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INTERNATIONAL AEROBATIC CLUB
EAA

SPORT
AEROBATICS

MAY/JUNE 2021

OFFICIAL MAGAZINE OF THE INTERNATIONAL AEROBATIC CLUB

IMMERSED IN Aerobatics

Pg. 46

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Mark Cunningham, IAC 437244, flies over Pitt Lake Practice Area just east of Vancouver, British Columbia.

Photo courtesy of Mark Cunningham

ABOVE:
Mark Cunningham coming in for a landing at his first Advanced category contest at the 2020 Canadian Nationals at Rocky Mountain House, Alberta.

Photo courtesy of Mark Cunningham

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Trying New Things

BY JIM BOURKE, IAC 434151

NATIONAL AEROBATICS DAY

THE RECEPTION for National Aerobatics Day (June 26) has been very positive. Numerous IAC and EAA chapters will be supporting it.

Some of the ideas I've heard include setting aside the day for practice and critique, hosting a fly-in, sponsoring a chapter fly-out to grab a hamburger, spin training as a group, and introductory aerobatic ground school for new competitors.

The IAC is grateful for the support of the EAA, ICAS, AMA, IMAC, the NAA, and all the chapters that are helping to promote our beloved sport. Stay safe and put a smile on your face doing what you love!

Please let me know how you are celebrating National Aerobatics Day so the IAC can help make your event a success!

TRY GLIDER AEROBATICS

I've had my glider rating for about a year now. I've learned a lot already, though I have a long way to go to be a great Unlimited glider pilot.

One lesson I've learned is that, in a glider, things happen very slowly, and then very fast. What I mean is that as long as you are in (near) horizontal flight, the airspeeds are low and it feels like you have all day to get set up for the next maneuver. But as soon as you point the nose away from the horizon in either direction, you must be very quick with the controls. Speed builds up, even on a 45-degree downline. There is no time to contemplate the inputs for a snap-roll on a vertical downline in a glider. The time to load the snap is *now*!

Gliders have also taught me a lot about energy management, and I'm way more comfortable with the idea of an engine-out situation in my Extra than I was before. These are great reasons for every aerobatic pilot to fly gliders: It will make you safer and more confident.

One thing I did not anticipate when flying gliders is how humbling it is when I make a mistake. If I mess up a tailslide in my Extra, I just set back up and try again. In a glider I have to wait about 20 or 30 minutes to land, get myself out of the plane, queue up, connect to the towplane, get myself strapped back in, and get back up to altitude. That's a lot of time to regret a mistake. It's more important in a glider to plan your flight on the ground, anticipate your energy state, visualize what you will see, imagine all the control inputs, and execute everything correctly. You have just one shot to get it right in a glider. All hope is lost if you make a major mistake at the beginning of an Unlimited glider sequence!

You can see these added challenges as advantages or disadvantages, depending on your perspective. But some things about gliders are just flat out *better*. For example, you do not have to hold a medical certificate to fly a glider. That opens up aerobatics to a lot of people. Another advantage is that the *g*-loading is a bit lower than when flying a powered aircraft. In my glider I can fly all the sequences and experience at most +6*g* and -4*g*. This compared to +9*g*/-9*g* in my Extra. Flying a glider isn't easier in a technical sense, because the challenge of flying a sequence still relies on precise timing and correct movement of the controls, but it's a lot less headache-inducing all the same.

If you have an interest in gliders, contact the IAC's glider chair, Jason Stephens, at *jason@azsoaring.com*. Jason can steer you in the right direction.

CHAPTER LEADER ROUNDTABLE

This year we've been improving communication with IAC chapters by holding quarterly roundtable video conference calls. I've learned a lot about what our chapters are experiencing, and we've been able to make headway with regard to some long-standing problems.

Several chapter leaders expressed frustration over the process of getting FAA waivers. This is always going to be a tough thing to improve because FAA staff members tend to rotate, and it seems like we never finish the job of training new FSDO staff on the process. This is something we are working very hard to improve, so do not hesitate to reach out if you need help.

Another sore spot is the EAA's process of providing certificates of insurance for contests. We've made some progress here as well. In fact, I like to believe we've solved the major communication hurdles we faced and have everyone working from the same script. But I recognize that may be wishful thinking. Again, if you get stuck working through an issue, we want to help you out, so please bring IAC headquarters into the conversation and let us grease the skids for you. The IAC's executive director, Steve Kurtzahn, is ready to help you. Email him at *execdir@iac.org*.

Want to give me your thoughts, suggestions, comments, complaints, or money? Contact me at *president@iac.org*. IAC

▸ Please send your comments, questions, or suggestions to president@iac.org.

PHOTOGRAPHY BY **CHRIS BECERRA, ALTEZA FILMS**

Long-Distance Volunteering

BY LORRIE PENNER, IAC 431036

WHEN WE THINK OF VOLUNTEERING at the International Aerobatic Club, we picture a contest with the guys and gals feverishly working in the office on all the judge paperwork, busy tech inspectors around each competitor's aircraft, the starter coordinating the competitor's launch to the box, and sitting out on the boundaries or acting as a grading judge, assistant, or recorder. However, there is so much more to volunteering.

There are many IAC volunteers who may or may not ever attend a contest. They work from home attending teleconferences, contribute to work being done on committees, and write or proof articles. I have been fortunate to have some behind-the-scenes help on *Sport Aerobatics* and *In the Loop*.

Thank you to Arturo Landaure, currently living in Peru, who helped me with a translation on an article that was submitted in Spanish. Although EAA does copyediting for us, I am fortunate to have Lynn Bowes of Nebraska and Gordon Penner of Ohio doing proofing to look for "insider" aerobatic information that others outside IAC may not recognize.

All of our #IAC_FlyingFriday Instagram social media posts this year have been handled by Sol Garófalo Pidal, who lives in Argentina. All of our #IAC_chaptercontest posts in 2020 were accomplished by Cleta Sweeney of Missouri — thank you!

Our social media presence has expanded dramatically, and I am looking for more volunteers to help in this endeavor. We have nearly 5,000 followers on Instagram and 12,000 on Facebook. Not only do our followers enjoy the content we are pushing out, but also we get a lot of leads on great stories about our IAC members there. Thank you to all of you who tag #IAC_HQ! Contact me if you are interested in volunteering in social media by writing to *editor@iac.org*.

LETTER TO THE EDITOR

BY STEVE KURTZAHN, EAA 135819 AND IAC 441074

Dear Lorrie,

Thank you for the article about Alain Aguayo in the March/April 2021 issue of *Sport Aerobatics*. You did an excellent job, as usual!

I want to share with our readers something that happened in April 2020. A new IAC chapter (136) was starting in Buenos Aires, Argentina. We wanted to do something special to reach out to our new members in South America, but no one at our office in Oshkosh or in our IAC leadership spoke fluent Spanish. We put the word out to our chapters, and Alain stepped forward to do a personal video greeting for our new members in Argentina – in Spanish! He did a wonderful job and spoke of what the IAC meant to him personally. IAC 136's president, Pablo Quintero, was thrilled to get the video and promised to show it at one of their chapter meetings. I have no doubt it was a big hit!

It is indeed a pleasure and an honor to say that we have many, many dedicated IAC members like Alain who go out of their way to promote aerobatics, not only in the United States and Canada but around the world! IAC

Steve Kurtzahn
IAC Executive Director

SUBMISSIONS: Photos, articles, news, and letters to the editor intended for publication should be emailed to editor@iac.org. Please include your IAC number, city, and state/country. Letters should be concise, polite, and to the point. All letters are subject to editing for clarity and length.

TOP STORY

National Aerobatics Day

THE SKILL, BEAUTY, and excitement of aerobatic flight will be celebrated on Saturday, June 26, during the inaugural National Aerobatics Day, as announced March 10, 2021, by Jim Bourke, president of the International Aerobatic Club (IAC).

"National Aerobatics Day is the perfect day to host an aerobatic camp, a barbecue, a practice session, or to share videos of aerobatic activity online," Bourke said. "With over 40 chapters nationwide and two international chapters, IAC members will be organizing these types of activities and others to engage the public and general aviation pilots in aerobatics."

The IAC has established National Aerobatics Day as the fourth Saturday in June each year. It will highlight the dedicated pilots who fly these precision maneuvers as well as the support teams and volunteers who make it possible.

IAC Chapter 89 had a great experience in 2019 at Leeward Aviation Day. Their single day of fun flying, great food, and community togetherness is an example of how many IAC chapters will be celebrating National Aerobatics Day.

PHOTOGRAPHY BY **BOB SCHALMERS**

ABOVE: Jerry Esquenazi, IAC 438873, flying his RV-8 that he built from a kit. He enjoys traveling around to different chapter events.

RIGHT: Marianne Fox, IAC 441091, pictured with Jim Bourke, IAC 434151, is looking forward to a fly-out with IAC Chapter 77 on National Aerobatics Day.

Greg Principato, president and CEO of the National Aeronautic Association, enthusiastically stated: "Aerobatics thrill. They also inspire. And there is no telling to what heights that inspiration will take someone!"

Originally developed as evasive maneuvers during World War I, aerobatics is a proven discipline that builds confidence and improves pilot proficiency. The loops, rolls, hammerheads, and lomcevaks are examples of precision flying at its finest, and most fun!

"There are few things in life and nothing else in aviation that are as joyful and liberating as flying aerobatics," said John Cudahy, president of the International Council of Air Shows. "And the idea of devoting one day each year to celebrating aerobatics is brilliant."

The IAC exists to promote the safety and enjoyment of this great sport — what better way to celebrate than to set aside a special day to recognize the aerobatic community, and engage in sharing a passion that too few get to experience?

More information is available on IAC.org, which also includes information on IAC chapters throughout the country and IAC contest and events calendars for aerobatic activity on June 26 and year-round!

PHOTOGRAPHY BY **CONNOR MADISON, GARRET WOOD**

EAA AirVenture 2021 – IAC Forums Schedule

EAA AIRVENTURE OSHKOSH 2021 will include a full roster of forums at IAC's Vicki Cruse Educational Pavilion. The forums are scheduled daily from Tuesday, July 27, through Friday, July 30, 2021, and run for approximately one hour and 15 minutes each.

A fantastic lineup of aerobatic and unusual attitude forums throughout the week are being planned. The speakers below are scheduled. We do have three open forum times, so if you are interested in being a speaker, please contact Michael Church, IAC AirVenture Forums chair, at mc@sunriseaviation.com.

2021 FORUMS SCHEDULE

CHECK OUT ALL THE PLANS FOR AIRVENTURE ON THE IAC WEBSITE.

TUESDAY, JULY 27
8:30 A.M. – Budd Davisson: Aerobatic Classics: How Do They Fly?
10 A.M. – Gordon Penner: Flying With Broken Flight Controls
11:30 A.M. – Dagmar Kress: Aerodynamic Principles Demonstrated in Aerobatics
1 P.M. – Cecilia Aragon: Rolling Fear: Upside Down With Aerobatics

WEDNESDAY, JULY 28
8:30 A.M. – OPEN
10 A.M. – Bill Finagin: Suddenly Out of Control: What Do You Do?
11:30 A.M. – Michael Church: The Possible Turn: Can You Go Back?
1 P.M. – Tony Horvath and Josh Pruzek: Pitts Model 11: Eleven Years in the Making

THURSDAY, JULY 29
8:30 A.M. – Susan Bell: Competition Aerobatics 101
10 A.M. – OPEN
11:30 A.M. – OPEN
1 P.M. – Skip Stewart: Precision Aerobatics

FRIDAY, JULY 30
8:30 A.M. – Annual IAC Membership Meeting
10 A.M. – Mike Lents: Sequence Design
11:30 A.M. – DJ Molny: Alluring Figures
1 P.M. – Greg Koontz: Taming the Taildragger

PHOTOGRAPHY BY **NICK MOORE**

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YAK-52 YA52

YAK-52 YAK-52

PIREP from Lithuania

BY JORGE MACIAS, IAC 432353

THE YEAR WAS 2000. At the age of 22, I had achieved my dream of entering one of the great Spanish airlines. I'd worked hard to get there, finished all my courses, and became more settled financially, so I could finally afford to approach the world of aerobatics as a pilot. Having been involved my entire life in the air show world as a mechanic's assistant, trainer's assistant, airplane cleaner, video recorder, and general do-it-all guy, I was lucky enough to get some flights, but now it was my turn to compete. It was in the summer of 2001 that I traveled to Lithuania for the first time.

PHOTOGRAPHY COURTESY OF **EAA ARCHIVES**

YAK-52

That first trip to Lithuania changed everything. I got hooked on the "aerobatic poison," as Vytas Lapenas, former Spanish team trainer and former member of the Russian team, put it. I needed just one more trip to Lithuania, and less than a week after coming back, I bought a one-fifth share of a Zlín 50.

In Lithuania, Vytas Lapenas and the Yak-52 were waiting for me. In those times, nothing in Spain was comparable to the Vytas Lapenas Flight School. Istra, a small runway in Kaunas, had a small control unit/house where Vytas lived. It also had an annexed restaurant-hotel with a hangar where the planes were kept. Breakfast started at 9 a.m. each day, and at 8:30 a.m. Vytas would wake you up with the incredible sound of the Su-29 flying in the aerobatic box above the hotel. The Yak-52 adventure and my lessons with the master began later.

ABOVE: Jorge at the Vytas Lapenas Flight School.

Jorge flew the Stuadacher S-300E in the 2007-2015 air show seasons.

The first thing that catches the eye of a Westerner who's preparing to fly a Yak-52 in an Eastern country is that, as one approaches the plane, a mechanic has already prepared, reviewed, and refueled it. That's how these planes were designed — they're tough, but you need a mechanic nearby to help you operate them. After the preflight inspection, we tied up under the careful supervision of our instructor. When starting the engine, you're forced to select many of the switches and circuit breakers from memory, as they are in Russian.

