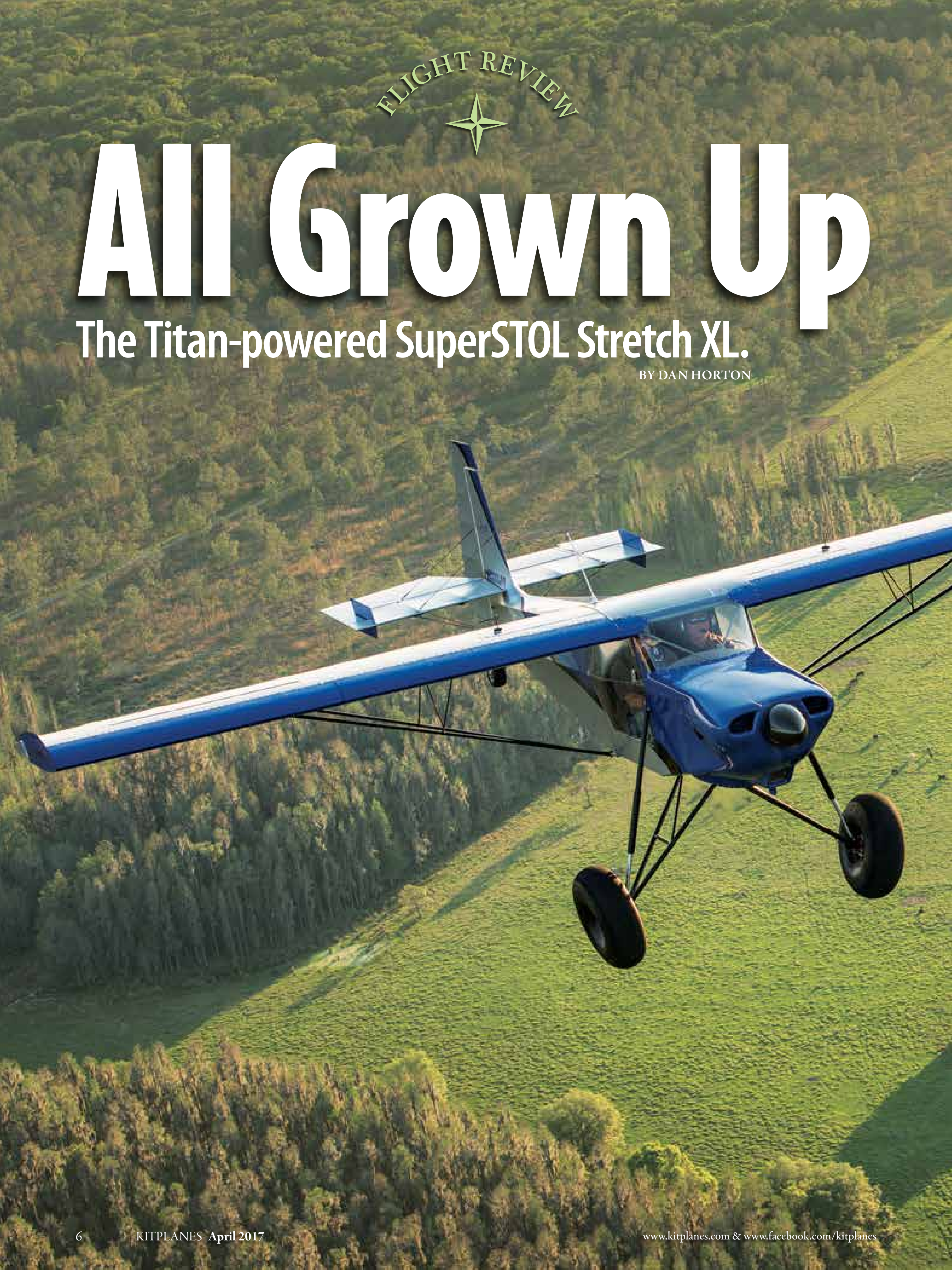
FLIGHT REVIEW

All Grown Up

The Titan-powered SuperSTOL Stretch XL.

