



“ This is exactly how you fly when you dream that you fly. ” — **YVES ROSSY:**

BY THIERRY DUBOIS

FULFILLING THE PUREST
DREAM OF FLIGHT

JETMAN

IT

IS THE UNIVERSAL DREAM.

Dating as far back as the Greek myth of Daedalus building wings of feathers and wax for himself and son Icarus, to comic book heroes like Superman, the desire to fly free and unencumbered among the birds has always been with us.

Yves Rossy has taken that dream and with a touch of technology made it real. The result is Jetman—the only man in the history of aviation to sustain flight with a jet-powered wing strapped to his back.

Having done so, he has struck a chord with people around the world, generating interest from more than just the aviation community. He has become famous worldwide following his flight across the English Channel in 2008.

Yves' background is in engineering, but his interest in this form of flight is philosophical. "We have lost the contact with air. Aviation pioneers started in a lying position on the aircraft, then they sat down and eventually protected their faces with glass, followed by pressurized, air-conditioned cockpits," Yves said.

Using technology, he has returned to aviation's early roots—feeling the speed, density, and temperature of the air from a

horizontal position. Yves straps on a delta wing powered by four small model-aircraft jet engines, jumps from an airplane—and then the fun begins.

There are no instruments. And most astounding, no ailerons, elevators, rudder, or any other aerodynamic controls. Yves steers his flying wing using his body—arching his back for pitch control and angling his head to execute a banked turn. After 10 minutes or so of heart-stopping soaring through space, Yves deploys his parachute and descends to a gentle landing. He may be the most daring pilot alive.

THE MAN BEHIND THE WING

To get a sense of Yves, you have to look no further than a one-day tour of his native Switzerland he conducted in 1991. By air he flew a DC-9, a helicopter, and a hang glider and went paragliding and sky

diving. By land he ran barefoot, rode a mountain bike, a horse, and a motorcycle, and drove a race car. He found time to go mountaineering, skiing, and snowboarding. If that wasn't enough, he took to the

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water where he piloted a speedboat and went water-skiing, wakeboarding, kayaking, and white-water rafting. Most people won't do all that in a lifetime, but for Yves it was all in a day's work.

Jetman's journey to the sky began in the late 1970s. A youthful Yves began his education with a mechanics apprenticeship—not related to aviation—and earned a degree in engineering. He learned to fly under a Swiss

"You feel that you're falling, gliding ...you're in flight. Then you hit the gas and vroom, bang! You feel it push and it starts flying horizontally. It's great."
— Yves Rossy

"It's as if there's a big handle on your back and the good Lord grabs you and shoves you through the air. It's fantastic!"
— Yves Rossy



He then moved to the civil sector but kept ties with the military as a reserve officer. His latest position was as captain flying Airbuses for Swiss International Air Lines. That was before he took a sabbatical in 2008 to work full-time on his wing.

The Jetman concept traces its roots to Yves' experience in sky diving. In the early 1990s, he envisioned that a sky diver in free fall could maneuver better in a standing position. "This is more natural," Yves said.

He became one of the "skysurfing" pioneers, though the early trials were not really satisfactory. "On something that is adapted

from a surfboard, horizontal movement is hardly faster than what you can achieve when you lie face down," he said. So Yves started experimenting with surfing on an aerodynamically shaped board, and the results were better, yielding a 2.5 lift-to-drag ratio. For safety when testing his prototypes, Yves fastened his feet to the board with bindings that he could release. He was on his way.

He also explored wingsuits—sky diving overalls with bat-like fabric "wings" that were sewn between the arms and legs. Yves studied the wingsuit concept in a wind tunnel. Despite the merits of the idea, he found

that the aerodynamics were not very good. Moreover, "It required a lot of strength in the arms to keep the wing in tension, and I did not feel free to move," Yves recalled.

