Old dog, new trick

The gyroplane is half-airplane, half-helicopter and 100-percent fun

BY PATRICK R. VEILLETTE

I was driving past the airport when I glanced up and took a double take to make certain my eyes were seeing right. I saw something that looked half-helicopter and half-airplane on final approach, something I had only seen before in a James Bond movie.

As it landed, it rolled out about 25 feet and turned off the runway. I just had to go take a look. I entered the hangar of Airgyro at the Spanish Fork-Springville Airport in Utah and found a group of other pilots asking questions about this aircraft called a "gyroplane." When I found out the operator offered intro rides, he didn't have to offer twice. I just had to try flying this machine.

Ground school

Mike Burton, the chief instructor, first gave several of us some ground school on what makes a gyroplane fly. Since he was also a CFI for fixed-wing aircraft, he pointed out the similarities and differences between flying an airplane and a gyroplane. First, and quite obviously, the "wings" of the gyroplane are the rotor blades, and they provide the lift for flight. Unlike on a helicopter, the rotor blades aren't directly driven by engine power on a gyroplane. Instead, air flowing "up" through the rotor blades provides the driving force to turn the blades. So what does the engine do on a gyroplane? It simply drives a separate small propeller for forward thrust. In fact, when the gyroplane is moving forward at only 25 to 30 mph, the main rotor can spin so fast that the rotor tips are going nearly 350 mph. That's why gyroplanes don't stall.

The gyroplane we were going to fly was the SparrowHawk, which is an amateur-built gyroplane available in kit form from Groen Brothers Aviation. It is a two-place, centerline-thrust gyroplane with a semienclosed cabin. The pilot and instructor sit side by side and each seat is equipped with its own set of controls. The SparrowHawk is powered by a four-stroke Subaru engine located on the aircraft's vertical

History of the gyroplane

The first rotary-wing-aircraft designers had problems resolving the unequal lift across the rotary blades. As the advancing blade rotated forward it created more lift, while on the retreating blade it created less lift, both of which caused a constant rolling moment.

Spanish civil engineer/nobleman Juan de la Cierva designed a hinge, which allowed the rotor blades to flap, solving the problem with the unequal lift, and on January 9, 1923, he successfully took to the air near Madrid, Spain, with his autogiro design. Ironically he designed the autogiro after an aircraft he designed had stalled and crashed. It was de la Cierva's intent to design an aircraft that wouldn't stall, and he succeeded with the design of the autogiro. No matter how slow the gyroplane flies, it will simply lose altitude at a controllable descent rate.

An American aircraft designer, Harold Pitcairn, then brought the autogiro to the United States, and on April 2, 1931, his 1931 Pitcairn PCA–2 autogyro was granted type certificate No. 410 as the first rotary-wing aircraft to be certified in the United States. One of the PCA–2s even landed on the White House lawn during a demonstration. Shortly thereafter, the U.S. Post Office used these craft for mail delivery from the roofs of post offices for nearly 10 years. Hundreds of flights carrying thousands of pieces of mail were performed by Pitcairn gyroplanes flying in Camden, New Jersey; Philadelphia; Chicago; New Orleans; Washington, D.C.; and other cities. (See "Pilots: Johnny Miller," December 2003 *Pilot*.)

During World War II, gyroplanes even saw duty on German submarines. The simple design was barely more than an open frame for the pilot, who controlled the tilt of the rotors with a single cyclic. The gyroplane was towed by the submarine. It would climb to several hundred feet above the ocean so the pilot could look for other ships.

Dr. Igor Bensen, an engineer working for General Electric, was asked to evaluate a British design and was so enthused by the idea of the gyroplane that he founded his own company in 1953 to build an engine-powered version. Variations of his early gyroplanes included floats as part of the famous water shows at the Cypress Gardens, Florida.

You may think that all gyroplanes have been small, but a British aircraft manufacturer, Fairey Aviation Co., Ltd., developed the Fairey Rotordyne, which was a 44-passenger gyrodyne (a hybrid version of a gyroplane) that used rotor-blade tip jets to power its rotor for vertical takeoff and landing, and the ability to hover. The Rotordyne was certificated in the Transport category in 1958. Because of its unique design, it was able to hover and transition into autorotation for forward flight. Once in forward flight, the tip jets were shut down and the aircraft flew as a propeller-driven gyroplane for the remainder of the flight. This 200-mph VTOL (vertical takeoff and landing) airliner was, in its day, the fastest way to get from downtown London to downtown Paris.