First we prime the fuel system and then the cylinders with a primer that would dwarf that of a C-172; everything here is massive and oversized. With the magnetos off, our mechanic is responsible for turning the propeller. Once free, we press the starter button. The air is injected directly into the cylinders, alternately causing it to start spinning, and at the first sign of ignition we connect the

Although Yak-52s are heavily loaded with two pilots and fuel, they accelerate quickly and climb with energy.

magnetos while playing with the primer and gases to accelerate and stabilize the engine at 41 percent rpm. With the engine stable, we check the parameters, close the cylinder and oil-cooling gills to heat faster, and taxi to the threshold.

The first thing that draws our attention while we're taxiing is the aircraft's strange braking system. A lever on the control stick is activated by hand and resembles a bicycle brake. The pressure of the pneumatic system drives both of the brakes at the same time. By stepping on a pedal and operating the brake, we can shift the pressure to the side we've stepped on. The front wheel goes "free," so for the tighter ground turns it's important to use differential braking. Vytas explains how to do it: "Chiki, chiki," he tells me through the headsets. If we press and hold the brake, we will release more and more pressure, so we could end up locking the wheel. Instead, small and short applications are more effective. ("Chiki, chiki" — pressure applied like a child, because they are not as strong as a man.)

The visibility — both forward and peripheral — is perfect while taxiing, and little by little we get used to the braking system. At the head of the runway and with the parameters in green we do the engine run-up; everything goes backward compared to a Western plane. At 67 percent of power we first test the propellers and then the magnetos. The noise is deafening when the cabin is open.

We close the cockpit, do our last checks, and launch ourselves in takeoff roll. Everything goes the other way; we use left rudder to compensate for the torque (the propeller turns counterclockwise), and the powerful 360-hp engine soon launches us into the air. Although Yak-52s are heavily loaded with two pilots and fuel, they accelerate quickly and climb with energy. This is much more than Western pilots, who tend to train on Pipers and Cessnas, are used to.

With a positive rate of climb and no more runway remaining, we select landing gear up. With its pneumatic system, the gear rises quickly and noisily. Normally we take off without flaps, and at 400 feet we reduce to climb power. As always, the other way around as a Westerner. First the propeller (the engine is supercharged by reducing the rpm lowers the intake pressure) and then the gases to leave them adjusted. There is no mixing, as the carburetor adjusts automatically while we climb.

This desire to make this plane different from a Western aircraft seems obsessive if we look at the artificial horizon. The upper part is brown and the underside dark navy blue, almost black. Being a Western pilot, I don't want to know what it feels like to fly in IFR with that horizon! Looks like we're upside down when we're flying normally.

In the air, you realize how well this plane flies. Its controls are harmonized and smooth, and the aircraft responds vigorously to the inputs we give it. Gradually during the climb, we get used to using left rudder to correct the torque. Its controls; its oversized cockpit full of instruments, warning panels, and switches; its glazed cockpit; and the noise from a nine-cylinder M-14P engine make you feel as if you're flying a World War II fighter plane.

PHOTOGRAPHY COURTESY OF **JORGE MACIAS**

At the Vytas Lapenas Flight School, a mechanic had already prepared, reviewed, and refueled the Yak-52.

Once we reach our maneuver altitude, we start our work. We check for traffic, tighten our seat belts, and check parameters. We accelerate to 230 kph for a half-roll inverted flight to check the seat belts, and then half-roll again. We pitch up a little with maximum aileron deflection, and in no time, we do another half-roll. The ground is over us, the sky at our feet, and Vytas tells us, "This control stick is capable of moving the world." Meanwhile, we are still. The maximum expression of freedom! We maintain the inverted flight, which requires us to keep the nose well above the horizon, and put some forward pressure on the control stick. The Yak-52 has a Clark YH asymmetric profile that's very docile and effective during normal flight but requires a high angle of attack to produce the same lift in inverted flight. Once the seat belts and the engine are checked during inverted flight, we go back to normal flight.

The first figure we work on is the loop. We accelerate to 300 kph with the propeller at 80 percent and the throttle full. Establish a horizontal line and we'll pull at 4*g*. As the aircraft approaches the vertical, we loosen the pressure on the stick for the inverted flight area being at 0*g* in parabolic flight to round the loop well. At this point the aircraft requires a little left foot to compensate for the torque. As the nose begins to point to the ground, we reverse the inputs to end up pulling the same *g*'s we started with and a loop as round as possible.

Surprisingly, the first thing Vytas taught me during those loops was not how to do them but where to look and where to get information. More than 10 years later I continue to do the same thing when I fly and still teach it the same way to my students.

Also, it is our first exposure to *g*'s, and Vytas tells us that to withstand them we have to tighten our muscles and breathe "like a panting dog." The Yak-52's seat posture is more typical of a desk than an aerobatic aircraft. A straight back, straight head, and low arms make the *g*'s very hard to bear. On the other hand, you can teach a pilot to compensate for the effects of these.

For the roll we use a comfortable speed of 230 kph. Its 140 degrees per second will allow you to do well if you use the correct inputs. You have to be "alive" with your feet to hold your nose, and you need to push when you're going through inverted flight. This is because of the asymmetrical profile. Its soft and harmonious controls make this heavy machine move with joy and grace.

PHOTOGRAPHY COURTESY OF **EAA ARCHIVES**

Stalls and spins are textbook-like, with a stall speed the plane clean of about 110 kph (with normal weights). Its well-known Clark YH profile makes it seem docile. It's impressive that a machine as hard and big as the Yak handles itself like a sweet kitten when it spins. During these maneuvers, we always maintain reasonable control with the control surfaces, whether to put the Yak in stall or a spin, during its execution and especially on the way out.

In the stall turn we use a speed close to 300 kph (more to describe a good line to the vertical). Its 360 hp helps us accelerate this heavy machine; once on the horizontal line, a pull of 5*g* will take us to the vertical. It's important for instructors to tell us what the correct position is (neither positive nor negative) since its asymmetric profile does not make it easy. Eventually it will need left rudder, by the time you are at 60 kph, kick with the right foot and pivot. We apply a little counter aileron as we pass the nose over the horizon, and once vertical down we enjoy 360 hp and gravity accelerating toward the ground. Good vertical and a new pull at 5*g* should get us out to the height where we started.

After working on the box, we reduce throttle, close the cooling gills, and, if necessary, lower the landing gear to descend faster. The feeling of freedom as we open the cabin in flight is unmatched and prepares us for the approach. Flaps one step, landing gear down, full flaps, and about 160 kph at the end to be over the threshold with about 150 kph.

In Istra we use the grass runway for the landing, so we look for the minimum contact speed, keep the nose high once on the ground, and look for aerodynamic braking. Almost without speed, we let the nose down and gradually continue to learn to taxi with the "chiki, chiki" on our way to the parking area. *IAC+*

JORGE MACIAS is a professional airline pilot with more than 16,200 flight hours, including more than 740 hours of aerobatic flight. He's a fourth-generation pilot, going back to the origins of aviation in Spain. In 2005 he was the first pilot to represent Spain in an international competition in the Advanced category. In 2007 he joined the Spanish Aerobatic Flight Team in Unlimited, representing Spain in 2007, 2008, and 2009. www.JorgeMaciasAlonso.com.

PHOTOGRAPHY COURTESY OF **JORGE MACIAS**

TOP: Landing the Yak-52 at the flight school in 2001.

BOTTOM: At a comfortable speed of 230 kph, the plane rolls at 140 degrees per second.

YAK-52

PHOTOGRAPHY BY **MARSHALL EKSTRAND**

Acro-1

Exceeding all my expectations!

BY MARSHALL EKSTRAND

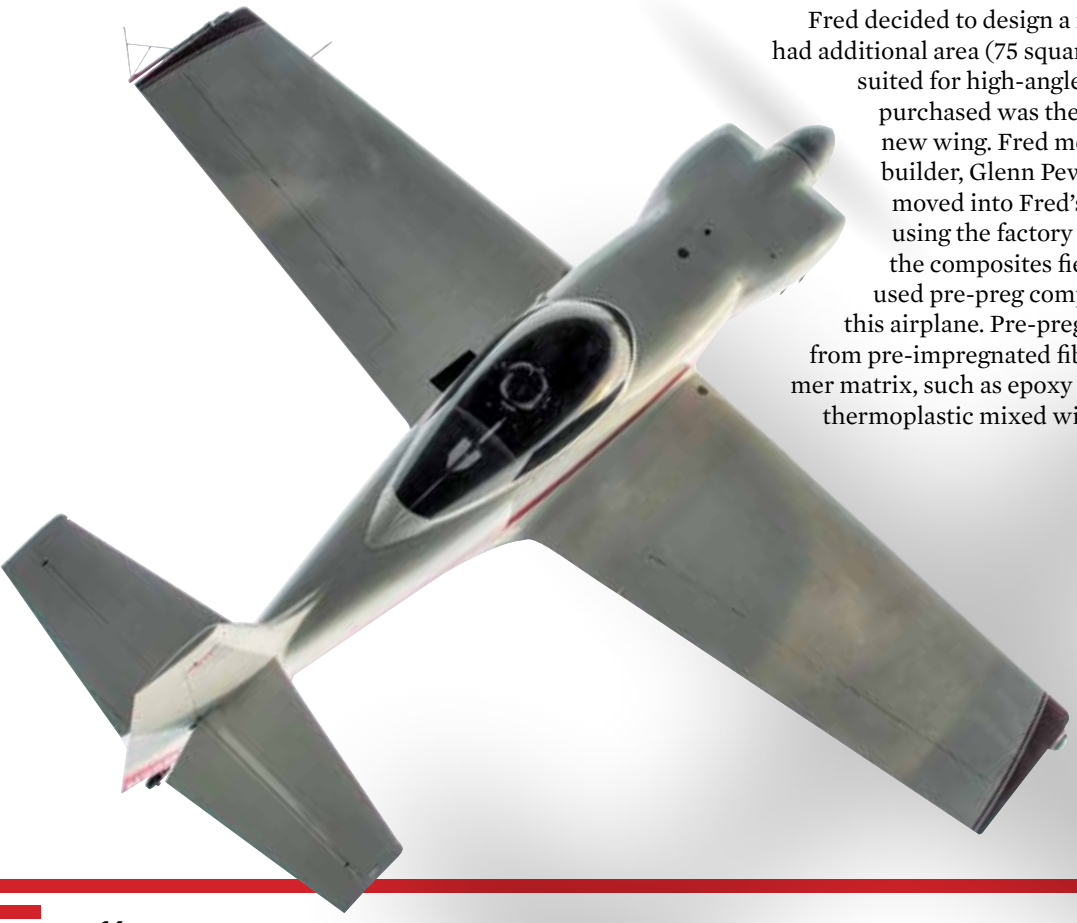
IN 2016 WE PURCHASED a home in an airpark just north of Seattle. Almost immediately I was on the hunt for a nice Christen Eagle to replace the one I had foolishly sold several years before. My wife, Anissa, was instrumental in making my lifelong dream of living in a fly-in community a reality and was really the driving force for the move. Since I was the only one in our family who flies, I didn't want to selfishly move our family away from their friends just for my benefit. I wish I had listened to my wife sooner, as moving into the airpark was a wonderful decision. We're now part of an amazing community with lots of great friends who all happen to have the same hobby!

It didn't take long after the move for me to realize that I could easily find time to fly just about every day that the weather was nice, which is more often than you'd think for the Pacific Northwest. I knew I had to find another aerobatic aircraft! We had our "family" plane (Cessna 170) and a Thorp T-18, but I wanted something I could fly competitive aerobatics with. Unfortunately, I wasn't having much luck with my search for a nice Eagle that was actually for sale. My unsuccessful Eagle search forced me to expand my wish list to include the DR-107 One Design and Laser.

I really wanted a small four-cylinder airplane, as my last aerobatic airplane (the nine-cylinder Interavia E-3) was quite thirsty, and I didn't want to burn that much fuel. I already had a Pitts S-1S — a long-term project that still hangs in the ceiling of our hangar — but I wanted something I could fly right away. I had looked at a couple different One Designs, but I didn't fall in love with either. One wasn't really finished, and the other didn't have great workmanship. I would have loved to include the Giles airplanes in my search, but they were just outside my budget.

In January 2017 I spotted an online ad for the Acro-1. I remembered seeing the unfinished prototype at Oshkosh in 1993 and the flying prototype at SUN 'n FUN in 1994. I distinctly remember looking at the prototype and discussing the aircraft with its designer, Fred Meyer. At the time I was an 18-year-old kid, so the aircraft's low cost and high performance were very appealing. The aircraft was quite small, but it performed well, even with its small Continental engine and fixed-pitch prop.

The Acro-1 structure is primarily molded fiberglass using vinyl ester resin.



I immediately called the number in the ad and spoke with the owner of the Acro-1. The owner, Gary, had purchased the airplane from the builder. Gary had previously owned another of Fred Meyer's aircraft designs — the Meyer-360. As a result, he was able to describe the aircraft's strong and weak points with a relevant perspective. After a brief conversation with Gary, I knew the plane was worth a look. The next day I flew out to Colorado Springs to see the plane in person. I was very impressed with both the airplane and Gary, and I flew the Acro-1 home as its new owner.

On the drive back to Denver I tracked down Fred Meyer's phone number and called him to inquire about the airplane. We spoke for about an hour regarding this particular Acro-1. Fred explained the development of the Acro-1. The airplane was originally designed as a high-performance sport aircraft with aerobatic capabilities. It was originally equipped with a smaller, thinner wing that boasted 60 square feet of wing area and a Continental IO-240. The prototype was then refitted with a 200-hp Lycoming AEIO-360 and a constant-speed prop so they could further explore its flight envelope. Fred eventually realized that, with the bigger and heavier engine, the smaller wing wasn't well suited for serious aerobatics, as the wing loading was just too high for the airplane to corner well.

