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WHAT IF?

THE 23BIS

BUILD VS. RESTORE

CHOOSE WISELY



Glass

Haulin'

GRAND CHAMPION
VELOCITY



ON THE

First Try

Tom and Loretta Irion's Velocity takes home the gold

BY BUDD DAVISSON





Top: After a demo ride in the Velocity at the factory, Tom and Loretta decided that was the airplane for them.

Bottom: The 70-inch AeroComposite constant-speed prop is driven by a 310-hp Continental IO-550N.



"I LIKE TO BUILD THINGS. Simple as that," said Tom Irion of Livermore, California, "My mom said I was building from the time I was born. But, with our company expanding, I found myself spending more time driving a desk than I did out in the shop with the building product. I very much missed that. So, the thought of building an airplane really appealed to me."

Among Tom's past building projects were a long string of mechanical and architectural projects that started with a \$100 truck he rebuilt in high school and a number of house rebuilds that culminated in "building elevators. Lots and lots of elevators!" However, he didn't get serious about aviation until fairly late in life.

A FRUSTRATED PILOT

"In the early '80s I was working in the elevator trade on the shuttle complex at Vandenberg Air Force Base, but living in Livermore, California," Tom, EAA 826621, said. "One of my fellow employees lived in the Sacramento area and would fly a rented Cessna 172 to Livermore each week and pick me up on the way to Vandenberg. We did that for about six months. At that point I wanted my pilot's license, but I had to wait years until our business grew to the point that I could afford to get my license."

In 2005, Tom's aviation interest finally dragged him out to the airport and put him in the left seat of a C-172 where he earned his certificate.

"At that point, I also discovered that it was possible to actually build your own plane and fly it," Tom said. "Wow! Really. That sounded right down my alley. Plus, my itch to build was getting unbearable."

Airplanes, as any pilot or aviation enthusiast knows, are a combination of the mechanical and the artistic. This is one of the things that subliminally attracted Tom to aviation. For his entire life he has had an artistic eye. In fact, he was barely into his 20s when he landed a job doing architectural design for a building contractor.

"Then, I got into the elevator business, first as a mechanic," Tom said. "A few years later I connected with an elevator interior company where I could use both my architectural design skills and my elevator knowledge. This was a really good match."

"In 2001, I started an elevator interior business with a friend from the previous company. We're still designing, fabricating, and installing custom elevator interiors in northern California with the majority of them in San Francisco. Our business has grown to the point that we have 40 employees and are still growing. I have no doubt that the amount of time I spend involved in the conceptual details of elevator interiors helped me when I finally got around to building an airplane."

But, what airplane? The "what do I build?" question isn't one any would-be builder to answer. Tom, however, had definite parameters that led him to the Velocity.

ENTER THE VELOCITY

Tom said, "I liked the idea of a canard pusher because of the stall/spin characteristics of the canard and the efficiencies of a pusher prop. Also, the fact that you can carry five people cross-country at a high speed is hard to ignore. On top of all of that, I really like the way it looks. It has beautiful lines!"

The Velocity, for those unfamiliar with the type, was *not*, contrary to popular belief, designed by either Burt or Dick Rutan. However, in 1984, when Danny Maher of Sebastian, Florida, sat down to design a four-place, cross-country airplane, he definitely acknowledged the benefits to be gained from Rutan's design philosophy and those things we've come to accept as being "Rutanisms." Although Rutan will freely admit to not having invented them, it is through his efforts that the canard, winglets, and pusher configurations came into modern times. He brought existing concepts down out of the attic and made them actually function. Much of his work eventually bled over into certified aircraft, which is especially true of winglets.

Rutan also pioneered some construction techniques, notably moldless composite methods (laying fiberglass over foam cores). He also, of course, used molded sandwich construction in later designs, but the moldless concept was ready-made for the homebuilder. Danny looked at the wildly successful and highly efficient Long-EZ and incorporated some of the concepts it contained into his new design. Besides the obvious—the canard, pusher configuration—his Velocity's wings are glass-over-foam structures, while his fuselage features composite sandwiches made from female molds. This is the primary reason all of the Velocity variants available have the fuselage already pre-molded. To do so in someone's garage would be a gargantuan, time-consuming project. Building female molds that size isn't for the faint of heart.

In 1986, among the very first Velocity builders were the father and son team of Scott and Duane Swing. They modified their fixed-gear airplane to incorporate retractable gear, which eventually became a Velocity factory option, when they purchased the company from Maher in 1992.

When Tom and Loretta fixed their sights on the Velocity, they took a trip to Sun 'n Fun, in Lakeland, Florida, to investigate the airplane further.