BY DAN HORTON



Really, it was only a matter of time. First there was the Highlander, a nice little two-place side-by-side. In the hands of the "We land wherever we want" crowd, it quickly grew longer legs, big tires, and a rapacious appetite for little grass strips out behind the barn. When Just Aircraft's Troy Woodland swapped the wood-ribbed wing for an aluminum structure with automatic slats, the available angle of attack became so great that the next evolution was a damped landing gear with 21 inches of stroke. The new bird, introduced at Oshkosh in 2012, became the SuperSTOL.

A standard Rotax-powered SuperSTOL is something like a 4-stroke dirt bike on steroids. In the hands of an expert, it leaps into the air as if launched off a jump, returns to earth near vertically, then pivots tail-high and leaps skyward again in a burst of noise and dust. Like the bike, this sort of fun can keep a pilot engrossed all afternoon, grinning like a madman.

Contrast the original SuperSTOL with the de facto king of the off-airport world, the Super Cub. To some traditionalists, it somehow seemed a bit too small, too busy, perhaps even *immature*. None of these things are entirely true of course. The airframe is a bit smaller, with 5 feet less wingspan and 3 feet less length, but the baggage area is arguably larger, and the side-by-side seating is both roomy and ergonomically correct. Although a recent design, the SuperSTOL is also a product of long evolution reaching back to roots in the Idaho kit-aircraft industry, much as today's Cub clones all have roots in Lock Haven. So why the perception? Frantic antics aside, the key was the Rotax humming at 5800 rpm. To the old-school crowd, it just wasn't right, and never would be. Forget the 912's well-earned reputation for reliability; they wanted a traditional 2700 rpm, large displacement, air-cooled engine.

Woodland and partner Gary Schmitt like to have fun, but they are also sober men of business. They had watched the price of the 912 rise every year, until it was approaching Lycoming dollars. They knew competitors (those Cubs again) were trending toward more and more power, and even at an equal price, Rotax was not in a position to deliver 180, or even 160, hp anytime soon. And Woodland knew (in his heart, if not in hard statistical evidence) that there were a lot of dusty Lycoming O-320 core engines in hangars and shops. Combine a reasonably priced kit with a home-overhauled 320, and the result could be very affordable.

Titan 340 with prototype twin plenums and Lightspeed ignition.

Photos: Richard VanderMeulen, Dan Horton, and Acme Aero Fab

JUST AIRCRAFT SUPERSTOL STRETCH XL

Kit price (U.S. dollars, excluding QB option)	$44,300
Estimated completed price	$75,000–$95,000
Estimated build time	500–1000 hours
Powerplant as tested	ECI Titan X-340
Propeller	Catto 80-in diameter, 50-in pitch
	Catto 86-in diameter, 35-in pitch
Powerplant options	Lycoming O-320/ULPower 520i

AIRFRAME

Wingspan	31.27 ft, 8.50 ft wings folded
Fuel capacity	27 gallons
Cruise fuel consumption	6.5 gph @ 95 mph
Maximum gross weight	1550 lb
Typical empty weight	925 lb
Typical useful load	625 lb
Full-fuel payload	463 lb
LSA typical useful load	449 lb
LSA full-fuel payload	287 lb
Seating capacity	2
Cabin width	44 in
Baggage area	32 cubic ft

PERFORMANCE

Maximum cruise speed	90-95 kt/105 mph with 29-in Alaskan Bushwheels, Beringer wheels/brakes, and Catto 80/50 propeller
Stall, power off, no flaps	Less than 35 mph
Takeoff distance at 1550 gross	300 ft
Landing distance at 1550 gross	300 ft
Takeoff distance at 1320 gross	175 ft
Landing distance at 1320 gross	175 ft

All numbers are approximate. Specifications supplied by manufacturer.

CMG Titan 340 with P-Mag ignition.

The new model was called the SuperSTOL Stretch XL. Park the standard and XL models together, and the difference is obvious. Although they share the same wing, tail, and landing gear, the XL fuselage carries a longer cowl to enclose larger engines, and is extended about two feet behind the cabin for balance. The visual transformation is significant; the XL presents as a large airplane, yet manages to appear leaner at the same time. The long gear legs and 29-inch flotation tires seem to be in proper proportion, too. Overall, the impression is more 4x4 than bike, a serious machine for serious play.