Fred decided to design a new wing for the Acro-1 that had additional area (75 square feet) and an airfoil more suited for high-angle-of-attack flying. The Acro-1I purchased was the first flying example with the new wing. Fred mentioned that he knew the builder, Glenn Pew, well, as he had actually moved into Fred's house and built the aircraft using the factory tooling. Glenn was working in the composites field at the time, and he and Fred used pre-preg composites for the construction of this airplane. Pre-preg is a composite material made from pre-impregnated fibers and a partially cured polymer matrix, such as epoxy or phenolic resin, or even thermoplastic mixed with liquid rubbers or resins.

TOP: Marshall taxiing without fear with the 4-ounce camera system he added.

RIGHT: Marshall channels *Star Wars*' Poe Dameron as BB-8 rides along in the back.

The fact that my new Acro-1 was structurally completed with Fred at the factory really was a nice bonus. The Acro-1 structure is primarily molded fiberglass using vinyl ester resin. The wing spar is carbon fiber. The structure of the aircraft was designed by the late Martin Hollmann, who designed a number of successful composite aircraft in the 1990s. About 10 Acro-1 kits were produced by Aircraft Technologies, with just two ending up on the FAA Registry — the prototype and my airplane. Fred Meyer's business partner, Joe Tate at Aircraft Technologies, indicated that they sold "about" 10 empennage kits, but only three or four complete Acro-1 kits. This may explain why so few finished examples exist.

About two weeks later, Gary arrived with the Acro-1. The aircraft was built for a pilot a little taller than me (I'm 5 feet, 10 inches tall), so Gary offered to deliver the airplane, as I could either use full rudder or brake but not both at the same time. Thanks again, Gary! Following its arrival, I followed my normal routine of completely disassembling any "new to me" aircraft and going through each and every system and component.

The aircraft was completed in 2001, but it had a lot of mid-'90s components and technology. As my wife can attest, I'm terrible at leaving things alone, and I spent several months updating and improving the airplane. In the course of the rebuild, the airplane lost about 80 pounds as a result of my using modern lightweight components and removing anything that wasn't necessary. The airplane was in great condition structurally and cosmetically, but many of its components were dated.

I had to move the rudder pedals back about 3 inches, so I designed an adjustable pedal system and built new rectangular steel weldments. The pedals I build are 4130 steel, but they are my own design. I removed a 34-pound battery and replaced it with a 4-pound lithium battery. The instrument panel was also quite dated and ergonomically unsuitable. I built a new panel that included a small EFIS and graphic engine monitor, as well as the analog airspeed indicator and altimeter that I like to have for flying aerobatics. One challenge of living at my airpark is the terrain. We've got a lot of hills. After a close encounter with a stray vehicle, I added a 4-ounce camera system, so now I can taxi without fear of running into anything along the way, as most of our taxiways are too narrow for S-turns to be effective.

I also updated the radio and transponder and added ADS-B In/Out to the aircraft. The electrical system was completely rewired and simplified, and several heavy components were replaced with more lightweight and efficient modern substitutes. The fuel system was also completely updated, and I replaced a heavy fuel boost pump with a much more efficient and lighter pump. The short stack exhaust system was exceptionally light, but it was super noisy inside the airplane and sounded really strange from the ground.

PHOTOGRAPHY BY **MARSHALL EKSTRAND**

TOP: One disadvantage of owning a unique airplane is lack of off-the-shelf parts. This resulted in Marshall building his own exhaust system.

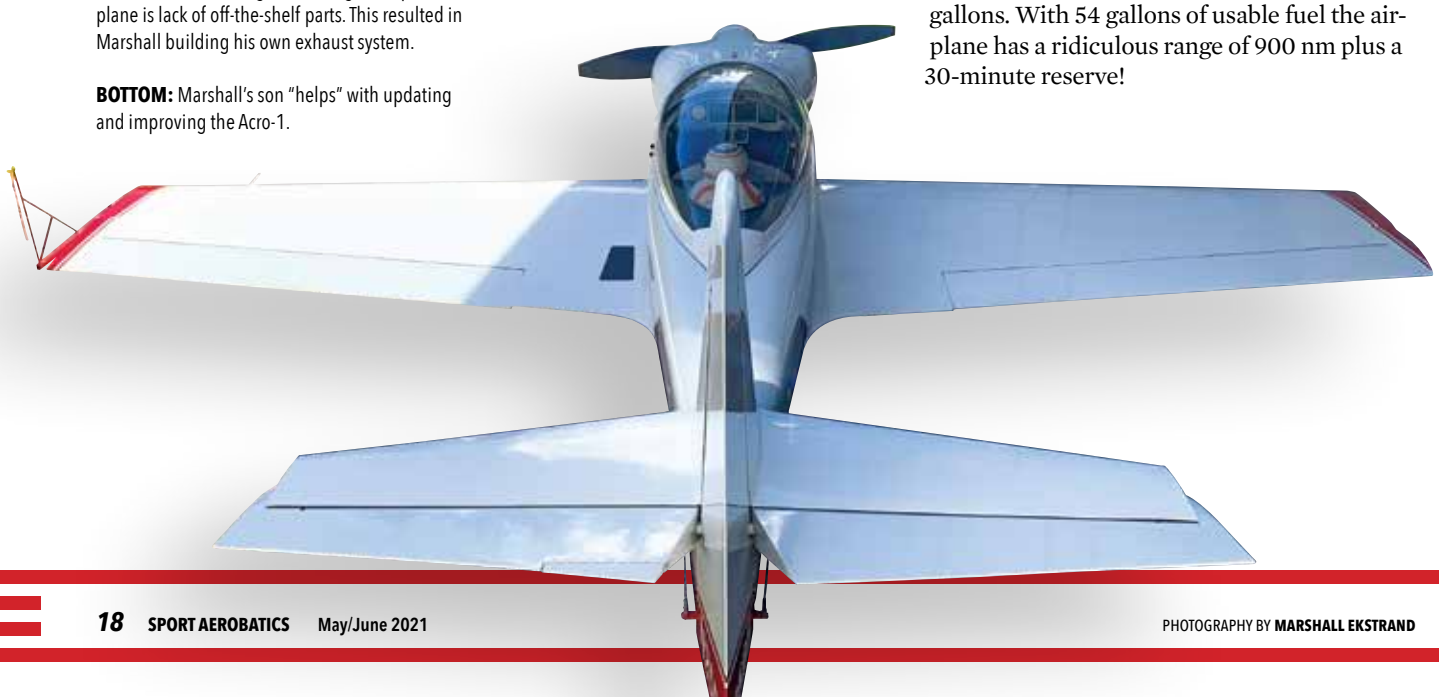
BOTTOM: Marshall's son "helps" with updating and improving the Acro-1.

One disadvantage of owning a unique airplane is the lack of off-the-shelf parts, like an exhaust system. Nothing worthwhile is easy, so I ordered a bunch of stainless steel tubing and bends, practiced my stainless welding, and built my own exhaust system, which now incorporates a smoke system, too! I also replaced the leaf spring and 6-inch tail-wheel assembly with a tapered rod type and 4-inch wheel to reduce weight and increase the aircraft's deck angle. This was done to help reduce its speed on landing, in response to a complaint Gary had had.

Fred Meyer has been an amazing resource throughout my ownership of this airplane. I never anticipated the level of support he would provide for an aircraft he last touched 20 years ago! In addition to always being available for questions, he's become a friend throughout this process, and we talk frequently about various aviation projects we are both working on.

The Acro-1 weighs in at 900 pounds empty and has a gross weight of 1,450 pounds. It is equipped with an AEIO-360 Lycoming engine and a Whirlwind 200C constant-speed propeller. The seat is reclined at about 40 degrees, so it's very comfortable and helps with *g*-tolerance. The new panel is logically designed, with maximum use of very little space. The fuel system controls are on the left, electrical on the right, and the EFIS and engine monitor in the center with radio and transponder outboard. My sequence card mounts over the EFIS.

The aircraft has exceeded all my expectations and is a great performer. I typically take off in under 500 feet and climb at about 3,000 feet per minute. The aircraft cruises at 185 to 190 knots at 25" MP/2500 rpm ("25 squared") and just under 10 gph, and it has a V_{NE} of 230 knots. It is equipped with three fuel tanks. The header tank holds 12 gallons, and each wing holds an additional 21 gallons. With 54 gallons of usable fuel the airplane has a ridiculous range of 900 nm plus a 30-minute reserve!



PHOTOGRAPHY BY **MARSHALL EKSTRAND**

ABOUT THE PILOT

I grew up in a nonaviation family, but I wanted to be an aerobatic pilot for as long as I can remember. I flew radio-controlled aerobatic aircraft as a kid, began my flight training at 16, and completed all my ratings as soon as I met the age requirements. I've been an EAA member since I was 15 years old and was fortunate to learn a great deal from the excellent members of EAA Chapter 1 as a teenager.

EAA Chapter 1 sponsored my attendance at the EAA Air Academy in 1992. That was my first trip to Oshkosh, and it was a wonderful experience. I had previously volunteered for a number of air show pilots in the Southern California area, and that experience paid off. During EAA AirVenture Oshkosh 1993 I ran into a performer named Don Johnson whom I had met at an air show in California, and we became friends. Several months later, I received a call from him that would drastically change my trajectory. He offered me a full-time job working with his air show team. Working in the air show industry for a couple seasons gave me a wonderful education. I traveled all over the country to air shows and contests and was able to fly some amazing airplanes and meet some truly great pilots.

Following that experience, I decided that I might want to pursue a career in the airline industry to help fund my airplane habit. I then focused on an airline career. I was very fortunate to get some great advice early on and was able to get a job flying cargo in turboprops in short order. That job led to another job flying corporate jets, which led to another job flying passengers in the DC-8. Unfortunately, that company went out of business, but not before I landed a job flying cargo again. I flew the DC-8, L-1011, and 747 freighters before I was hired by a major airline in 2004. I'm currently an Airbus captain and have made good on my promise to myself to always have a small plane so I can really fly.

I purchased my first airplane when I was 21 and have always had at least one ever since. I also enjoy maintaining my airplanes. I managed to get my A&P/IA mechanic certificate along the way and really believe that's made me a better pilot. It's a lot easier to make good decisions when you know exactly how something works. As a teenager I read Eric Müller and Annette Carson's great book *Flight Unlimited*. This book had a tremendous impact on how I think about flying. I share Eric's definition of aerobatics: "I would define aerobatics as self-assurance and safety in all flight attitudes. It is advanced flying technique that opens up the boundaries of flight and allows you to operate throughout the range of your known capabilities." I hope to improve my ability each and every time I fly, no matter what type of machine I'm flying.

I always wanted to compete in IAC contests; it just seemed hard to manage the time. When I flew cargo, I was flying all over the world and didn't have enough control of my schedule to make it happen. When I finally had the combination of schedule control and financial means, my two boys (Ethan and Andrew) were competing in their own sports (swimming and basketball), and I didn't want to be away from my family any more than I already was. My wife is a flight attendant, so that further complicated our schedules and time together as a family. I'm very lucky to be able to fly several times a week at home now without really affecting my family at all. The one positive of the pandemic is that I've been home a lot this past year. I now think my family would be happy to have the occasional weekend without me. I really hope to make it to a critiqued practice session this spring and then compete in a couple contests this year. I'm looking at the Apple Cup and the Apple Turnover for my first forays into the competition world.

The electrical system was completely rewired and several heavy components were replaced with lightweight and efficient modern substitutes.

I'm very lucky to have a practice area adjacent to our runway. Within a minute or two from takeoff, I can be in the box at 2,000 feet MSL or 1,500 feet AGL with two left turns. I typically fly aerobatics for about 15 minutes at "25 squared" and 10 gph. This power setting yields about 2,200 feet of vertical from 210 knots and burns about 3 gallons per session. The aircraft required a bit of development with respect to its tuning to get the spades just right. I now have the control forces well balanced and have attained a great roll rate of just over 360 degrees per second. It's a very well-mannered airplane with no unusual flight characteristics, and the wing has an amazing ability to hang on without buffeting when pulling tight corners. You can really load the wing up with a lot of *g*, even at low energy levels (high AOA), and the airflow stays attached across the whole wing until just prior to stall. The power-off stall speed is about 52 knots at Acro weight (loaded aircraft weight within aerobatic category limitations) and well below 40 knots indicated with power on.

For approach and landing, I normally enter downwind at about 180 knots, then slow in order to be over the numbers decelerating through 70 knots. I typically use about 1,500 feet to land. I've had the airplane loaded up to 8.5*g* positive and 5.5 negative. In addition to practicing sequences, I've enjoyed formation flying with my neighbors (upright and inverted) and have been assisting a local avionics corporation with product development and by testing some of its new products in every attitude with my Acro-1. I've flown the airplane just over 200 hours so far, with an average flight time of about 20 minutes. The airplane does exactly what you tell it to. The only limiting factor with this airplane is my ability to control it precisely.

If Fred brought the Acro-1 back into production, I think several of my neighbors would be interested. I truly enjoy the challenge of flying the airplane precisely in all attitudes, and I couldn't be happier with it. I've never owned an airplane that provided this level of fun and performance at such a reasonable operating cost. **IAC**

Acro-1 flies overhead as Atlantis II is admired during SUN 'n FUN in 2000.