So are gyroplanes just something for hobbyists? No. In fact, the Groen brothers developed a turbine-powered four-seat gyroplane for law enforcement officials that was flown during the 2002 Winter Olympics (see "Pilot Briefing: Gyroplane Takes Aim at Homeland Security," September 2002

The Autogiro was demonstrated by its creator, Juan de la Cierva, at London Airpark in 1933. de la Cierva's maiden flight took place in Spain in 1923.

Pilot). During its operational period for the Utah Olympic Public Safety Command (UOPSC), the Hawk 4 Homeland Defender gyroplane completed 67 missions and accumulated 75 hours of maintenance-free flight time. The aircraft was equipped with advanced surveillance equipment, including forward-looking infrared radar. The low acquisition cost, low operating costs, incredible maneuverability, and short takeoff and landing performance were attractive features. Since a gyroplane doesn't need a tail rotor, a gyroplane doesn't have the worrisome concerns about loss of tail-rotor effectiveness caused by critical wind quadrants, density altitude, or loss of the tail-rotor drive shaft or gearboxes.

Groen Brothers Aviation Inc. merged its two wholly owned subsidiaries, American Autogyro Inc. (AAI) and Groen Brothers Aviation USA Inc. (GBA-USA), November 1, 2004. It handles the manufacturing, sales, and marketing functions of the SparrowHawk Gyroplane, the first fully enclosed two-place, centerline-thrust gyroplane in kit form. Groen Brothers Aviation USA is doing business as American Autogyro for all of its SparrowHawk operations. Jim Mayfield, former AAI president, has joined the GBA-USA board of directors and has been promoted to executive vice president. Mayfield is one of the very few designated pilot examiners for gyroplanes, and during my practical exam to add the gyroplane rating, I learned that Mayfield also is a member of The Society of Experimental Test Pilots. Mayfield also heads the company's experimental research and development arm, the Hawk Werks division of GBA-USA based in Buckeye, Arizona. For more information, visit the Web sites (www.americanautogyro.com and www.gbagyros.com).

Only a few flight schools offer gyroplane training in the United States. Airgyro Aviation, of Spanish Fork, Utah, can be contacted at 801/380-7028 or via e-mail at info@airgyro.com. Visit the Web site (www.airgyro.com).

center of gravity (CG) for a very important reason. If the thrust line was above the vertical CG position and the gyroplane encountered a gust, it would create a quick decrease in rotor drag, and the thrust line of the engine would pitch the aircraft into a power pushover, which has happened on earlier gyroplane designs, sometimes with fatal results.

Groen Brothers solved this problem by not only designing the engine's thrust so that the center of the propeller is aligned with the vertical CG, but also designing it so that the prop wash from the propeller flows over the center of the large rudder and horizontal stabilizer, which provide additional longitudinal stability. Combined with the moderate amount of dihedral on the rotors, it gives the SparrowHawk static longitudinal stability.

Although N801GA had an "experimental" sticker on the side, it was legal to take commercial flight training in the aircraft, thanks to an exemption granted by the FAA that allows the commercial use of two-place, amateur-built gyroplanes for instructional purposes. One of the conditions of this exemption is to have an approved flight manual for the aircraft, which must be carried on board at all times. Burton grabbed the aircraft manual from the aircraft and walked several of us through the aircraft and its procedures.

How it works

The flight controls in the cockpit all looked familiar. The cockpit had a throttle, stick, and rudder. The "stick" is referred to as a "cyclic," and it tilts the main rotor to pitch and bank the gyroplane. Moving the cyclic to the right tilts the rotors to the right, which in turn banks the gyroplane into a turn to the right.

The rudders in the gyroplane function closer to the rudders in an airplane than in a helicopter. They simply yaw the aircraft left or right. That contrasts sharply with the anti-torque pedals in its cousin, the helicopter, and the entire difference has to deal with the helicopter's main rotor being driven by the engine. Sir Isaac Newton told us that for each action, there must be an equal and opposite reaction, which in a helicopter means the body will rotate in the opposite direction from the main rotors. An anti-torque rotor is needed to counter this motion.

A gyroplane is just the opposite. Since the main rotors on the gyroplane are driven by air flowing through the blades, the main rotor doesn't produce a torque, and thus the gyroplane doesn't need anti-torque pedals. In fact, the rudder really isn't needed in flight to make "coordinated" turns because there is no adverse yaw.

The gauges were quite similar to those in an airplane too. The engine tachometer and oil temperature and oil pressure indicators were pretty standard, as well as the altimeter, airspeed indicator, and vertical speed indicator. All of these should be quite familiar to any fixed-wing-aircraft pilot.

