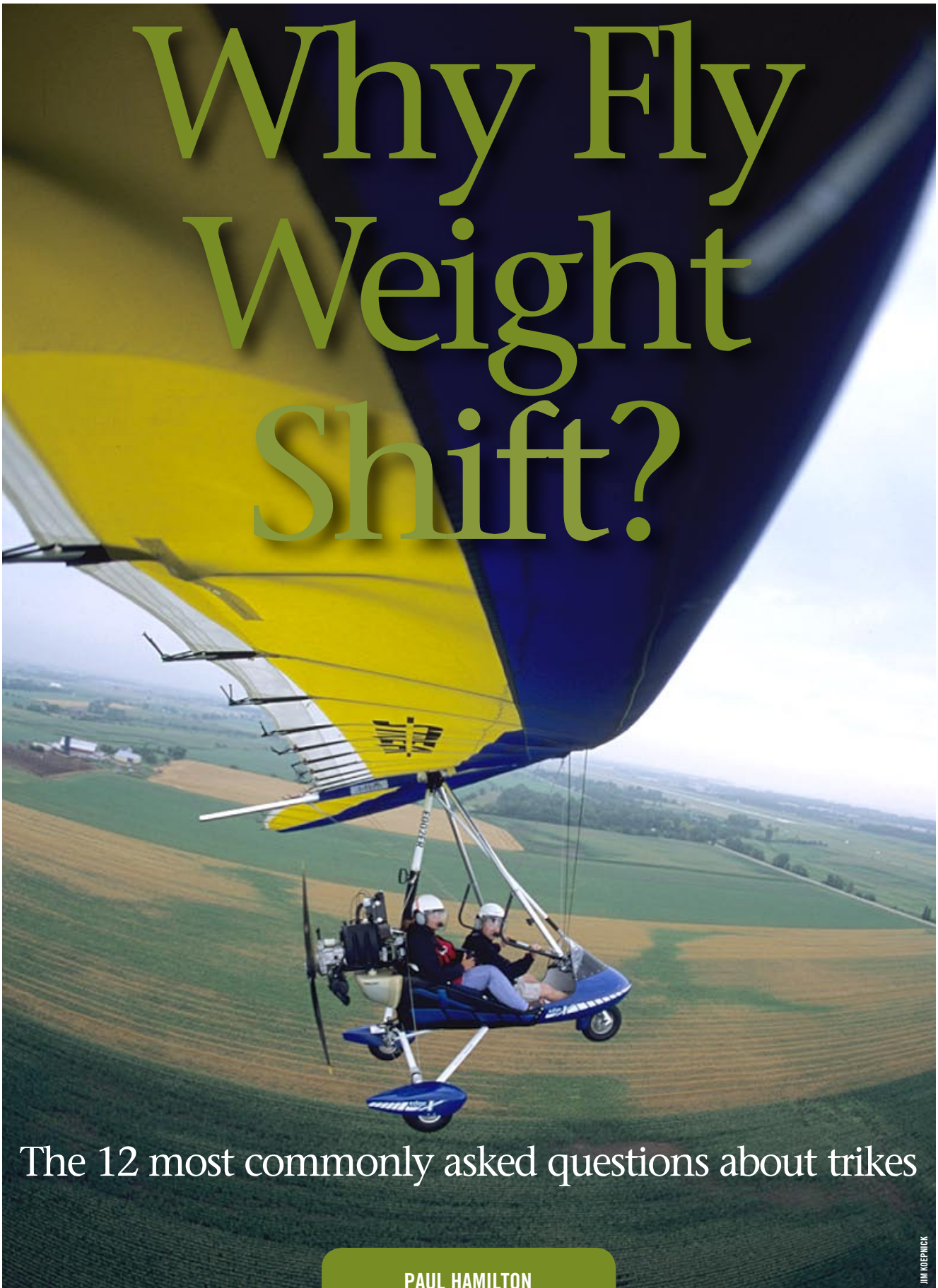
# Why Fly Weight Shift?



The 12 most commonly asked questions about trikes

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Trikes are not new, and many have seen them flying locally or in movies, like *Fly Away Home*, which was based on Bill Lishman and Operation Migration. The sport pilot and light-sport aircraft rule, however, has brought trikes to the attention of the masses. They offer a number of advantages, which account for their popularity, and they are worth a flight if you're thinking about buying an ultralight or light-sport aircraft. To prepare you for that first flight, here are the answers to the 12 most commonly asked questions about trikes.

### 1. What's the difference between a weight-shift aircraft and a trike?

Historically, ultralights and ultralight trainers with wings mounted above a tricycle undercarriage have been called trikes and powered hang gliders. In sport pilot/light-sport aircraft the FAA officially named this two-place light-sport aircraft category a "weight shift aircraft." We'll use the term "trike" to describe both single-place ultralight and two-place light-sport aircraft.

### 2. How long have trikes been around?

Trikes first appeared in the late 1970s when hang gliders evolved from primitive delta wings to efficient flying wings with higher aspect ratios, defined airfoils, and wing twist providing stability and performance. The wings have evolved over 25 years along with hang glider wings to be highly refined performance machines. Trikes have been certificated to strict government standards in Europe and Australia.