ILLUSTRATION BY **CORDELL WALKER**

Dreams TAKE FLIGHT

BY FRED MEYER, IAC 19516

MY NAME IS FREDERICK JAMES MEYER, but everyone calls me Fred. I grew up in a small tourist city in northern Minnesota called Brainerd. As a small child, I always believed that if I ran fast enough, I could fly. In my childhood dreams, I would run faster and faster, and then running even faster became very easy; magically, I would take to the air in flight. During the day, I would often stand on the picnic table in our backyard, wearing the Peter Pan outfit that my mother sewed for me on Halloween. Holding my arms out, I'd close my eyes, concentrate, and then jump forward. I always landed in the grass a few feet from the table, but that didn't stop me from trying again. I knew that if I kept trying with enough concentration, I would fly one day.

During my first day of kindergarten, I watched in amazement as the sixth graders were flying their model rockets. Deciding I could build one myself, I unrolled a roll of paper towels when I got home from school to get to the perfect-sized cardboard tube inside of it. I formed the fins out of some thin wood my father had in the basement and made a parachute out of a trash bag and kite string. By the time my father got home, the rocket was completed and painted. Seeing my enthusiasm, he brought me to the hobby shop, and we purchased a balsa wood nose cone and a real Estes rocket motor. We lit the rocket motor and up she went, almost out of sight. The parachute opened, and it floated gently back to earth, landing close to where we were standing.

From that point on, I was hooked. I continued to build rockets. Soon I was building line-control airplanes and also free-flight airplanes with small motors on them. I learned the flight characteristics of the store-bought kits and what I liked and didn't, and I tried to design something better. Using balsa wood from the hobby store, I built my own airplanes. Sometimes they were a flop, and other times they turned into a beautiful flying airplane. Either way, it was a great learning experience.

Fred Meyer with some of his early designs.

PHOTOGRAPHY COURTESY OF **FRED MEYER**

Acro-1, a truly enjoyable airplane to fly.

Since my father was a dentist, we were able to afford a digital proportional radio control unit when it was first invented. It was a four-channel unit made by Kraft. I remember it cost over $500, which was a lot of money back in the '70s. This allowed me to further my designs with more complex airplanes.

After high school, I got involved in flying competition model aerobatics and competing at the national level. I would often have two 150-mph competition planes in the back of my car. Each one was worth much more than I would pay for a car.

In 1986, I decided to take my love for aviation a bit further and got my private pilot certificate. It was in a Cessna 150 that I was able to rent for only $20 an hour wet. After flying the Cessna, I decided I wanted to build a full-scale airplane.

I looked around for kits and found the closest thing to what I wanted — a Van's RV-4. By the time I had finished the tail section, I already had redesigned the rest of the airplane. I also realized that my newly completed tail section was not ideal for my new design. I packed my airplane parts up in my car, drove down to SUN 'n FUN, and I sold the parts in the fly market.

While at SUN 'n FUN, I was impressed with all the new designs coming out and started putting together fresh ideas. I wanted a design that felt like you're strapping the airplane on you. I wanted the wings and every part of the airplane to feel like an extension of your body. As I started drawing on a fresh sheet of paper, I realized that I didn't have the finances to do what I wanted.

I thought that instead of only building one airplane, perhaps I could build tooling and sell airplanes to other people. With that idea in mind, I could form a company and find partners who could provide the money. Making money for me was never my goal. I just wanted to fulfill my childhood dream.

With the new plan spinning around in my head, I made a very difficult phone call. I called both my parents and tried to explain that I was giving up on my electrical engineering degree and going to become a professional airplane designer, even though I had no formal training. My goals were set, and I was both determined and dedicated. My plan was to build a large model of my new concept and bring it to the flying field with intentions of generating enough interest to find some financial backing.

I immediately started to get serious about my design. I built a seat out of wood that allowed my back to lie at a 40-degree angle and my legs to be raised so I could not only be comfortable but also could withstand heavy-*g* loadings. Then I started designing the airplane around that seat. I made a mockup engine out of Styrofoam and finished the fuselage using wood 1-by-2's and poster board. I laid it out in the yard using PVC tubing to shape the wings and tail. One day while I sat in my airplane, my landlord came by. We started talking about what I was doing. One thing led to another, and soon I was carving full-size plugs and making fiberglass molds for the new bird. My landlord would soon become a partner in my new business, and the plane now had a name — Acro-1.

Fred's first mockup of Acro-1 designed around the seat was made up of wood, poster board, and a Styrofoam engine.

With no formal education in aeronautical engineering, I made a trip to the used bookstore at Georgia Tech and bought everything I could think of to help me. In the process of designing and engineering every time I came across a calculus or physics problem, I would simply open my books and learn the chapter that applied to that problem. I also purchased every aircraft design and engineering book that I could get my hands on and studied them from cover to cover. I hired the late Martin Holman to assist me with the engineering on the Acro-1. I continued on to design and engineer the rest of my airplane on my own, using the software that he created.

Around 1990, I started Aircraft Technologies Inc. with my partners, Joe Tate and Don Snyder. The Acro-1 is a truly enjoyable airplane to fly, and it was my introduction into full-scale competition aerobatics. We built several Acro-1 kits. A few years later, we saw the need in the market for a new two-place airplane.

I started the design on the Atlantis aircraft. The Atlantis was designed not only as a competition aircraft but also as a comfortable cross-country bird. With a 1,000-mile range, 150-knot cruise speed, lots of baggage room, and side-by-side seating, it fulfilled this mission well. While I did fly the Atlantis in Unlimited class aerobatics and it performed very well, the airplane was only competitive through the Advanced category. It was also a spectacular air show aircraft excelling in tumbling maneuvers. However, Elgin Wells Jr. did place second in Advanced at the IAC Championships in Fond du Lac, Wisconsin.

The next aircraft design, the Meyer-360, was truly an Unlimited design. It was my personal airplane and was never intended to be kitted. With the plane having 850 pounds' empty weight, a 200-hp Lycoming, along with 450 degrees per second roll rate, I was able to get 10 rolls on a vertical upline with enough energy at the top for a clean hammerhead.

During the same time period that I was building the Meyer-360, one of my closest friends and hangar mate for 18 years, Elgin Wells Jr., was building his Starjammer. We had both started flying air shows with Leonard Pace and Criss Smissoin. The Starjammer originally started out as a One Design but ended up highly modified. I designed and built a custom wing for Elgin. After doing a stability analysis on his airplane, I ended up welding a 26.5-inch extension to the fuselage. I also became very involved in other aspects of the design and build of the airplane.

While flying air shows, I ended up at EAA AirVenture Oshkosh. There were many air show pilots who inspired me, including Art Scholl, Leo Loudenslager, and Bob Hoover. I actually met Bob my first year at Oshkosh when I couldn't find the pilots briefing room. I introduced myself to him and asked about the location of the elusive briefing room. He didn't know, either, and we walked around until we found it.

Although I spent more time in air shows than competition, I actually preferred the competitions. The IAC members were always helpful and friendly. There was great camaraderie even though we were competing against each other; the pilots freely shared their observations and tips on how to approach the sequences.

My first competition in the Acro-1 was a real learning experience. First, I didn't know where the box was located, so a fellow competitor pointed out an airplane on the field as a landmark and told me to do all my maneuvering over it. Then without any input from anyone, I thought I had to be real fancy on the entry into the box, so I dove in at 200 mph and did a 2,000-foot-high loop.

My latest project in the back of my hangar is truly unique but has been sitting idle for quite some time, waiting for technology to catch up with me. As of now, it's a welded fuselage sitting on landing gear and wheels, yet much of the design and engineering is complete. The design is for a high-altitude, fast cross-country aircraft. While still being capable of flying aerobatics, it is not designed to be competitive.

The basics of the concept for this three-place aircraft is a lightweight internal combustion engine driving the compressor stage of a jet engine on one end to provide enough air for the engine to breathe at altitude. The other side of the engine will be driving a generator to keep a 45-minute reserve battery pack charged and power the electric motors. The propulsion will come from two (possibly four) electric motors on the wings.

The electric motors already have advanced to where I need them. Siemens, now sold to Rolls-Royce, already has developed a 110-pound electric motor that delivers 260 kilowatts (352 hp), and it already has been flown on the Extra 300. I'm planning on using smaller motors. The battery technology is just a few years away from being usable for the project. Certainly, the design is subject to change and may even start flying in a different configuration. It is planned to be a one-off personal airplane and will not be available for sale.

Fred's childhood dream fulfilled. The Acro-1 is reality.

WHAT I'M DOING NOW

After leaving the kit plane business, I spent some time flying 30 passenger regional airplanes for Atlantic Southeast Airlines (Delta Connection). Following that experience, I went off to start and run an auto repair business for many years. Initially, I liked setting up the business. But even though it made good money, I was never happy. My heart is in aviation. I'm currently working as an A&P freelance mechanic and loving life once again. The biggest lesson I have learned is that if you want to be happy, you have to follow your heart and follow your dreams. Dreams do take flight. *IAC*

PHOTOGRAPHY COURTESY OF **EAA ARCHIVES, FRED MEYER**

DREAM

With hard work and perservance, the Acro-1 made its public debut at SUN 'n FUN 1994.

PHOTOGRAPHY COURTESY OF **FRED MEYER**

Two Experiences With G-LOC

BY TOM MYERS, IAC 16830

I READ WITH GREAT INTEREST Dave Farley's Human Factors article on his personal experiences with G-LOC in the July 2020 issue of *Sport Aerobatics*. My two personal experiences with G-LOC happened for reasons different than Dave's, so I would like to add to the subject.

Silicon Valley is surrounded by steep ridges. I have been running and bicycling the roads and trails up these ridges for decades. As a result, my blood pressure and resting heart rate are at the very low end of the scale. Great for cardiovascular health. Potentially not so great for aerobatics. The result of this reality is that I have to pay close attention to mitigating the effects of pulling high positive *g*'s. I will explain.

Coalinga contest in 2015.

PHOTOGRAPHY BY **ZINNIA KILKENNY**

My first airplane was a Super Decathlon. I never exceeded more than positive 5*g* in it. I would "suck and grunt" during positive *g*'s, and I was always just fine. When I bought my Stephens Akro, I moved up to Advanced. I was now pulling up to 8.5*g*. I'm sure you can see what's coming.

My first G-LOC experience occurred during a practice not long after buying the Akro. The first figure of the flight and of the sequence was a half-loop up with a combination of rolls on top. I needed to have plenty of energy entering the rolls so I would not fall out of them, so I entered the half-loop up hot and pulling hard. I was too preoccupied with executing the rolls as I proceeded through the half-loop up, and I allowed my suck-and-grunt straining maneuver to fade much too early. Because it was the first figure of the flight, my cardiovascular system was still in idle. As I was approaching the horizon inverted, the world faded to gray.

I was still conscious and aware of what was happening. I had already started bringing in some forward stick before the world faded away, so I knew I was not going to immediately end up headed straight down. I therefore made the decision to leave all the controls where they were and not try to do anything while I could not see. I was confident that my vision would return quickly because I was aware, inverted, and could feel the surge of adrenaline already starting to hit me. My vision was back to normal within a couple of seconds, and I gingerly rolled upright. No panic, no problem.

I learned a lot of lessons from that incident and changed a number of my behaviors as a result.

I was not flying in an environment in which I could afford to be sloppy with my straining maneuvers. I worked on being very deliberate, consistent, intense, and thorough when executing them. The better the execution, the better the result. Same as it ever was.

I make it a point to push my airplane around as much as possible before a flight to help kick-start my metabolism before my first hard pull. I make it a point to execute a straining maneuver on the first hard pull of a flight that would be worthy of a double-digit *g*-load to assure I have plenty of physiological *g*-margin. That first hard pull triggers the adrenaline rush that throws my cardiovascular system into high gear, and I am good to go after that. The good news is that when my cardiovascular system kicks in, it really kicks in. Imagine a 5-year-old with a mega box of Sugar Bombs breakfast cereal, and you will have some idea of what my voice sounds like on the radio when I call in to land after a few sequences.

I flew my Akro for 24 years. I then bought my Edge. My second G-LOC experience occurred during a practice not long after buying the Edge. Sounds like a familiar theme in this article, doesn't it? There is an important lesson here. When transitioning from one aircraft to another, whether we like it or not, we carry baggage with us. Some of the baggage is good. Some of the baggage is not so good. It is important to be aware of this and be vigilant to assure that one is flying the new airplane, not the old airplane. It sounds easy and simple and obvious. From personal experience, it is none of those. It is not the obvious stuff that bites you in the tail. It is the subtle stuff that bites you in the tail.

This was taken about five minutes after arriving back at Palo Alto after just buying the plane. You can tell how jazzed I was (and still am).

PHOTOGRAPHY COURTESY OF **TOM MYERS**

I LEARNED A LOT OF LESSONS FROM THAT INCIDENT AND CHANGED A NUMBER OF BEHAVIORS AS A RESULT.

The first figure of the flight and of the sequence was a pull to vertical for a hammer. I performed my heavy-duty straining maneuver as usual, and about the time I had hit the vertical, the world disappeared. I was still conscious enough to keep the controls where they were and ride it out. When the world returned, I was hanging from the prop at the top of the hammer. I kicked the airplane over, gained some airspeed, and gingerly pulled to horizontal. Again, no panic, no problem.

I learned a lot of lessons from that incident and changed a number of behaviors as a result.

The Stephens Akro is an old-school airplane. The seat back is vertical. The control forces are heavy. The authority of the controls is great for a 1960s design. The Zivko Edge is a new-school airplane. The seat back is reclined. The control forces are very light. The authority of the controls takes your breath away.

Feedback from the controls when flying the Akro comes from the forces against which you are pushing. Full control deflection at high speeds is a challenge. Controls are deflected to the limits of your strength, and the response you get from the airplane is what you get. Nothing like Akro control forces exist in the Edge. You can deflect the controls in an Edge to their limits and not feel very much push-back from the controls. But I guarantee you that what you get assaulted with by the rest of the aircraft is off the charts and comes on like a charging bull. Edge control motion needs to be anticipated. Edge controls need to be manipulated with sensitivity to deflection as well as forces.