Flying it

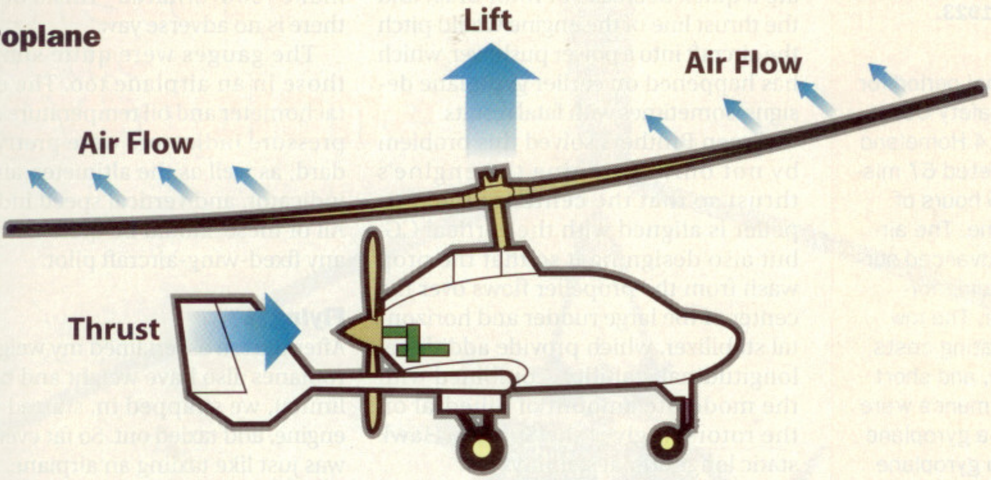
After Burton ascertained my weight (gyroplanes also have weight and balance limits), we strapped in, started up the engine, and taxied out. So far everything was just like taxiing an airplane, except that the cyclic is locked to keep the rotor from flopping around in the wind. We then lined up on the runway and this is where Burton calmly said, "I'd better demo the first takeoff." It was a good thing he did because the takeoff procedure has some distinct differences from an airplane. It took me about five seconds to realize this is not something that a fixed-wing-aircraft pilot can teach himself. It is absolutely necessary during the takeoff sequence to get the rotor to an adequate rpm so it can create enough lift, and doing so requires following a very definite set of procedures to keep the blades behaving correctly and avoid several potential problems.

Some older and simpler gyroplanes require the pilot to pre-rotate the rotors to a certain speed by hand (imagine "hand-propping" a 30-foot-diameter rotor). The SparrowHawk uses a pre-rotator from the engine to get the rotor blades up to 160 rpm. Once adequate pre-rotation was obtained, Burton applied a bit more throttle to get the gyroplane moving forward with the rotor disc tilted aft. This positioned the rotors so that more air would flow through the rotors, eventually accelerating the rotors to sufficient rpm for takeoff. As the gyroplane started to lift off, Burton kept it in ground effect for a short time until we had sufficient airspeed for climbout.

My old fixed-wing flying habits always relied on visual clues such as cowlings, wings, and windshields to determine the aircraft's pitch and bank, but these are not part of many gyroplane designs. In fact, the view is nearly unobstructed in the gyroplane. I was almost overwhelmed by looking at the

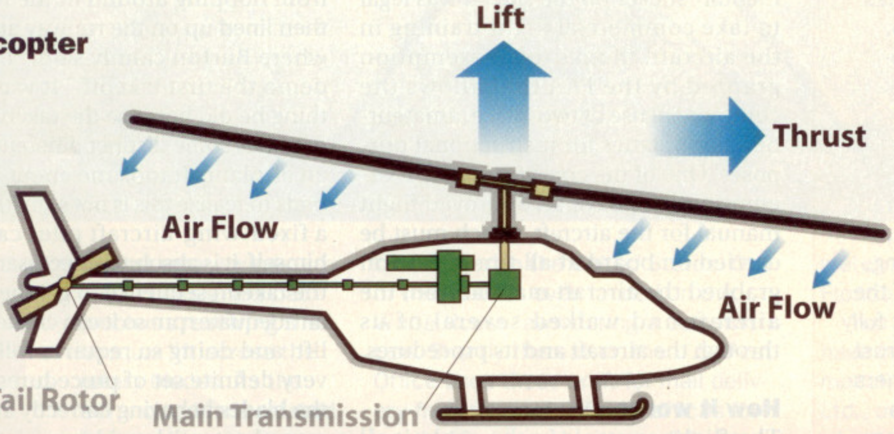
How they fly

Gyroplane



Gyroplanes derive lift from freely turning rotor blades tilted back at an angle of attack to catch the air. The rushing air spins the rotor as the aircraft is thrust forward by the engine-driven propeller.