The first public example was built for a European client, the bright red Stretch XL reviewed in the January 2016 issue of KITPLANES®. Reflecting the customer's Euro preference (and Woodland's willingness to try new things), it mounted a ULPower 520i six-cylinder, rated at 180 horsepower. I found both the airframe and engine delightful to fly. Could traditional power make it better? The answer would require another trip to Walhalla, South Carolina, to fly the latest Stretch. It's good work if you can get it.

Big Blue

The Just Aircraft demo and test mule, N223JA, is painted an attractive medium blue, with the silver belly seen on most SuperSTOLs. Although it looks great with any primary color, the silver is not strictly a decorative pick. It's actually

The KIS principle at work; GPS, radio, engine monitor, and an ELT head.

Speak softly and swing a bigger Catto.

Poly Fiber's Poly-Spray, normally used under a top coat; the color is UV-blocking aluminum powder. Bare Poly-Spray is a practical choice for an off-airport airplane, as it makes fabric repair easy when sticks and stones poke holes in the belly. No topcoat also saves a little weight.

N223JA's powerplant is a Continental Motors Group (CMG) Titan OX-340. It's the current darling of the off-airport clan, shared (with various accessory differences) by the popular Carbon Cub and the new Super Legend HP. Stroking adds little mass, thus the X-340 weighs roughly the same as a similar 320 from Lycoming, Superior, or Titan. However, using the OX-340 bumps available horsepower to 180, which translates directly to increased climb rate.

Catto supplied two of their famous wood/composite propellers, an 80x50-inch pitch (also shared with the Cubs) and an 86x35-inch pitch, which factory pilot Harrison Smith frankly calls "the show prop." The 80x50 is the all-around performer, and results in excellent climb while still turning in efficient cruise speeds. The 86x35 maximizes STOL performance, something that often draws involuntary expletives from first-time passengers. Customers may pick either, and many will buy both.

What's in the Box

Quite a lot actually. A SuperSTOL kit is delivered in a single large crate containing everything to build a covered, rolling airframe. Customers will later select their firewall-forward choices, avionics, and finish paint at additional cost.

Steel components are shipped bare, unless the customer requests optional powder coating. The standard off-the-rack color is a neutral gray. Custom colors are available, although a buyer should expect some increased cost and lead time. The standard seating package includes cushions, tailored upholstery, and seat/shoulder belts. A deluxe interior option is available, with side panels and a fully finished baggage compartment. All airframe controls are included, but engine controls and electrical wiring are not.

Matco wheels and dual-caliper Matco brakes are standard, as are the associated master cylinders and plumbing. Beringer wheels and brakes are a popular option. Twenty-nine-inch tundra tires are included with all SuperSTOL kits, as are the damped, long-travel landing gear struts, and the shock-absorbing tailwheel assembly.

SuperSTOL wings are all aluminum, assembled with pull rivets. Customers building their own wings will need to first set up a simple assembly jig, to ensure the finished product is straight and untwisted. The factory does offer a quickbuild wing option in several stages. The basic $1500 choice assembles the primary wing structure in a factory jig. An additional $1000 assembles the leading edge slats and hinged arms. Complete fully rigged wings, ready for cover, is a $5440 option. All SuperSTOL wings get 13.5-gallon fuel tanks.

The roll spoiler system remains an option, although we can't imagine why anyone would not order it for their SuperSTOL. The system is a bargain at $1000, or $2500 fully assembled into a factory-built wing.

Just Aircraft's steel framed all-in-one shipping crate.

Covering fabric, fabric tape, and adhesive is included with the base kit. The in-house covering shop prefers Poly-Fiber products, so expect Poly-Tak adhesive in the box, and later, a separate purchase of Poly-Brush, Poly-Spray, and a topcoat. Customers who prefer another covering system may delete the Poly-Fiber products and receive a credit.

