I would never have known this without telemetry. It's a useful tool that was developed to improve model safety.

## Linkages

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Linkages and linkage geometry are important with any aircraft, and with jets they are extremely important because of the high speeds that the aircraft fly. This creates higher-than-normal control surface loads. Good-quality metal linkages should be used wherever possible. Most of the manufacturers supply good hardware, but the instructions often assume that you have built a jet before. Seek the advice of someone more experienced if you're not sure what to do. Tightly lock any metal-to-metal connections, especially landing gear linkages. Pay attention to geometry so you're getting the maximum performance out of your servos. Remember that putting a 2-inch arm on a 500-ounce servo only gives you 250 ounces of torque. The smaller the servo horn that you can get away with, the more power you will get from the servo.

## Wheel Brakes

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Brakes are necessary on a jet. It states in AMA's "Safety Regulations for Model Aircraft Powered by Gas Turbines" that "the model shall be able to come to a controlled stop on command." Jets land and take off at higher speeds than most other RC aircraft, so they really need brakes. Some jets can be operated out of fairly small grass fields. In fact, my Hawk could easily get onto and off of a 500-foot runway, but I would need to brake before getting to the end if I landed too fast or aborted a takeoff. Most people think brakes are only for landing, but they are equally important for takeoff. I saw a model heavily damaged when a pilot was attempting to abort a takeoff. His brakes didn't work and he rolled off the end of the strip at great speed. All of the popular brake systems are proportional air-operated brakes. I have had the most success with BVM Smooth Stop and the Ultra Precision UP6 Valve from ElectroDynamics. Both options are proportional and easy to set up.

## Systems Redundancy

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Although this may appear obvious to many, you would be surprised by how many single-point failures occur. Although some are unavoidable, many can be avoided. I prefer two batteries with a power-safe switch. I see many switch failures, so I remove all switches from the power supply. The soft switch-type receivers have the switch separate from the main power supply—all they do is turn the system off. If you unplug the switch, the system turns on therefore it's an always-fail-on scenario if the main power switch fails. If you don't have a power-safe-type receiver, then use two switches into the main receiver bus. Multiple receivers, (or multiple remotes if you're using a Spektrum system), are important. I always use four of the Spektrum remotes strategically placed throughout the jet to get a good signal no matter what the orientation. This ensures that good radio feed data is being transmitted in all orientations. Try to double up servos where possible. Sometimes it can't be avoided, especially with Scale jets. I try to always have two servos on the aileron and the elevator.

# Turbine Related Questions

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Q: *Do I need a waiver to operate a turbine-powered model?* A: Yes, according to the current AMA Safety Code and the turbine regulations. Q: *How can I get a turbine waiver?* A: You can find the necessary paperwork on the AMA's website. Go to the AMA Documents tab ([www.modelaircraft.org/documents.aspx](http://www.modelaircraft.org/documents.aspx)) and select Turbines from the content list. This will take you to pertinent turbine information. Be advised that both fixed-wing and rotary-wing waivers are issued, and each has a separate application process. Contact the AMA if you want a hard copy mailed to you. Q: *Is there a fee to obtain a turbine waiver?* A: No. You merely need to submit the completed documentation.

## Wrapping Up

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It's difficult to write a conclusive article for getting into jets in the allocated space. I hope this covers the basics for you. The recommendations I have passed on are what 70 to 80% of the jet community is doing and I'm confident that if you follow the basics, you will have a great experience. Jets are cool. They have the purest and most powerful performance you will ever experience in an RC aircraft. The smell of jet fuel is addictive, and to have a successful flight with a RC jet is extremely rewarding. When you're ready for your first jet or on an exploratory mission, I hope to see you at the next jet event. —*Peter Goldsmith*