The reclined seat back of the Edge can mask the intensity of *g*-loads. You can be subjecting your body to many more *g*'s than you are sensing. The relationship between actual *g*'s and sensed *g*'s needs to be recalibrated when transitioning to a reclined seat back.

When I pulled to vertical for that hammer, I went to positive 9.5*g* in the blink of an eye. I pulled many more *g*'s than I had intended to or initially felt. I had commenced my straining maneuver at the onset of pulling *g*'s. That was already way too late. As a result, the bad outcome of the pull was determined before it had even started. As I have written previously, things happen so quickly in an Edge that if you don't already know what you want to do at any moment, it is already too late. I had made a huge mistake. I had tried to go directly to flying sequences before I had learned to fly the airplane. This meant immediately going back to basics.

I changed the timing of my straining maneuver. I put a lot of effort into training myself to habitually initiate the straining maneuver far enough in advance of pulls that I reach the full intensity of the straining before I reach the full intensity of the positive *g*'s. Harder physical work, you bet. Better outcome, you bet.

I spent a lot of time glancing at my *g*-meter to learn to anticipate the actual *g*-loading that would result from varying degrees of control deflection, and to learn what the actual *g*-loading feels like.

I diligently focused on learning the relationships between control deflections and control forces and aircraft motion results. Put another way, I put a lot of effort into first learning to fly the airplane, and then learning to fly the figures and sequences. The effort has afforded me a much better ability to command the airplane to do what I want it to do, with *g*-loadings that I want to achieve. The better that I have gotten at it, the lower the peak *g*'s that I have needed to utilize, and thus the greater my physiological *g*-margin has been. In other words, the greater my safety margin has been.

One final note. The events described above occurred on ascending figures because I had decided ahead of time to initially work on altitude-gaining figures as opposed to altitude-losing figures. Please be very cautious when the very first figure of a flight is a hard-pull, altitude-losing figure, especially when the *g*-loading transition from the top to the bottom is negative to positive. A Figure No. 1 downward half-inside-loop from inverted to upright is an example. Nose-down, hauling, and low is not where you want a G-LOC event to occur, and the situation has G-LOC potential written all over it.

Fly safe. IAC


Dave Watson and Brittanee Lincoln

IAC Achievement Awards Updates

BY DAVE WATSON, IAC 26557, AND **BRITTANEE LINCOLN,** IAC 440740, ACHIEVEMENT AWARDS PROGRAM CO-CHAIRS

WE ARE VERY EXCITED to announce a few changes to the Achievement Awards program, which on the surface may seem minor, but we are hoping it will enable more of you to earn these prestigious awards and add them to your "walls of glory." We submitted a proposal to the IAC board at the fall meeting to streamline the qualification process for Smooth Achievement Awards, and our proposal was approved! We hope you are as excited about it as we are, and we look forward to seeing many of your award applications in our inbox.

BACKGROUND ON ACHIEVEMENT AWARDS

I know we recently wrote an article explaining the Achievement Awards program, but here is a quick reminder about Smooth awards for those of you who may have missed it or who were distracted by the mesmerizing photo of Dave Watson with his Mastery of Flight bling. Smooth awards may be earned by flying prescribed figures (for each category) in a noncontest environment. Candidates can earn Smooth awards by one of two methods: Method A, consisting of having the prescribed figures judged by an International Aerobatic Club judge from the ground (for example, at a critique day), or Method B, which involves scoring by the grading judge as an occupant in the aircraft (only allowed for Primary, Sportsman, and Intermediate Smooth awards). When being judged from a ground-based IAC judge (Method A), the figures are scored according to the rulebook (0.0 to 10.0), and each figure must receive better than 5.0 to qualify for the award. When scoring takes place with Method B, the figures can be scored by the judge from inside the aircraft as a "grading observer," whereby the judge simply determines if the figure flown would have qualified as a 5.0 or better (as if it had been observed from the ground). Method B cannot be used for qualifying for Advanced or Unlimited Smooth awards.

According to previous IAC rules, the grading judge for Method B had to possess an FAA CFI rating. Since being a CFI is not a requirement to be a safety pilot in IAC competitions and does not in any way add to the qualifications of a person to score IAC figures, we felt this requirement was arbitrary and possibly overly burdensome in allowing members to earn Smooth awards. The IAC board agreed, so this stipulation has been removed from the criteria for Method B. The updated rule now states that the grading observer must only be a current IAC member and possess an Achievement Award (Smooth or Star) that is at least one level higher than the one being sought. These two requirements are unchanged from previous requirements.

SAFETY IS ALWAYS THE PRIORITY AT THE IAC, SO PLEASE FLY ONLY WITH PERSONS YOU KNOW HAVE THE SKILLS, PHYSICAL CONDITION, AND TRAINING TO PERFORM AEROBATICS SAFELY WITH YOU.

PHOTOGRAPHY COURTESY OF **BRITTANEE LINCOLN**

Safety is always the priority at the IAC, so please fly only with persons you know have the skills, physical condition, and training to perform aerobatics safely with you. We hope this change increases the opportunity for more of you to qualify for the Smooth Achievement Awards. So as you are preparing for the 2021 season and working with coaches or flying at local critique days, keep the Smooth awards in mind and use them as a tool to challenge and reward yourself. We love seeing your accomplishments and awarding you with bling! We also like receiving photos of your smiling faces with the awards that you earned! Please share your photos with *editor@iac.org* and tag us on Instagram: @iachq.

FALL 2020 UPDATE

The Achievement Awards program was pretty active in 2020 despite the drop in the number of contests. We are happy to report that 38 pilots earned Smooth and/or Star awards from March to September 2020. As you can see from the table insert, the majority of the awards were Smooth awards, which we believe is an indicator that IAC pilots are still getting coaching and working with their mentors to safely advance their aerobatic skills. Keep it up!

CERTIFICATES ISSUED

	PRIMARY		SPORTSMAN		INTERMEDIATE		ADVANCED		UNLIMITED		SPECIAL ACHIEVEMENT			
	Smooth	Stars	Smooth	Stars	Smooth	Stars	Smooth	Stars	Smooth	Stars	ALL 5	ALL 10	Mastery of Flight	Total
Power	7	2	7	1	5	1	7	0	2	0	2	1	3	38
Glider	0	0	0	0	0	0	0	0	0	0	0	0	0	38

There were a number of highlights: Aaron McCartan achieved all five of the Power Smooth awards, which also qualified him for the All Ten Power. Eric Lentz-Gauthier qualified for the Unlimited Power Star at Borrego Springs, California, but he has not yet applied for the award. We have reached out to him to notify him of this Power achievement and his previous achievement of Glider Unlimited Star.

For award applications and more information on the Achievement Awards program, go to IAC.org > Programs > Awards. IAC

Super excited! I earned the Unlimited Smooth and All 5 IAC Achievement Awards! I am told I am only the eighth woman in the IAC history to do so! Thank you @aerobatika for all of your coaching and support! #girlpilot #mxaircraft #flylikeagirl #vitaming #excited

PHOTOGRAPHY COURTESY OF **BRITTANEE LINCOLN**

THE WAIT IS OVER

- Free Youth Admission
- Jeff Boerboon
- Kirby Chambliss
- Patty Wagstaff

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BOEING

Inverted Oil Systems

BY STEVE JOHNSON, IAC 20081

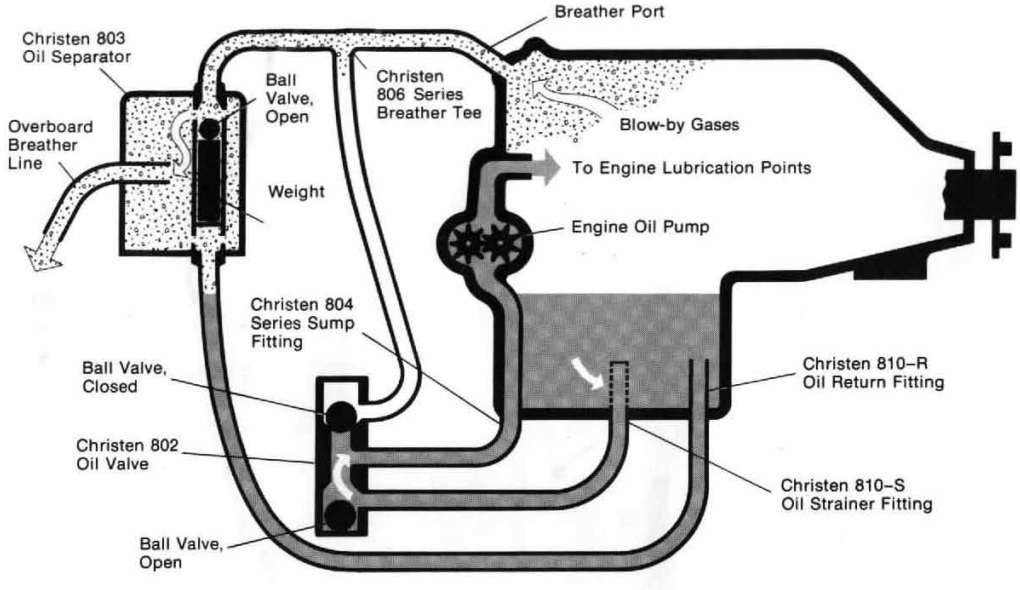
I WAS RECENTLY ASKED about the scavenge pump on my MX2 aerobatic airplane, and the conversation rapidly got into aerobatic inverted oil systems, in general. The IAC Tech Tips manuals have a lot of information about early inverted oil systems, and while the concepts haven't changed, the technology has advanced over the years.

The typical inverted oil system, similar to the Christen or Raven inverted oil systems, uses two pickup points to gather oil from the engine case — the normal one at the bottom for upright or positive-*g* flight, and another pickup at the top of the engine for inverted flight. There is also a "three-way valve" that is gravity operated to ensure the oil pump suction can access oil from the top or bottom of the engine case as needed. This valve is shown in the drawings below where three hoses attach to the valve, which is gravity operated with weights to provide the correct routing of oil and to prevent the oil pump from sucking air instead of oil. When the aircraft is upright, the weights fall one way, allowing oil to pass and preventing air leaks. When inverted, the weights fall the other way and route the oil correctly.

Normal aircraft engines have a crankcase breather hose that allows internal crankcase pressures to be relieved either from altitude changes or piston ring blowby. In aerobatic engines, a typical breather hose would allow oil to escape from the crankcase during any inverted or negative-*g* flight. A large air/oil separator is installed in the inverted oil system to catch the oil from the crankcase breather and return it to the crankcase. Breather air is allowed to escape, and most of the oil is caught and returned, via gravity, to the crankcase.

The biggest issue is that last statement: "most of the oil is caught and returned, via gravity, to the crankcase." There is always some oil lost through the air/oil separator during aerobatic flight. In our 8-quart crankcase for four-cylinder engines, or 12 quarts for six-cylinder engines, the inverted oil system cannot adequately capture 2 or 3 gallons of oil being sloshed around in the engine. Some of this oil is caught in the air/oil separator and returned to the engine while some oil is lost through the breather. The better an inverted oil system, the less oil is lost.

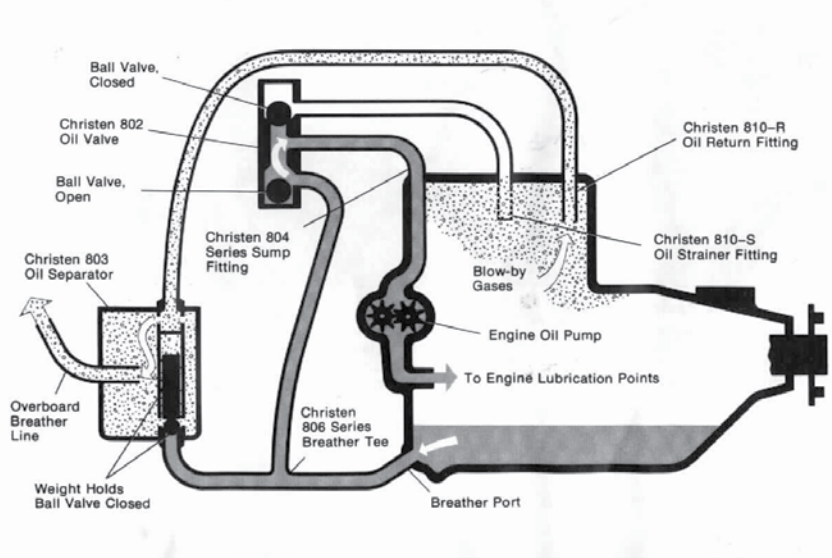
AEROBATIC OPERATION



NORMAL FLIGHT

During normal flight, the weighted ball valve at the top of the Christen 803 oil separator is open, allowing blow-by gases from the engine crankcase Christen 806 Series breather tee, to the top of the oil separator, and out through the overboard breather line. The top ball valve of the Christen 802 oil valve is closed, and the bottom ball valve is open. This permits oil to flow from the sump out through the Christen 810-S strainer fitting to the oil valve, back through the Christen 804 Series sump fitting to the oil pump and engine lubrication points.

PHOTOGRAPHY COURTESY OF **STEVE JOHNSON**



INVERTED FLIGHT

When the aircraft is inverted, engine oil falls to the top of the engine crankcase. The weighted ball valve in the oil separator closes, preventing overboard loss of oil through the top of the oil separator. Blow-by gases from the engine crankcase are vented from the sump to the bottom of the oil separator and out through the overboard breather line. The top ball valve of the oil valve is open, and the bottom ball valve is closed, allowing oil to flow out from the breather port, through the breather tee to the oil valve, through the sump fitting to the oil pump and engine lubrication points.

Any oil in lines that fails to return to the sump during the transition between normal and inverted flight drains into the oil separator. This oil then returns to the sump from the bottom of the oil separator during periods of normal flight.