YVES' FIRST WINGS

So he designed a rigid wing glider, constructed of carbon fiber, which he could strap to his back with a harness and could release in flight. He was undaunted by history. "Those who tried this sort of wing, as early as the 1950s, killed themselves because they could not release the wing," he asserted. The first wing Yves attached to his back

"TO PITCH UP, I ARCH MY BACK. TO PITCH DOWN, I BEND MY BODY FORWARD. TO MAKE A RIGHT TURN, I TILT MY HEAD TO THE RIGHT. TO INITIATE A ROLL, I MOVE MY SHOULDERS," YVES EXPLAINED.

made him look like Buzz Lightyear. It had a 5-foot span—anything wider would have been too large for the jump airplane.

The next idea was to try an inflatable wing. "A Swiss company managed to manufacture an inflatable wing with the given profile and twist," Yves said. For wind tunnel testing, he traveled to Ukraine where facilities were more affordable. Tests showed the configuration yielded a lift-to-drag ratio of about 4-to-1. In 2002, Yves jumped from a Pilatus PC-6 with his inflatable wing and was able to glide the 12 kilometers across Lake Geneva.

But Yves was really still sky diving—maybe sky gliding is a more accurate term—not really flying like a bird. He needed power.

JET PROPULSION

His calculations showed that a total thrust of 77 pounds would be enough to sustain level flight. JetCat, a German specialist in building jet engines for model aircraft, had engines with 52 pounds of thrust each. So, in 2003, Yves attached two engines to his 9-foot-span,

inflatable wing. But the weight of the jet engines quickly called for a more rigid wing. So Yves designed a new wing—one of 15 different designs he has tried in the past 15 years. In 2006, he flew a rigid, foldable carbon structure fitted with four JetCat engines, which enabled him to actually climb.

To help refine his foldable wing, Yves established a partnership with Swiss company RUAG Aviation, testing his latest version in its wind tunnel in Emmen, Switzerland. "The tests were used to get baseline data for validation of the theoretical models, which were then used to design the new wing," a RUAG spokeswoman said. These studies showed that Yves' craft was unstable in yaw and roll, being stable only in pitch.

With continued modifications to improve the wing, Yves followed the path that Louis Bleriot flew 99 years earlier and crossed the English Channel in September 2008. The 13-minute flight made headlines around the world and generated millions of views on YouTube, capturing the imagination of a global audience.

Still, not all his efforts have been successful. In November 2009, Yves attempted to fly from Morocco to Spain, across the Strait of Gibraltar. Due to bad weather and clouds, he had to jettison his wing and take to his parachute over the ocean. He was plucked from the sea by a helicopter.

Having attempted level flight over significant distances, the next challenge was to improve the thrust ratio and agility of the wing so Yves could climb and perform aerobatics.

The staff at RUAG rolled up their engineering sleeves and helped Yves improve his craft. To say he is pleased with the changes is an understatement. He put it this way: "I used to have a motorglider. Now I have a fighter."

Among the substantive changes: The sweep angle was increased and the platform is now close to a delta. Its winglets were moved farther aft to increase lateral stability.

"Through optimal twist distribution, we made the wing more stable and improved stall behavior," a RUAG spokeswoman said. The airfoil also was altered for improved performance, and the position of the "human fuselage" relative to the wing is now different.

The wing's span was reduced to about 6 feet for agility and is no longer foldable, saving 15 pounds. The wing used for the Channel crossing had an empty weight (without the engines) of 59 pounds and a total weight of 132 pounds.

Using the lighter wing, Yves attempted his first aerobatics in November 2010. He climbed to altitude in the Esprit Breitling Orbiter balloon piloted by Brian Jones, winner of the first nonstop around-the-world

EVOLUTION OF JETMAN

➔ In his quest to fly with total freedom using only his body to steer, Yves' flying has evolved from sky diving to sky surfing. He tried sky diving with wingsuits before strapping a wing to his back that would allow him to glide. With the addition of model jet engines, Jetman was born.



Yves started by experimenting with sky surfing. Here he is surfing a model of the Mirage fighter he flew in the Swiss Air Force.

1994



Using an inflatable wing, Yves improved his lift-to-drag ratio to 4-to-1. With this wing he glided the 12 kilometers across Lake Geneva.

2002



Yves' first four-engine wing had a rigid, carbon structure and folding wingtips. The four engines provided enough thrust for Yves to climb.