Crating and shipping is extra. The standard crate is mostly square steel tubing, which can be re-purposed for jigs, tables, and shop fixtures. It's tough enough to allow truck or container shipping to almost anywhere.

The complete SuperSTOL price and option list is available at *www.justaircraft.com*.

—D.H.

Early prototype cowl inlets.

Development required the Just Aircraft crew to spend some time on cooling experiments. The problem with any high-power STOL aircraft is the very low airspeed used for maximum performance. A short burst at V_X is no great challenge, but extended climbs at best rate speed can be another story. The 340-powered Stretch has a V_Y of 68 mph (59 knots) at 1550 pounds. Aircraft velocity that low means the available dynamic pressure to drive cooling flow is little more than 2 inches H_2O near sea level, and even that measly figure drops to 1.7 inches at 10,000 feet. As a rough rule of thumb, an engine like the 340 requires about 2 pounds of cooling air per second to keep CHTs below limits; with standard-wrap baffles, delivering that mass flow requires 5 to 6 inches of pressure drop across the cylinder fins. Clearly it can't be done with aircraft velocity alone, so much of the necessary pressure must stem from high-velocity propeller outflow, and the inlets must capture it effectively.

The inlets you see in these photos were in place last spring at Sun 'n Fun. They fed individual plenums over each cylinder bank, while air for the oil cooler entered via a NACA duct on the right side. By Oshkosh, the inlets had grown, as had the exit area, but CHT would still reach 440°F when asked for maximum performance. The latest cowl (installed on a customer airplane, not shown here) nearly doubles the original inlet area. It also incorporates conventional flap baffle seals around a single large plenum volume, and feeds the oil cooler from behind the #4 cylinder. The new cowl is holding CHTs at a typical

The Shocking Facts: Engineering for Arrival

Let's face it. A pilot's reputation is too often based on the smoothness of his landings. A 30-year professional may shepherd a million pounds of airplane across a continent, through airspace, weather, and traffic, but let the landing be just a little too firm and even the 6-year old seated in coach calls him a noob.

In one respect, our aversion to hard arrivals makes "normal" landing gear design a little easier. In the case of a certified light airplane, FAR Part 23 says a designer need not assume a vertical component at ground contact of more than 10 feet per second, a descent rate pilots recognize as 600 feet per minute. The regulation assumes no operator would intentionally drive the typical Bonanza or Cirrus into a runway surface at more than 600 fpm. A "good" landing is certainly much, much less.

Not so for the backwoods pilot. Short landings are all about minimum speed and maximum vertical component, as both reduce the landing roll. The perfect short final is steep and slow, often followed by a "chop-and-drop." However, drop in from too high, and the result can be a bounce. Every pilot knows it doesn't take much additional drop to magnify the size of a bounce, but they may not know why.

Assume a 1550-pound airplane, with 1500 pounds on the maingear and 50 pounds on the tailwheel. We'll start by driving it into the runway with a vertical velocity of 10 feet per second (fps), the 600 fpm maximum from FAR 23.473. Any moving mass stores kinetic energy; the equation for how much is $k = 0.5 * \text{mass} * \text{velocity}^2$. If we convert 1500 pounds to mass and square 10 fps, we find that our maingear must absorb 2344 foot-pounds of energy.

Although the FAA doesn't *require* a designer to use more than 10 fps for certification, the steep approach angles typical for STOL aircraft demand much more. A no-flare impact at 15° and 40 mph is over 15 fps, and a chop-and-drop may be higher yet. The design challenge is how to deal with the huge jump in required energy absorption. Remember, kinetic energy is a product of velocity *squared*. If we increase vertical velocity from 600 fpm (10 fps) to 1000 fpm (16.666 fps), energy jumps from 2344 foot-pounds to a whopping 6510 foot-pounds.

So what can a designer do to manage the increase? The first measure is to store some of that kinetic energy in a controlled manner. A mass can't be brought to a halt *instantly* without catastrophic results; the equal and opposite reaction would destroy the structure. Instead, the mass must be slowed to zero velocity over a reasonable distance. The familiar term for the resulting reaction is a deceleration we call "G," expressed as multiples of standard Earth gravity. Here distance equates to landing gear stroke, the total of tire and spring compression. More stroke means less G, and decreased stress for both airframe and occupants.