Helicopter



In a helicopter, powered rotors produce both lift and thrust. The main rotor (transmission) powers the rotor blades, which are at a slight angle of attack.

ground between my toes; sitting in an aircraft with no doors, I kept praying that my seat belt would keep me firmly secured into the seat, because otherwise there was nothing but air between my left hip and the ground.

At about 100 feet agl Burton relinquished the flight controls to me, and at this point it seemed to fly quite like an airplane. If I moved the cyclic back, the nose pitched up and the airspeed slowed. If I moved the cyclic to the right, we turned to the right. We continued to climb out straight ahead in gusty conditions. I expected the light gyroplane to bounce around more in the gusts, but I was surprised. The small-chord rotor blades and the relatively high "wing loading" (technically called "disk loading") absorb turbulence much better than a Cessna 152 in the same conditions.

In flight, the fuselage of a gyroplane essentially acts as a plumb suspended from the main rotor, and it tends to swing back and forth very slightly. I later learned that when the airspeed of the gyroplane increases in level flight, the rotor-disc angle of attack must be decreased. This causes the pitch control to become increasingly sensitive. It is possible to overcontrol a gyroplane when encountering turbulence. In a way, it's very much like a pilot-induced oscillation in a fixed-wing aircraft. It ended up that I got a hands-on lesson in the natural stability of the gyroplane. My seemingly minor control inputs were actually making the oscillations greater. Even in normal conditions, a gyroplane requires hands-on attention to maintain straight-and-level flight. Although more stable than helicopters, gyroplanes are less stable than airplanes.

Burton then said, "Remember when I mentioned that the gyroplane doesn't stall? Bring the nose up…more, more, more." Now realize that I have spent the past six years flying Boeing 727s or Hawker 800s, and 120 knots is the slowest airspeed I've seen in years. As the airspeed bled below 40 knots, I, with my old fixed-wing-aircraft background, got real nervous. I had used this maneuver many times in the Piper J–3 Cub to teach spins to students. As the nose came up steeply, I expected the aircraft to abruptly drop a "wing" into an incipient spin. I wanted to thrust the nose forward and scream, "Get the nose down!" Burton calmly said, "See how the rotor on a gyroplane never stalls? All we're doing is descending in a stable manner." In fact, he pulled the nose up even farther and soon the airspeed indicator was read-

STEVE KARP

ing zero. We were actually moving backward over the ground. I had done a maneuver like this in sailplanes during mountain-wave conditions, so this wasn't the first time I'd gone backward, but seeing the airspeed at zero with the nose so high was so counter to anything I had ever done in an airplane.

Maneuvers

We landed a few minutes later and I had a big smile on my face. The view is absolutely spectacular from the gyroplane. It was a real learning experience for this old fixed-wing dog, and it had been fun. It didn't take much to convince me that I wanted to learn how to fly the gyroplane, although I warned Burton that it would take a lot of patience on his part to teach "an old dog like me new tricks."

I came back the next day, and after takeoff we did turns around a point. It was quickly obvious that the gyroplane redefines that maneuver. Its ability to maneuver tightly over a spot on the ground is eye-opening. I can see why law enforcement and search-and-rescue teams would look at gyroplanes as options.

Then we did touch and goes. It was interesting to see that stabilized approaches are as important in a gyroplane as in an airplane. Although normal approaches are steeper in a gyroplane than the standard 3-degree glidepath for an airplane, the concept of energy management was still very much applicable to the gyroplane. In some ways, flying final in the gyroplane was a bit easier than in a fixed-wing aircraft because pitch largely controls the airspeed and power basically controls the altitude. When I was a bit high, I simply rolled off some power and let the aircraft sink at a slightly faster rate to regain the desired glidepath while keeping the nose on a rather steady pitch attitude. Flying final approach between 60 and 65 knots quickly felt comfortable.

Aim-point judgment also was the same as flying an airplane. Burton gave me the hint to aim for a point about 100 feet shy of the desired touchdown point. As we approached ground effect, I'd shift my vision toward the end of the runway and let the airspeed bleed off in the flare. About 2 feet above the ground, our groundspeed would bleed off to just about zero while I gradually increased the back cyclic as the gyroplane began settling down, gently touching on the tailwheel first. It didn't take long to learn how to make a "safe enough" landing. Takeoffs are still a bit more complicated than in fixed-wing aircraft, and it was clear that I needed some more practice on that maneuver. As we taxied back into the FBO after the full-stop landing, I still had a big grin on my face. It had been another good learning experience.