2006



With a smaller version of the folding wing, Yves crossed the English Channel in 13 minutes; 99 years earlier, it took Louis Bleriot 37 minutes to become the first pilot to accomplish the feat.

2008



Reducing the size of the wing to 6 feet eliminated the need to fold the wings, saving 15 pounds. With the lighter, more agile wing, Yves performed his first aerobatics—two loops.

2010

balloon flight in 1999. Yves leapt from a platform on the side of the basket, stabilized the wing, and completed two loops.

He is now working on an even lighter wing that will bring empty weight down to 30 pounds and total weight to 100 pounds, including engines and fuel. Endurance will be increased from six to 15 minutes. "It is brand new, with a better weight distribution," he explained. And that's not all. JetCat is developing new, more powerful engines for Yves that the company expects will deliver 90 pounds of thrust each. Yves expects the new engines will provide a 1-to-1 thrust-to-weight ratio, which will enable vertical climbs.

GROUND-BASED LAUNCH...MAYBE?

So could Yves' wing take off from the ground one day? With his current wing and engines, he can attain launching speed from a fast-moving car. But it would take 90 seconds to reach 2,600 feet, the minimum he calculates he needs to be able to release his wing and use his parachute with enough margin in case of a mishap. However, Yves is working with the company Parachutes de France to design a parachute that will use ballistics to deploy the chute—like the emergency recovery parachutes found on ultralight aircraft. If successful, the safety altitude will be reduced to 650 feet. Taking off from a car, it would take 10 to 15 seconds to reach the safety altitude. So the level of risk would be no greater than that of a light aircraft on takeoff, Yves pointed out.

And what about independent takeoff from the ground? Yves feels it would be too tricky. As with every wing, his needs sufficient airspeed to provide lift. Even with very powerful engines, the launch from a standing start would be very unstable until the airfoil reached sufficient airspeed. One consideration is the possibility of taking off from an inclined ramp or a catapult. Yves does not rule out anything, as long as the approach is prudent and well founded in engineering. "I am not a daredevil," he said.

HOW JETMAN FLIES HIS WING

So how does Yves fly his wing? There are no control surfaces. No ailerons, flaps, rudder, or elevator. An early version did have small ailerons, but the later versions do not. Control is achieved through body movements. "To pitch up, I arch my back. To pitch down, I bend my body forward. To make a right turn, I tilt my head to the right. To initiate a roll, I move my shoulders," Yves explained. He said that only small movements are needed. The secret is how the wing is installed and set on his back.

Before jumping out of the plane, helicopter, or balloon, he starts the engines and brings them to idle. He then dives (rearward, if from a helicopter or an airplane) from an altitude of about 8,000 feet and is in a free fall. At about 6,500 feet he stabilizes the wing, and as he picks up speed, he gains lift.

"As soon as the wing provides enough lift, I arch my back," he explained. He increases the throttle of the engines and

flies for about 10 minutes. Engine power is controlled by a small potentiometer that clings to a finger on his right hand, so Yves' hand retains its freedom of movement. There are almost no instruments, just an audible altimeter that speaks his altitude and has easily recognizable signals for warning altitudes that Yves sets before each flight. Cruise speed is known to be more than 130 knots.

In case one engine fails, the symmetrical engine on the other side is automatically shut down within one-tenth of a second. "Otherwise the asymmetrical engine thrust would initiate an uncontrolled roll," Yves explained. Two of the four engines generate enough power to maintain level flight.

He flies with a combination of three parachutes: the main and reserve chute every sky diver has, as well as a third parachute incorporated into the wing itself. When the fuel runs out, he deploys his parachute and lands with the wing still attached to his back.

"In theory, I should not have been able to fly," he said. "But I corrected instabilities with instinctive body movements."

That isn't to say he hasn't had his share of mishaps. In 2004 at the Al-Ain air show in Dubai he went into a spin, released the wing, and tore his parachute. A year later, despite modifications to improve aerodynamics and stability, uncontrollable oscillations again forced him to release the wing, which crashed to the ground. Yves estimated he has made a total of 250 to 300 flights with the various versions of his wing and has had to release the wing's harness 25 times.