### What are the controls, and how easy are they to fly?

First, it's important to understand that a trike is trimmed to fly at a certain speed (we'll use 45 mph, since it is where my trike is trimmed). In calm air you can let go of the controls and the trike will fly straight and seek the trim speed designed into the aircraft. Just as is in cars and airplanes, flying hands off requires slight corrections in direction.

Unlike airplanes, which have three

Paul Hamilton, seated in the trike, reviews weight-shift control with FAA's Sue Gardner and Scott Sedgwick.

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axes—ailerons (roll); elevators (pitch); and rudder (yaw)—controlled by a stick/yoke and rudder pedals, the trike has two axes—roll and pitch—that are controlled by a bar connected to the wing. The design of the trike's swept wing, with a certain amount of twist and airfoil shape, provides automatic yaw control.

In other words, trikes are comparatively easy to fly because you are only controlling two axes rather than three axes. An easy touch on the controls is the key to learning to fly a trike. When you shift your weight to one side of the trike, it warps the wing by providing more twist on one side than the other. Similar to the Wright brothers' wing warping, the increased twist generates more lift on that side, and that produces roll.

In the 1980s, when hang gliders evolved from crude delta wings to flying wings, the "floating crossbar" became the industry standard control system. This simple wing warping is the key to the weight-shift wing efficiency and rapid roll response. To pitch the nose up you simply push on the bar, and you pull it toward you to pitch the nose down. Control is intuitive because you have hold of the wing, and it goes wherever you move it. The motions are similar to riding a bicycle or motorcycle.

### 4. What about transitioning from stick and rudder to weight shift?

Airplane and trike controls are different, so airplane pilots will have to "unlearn" their stick and rudder skills when learning to fly a trike. Adding to the difference is the sitting in the open and the loss of the airplane's "window" reference to the horizon.

Typically, airplane pilots feel disoriented for the first 20 minutes and must think about the necessary control inputs for the first hour or two. Normally, airplane pilots are comfortable flying trikes after about two hours in the air, and many have developed the proper "habits" and are ready to solo after five hours. These are general observations based only on my experience. Some pilots pick it up immediately, and others take a little longer. It is no big deal to learn to "fly the wing" rather than move and coordinate the controls.

### 5. How do they stall?

Stalling the wing of a trike is an easy, gentle, and forgiving maneuver. The wing's "nose" is at a higher angle of


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attack than the wingtips. At high angles of attack the nose buffets first, loses lift, and naturally falls through while the tips in back keep flying. In addition, with the weight of the cart and occupants below, the pendulum effect naturally brings the nose down. Both factors result in a stall-resistant aircraft.

### 6. How fast are trikes, and what is their range?

Traditionally, trikes have flown in the slow—30-40 mph cruise and 25 mph stall—and medium—40-60 mph cruise and 30 mph stall—speed ranges. With newer wings and larger engines, trikes are now moving into the fast speed range, cruising at 60 to 90 mph. The wing's size affects speed. A trike with a large 19-meter wing (200 square feet) will fly slowly. A 16-meter wing (170 square feet) gives you the medium speed range. And a small wing, 11 meters (115 square feet), provides the fast speeds range.

A trike undercarriage (or chariot) can be fitted with different wings, which means you can easily expand your flying options by having more than one size wing. Generally, the wing represents about 25 percent of the trike's total cost, but smaller wings generally need more engine power. New trikes currently being tested have enclosed cockpits to keep the wind off you at higher speeds. We will see trikes evolve into higher speed machines considering creature comfort and fuel efficiency.

Speed is one part of the range equation. Endurance—how much time you have in the fuel tank—is the other. A trike cruising at 50 mph for three hours will travel roughly 150 miles—unless it's flying into a head wind, which reduces the distance. Trikes are powered by two- or four-cycle engines. With the same fuel capacity, four-cycle engines give better range because they use significantly less fuel than the two-cycle engines.

### 7. How do trikes handle the wind, crosswinds, and turbulence?

Generally, an intermediate or advanced trike pilot can fly in a head wind that's about two-thirds your stall speed and a crosswind of one-half your stall speed. Trikes and fixed-wing aircraft can taxi, take off, and land in comparable crosswind conditions.

The configuration and size of the wing affects crosswind capabilities for both types of aircraft. Higher-speed aircraft typically have greater crosswind capabilities because higher speeds mean less crab angle on approach. To land a trike in a crosswind, you line up on the runway centerline naturally crabbed into the wind and fly it crabbed to touchdown. As your back wheels touch, the nose wheel swings around straight down the runway.

Crosswind takeoffs are similar. When you lift off the runway, the wing naturally weathervanes into the wind set-

# Sport Pilots and Trikes

The final sport pilot and light-sport aircraft (SP/LSA) created new pilot certificates, both at the sport pilot and private pilot level, for airmen flying weight-shift trikes. In addition, it created a path for trike pilots operating machines that fall outside the definition of a legal ultralight (per FAR Part 103) and ultralight instructors teaching in two-place trikes to transition themselves and their machines to sport pilot/light-sport aircraft status.