Oil that is lost through the air/oil separator is either piped to the tail of the airplane for expulsion or piped into the exhaust stack to be vaporized and expelled. There are pros and cons for both systems, so builders or pilots have to decide which exhaust system to use. Piping oil to the tail requires some extra tubing to be installed in the airplane from the air/oil separator to the very tail of the airplane. Some extra weight is required, but few complications are noted, except for flight in extreme cold when the tubing can freeze and become clogged, causing excessive crankcase pressure.

Breather lines piped into the exhaust system are typically shorter, all forward of the firewall, with little extra added weight. But the breather tubing must be plumbed into the exhaust at very specific points so that there is always lower pressure at the breather line; otherwise, again, excessive crankcase pressure can build up.

As a side note, excessive crankcase pressure generally results in a crankcase nose seal failure, which is a catastrophic failure allowing most engine oil to be pumped overboard fairly rapidly.

Back to that three-way valve — it works great in upright or inverted flight, but what about vertical flight? In vertical flight, there is no gravity pulling on the weights as they are now oriented horizontally! Most acro pilots will put wedges or washers between the three-way valve and the firewall to ensure that the valve can experience a *g*-loading, positive or negative — such that the weights will fall one way or the other — during vertical flight, to maintain oil pressure and flow.

The braided hose pictured is the connection from the bottom of the air/oil separator into the scavenge pump.

Different people have tried modifying the inverted oil systems to keep as much oil as possible in the engine, such as running a longer oil hose from the oil system to the breather or raising the breather hose as high as possible in the upright position, both in order to keep oil from being pumped overboard prematurely.

One newer system available involves using an aircraft-style scavenge pump to capture and return oil to the system before it is lost overboard. The inverted oil systems described above capture oil in the air/separator and hold the oil in the tank until the tank is under positive-*g* loading. The positive loading allows the oil in the tank to return to the engine under normal gravity, and the oil will not return to the engine until that positive loading exists. A scavenge pump system, run from the engine accessory case, provides a positive vacuum source at the tank of the air/oil separator at all times and under all positive- and negative-*g* loading.

I learned of this scavenge pump system while at the World Aerobatic Championships in Malelane, South Africa, in 2017. All of the American pilots were flying rented aircraft, mostly from the French team who had brought their own airplanes. It was an Unlimited contest, so very complex high positive- and negative-*g* figures were being flown. Most pilots had to add at least one quart of oil for 20- to 30-minute practice flights. One American pilot, Rob Holland, had rented a South African aircraft from Mark Hensman, a pilot on the South African team. I had noticed that neither Rob nor Mark were adding oil at the same rates as the other pilots. I asked Mark about it, and he told me of the scavenge pump he had installed in his MX2 aircraft.

The braided hose in the photo to the left shows the new connection from the bottom of the air/oil separator into the scavenge pump mounted on the engine accessory case.

The smaller fitting in the photo on the next page is the new one that needs to have a boss welded to the air/oil separator during installation.

Most of the aircraft at this contest had the breather hose routed through the exhaust system as described earlier. Using this system, the oil lost overboard is vaporized into the atmosphere, similar to air show smoke systems. Competition aerobatic pilots don't want or like this "accidental smoke" during their competition flights for several reasons, mostly because it is distracting to the judges and may cause lower scores for the pilot. After learning of the scavenge pump system, I watched the smoke trails being generated and noticed that Mark's and Rob's flights didn't leave as many smoke trails, indicating that the scavenge pump system was effective. The scavenge pump was returning oil to the engine at a higher rate than the typical passive inverted oil systems were able to and was preventing the smoke trail effect of oil lost overboard through the breather and exhaust system.

PHOTOGRAPHY COURTESY OF **STEVE JOHNSON**

After watching that contest, I purchased the scavenge pump for myself. Sky Dynamics (SkyDynamics.com) sells a kit for the scavenge pump, which includes the pump itself, Lycoming assembly 29A21372, and a weld fitting to be welded to the bottom of the air/oil separator. You must also purchase or fabricate a hose to connect from the air/oil separator to the scavenge pump. Different installations would require different-length hoses, so it's not included. After installing mine, I could immediately notice there were fewer smoke trails during my aerobatic flights. I also found a significant reduction in oil loss during aerobatic flights, based on my knowledge of oil use in previous flights.

This scavenge pump system appears to be the best new answer for helping to prevent oil loss during aerobatic flight. Even during rolling turns, where I used to see significant smoke trail, I now get very little smoke. While a little cumbersome with our tightly cowled airplanes, the pump and fittings can be installed in a few hours, with only a 1-pound weight increase.

STEVE JOHNSON has served on the IAC Safety Committee as the chairman and is currently a national judge and coach. He is a CFI and gives instruction in basic or competition aerobatics, unusual attitude/upset training, Pitts Special checkouts, and RV aerobatics. He has been a member of the U.S. Advanced Aerobatic Team and continues to fly his MX2 aircraft in the Advanced category.

The smaller fitting in the photo above is the new one that needs to have a boss welded to the air/oil separator during installation.

A Turn Is a Loop Laid on Its Side, Part 1

BY GORDON PENNER, IAC 429704, THREE-TIME MASTER CFI-A, FAA GOLD SEAL CFI, B-767 CAPTAIN, SAFE MEMBER

WELCOME. THIS IS JUST ONE IN A SERIES of articles trying to educate pilots about the fundamentals of maneuvering flight that most of us never got when we were new. Here, we are talking about understanding turn dynamics.

"Almost all fatal flying accidents are caused by loss of control during a turn." — Wolfgang Langewiesche, *Stick and Rudder,* 1944

"Actually, elevator is our *primary* turn control and stall speed is a useless number without a *g*-load." — Rich Stowell, *Emergency Maneuver Training* (*EMT*), 1996.

"Let me tell you, grasshopper, lift turns an airplane. As I tell them, lift goes perpendicular to the top of the wing, and it takes you wherever you point it." — Greg Koontz, *Sport Aerobatics* magazine, May 2020, "Three-Dimensional Thinking."

"Experts say Loss of Control (LOC) accidents share a common cause: pilots' lack of understanding on the correct use of the rudder." — Rob Mark, *Flying* magazine, February 2018, "Loss of Control: The Persistent Threat."

It sure looks like the problems with turning flight, or *curving flight* as Rich Stowell and the engineering texts call it, have been with us for a while. So what is the big picture about turning?

A turn is a loop laid on its side. A loop is just a turn with zero degrees of bank.

Lift acts perpendicular to, or 90 degrees from, the wings. You turn by pointing your lift sideways, and you manage that lift with elevator and power until the turn is done. Pitch + Power = Performance.

Once you level your wings, you point your lift straight up and you stop turning. When you are upside-down, you are pointing your lift toward the ground. (Figure 1 below.)

The airplane does not turn like a boat or a car. The rudder is only a trimming device used to cancel out unwanted yaw motions while the aircraft is turning. You do not turn with the rudder.

Correct rudder usage causes the tail to follow directly behind the nose into the relative wind, whether turning or flying straight. At that point there is no side load on the aircraft or the pilot. Excess rudder, one way or the other, can lead to loss of control. (Figure 2.)

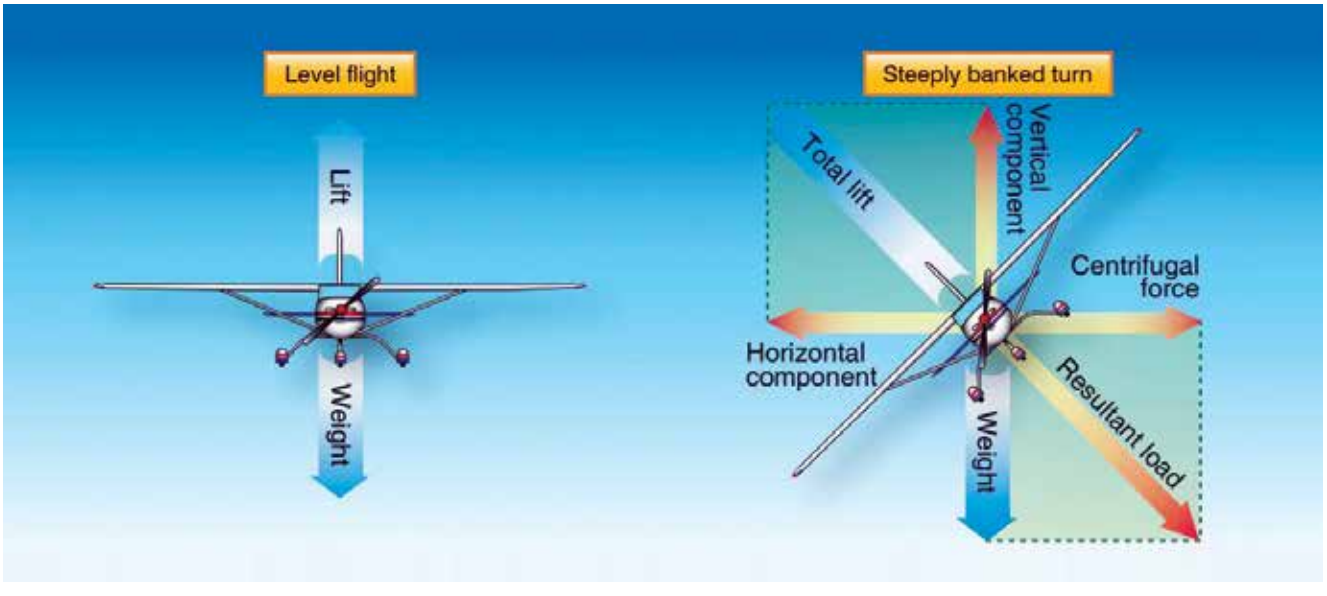


FIGURE 1: When the airplane is banked into a turn, total lift does two jobs: it holds us up and turns us.

PHOTOGRAPHY COURTESY OF **FAA AIRPLANE FLYING HANDBOOK**

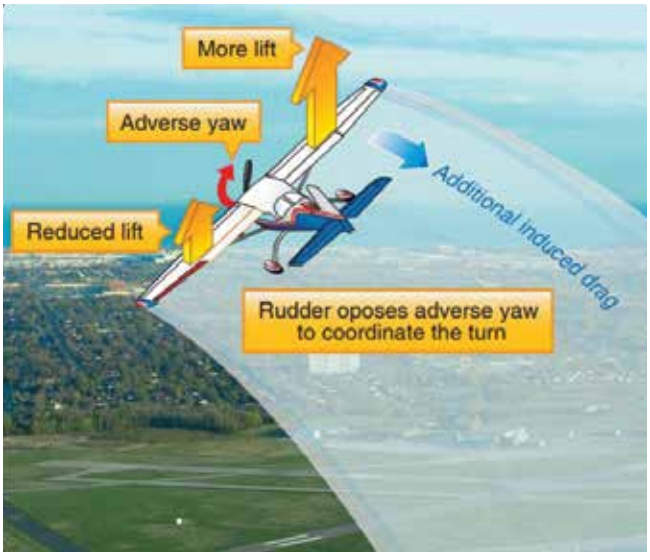


FIGURE 2: The rudder opposes adverse yaw to help coordinate the turn.

That is the big-picture view of turns that will help you correctly see what a turn really is, and why the airplane gets heavier in a turn.

Let's go further.

David Robson has an excellent test question to check understanding of turns in his book, *Skydancing: Aerobatic Flight Techniques.*

QUESTION: What angle of bank would be needed to do a level, 360-degree turn *in a world with no gravity*? The aircraft must be coordinated throughout that turn.

ANSWER: NINETY DEGREES OF BANK. Anything less than 90 degrees would be a climbing turn. Anything more would be a descending turn. It is all about where you point your lift. Makes you think, doesn't it?

Because we *do* have gravity, however, we must point our total lift at some angle between horizontal and straight up so that our lift vector, or arrow, can hold us up and turn us. Think of total lift in pounds of force. Our total lift must do two jobs the second we bank away from level flight. Gravity, however, always points toward the center of the earth.

That is why we must add back-elevator and power to make total lift greater, curving "up" into the turn. *Pitch + Power = Performance.* The aircraft resists this change in direction in an equal and opposite amount, which makes the airplane heavier.

How most people fly shows they don't have a true understanding of turns as a foundation underneath their flight control manipulations.

The levels of learning are:

1. Rote
2. Understanding
3. Application
4. Correlation

Many times in our modern training learning is at the rote level, which is basic memorization. Actors on medical shows may "sound" like surgeons, but please do not let them loose upon your person with a scalpel. When it comes to the balance of the four forces of an aircraft and angle of attack (AOA), we must try harder to get to the understanding level. That will make our application much better.

Our general aviation pilots are not at the understanding or application levels concerning turns and lift production. The base-to-final turn accidents are just one indicator of that.

Instructor Greg Koontz hits this point on the head in his great article in the May 2020 issue of *Sport Aerobatics* called "Three-Dimensional Thinking."

I always use the phrase "Think like the horse," alluding to Wolfgang Langewiesche's book *Stick and Rudder,* and Rich Stowell's *EMT* manual. This means that the airplane is the horse, and you must think like the horse because the horse does not care how we think.

Koontz teaches at his home airfield in Alabama and puts the students up at his home while they train. He said he is able to "see what they have retained from their training and flying experience. In other words, I get to see the real product of our system of producing pilots. I regret to say it is a bleak picture. But the pilots I meet are not to blame.

"**The problem:** People are not being taught how to fly; they are being taught procedures that make an airplane fly. By definition, teaching is providing information that creates a change in understanding and behavior. When you give your student a mental checklist of what to do to enter slow fight, you are providing *information* but not necessarily *understanding.* One of the greatest tools to understand how an airplane flies has to do with the four forces that act on an airplane in flight. (Figures 3 and 4.)