The second measure is add compression damping, which dissipates some of the energy *before* it can be stored in the springs. A typical hydraulic damper does so by forcing a viscous liquid through an orifice; viscous friction converts energy to heat. The orifice may be fixed, with damping proportional to velocity squared, or valved, so damping can be varied as desired. In reality, it is usually a combination.

At full compression, the former kinetic energy not dissipated by damping is stored in some type of spring as potential energy, and left uncontrolled, it will launch the airframe skyward again by forcefully extending the gear. In the case of a system that has stored a *lot* of energy, rebound damping becomes critical, greatly slowing the velocity at which the suspension extends. Rebound damping operates the same as compression damping, with valves arranged for oil flow in the opposite direction. The use of separate valves means that compression and rebound may have different damping rates.

Horizontal stabilizer tip fences.

Roomy cabin offers plenty of legroom.

400°F or so, which Titan considers to be entirely satisfactory.

Sharp-eyed SuperSTOL fans will notice two experiments at the tail. The horizontal stabilizer is now an inverted airfoil, rather than the slab stabilizer previously used. In addition, small fences have been added to the tips of the HS. Smith reports subtle differences in cruise speed and handling, all of them good, so the changes are expected to be seen in regular production.

Mister Manners

Is it a better airplane? Heck, yes. Let's go fly.

Entry is easy; big doors open upward, and the strut attach points are out of the way, aft of the door. The seats are easily adjustable, the doors bow outward for elbow room, and the pedal angles work. I'm a bit more than 6 feet 2 inches tall, top 220 pounds stark naked, and come factory-equipped with size 14 shoes. Even so, there is plenty of room in every dimension.

The carbureted OX-340 is dirt simple to operate; prime or pump, ignitions on, and crank. Idle, taxi, and run-up are conventional. The fun starts when the

Traditional light planes with bungee springing have no active damping. The same is true of tapered-rod (or leaf) gear legs. Both systems depend on pilot skill to minimize vertical velocity (V_V) immediately before impact, regardless of V_V throughout the approach. More advanced aircraft incorporate viscous damping in the form of oleo struts. At the far end of the spectrum, naval aircraft are designed with damped landing gear fully capable of absorbing a no-flare impact with the carrier deck…but even they don't drop in like a really botched STOL arrival full of moose meat.

Early in the development of the SuperSTOL's slatted wing, Just Aircraft's Woodland and Schmitt found they had an interesting problem. The wing would maintain significant lift at a radical angle of attack, so much so that in a maximum-effort landing, the tailwheel was touching *feet* before the mains. The resulting gear impact at high V_V was stressing structure unnecessarily, and anyway, Woodland knew legs allowing a near-vertical drop would really shorten landing distance. So, the Just gang undertook development of the damped long-travel strut first shown at Oshkosh in 2012. The design was prototyped, reviewed by an independent engineer, and then drop tested inside the plant. In due course, Woodland progressed to gritting his teeth and stalling the test airplane into the ground at its maximum descent rate, roughly 850 fpm at engine idle. The system is designed for 1000 fpm.

Development has never stopped. Today's SuperSTOL strut is produced by Acme Aero Fab in Charlotte, North Carolina. Owner Matt McSwain is a mechanical engineer with deep roots in the North Carolina auto racing community. At press time McSwain and operations chief Eric Robinson were wrapping up a new strut design specifically for the SuperSTOL. The key difference is the use of wound flat-coil steel springs, rather than the original strut's total reliance on high-pressure air. The actual nitrogen charge will drop from 450 psi to around 75 psi max; that pressure remains largely to ensure low aeration of the damping fluid. The photo above shows a prototype "test mule" strut with an external spring. The production strut will use springs with less diameter, and only weighs a few ounces more than the original air strut.

Prototype coil-over "test mule" struts for the SuperSTOL.

Acme Aero Fab's damped shock units for the Legend Cub.