Maintenance on the flying wing also involves maintaining Yves himself. "The idea is to have the 'landing gear' working well," he quipped. He has no specific training program but endeavors to keep in a good shape. "Skiing is good for strength, mobility, suppleness, and reflexes," he insisted, not shrinking from the fact that he will turn 52 this year.

SEEK FORGIVENESS, NOT PERMISSION

Another challenge in pursuing his activity involves the civil aviation authorities. For the initial, unpowered wing, the Swiss Federal Office of Civil Aviation (FOCA) was happy to greenlight Yves as long as he held both parachuting and hang-glider licenses.

But the first trials of the powered wing were another story. He fell back on the old advice, it's better to seek forgiveness after the



TECHNICAL DATA (2010 WING)

DIMENSIONS

SPAN: 2 meters (6 feet)

WEIGHT

WITH FUEL & SMOKE: 55 kilograms (121 pounds)

DRY: 30 kilograms (66 pounds)

ENGINES

TYPE: change to 22 kilograms (9 pounds) thrust each

FUEL: Mix of kerosene and 5 percent turbine oil for lubrication

FUEL CAPACITY: Between 15 and 30 liters (4 to 8 gallons)

PERFORMANCE

SPEED:

- Average: 200 kilometers per hour (125 mph)

- At Ascent: 180 kilometers per hour (112 mph)

- On Descent: 300 kilometers per hour (186 mph)

CLIMB: 330 meters per minute (1,086 fpm)

FLIGHT TIME: From 6 to 13 minutes

SECURITY

PARACHUTE: Parachutes de France

CANOPY: PD Spectra 230

HARNES: Cut-away system with engine shut down and automatic opening of a rescue parachute for the wing

fact than permission beforehand. "I would never have been authorized, so I did not ask," Yves said. "I went and tried the wing over an uninhabited area in Spain in 2003." But Yves did not proceed completely unprotected. "I had special insurance covering up to 10 million euros [\$13 million] in damages," he recalled.

The FOCA filed a complaint. "I went to them and explained that all pioneers had to test their inventions. I also pointed out I had not jeopardized anybody, except myself," he said. His arguments were successful in gaining their blessing, and Yves now holds FOCA approvals for flying at air shows. He has to comply with wind limitations, however. For the Channel crossing, French and UK authorities issued special



Yves conducted wind tunnel tests at RUAG Aviation in Emmen, Switzerland.

BOTTOM RIGHT: The engines are controlled with a handheld potentiometer, allowing Yves to move his arms freely in flight.

authorizations. It helped that the attempt was taking place over water.

FUTURE FLIGHTS

What's next? Yves hopes to fly at venues such as the Paris Air Show, over the Grand Canyon, and perhaps somewhere in the United Arab Emirates. A trip to EAA AirVenture Oshkosh would make a big impression on U.S. aviation enthusiasts who have followed his exploits online.

EAA has been assisting Yves with his goal of flying in the United States. The FAA has concerns about issuing a special waiver to allow Jetman to fly in its current configuration. However, there are possibilities. Yves would need to certificate the wing as an experimental aircraft in either his home country or the United States, and he would then require a letter of authorization from the FAA because it is a turbine-powered aircraft.

Besides flying in the United States, Yves is interested in flying alongside different aircraft. He already has flown in formation with the Breitling wing walkers in their

Stearman biplanes last July. Maybe more spectacular, he is considering flying in formation with jets.

Making the aircraft greener also is important to Yves. "Like the entire aviation industry, I need to find a fuel that is as effective as a fossil fuel but has less environmental impact," he said. He already has planned tests with a "bio-kerosene"; the expected bottom line is half the carbon dioxide emissions.

Ultimately, Yves envisions marketing examples of his wing. "The potential of my wing is huge," Yves said. "I'd like it to be a way to commute to work."

Certainly, Yves has captured the imaginations of all who love to fly—and not just pilots. To everyone who has dreamed of soaring headlong into thin air—like Daedalus or Iron Man—Yves is living our dreams. Thanks to him, someday we might be doing the same. *EAA*

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