"The point is the four forces work in unison. The way they say it suggests they expect the drag to reduce speed if they just reduce the thrust. But if only thrust is changed, the plane doesn't slow down; it goes down instead. The first three-dimensional thought a student could have learned is usually overlooked as just a silly diagram that seemed to say the obvious when, in fact, it holds the secret to it all."

PHOTOGRAPHY COURTESY OF **FAA AIRPLANE FLYING HANDBOOK**

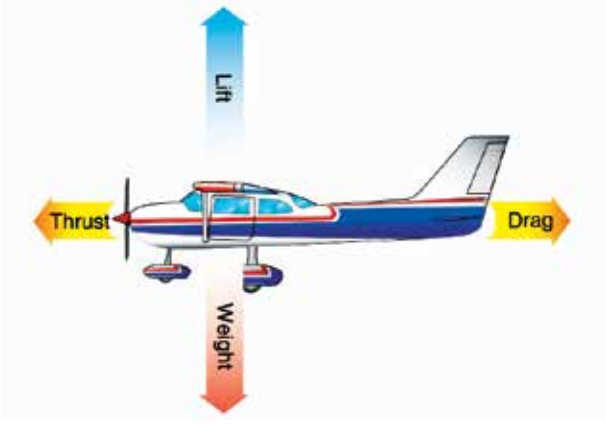


FIGURE 3: Relationship of forces acting on an aircraft.

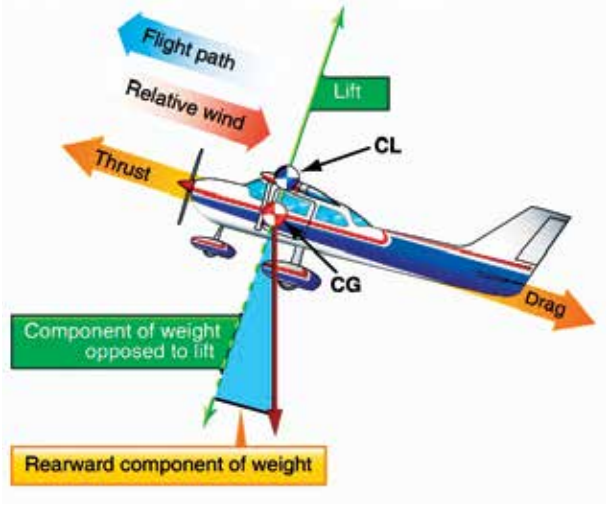


FIGURE 4: Force vectors during a stabilized climb.

I couldn't agree more with Koontz. Look at the difference in the figure below between level, unaccelerated flight and a stabilized climb. You would add power in a climb or expect a loss of speed, wouldn't you? The turn is like climbing into the loop plus banking to offset your lift from directly opposing gravity. No wonder the airplane gets effectively heavier in a turn!

The indicator I see of pilot understanding is when I have a pilot perform a 45-degree-bank steep turn during a flight review. Once they are in 45 degrees of bank and are adding back-elevator to hold level flight, many will not also add power to hold their airspeed. Plus, they are not coordinated throughout the turn.

I even see some pilots trying to hold altitude with top, or sky, rudder.

Bad dog, bad dog!

LIFT GENERATION

In his book *Better Aerobatics,* British aerobatic champion and instructor Alan Cassidy has the best description of lift generation.

"Accuracy requires a full understanding of the lift-generating system, of which both the elevator and its trim control are essential parts.

"A simple wing moving through the air would always try to take the path of least drag, which would mean zero AOA (alpha) and no lift. *(The AOA has to go to approximately -3 to -5 degrees for a regular, nonsymmetric airfoil for zero lift. — Ed.)*

"The wing in flight generates lift only because the elevator produces down force that holds the wing at a non-zero AOA. The elevator and the wing together form a lift-generating system that we can vary and control." (Figures 5 below.)

"When the pilot moves the elevator control, he/she is actually demanding a change in the AOA of the wing," Cassidy wrote. "The position of the control column, in the fore/aft sense, is effectively a measure of the AOA of the wing.

"There is a very important stick/yoke position in every aircraft where the elevator in fact does nothing, and the wing then has zero alpha and generates no lift. I shall call this position the *'neutral point'* in reference to the elevator control."

"The amount of lift being generated (by the AOA) is proportional to the airspeed squared."

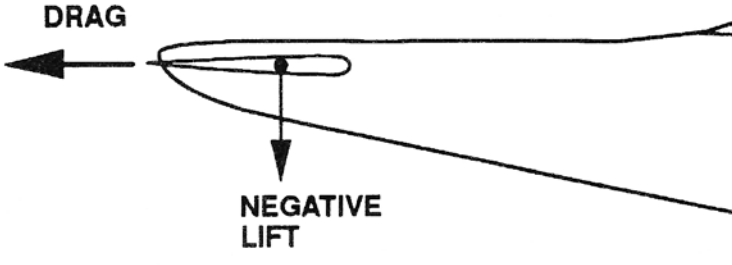


FIGURE 5: Balancing the forces of flight.

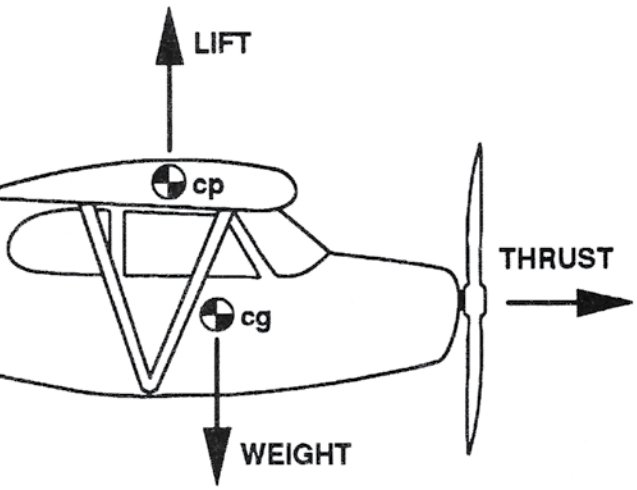
PHOTOGRAPHY COURTESY OF **FAA AIRPLANE FLYING HANDBOOK**

"LET ME TELL YOU, GRASSHOPPER, LIFT TURNS AN AIRPLANE. AS I TELL THEM, LIFT GOES PERPENDICULAR TO THE TOP OF THE WING, AND IT TAKES YOU WHEREVER YOU POINT IT."

— GREG KOONTZ

TURNING, NOT TURNING, AND UPSET

Back to Greg Koontz: "We fail our students when we try to convince them it is like driving a car. It's not, and in reality, our worst enemy is our car-driving habits. When I ask students what turns an airplane, I get a variety of answers that try their best to give credit to one of the controls." He then shows them that moving the controls so the four forces are balanced against each other controls direction both vertically and laterally.



"Now we are beginning to think three-dimensionally. We are realizing the up and down and not just the back and forth, left and right. Let me tell you, grasshopper, lift turns an airplane. As I tell them, lift goes perpendicular to the top of the wing, and it takes you wherever you point it.

"Now here is the UPRT (Upset Prevention and Recovery Training) kicker. In between the negative and positive lift angles of attack lies the middle ground, an AOA I like to call the zero-lift AOA. ... But here is the big secret. It is how to turn off the wing! You know how to get rid of the thrust if you end up pointing straight down. It could keep you from pulling the wings off. But far more important in an upset situation, knowing how to turn off the lift is imperative to avoid being straight down in the first place." (Figure 6 shown on the next page.)

PHOTOGRAPHY COURTESY OF **RICH STOWELL'S EMERGENCY MANEUVER TRAINING MANUAL**

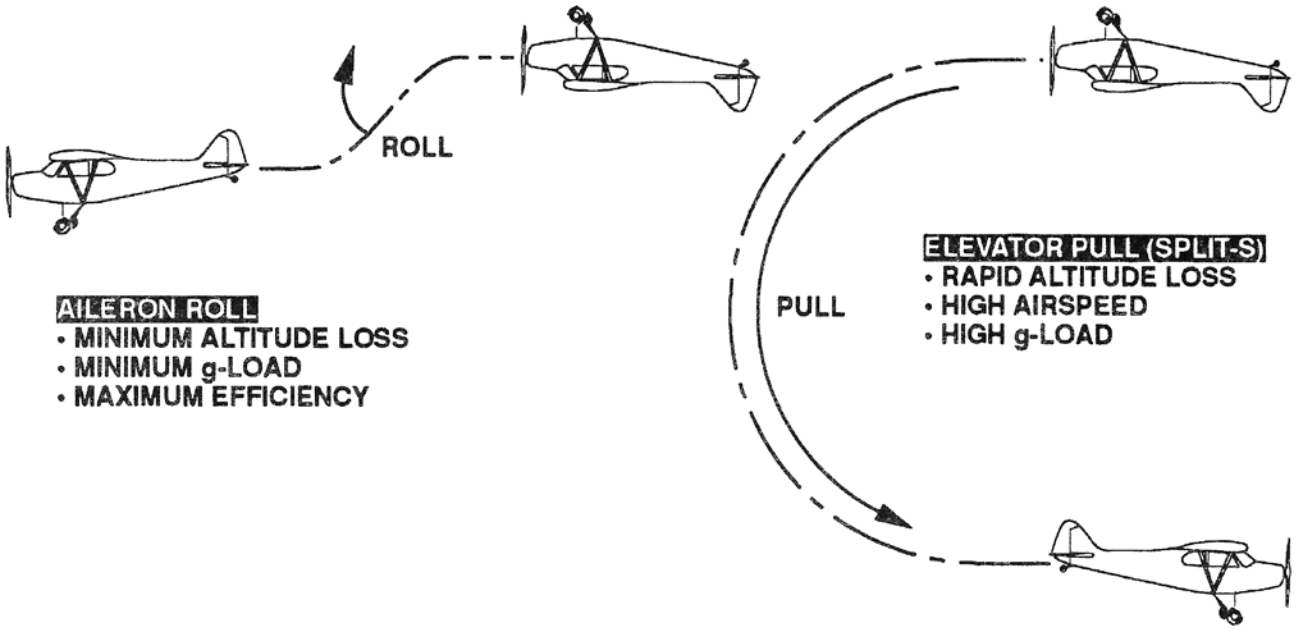


FIGURE 6: Comparing a roll vesus a pull recovery from inverted.

CURVED FLIGHT

From Rich Stowell's *Emergency Maneuver Training* manual: "Since improperly executed turns often precede fatal accidents, the need for proper coordination and proper turn technique cannot be overemphasized.

"Actually, elevator is our *primary* turn control. Aileron inputs merely characterize our turns. They cannot, and do not, curve our flight path. They do, however, permit a wide range of possible curves facilitated by pointing Lift in different directions."

"It's the growing horizontal component of Lift that pulls the airplane away from a straight line," Stowell wrote. "As the flight path bends under this unopposed force, the tail assembly continually weather cocks the nose up into the changing relative wind. The result is a smooth, sweeping arc. But as the loop demonstrates, an angle of bank isn't necessarily a prerequisite for curved flight. (Figure 7 shown to the right.)

"*G*'s are a measure of the *effective* weight of an airplane in curved flight." The increased effective weight affects aircraft performance as though it was an increase in the actual gross weight."

In the following diagram, Stowell shows this effect in a *level* turn on the power required to perform a 30-degrees-of-bank turn. Adding back-elevator to hold altitude effectively made the airplane heavier. He shows what happens to your airspeed if you do, or do not, add power with your back-elevator. (Figure 8 on page 43).

"But *g*-load doesn't increase appreciably until we approach 45 degrees of bank; consequently, the minimal elevator inputs required in shallow turns often goes unnoticed."

In a 45-degree banked turn, holding altitude with a 1,000-pound airplane, you must produce 1,400 pounds of lift (1.4*g*) or you will descend. Your vertical component of lift is 1,000 pounds. As a reaction, the weight of the airplane is now 1,400 pounds. Your stall speed has only gone up 18 percent.

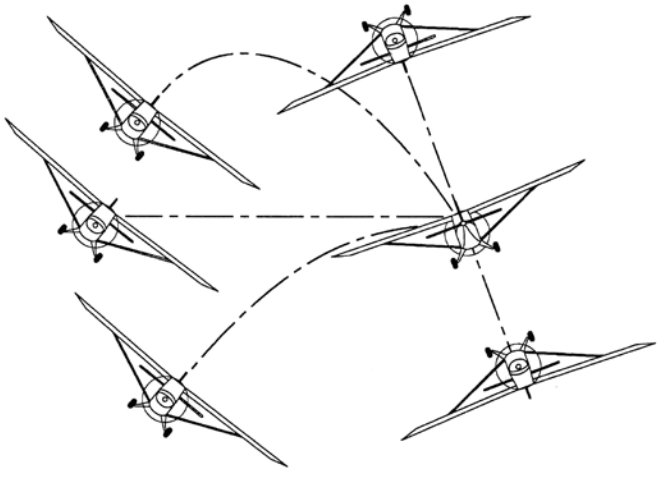


FIGURE 7: Various turns starting with 30 degrees of bank.

PHOTOGRAPHY COURTESY OF **FAA AIRPLANE FLYING HANDBOOK**

"ACTUALLY, ELEVATOR IS OUR PRIMARY TURN CONTROL AND STALL SPEED IS A USELESS NUMBER WITHOUT A G-LOAD."