Acme has also developed a high-performance exhaust system for the Rotax 9-series engines, and builds SuperSTOL wings to order. However, their most interesting development project is a line of retrofit shock strut systems for aircraft currently equipped with bungees or bare springs, notably the Legend Cub and various CubCrafters models. The physical constraints of a retrofit don't allow the impact performance of the long-travel SuperSTOL strut, but adding compression and rebound damping to the typical touchdown can make even the most ham-handed Cub driver look like an ace…no bounce! The Legend and CC struts are expected be marketed OEM-only, but homebuilders and E/A-B designers are more than welcome at Acme. The improvement in landing ease could be *shocking*. More at *www.acmeaerofab.com*.

—D.H.

Leading edge slats extend automatically.

The ailerons can now be teamed with a spoiler system.

throttle goes in. Although it can be flown like any normal taildragger, a full yee-haw departure requires nothing more than a rapid application of WOT and a tug on the flap handle…one thousand one, one thousand two, and it's airborne. Pick a pitch angle somewhere between mild and wild, depending on desired view out the windshield. I'd usually be a bit shy about the maximum, while Smith constantly encouraged more pull.

As you might already guess, the slow-turning OX-340 and its 80-inch prop outclimbs the Belgian six-cylinder, which spins a 76-inch Catto at a higher rpm. The European also has a 5-minute power limitation, while the Titan has none, unless (of course) the airframe is licensed Light Sport. To its credit, the six-cylinder is smoother, while the four is more harsh, a natural result of physical mechanics (a flat six has no free inertias or free moments; reciprocating forces don't result in vibratory block motion). Regardless, the old-school motor quickly fades from notice. For anyone raised on Brand C, P, B, or M, it just feels *normal*.

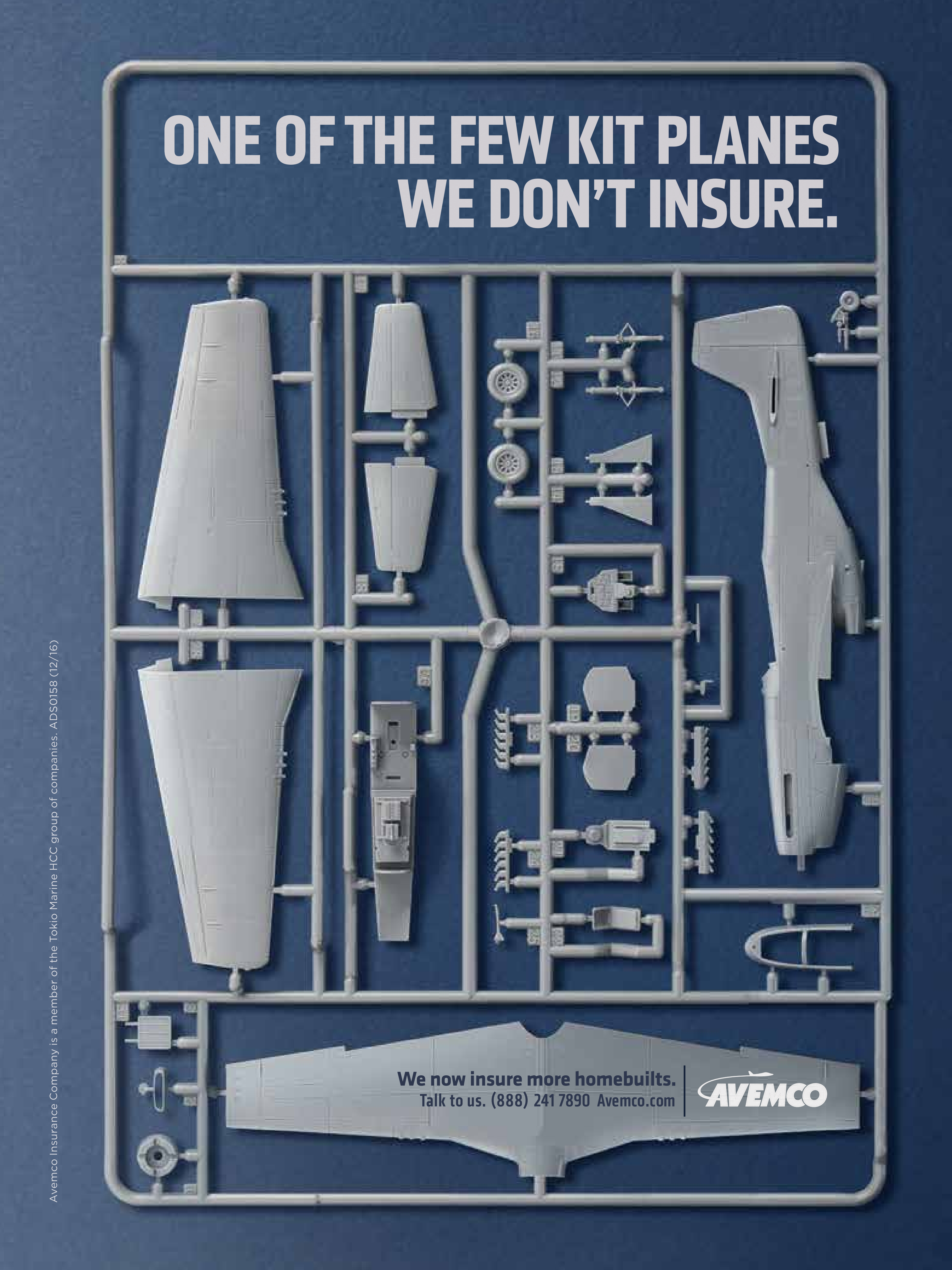
Practically all late-model SuperSTOLs (both short and long) are equipped with a roll spoiler system to augment the ailerons at low speed. The spoilers work very well indeed, providing positive roll control with the airplane in a fully stalled condition. Actually it's not *really* stalled, as the extended leading edge slats largely maintain attached flow over the wing. Power off, nose up, the airplane merely settles into a sink rate, typically between 800 and 850 feet per minute depending on temperature and weight. While sinking, stick fully aft, Smith even applied a bunch of aileron and then held the aircraft upright with a boot-full of opposite rudder…stalled, while sideways, in full control.

