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Zenith's Easy-Building CH 650 B Tries On A New UL Power Engine

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On the cover: Marc Cook photographed the Zenith CH 650 B in Mexico, Missouri.

FLIGHT REVIEW

ZENITH CH 650 B

A revitalized low-wing design showcases a fresh engine for Zenith.

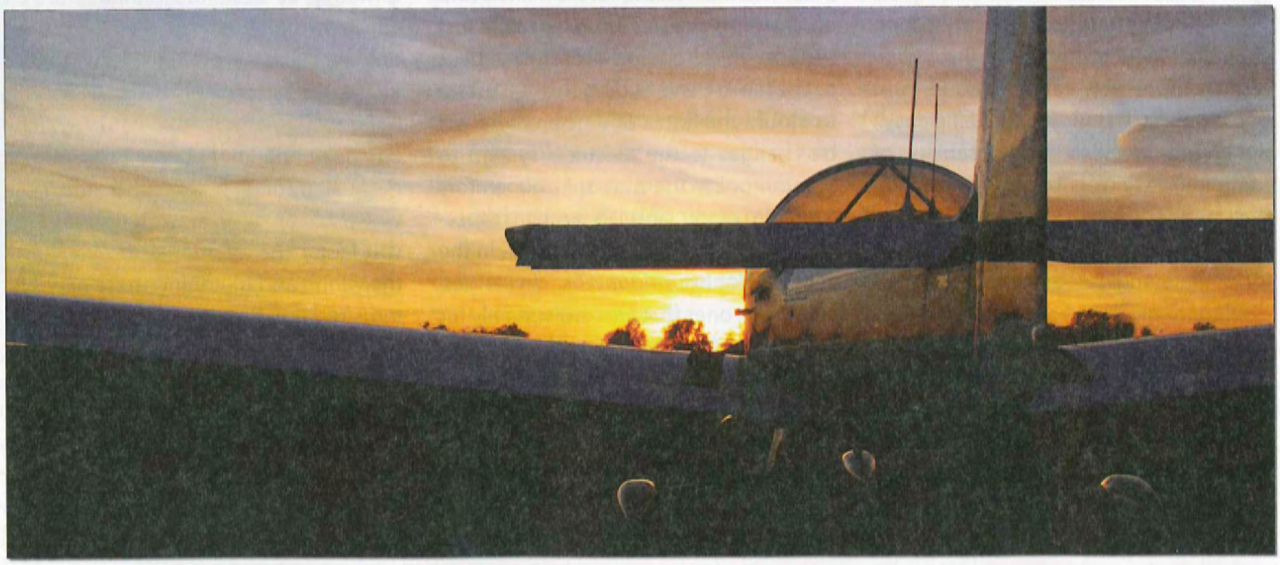
BY MARC COOK

Product development by increment is the proverbial double-edged sword. Manufacturers, for their part, love it. You can create a new or substantially changed model without having to rework every bit of hardware in the place, rewrite all the manuals and experience all over again the inevitable mistakes made in the long stretch from great idea to parts rolling out the door. There's a very good reason Cessna didn't reinvent the Skyhawk every year.

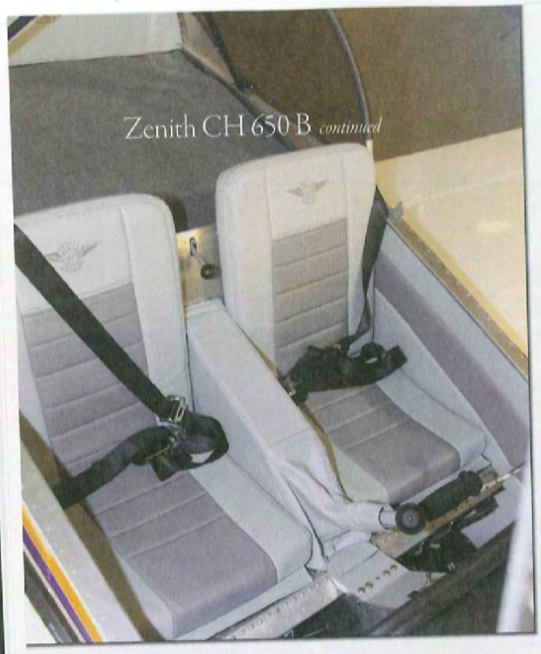
Consumers...well, it's harder on them. Unless a new design is visually different—and by this I mean significantly different—there's a risk they'll walk right by at the big airshows. "Oh, it's another one of *those* with new paint. Moving on."

Zenith was somewhere in the middle of the great radical/subtle continuum during the development of the CH 650 B. As you may know, the B suffix refers to the myriad changes made to the basic Zodiac airframe as the result of six inflight breakups of 601 and 601 XL models through 2008. (Six out of a fleet of more than 1000, mind.) That story has been told before, so let's skip to the conclusion: Zenith made scads of structural upgrades to the design, including a stronger main wingspar and beefed up mounting points for the aileron-control system; the structure making up the wing box section under the seats is also more robust, as are the aft-spar attach points. Builders were expected to incorporate the new parts into their projects, while those already flying were strongly urged to retrofit the modifications. Of course, all of the new kits being shipped had the modifications in place.