PROJECT IS BORN, SOME DECISIONS MADE

Tom said, "While we were there we took a trip to the Velocity factory for a tour and a demo ride. They sat down with us and spelled out all the options. Almost as soon as we arrived back home, we got a check in the mail to them.

"We decided on the fast-build kit, which saved a huge amount of time. More important, that option accomplishes a lot of critical tasks that may be too difficult for a first-time builder working on his own. For instance, in the fast-build option, the fuselage halves are aligned and permanently joined. The bulkheads, firewall, conduit ducts, nose gear, main gear, axles, windshield, and side windows are installed. The cowl halves are separated from the fuselage and flanged. The gull wing doors, which are tedious to build, are aligned and installed with door flanging completed. It goes on and on. The wings are in a similar state and finished with rough primer. However, no one should let all of this fool them: There is still a ton of work left to be done."

Tom went for all the optional bells and whistles, except one that would appear to be slightly surprising: He decided on fixed rather than retractable gear. And he had good reason.

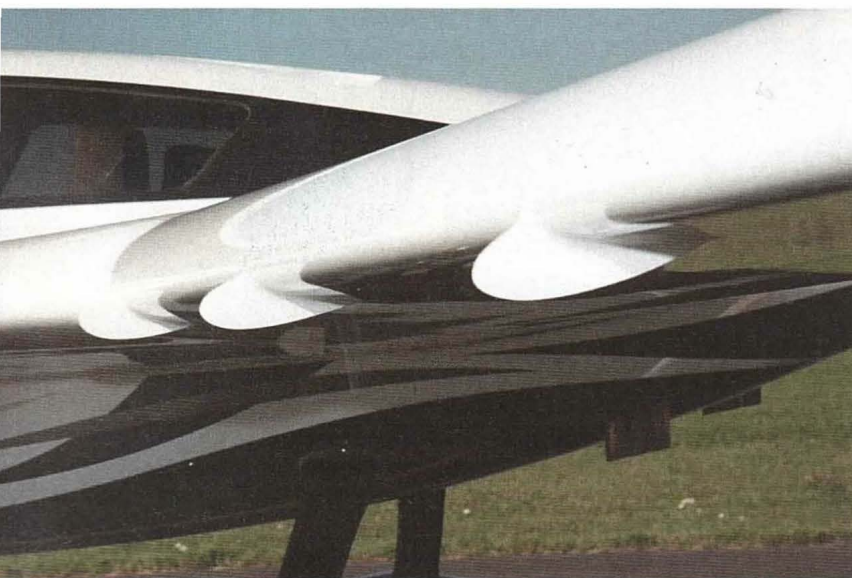


Top: The leather interior and Garmin G900X instrumentation makes for a comfortable, state-of-the-art cabin. **Bottom:** The Velocity has some of the slickest frontal aerodynamics of any aircraft, courtesy of its pusher configuration.





Grand Champions are all about doing the details right and the Iron Velocity clearly shows that. From winglets to engine engine compartment, Tom went out of his way to try for perfection.



"I looked at that quite closely," he said, "and decided the pros didn't outweigh the cons. Among the downsides of the retractable gear versions was that they cost more and take longer to build. Retractable gear adds complexity; these airplanes are harder and more expensive to insure, and they always have the potential of a gear-up landing. The two biggest advantages are that not having the gear hanging out lets it go 10 knots faster and makes the airplane look really sexy in cruise up where no one can see it, so the effect is lost.

"The fixed gear cons are that it is slower by 10 knots but who really cares when the plane is that fast anyway? The upsides include it's a cheaper, faster-to-build, simpler aircraft that cannot have a gear-up landing. Plus the insurance costs less, and it is easier to insure. Also, when the wheelpants are on, I think it looks really cool sitting on the ground."

THE FIRST CHALLENGES: SPACE AND SKILL

Tom's kit arrived in early December 2007, and he almost immediately came face-to-face with the same problem that affects almost every homebuilder: He barely had enough room to build.

"In the beginning, I worked on it in my two-car garage," Tom said. "It fit okay, but being a fast-build kit, many of the parts that arrived were already the size they would be when finished, so as I began assembling things, the shop quickly got tight and I was continually bumping into myself. The airplane needed room to grow. Loretta and I had talked about moving into a bigger house, so we began looking around. Loretta wanted a little larger house anyway, and I wanted a four-car garage that was close to the airport. In the end, we both got what we wanted, and we are five minutes from the airport. I continued building in the new garage until the last two years when we needed to move the plane to our hangar at Livermore Muni."