The spoilers are not just for the freak show. They're located at the crest of the airfoil, and deploy straight up through slots in the wing surface. Ailerons and spoilers are linked so that each spoiler extends progressively when its companion aileron is deflected upward. In this way, it both kills lift and *adds* drag, nicely offsetting the lifting drag of the opposing downward-deflected aileron. The result is limited adverse yaw and less pedal requirement. The entire roll system exhibits little friction. When combined with the longer XL fuselage, it's very pleasant to fly, even on the bumpy days.

Since we were out having a good time, it was only natural that we visit the land-like-a-fly-on-the-wall hillside airstrip at the Just Aircraft plant. Smith handled that one, but careful observation says success mostly requires aim and timing, because the actual vertical speed at impact doesn't matter very much. The damped, long-stroke gear soaks it up. Earlier, back at the Clemson airport for a gas stop, Smith had grinned and said, "Watch this," then proceeded to put the stick in his lap and drop it in from about 10 feet up. It didn't even bounce.

So there you have it. The original SuperSTOL is great fun, and it's really hard to knock any Rotax 9-series. Most of the airframe features are shared with the XL; there is nothing lost by choosing the smaller of the siblings. That said, for an old-school guy, the familiarity of Lycoming-style engines brings a certain comfort level to the game…and there are a lot of ways to play. Lycoming, Continental, and Superior all offer suitable power. There are good custom shop rebuilds, used-but-serviceable salvage motors, and a frugal builder can always team up with his local A&P for an educational field overhaul. The Stretch XL offers choices…and all of them are good. ✈

Hmmm...can we clear that treeline?


ONE OF THE FEW KIT PLANES
WE DON'T INSURE.
We now insure more homebuilts.
Talk to us. (888) 241 7890 Avemco.com
AVEMCO
Avemco Insurance Company is a member of the Tokio Marine HCC group of companies. ADS0158 (12/16)