SPECSHEET

SparrowHawk
Kit price: $34,980

Specifications

Fuselage length	12 ft
Height	9.75 ft
Width	6 ft
Rotor dia	30 ft
Dry weight	850 lb
Useful load	500 lb
Max gross weight	1,350 lb
Engine	Subaru EJ-22, 148 hp
Fuel	Unleaded
Fuel consumption	6 gph at 80%
Fuel capacity	23 gal

Performance:

Normal takeoff ground roll	400-500 ft
Rate of climb	500 fpm
Max never-exceed speed (V_{NE})	100 kt
Normal cruise speed	70 kt
Service ceiling	10,000 ft
Range at cruise	245 nm (with reserve)
Operating costs	$20/hour includes fuel, maintenance, and overhaul costs

For more information, contact Airgyro Aviation, Hangar 75, 350 West 2050 North, Spanish Fork, Utah 84660; 801/794-3434; info@airgyro.com; www.airgyro.com

All specifications are based on manufacturer's calculations. All performance figures are based on standard day, standard atmosphere, sea level, gross weight conditions unless otherwise noted.

Autorotations

I was back the day after, and we started off with touch and goes again. After a few patterns, I asked Burton what an engine failure (autorotation) looked like. I've heard a lot about autorotations from my helicopter buddies, so I just had to experience one of these myself. Burton was happy to comply with the request, so on downwind he told me to keep the throttle open during base and final. We were almost over the numbers of the runway when he said, "OK, this will work. We're outside of the height-velocity curve here."

Like helicopters, gyroplanes have a height-velocity diagram that defines what airspeed and altitude combinations allow for a safe landing in the event of an engine failure. In simple terms, the blades of a rotorcraft in the autorotation mode must have enough air going through the blades to keep up their rotation rate to produce enough lift. If the rotorcraft is too low and too slow, there isn't enough airspeed and/or altitude to keep the rotor speed at a sufficient speed, and a hard landing is almost assured. In the SparrowHawk, having more than 250 feet of altitude or more than 60 mph is enough to allow a soft landing.

Burton retarded the throttle and calmly said, "OK, pitch over a bit to keep the airspeed between 60 to 65...." What surprised me was how steep I had to pitch over the nose of the gyroplane to keep the airspeed at a proper value. It seemed steeper than going downhill on a roller coaster. A gyroplane tends to have lower rotor-disc loading than a helicopter, which provides a slower rate of descent in autorotation. In fact, the SparrowHawk's rotor disc covers an area of nearly 700 square feet. The flare during the autorotation is a bit faster than during a normal landing, but it wasn't that different from flaring a taildragger. Once again I stepped out of the gyroplane at the end of the lesson and said, "That was a fun learning experience."

Gyroplanes do look deceptively simple, and perhaps that is why some pilots have attempted to fly gyroplanes without proper instruction. However, that would be a very bad overestimation of anyone's flight skills. Obviously the files of the NTSB have more than a few reports showing such temptations. Learning to fly a gyroplane will require flight instruction.

Requirements

So what does it take to add a gyroplane rating to your private pilot certificate? FAR 61.109(d) states the requirement for 40 hours of flight time, but notice that it doesn't specify that an applicant for a gyroplane rating must have 40 flight hours in a gyroplane. Specifically, you must obtain the following flight experience in a gyroplane: three hours of cross-country training; three hours of night flight training including one cross-country flight more than 50 nm in total distance, and 10 night takeoffs and landings to a full stop; three hours of flight-test preparation; 10 hours of solo, which include three hours of cross-country flight more than 75 nm in distance and to three different airports, and three takeoffs and landings at a towered airport. Of course, if you don't want to add the rating to your private certificate but would still like to explore flying one for recreation, the SparrowHawk falls under the light-sport aircraft category.

Do you need much of a runway to operate a gyroplane safely? No. The landings need barely more than 50 feet total, but takeoff does need some room for the ground roll and then an unobstructed clearance path for the climbout. The aircraft flight manual recommends 1,500 feet for a minimum takeoff area. With the new light-sport aircraft category, and with operating costs estimated around $20 an hour, this just might be the option with which a lot of us can afford to renew our passion with recreational flying. AOPA

Patrick R. Veillette, of Park City, Utah, is a commercial airline pilot.

Links to additional information about gyroplanes may be found on AOPA Online (www.aopa.org/pilot/links.shtml).