As with most new composite builders, Tom was unfamiliar with fiberglass work. He understood the process well, but putting it into operation is sometimes harder (and messier) than it sounds. Many kit factories, Velocity included, offer some form of builder assistance program that has builders practically living at the plant for several weeks while they work on their airplane under the watchful eye of factory staffers. Velocity calls its "Head Start," and Tom would have used it if he could. But, he couldn't.

"I didn't use the Head Start program because Florida is just too far away for me. More important, at the time the build started, my company required me to be there most of the time. If I was going to take time from work, I have three kids and needed to be using that time for family activities, not personal pleasure."

Still, he needed to learn the ins and outs of working fiberglass. He was going to be flying this machine and didn't want to be relying on guesswork. So he did something inspired: He developed his own mini builder's assistance program. He couldn't go to Velocity so he had Velocity come to him.

"I had Travis Holland from the Velocity factory spend an extended weekend at my house to go over the basics of working with fiberglass," Tom explained. "That was a big help because I knew little about it. Having Travis right there to deal with the details really shortcut the learning process and gave my self-confidence a huge boost."

WORK BEGINS

The first thing I did when I started working on the kit was to cut holes in the fuselage for five NACA scoops, the canard area and doghouse, speed brake, and where the strakes attach to the fuselage,” Tom said. “This was quite scary, because there’s no straight line to measure from anywhere on the airplane. However, I soon learned that making a mistake with composites wasn’t like working with aluminum or steel. Mistakes are quite easy to fix.”

When he started building, the concept of building an award winner wasn’t part of the equation. He did, however, want to build as nice an airplane as possible, and he had an example to use in judging his work against, as well as fellow Velocity builders who could offer advice, when he was stuck.

He said, “I need to give credit to Dave Dent and John Youngblood for their technical and moral support. They both had Velocities at Livermore during my build. Dave has 50 years of A&P experience and received a Master Mechanic award from the FAA a couple of years ago and has been working with experimentals forever. John’s Velocity is amazing and won a Bronze Lindy four years ago. Steve Robinson helped with the final sculpting of my plane before paint, which was a giant help, sanding, sanding, and more sanding. So having those three guys in my back pocket was huge.”

One of the aspects of composite construction that lends itself to increased build quality is the ability to tightly control both the surface quality and the overall fit and finish. This assumes the builder is willing to invest the massive amount of time and effort required. Perfection is quite often the enemy of completion.

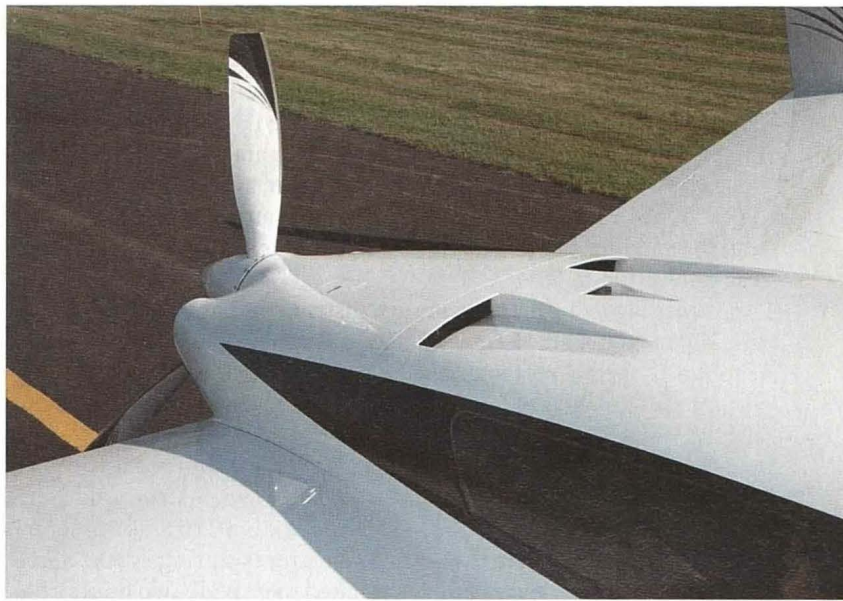
“Imperfections in the surface and keeping the edges of openings and panels exactly straight and tight is really a matter of just adding more epoxy and fiberglass, and sanding until it’s right. The finishing, for instance, starts with shaping the plane as closely as possible with fiberglass and resin, then a thin coat of micro balloons and epoxy is applied to that and sanded, and sanded, and sanded. At the time I was doing all of this, I wasn’t thinking about awards. However, from the beginning I told my wife that I’d love to build an airplane that was as nice as John’s. His was the quality yardstick I used in measuring my own work.”