— RICH STOWELL

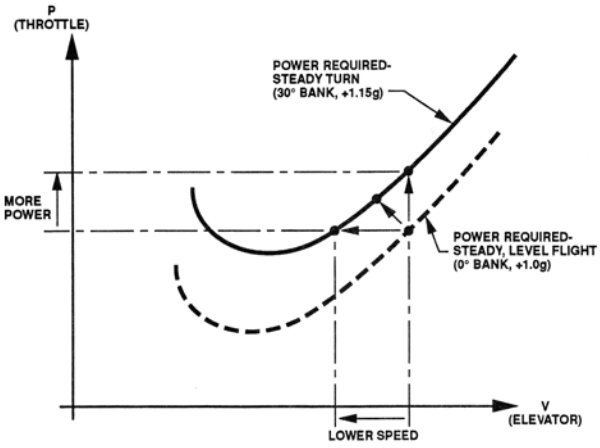


FIGURE 8: Balancing pitch and power during a 30-degree banked turn.

SUMMARY

Greg Koontz wrote, "I never start the aerobatics or the upset recoveries until we do steep turns (check use of attitude control), slow flight (check understanding of the four forces working together), Dutch rolls in slow flight and cruise (check understanding of adverse aileron drag), and stalls (see if the student is looking for speed or a reduction in AOA)."

In future articles, we will talk about *g*-load, banking, coordination, lift, etc.

Fly safe! IAC

Practicing for Hammerfest in VR

BY ADITYA ANNE, IAC 441109

THE ONLY WAY TO FLY a round loop is to use visual references.

Assembling a round loop is like swinging a rock on a string: The speed of the rock changes constantly, as does the force on the string. You can release a bit of back-pressure and float the airplane over the top, but once you throw in a few knots of wind, a purely kinesthetic approach will fail.

A hummingbird is nature's ideal aerobatic pilot: When it flits between flowers, its precision rivals even the most expensive industrial tooling. Neurons tick inside the bird's head when a flower's petals are arranged asymmetrically in front of it, and the bird makes immediate corrections.

Visual processing starts inside the eyeballs, even before any signals reach the brain. After a summer spent flying cross-country in low-performance gliders, I decided that visual parallax was more useful than the variometer for centering gusty thermals. When I practiced in virtual reality (VR), it was still possible to use visual parallax in this manner, which strengthened my conviction that visual input was more important than kinesthetic input. For Hammerfest, I used VR to practice flying consistently round loops.

Loops went well in the sim. I stared into infinity, pulled back on the stick, and voila! Round loop every time. There was one problem — they didn't transfer to real-life flying! Actually, this sight picture was only relevant because I was flying a virtual Yak. In the real-life Decathlon, the wings sat above the pilot, occluding the point of zero motion.

Aditya with his first-place plaque from the 2020 Hammerfest contest.

Acro FS is a recreational, stick-and-rudder flight simulator for high-performance aerobatic aircraft, created by Jim Bourke and developed by Knife Edge Software.

The week before Hammerfest, I spent several hours practicing in Acro FS, interpreting radii based on what I could see out the side window of the simulator's virtual Decathlon. It was much harder to fly round loops, which was closer to reality. Based on the reflections and peripheral cues, I improved my ability to extrapolate the center point of the looping segment, and I hoped that this skill would carry over to a real aircraft.

Thanks to Hammerfest, I got a chance to test my theory. My dad agreed to pay for practice time (thanks, Dad!) and Marc Augustin, a pilot from Fault Line Flyers, offered to let me compete in his Decathlon. Only moments after Marc emailed me his insurance information, a student at the local flight school smacked an airplane's wingtip into the hangar door, taking out the only local Decathlon available for solo rental.

We were out of options! If Marc's airplane didn't pass inspection, I was driving home without competing.

The lack of a practice airplane also meant that Hammerfest would be the first opportunity to validate my practice method. Flight simulators are realistic: Acro FS shows reflections and shadows on the bottom of the Decathlon's wings. But there was no way my desktop computer could replicate the vestibular sensations of flight, and in VR my peripheral vision was also limited.

The first day of the contest, Marc arrived in his 1978 Bellanca Super Decathlon. The aircraft actually sat at a hunch, the right wingtip a head lower than the left, and the fuel sump dripped like a faucet. In the back seat, aluminum water bottles, jackets, and miscellaneous binders sat packed into dilapidated cardboard boxes. Marc also tossed in two folding lawn chairs and an empty fish bowl.

PHOTOGRAPHY BY **LOUIS BUSTAMANTE JR.,** PHOTOGRAPHY COURTESY OF **ADITYA ANNE**

We put all the loose items inside a hangar and got the airplane inspected. I crossed my fingers ... the airplane passed, and we were ready to compete!

On the first day of Hammerfest, we signed up for two practice slots. Since I entered the loops with a stiff tailwind, I floated for what seemed like an unreasonable amount of time over the top. It felt nothing like what I had practiced in Dallas, but Chrissy, one of the judges, provided radio critique, which validated the sight picture and allowed me to focus on visual input instead of on my gut instincts. I started my contest flying with a lot of confidence in my looping figures, even though the kinesthetic feedback felt all over the place.

On Friday morning, I woke up with my greatest fears looming over me like a meteorite: 1) over-rotating the spin and 2), violating the western boundary of the box. We flew two scored flights. During that time, I reverted to my primal instincts. I grunted a lot, kicked the rudder pedals, and at the end of each flight, I was sweatier than the situation warranted.

In the end, we placed first in Primary. We won our class and also took home the American Champion Aircraft (ACA) medal. With 77.84 percent overall, we edged out the second-place competitor by a fraction of a percent.

The figures that I flew approximated perfect figures only as far as dinosaur kits approximate real anatomy. Bones are full of divots and attachment points, and more complicated than the wooden parts. Packed into sheets, the pieces are neat and orderly; they slide out of the box and crunch into place. The end product is symmetrical, full of curvilinear shapes overlapping in perspective. The result, like an aerobatics sequence, is a series of intricate concessions and compromises, yet it is still possible to recognize the dinosaur from the parts.

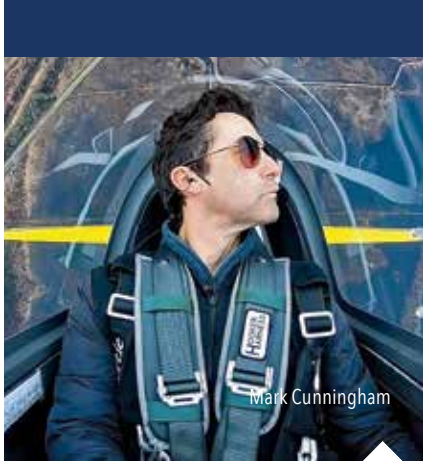
In addition to practicing in VR, I got my sequence critiqued by Matteo, an instructor at Four Winds. On a video file from these practice sessions, a person in the background can be heard making less-than-enthusiastic remarks, saying that my airplane was getting "awfully slow" at the top of the loops. The person felt uneasy watching an aircraft decelerate under the 1*g* stall speed, and presumably he didn't want to be held responsible for the inevitable consequences. While there are various explanations as to why this viewpoint is or isn't a valid one, the fact is that almost every person knows what a circle looks like, and the more a pilot's loops look like circles, the less their detractors are liable to complain. *IAC*

2021 IAC CONTEST SEASON CALENDAR

IAC.org/Contests

DATES	HOST CHAPTER	NAME	REGION	LOCATION	AIRPORT
May 14, 2021	3	2021 Mark Fullerton Memorial Bear Creek Bash	Southeast	Georgia	KRMG
May 14, 2021	24	Lone Star Aerobatic Championships	South-Central	Texas	KGYI
June 4, 2021	15	Harold Neumann Barnstormer	South-Central	Kansas	K0WI
June 4, 2021	38	Coalinga G Fest	Southwest	California	C80
June 4, 2021	67	Apple Cup	Northwest	Washington	KEPH
June 25, 2021	80	Midwest Aerobatic Championships	South-Central	Nebraska	KSWT
July 10, 2021	88	Michigan Aerobatic Open	Mid-America	Michigan	2CM
July 16, 2021	35	Green Mountain Aerobatics Contest (GMAC)	Northeast	Vermont	KVSF

PHOTOGRAPHY COURTESY OF **IAC ARCHIVES**


Mark Cunningham

Mark Cunningham

BY ZINNIA KILKENNY, IAC 437244

ZK: WHAT INSPIRED YOU TO FLY?
MC: I grew up building model airplanes, flying control line and RC airplanes, while attending the Abbotsford International Airshow and dreaming of being an astronaut! I mean, what kid doesn't, right?

Watching my older brother become a pilot and purchase a Cessna 180 introduced me to backcountry aviation. It sparked this dream of combining my passions for rock climbing and mountain biking with flying. The idea of loading gear into an airplane, flying to some cool destination, camping under the wing, then riding and climbing for a few days was my definition of freedom.

ZK: YOU'RE THE THIRD OUT OF SIX CUNNINGHAMS TO FLY. AVIATION RUNS THROUGH YOUR VEINS.
MC: Our aviation path started with my brother Steve, who is an airline pilot and an avid GA pilot. He inspired me and my older brother, Terry. Steve's two sons and wife are all pilots as well. Steve, Terry, and I all enjoyed many backcountry hours flying in Cessna 180/185s in our early years.

Aviation has created a family bond and connection through a common passion, while providing each of us the ability to pursue our own areas of interest. This comes with the huge benefit of sharing our learning and knowledge with each other while getting to play with some very cool aircraft along the way. Over the years we have had the privilege of owning aircraft of varying types, including aerobatics, warbirds, jets, turboprops, backcountry, and sea.

ZK: WHAT WAS YOUR PROGRESSION INTO COMPETITIVE AEROBATICS AND WHY?
MC: My family attended the annual Abbotsford International Airshow, a world-class show in the '70s and '80s just outside Vancouver, British Columbia. Among the amazing acts, my favorite was the Canadian Reds two-ship Pitts formation team (later becoming The Ray-Ban Golds). The bug was set early on, but it took several decades for me to fulfill the dream. After flying for several years as a backcountry pilot, I took a 10-hour intro course in the Pitts S-2B. I loved it, but I was immersed in building my business and pushed the dream off.

MARK CUNNINGHAM

IAC: 439917

Chapter: IAC 67 and Aerobatics Canada 8

Occupation: Technology Entrepreneur

It took another 19 years before I finally decided I was going to pursue aerobatics. I flew to Florida and spent a week with Patty Wagstaff, with the goal of being able to safely fly my own Super Decathlon. Not only did I achieve that goal, but I came away with an amazing mentor who has inspired and motivated me to dive more deeply into the world of aerobatics. After a week of flying, all I needed to hear was, "Ya know, you are pretty good at this!" Whether I was or not, it left me with the belief that I could pursue aerobatics.

ZK: SHARE YOUR FIRST CONTEST EXPERIENCE. WHAT AIRPLANE WERE YOU FLYING, AND HOW DID IT GO?
MC: My entry into the competition happened quickly. I bought my Super Decathlon in December 2017. I flew to Florida for training in early March 2018. I attended my first training camp in Ephrata, Washington, in May 2018, and my first contest was the Apple Cup in Ephrata, in June 2018. I flew Sportsman, and I had a blast. I got what I call "white fever" and became obsessed with the box markers, so I didn't fly my figures very well, but I loved the experience and I was hooked.

I planned to fly another year in my Super Decathlon, but in 2018, I jumped at the chance to buy an Extra 300L from a friend and mentor when he decided to upgrade to an Extra 330SC. I wanted to progress into more advanced flying, and I was worried about doing damage to my Decathlon. In hindsight, it was the right decision.

ZK: WHAT IS THE CANADIAN IAC/AEROBATIC SCENE LIKE? WHILE THE U.S./CANADIAN BORDER IS CLOSED, WHAT ARE YOU PERSONALLY DOING FOR FORWARD MOMENTUM IN YOUR TRAINING?
MC: The aerobatic community in Canada is small and grassroots. Competitors are spread out across the country, with little concentration in any one location, which poses a challenge when hosting national championships or assembling international teams.

PHOTOGRAPHY COURTESY OF **MARK CUNNINGHAM**

The other major challenge is our weather. Vancouver is rainy in the winter, and the rest of Canada is cold and snowy. Both of these conditions make it a challenge to get practice time in. I spend my life booking meetings *around* my practice flights. You need a flexible schedule if you want to consistently fly during the winter in Canada. The byproduct of this is that the pilots who do fly regularly are very passionate and committed.

The other challenge we faced over the last year is the closure of the U.S./Canadian border. Canadian aerobatic pilots missed most of the contests and training camps that we love to attend in the U.S. Last year I planned to do at least four U.S. training camps, three to four regional competitions, the U.S. Nationals, and the Canadian Nationals. I was only able to compete in our Canadian Nationals, with no camps or ground critique. I'm crossing my fingers that 2021 will improve.

My first and only Advanced contest so far was at our 2020 Canadian Nationals. I placed fourth behind some super talented pilots, and I plan to improve on that in 2021. Without in-person coaching, I try to create as much structure as I can. I create clear plans and objectives for each flight, and I fly the plan. At the end of each flight, I will have a bit of fun working on some air show-type figures. Once I am back at the airport, I do a post-flight retrospective by watching videos, making notes, and sharing my videos with various coaches/mentors.

I am still hoping for a few camps and multiple contests in 2021, and longer term, I plan to join my fellow Canadians down in Las Vegas for the 2023 WAAC.

ZK: ANY WORDS OF WISDOM FOR SOMEONE WHO IS THINKING ABOUT COMPETITION?

MC: There are two major hurdles that I had to jump over: costs and courage. The hard costs are real, and it took a long time and a lot of grinding to get to a point where I could afford a dedicated aerobatic aircraft. If that isn't possible, there are clubs and fractional ownership models that I think work really well with aerobatic aircraft. Once you can solve the cost problem, the rest is a mental game. I found that I was able to break through this by surrounding myself with the right people. I went to one of the best teachers in the world, and I have a strong mentor network that keeps me motivated and pointed in the right direction. The right relationship can increase your outcomes by 10 times, and the wrong one can cut it in half. IAC

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