Trike pilots registered as ultralight pilots or ultralight instructors can apply their logged time toward the requirements for a sport pilot certificate (and, in turn, a sport pilot flight instructor certificate) with a weight-shift endorsement.

Those choosing to obtain a sport pilot certificate must either show proof that they have already fulfilled the required 20 hours of training (via a certified document from their registering organization), or log that training with a flight instructor. Then they must pass a sport pilot knowledge (written) test and a practical flight test with a sport pilot examiner (SPE) or other designated pilot examiner (DPE). Registered ultralight pilots have until January 31, 2007, to complete the transition to sport pilot status and receive credit for previous training and experience.

Current trike instructors operating under an FAA-approved exemption program may apply their training and experience toward the requirement for a sport pilot flight instructor's certificate. They, too, will have to pass a sport pilot knowledge test (either at the sport pilot or sport pilot instructor level) and a practical flight test with a sport pilot flight instructor examiner (SPIE). If these instructors have not previously taken the FAA Fundamentals of Instruction (FOI) course, they must also complete that course and its required test.

Trike pilots choosing to obtain a private pilot certificate with a weight-shift rating must complete 40 hours of training. Trike pilots transitioning from ultralight pilot status to private pilot status are advised to first obtain a sport pilot certificate with a weight-shift endorsement, and then acquire the additional training and experience needed for a private pilot with a weight-shift rating. These pilots must then take a knowledge (written) and practical test (checkride) at the private pilot level with a DPE.

## The Machines

Trikes currently being operated outside the limits of FAR Part 103 and/or as two-place trainers must eventually transition to N-numbered status to be legal aircraft. Most of these machines will become experimental light-sport aircraft (E-LSA). However, owners who have completed 51-percent or more of the construction of their trike can choose to certificate the aircraft in the experimental amateur-built category.

To transition the aircraft, the owner must apply for an N-number and, if certificating it as an E-LSA, have the aircraft undergo a one-time inspection by an FAA inspector or designated airworthiness representative (DAR). The owner may then continue to perform all routine maintenance on the aircraft; however, to conduct the annual condition inspection on the aircraft, the owner will be required to attend a 16-hour course to obtain a repairman certificate with an inspection rating. That course must be dedicated to weight-shift aircraft.

If the aircraft is certificated in the experimental amateur-built category (again, the owner must have built 51-percent or more of the aircraft), it must also be inspected by an FAA inspector or DAR. However, because the owner has completed the major portion of the aircraft, he or she may apply for a repairman certificate for that aircraft, which allows the individual to conduct the annual condition inspection without further training.

ting up a crab angle for you to proceed directly down the centerline of the runway. Naturally, each pilot's wind limits depend on his or her experience.

In turbulence, the wing moves more than the undercarriage resulting in less bumping around. Because the weight is under the wing, the undercarriage naturally wants to seek level flight. In moderate to severe turbulence you must hold onto the bar, which takes some muscle and can be fatiguing on long flights.

### 9. How fast do trikes climb and how high can they go?

Trikes have an advantage over airplanes—no tail—meaning they are not burdened by the weight, drag, and


down-force associated with the tail structure. This gives trikes better climb rates and the ability to carry greater loads.

For example, with a small but efficient 50-hp engine, my medium-wing trike has climbed 1,000 feet per minute, and (with oxygen) I've climbed to 17,000 feet. Fully loaded with two people, I climb at 500 fpm at sea level and can reach 11,000 feet.

In this configuration of small engine, low drag, and medium wing, the trike stalls at 30 mph, flies hands-off at 45 mph, and has a maximum cruise of 65 mph. A large engine (100 hp) on a single-seat chariot with a smaller wing (13 meters) climbs at 60 mph and 2,000

fpm. Your speed, climb rate, and service ceiling depend on your configuration.

### 10. How do trikes glide with the engine shut off?

Trikes are efficient aircraft and glide nicely at about a 6-to-1 glide ratio with the engine shut off. It is common practice to shut down the engine and land on a spot.

### 11. How do I decide what trike to buy?

This is the subject of another article, but, briefly, it depends on what kind of flying you want to do. For example, if you want to go from airport to airport, you'll want a smaller wing and undercarriage with skinny, streamlined tires. If you want to fly from beaches or in the boonies, you'll want a big wing and fat tires, and you know with the extra drag you'll not go very fast, or very far.

There are many combinations in between considering wing size, wing configuration, engine size, undercarriage configuration, and accessories. Overall, you must first decide what configuration, and then find the brand and dealer who can supply it. It is like buying a car. You must decide upon SUV, sports car, truck, minivan, or RV. Than you go looking for the dealer who can supply it.

### 12. What about transporting and storage?

A trike's wing folds into a 16-foot tube that is 8 inches in diameter, and the chariot fits in a garage or trailer. It takes less than an hour to set it up or take it down, and trikes are easily transported, which is one reason why they are so popular.

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