IT’S ALL ABOUT DETAILS

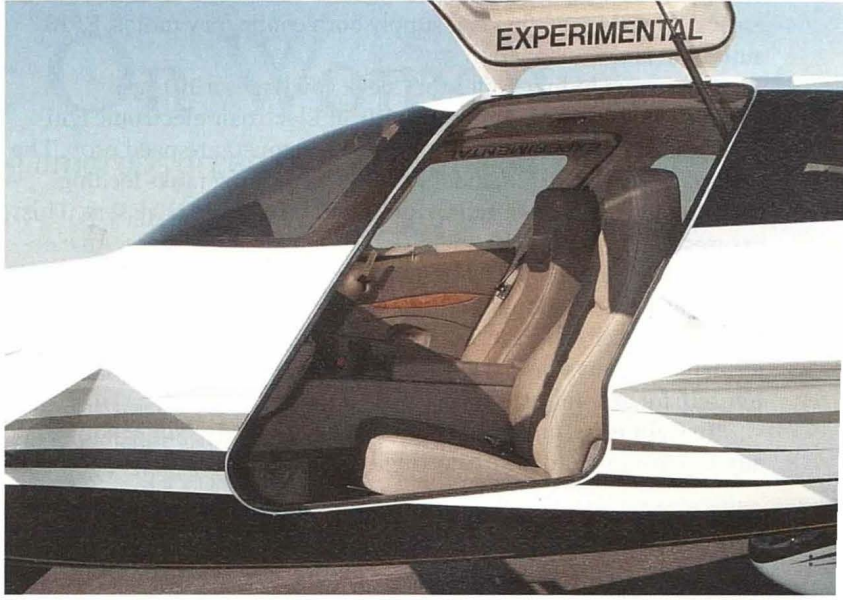
Building an award-winning aircraft is always based on attention to detail as well as incorporating features that set that airplane apart from others. In the case of N722XL, those include some details that are subtle and others that are obvious.

Tom summarized some of the details when he said, “I tried to eliminate as many screws and fasteners as possible on the outside of the airplane. This included those on the engine cowling, canard doghouse, and the wheelpants. Wherever possible I used imbedded piano hinges that were basically invisible.

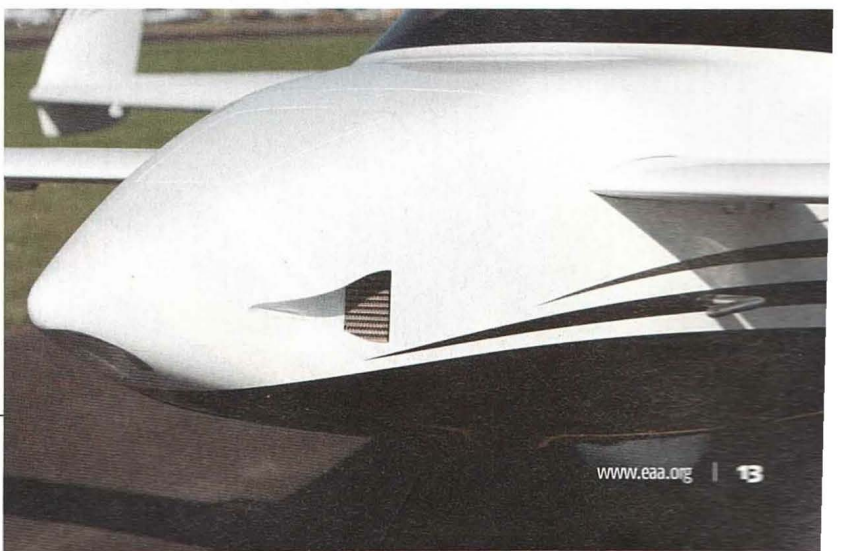
“When doing the interior I fabricated carbon fiber door sills and door pin plates. Then, taking a cue from some of the details we work into elevator interiors, I used maple lace burl wood as a design accent. The side sticks, for instance, are made from one block of wood so the grain and color of both would match exactly. Veneer in the same wood was used for trim pieces on the doors and side panels. These were made using pieces of book-matched veneer so that



NACA-type ducts funnel air into the big Continental with minimum drag.



Middle: Getting into a Velocity is just a matter of backing up and sitting down. Bottom: More NACA scoops for cooling critical components.



the left side of the plane's interior identically matches the other side. The back seat uses the factory bench seat bottom, but rather than using the one-piece back, I used two factory front seat backs. Then, I fabricated a custom insert that fills in between the two factory backs.

"Belardi Interiors in Watsonville, California, fabricated and installed the interior. Jeff Belardi, the owner, and I worked closely on how I wanted the interior installed. Elevator interiors are what I do for a living, so this had to be perfect. Luckily, Jeff is an absolute perfectionist."

According to Tom, the space age instrument panel was fairly easy to design and install. "Because I used a Garmin G900X, which is essentially one big rectangle, I only had to determine the locations of backup gauges and autopilot, so it was actually not very difficult to lay out. Garmin does not allow you to wire up their equipment—it must be done by a certified shop—so that was outsourced. I wired the rest of the instruments with the help of Wayne Lanza, who fabricates custom wiring harnesses. The autopilot is a TruTrak Sorcerer."

The electrical system is 24-volt and features a primary 100-amp alternator and a primary battery designed to provide two hours of safe operation. In case of primary alternator failure, there is also a secondary 30-amp B&C alternator and a secondary battery. An essential bus is used that can supply both comm/nav radios, EFIS, autopilot, and transponder.

The engine hiding under that sleek cowl is a 310-hp Continental IO-550N equipped with an Electroair electronic ignition and driving a 70-inch AeroComposite constant-speed prop. The fuel system feeding it includes two 38-gallon wing tanks feeding simultaneously into a 4-gallon fuel sump behind the back seat. This assures fuel supply to the engine in normal flight attitudes. An electric pump backs up the engine-driven fuel pump.

Regardless of what hides under an airplane's perfect skin, it's the paint that observers first see and forms their first impression of an airplane. In Tom's case, it was one of the few things he couldn't do himself, for several reasons.

"In California, no one paints their own airplane. Not legally anyway. You have to have a certified spray booth to paint anything

here. I used T&P Aero Refinishers in Salinas, California, who are absolute perfectionists and did a beautiful job. We used Scheme Designers, in Cresskill, New Jersey, to help with the paint scheme. We worked with them for almost 12 months before we were happy with the design. The painters and my wife, Loretta, worked extensively on perfecting the color scheme, and we're very pleased with how it worked out."

SO...WHAT ARE THE RESULTS OF ALL THAT WORK?

Tom made the first flight of the airplane himself on November 2, 2013. He said, "I was very nervous. I was wondering if it would actually fly, but it did, and I had very few squawks to work out. During testing I found it climbs pretty consistently at 2,000 feet per minute, so I can get up to cruising altitude fairly quickly. At 14,500 feet, it's running 185 knots TAS and burning about 10.5 gph, so it's quite efficient."

He reports his useful load is 1,000 pounds, and his approach speed is 95 knots but it takes some planning to get the airplane slowed down to approach speed. The belly board speed brake can go out at 120 knots, which makes holding speed much easier from that point on.

Tom said, "Velocitys don't have flaps and the main wing cannot be stalled, so you just fly it down to the runway and hold the nose over. It is important to not stall the canard, which happens at 76 knots, so you let it settle on a little nose high at about 80 knots. This sounds fast, but in zero wind, at gross, with good approaches a 2,500-foot runway is very doable. It'll land on grass okay, but in a pusher that's really putting your prop at risk."

THE SECRET TO HOMEBUILDING SUCCESS IS...

"I started keeping track of my time in a written log, but soon realized that I was spending too much time with the log and I really should be spending that time building. My plan, with which my wife agreed, was to try to do something every day, even if it just meant going out in the garage and staring at it and pondering my next move. It took seven and a half years to complete, but we had the plane flying in primer paint with no interior at six years."

"The factory was a big help. Scott Swing has been at this a long time, and when you're stuck and just can't figure it out, he's a phone call away. I would also like to give credit to Andy Millin and his awesome Velocity website. I didn't make a move without first looking to see how Andy did it. Thank you, Andy! Please don't ever take your website down!"

So, now that he's finished building this airplane, how is Tom going to keep that itch-to-build scratched?

He said, "We have a pair of old Fords, a Model A and a Model T, that both need some TLC. As for another plane, not yet, but I can never sit still for too long so who knows?"

EAA can hardly wait to see what he builds next. And, we're betting money there will be another airplane. *EAA*

With no steering to complicate the castoring nose wheel, Tom was able to fair it in nicely.



Budd Davisson, EAA 22483, is an aeronautical engineer, has flown more than 300 different types, and has published four books and more than 4,000 articles. He is editor-in-chief of *Flight Journal* magazine and a flight instructor primarily in Pitts/tailwheel aircraft. Visit him on www.AirBum.com.