At around the same time, Zenith launched the CH 650, now the 650 B. The new version takes the modifications to the 601/601 XL Zodiacs well beyond these structural upgrades. For starters, a new canopy provides dramatically increased headroom. A boon to taller pilots, the change also improves over-the-nose sightlines and makes it possible for shorter pilots to run with thicker seat cushions to raise their eye level. Taller pilots will be happy that they can run seat cushions at all. Quite beyond the visual aspects, the new canopy creates a much more open impression for the cabin,



Photos: Marc Cook



It's a comfortable cabin for two in the CH 650 B. The center armrest conceals part of the control system. Notice the new canopy latch handle between the backrests.

Zenith has fitted the factory CH 650 B with up-to-the-minute glass—a pair of Dynon SkyView screens. N104ZZ also packs the Dynon remote transponder, controlled from the main screen.

which is no wider than the 601 XL's, though it seems so. Zenith redesigned the canopy frame as well. Still front hinged, the apparatus is simpler and lighter than before and employs a single latching mechanism behind the seats. A short canopy-release lever protrudes from the bulkhead between the seats, reachable by either occupant. (No more stretching across the cockpit to unlatch the other side.) Overall, this new latching system is more secure and permits the use of a single locking handle on the exterior. The split line of the canopy—where it ends and the turtledeck glass begins—moved forward, which permits a sturdy rollover structure to emerge above the baggage area. In some ways, the 650's canopy is the company's improvement philosophy in microcosm: Adapt and improve without dramatically changing the design underpinnings.

Metal Maiden

For the rest of the CH 650 B, more traditional Zenith processes and materials are in play. Almost entirely made of 6061 aluminum, the airframe eschews complexity wherever possible. The constant-chord wing uses as many of the same ribs as possible. In the standard configuration, the ailerons have no conventional hinges—instead, the upper wingskin continues aft and flexes as the ailerons move. While the math says the material should have no problem with repetitive stress, pilots have balked at the idea; that's why conventional hinged ailerons are a popular option. (In the 601s and 650s I've flown, the stiffness of the hingeless ailerons was easily detected in flight.)

While Zenith didn't make any radical changes to the tail section to create the CH 650 B, a new rudder, with slightly more sweep, helps give the empennage a more modern appearance. Yes, it's still an all-flying rudder, with the only fixed surface the small nonstructural fairing ahead of the surface. The rudder is operated by cables, and is joined in motion by the nosewheel. As on other Zenith designs, the nosewheel steers with the rudder pedals and imparts noticeable drag in the rudder in flight. A bungee system does double duty, allowing the nosewheel strut to move vertically in a channel riveted to the firewall, but also resists nosegear rotation; as such, it adds drag to the rudder mechanism as well. Otherwise, the Zenith is conventional, with a pushrod-activated elevator flying behind a fixed horizontal stabilizer and trimmed with an inset tab run by an electric motor. Ailerons respond via traditional aircraft cables. Flaps are electrically motivated.

New and old. Zenith's latest low-winger stands in front of the factory's 601 XL. It isn't until you see them side-by-side that you realize how much has changed.

The Zenith demonstrator I flew was fitted with just about every option in the book, including a dual-screen Dynon SkyView EFIS suite with remote transponder, Garmin SL40 com radio and PS Engineering PM3000 intercom. It also carried the standard Y-shaped center control stick that's become a Zenith hallmark.

Building Blocks

Everything the builder has to assemble is done with Avex blind rivets, structural items that are as far from hardware-store pop rivets as the Academy of St. Martin in the Fields is from your local middle-school chamber orchestra. There are a few driven rivets in the airplane, but they're done at the factory, which has two CNC (computer numerically controlled) routers working full-time on sheets of aluminum. All structural items are drilled and pre-drilled so the entire airplane is self jigging. The rivet holes are just undersized, but the assembly process is made simpler by the fact that all of the rivets are universal head; there'll be no drill-deburr-countersink-assemble-rivet hula going on.

A top-down induction system is fed fuel through electronic fuel injectors. The air-cooled heads have sufficient fin area to keep the engine cool even at low indicated airspeed.

House 'plant

Most new for this particular CH 650 B is the UL Power 350iS four-cylinder engine on the firewall. Zenith is, atypical for a kit company, willing to try and advocate alternative engines on its designs. The UL Power—see Engine Update on Page 52—has been making slow inroads to the U.S. market; it was launched in Europe in 2006. At the moment, the company produces variants of two engines, both air cooled and direct drive. The smaller is the 2.6-liter (158 cubic inches) putting out 97 to 107 horsepower, depending upon compression ratio.

Zenith is using the most powerful UL Power in production, the UL350iS, which takes the 260's same 4.157-inch

One stick for two. Zenith's uncommon Y-shaped control stick gives both occupants a shot at the landing.

bore and increases stroke to a still-modest 3.937 inches for a total displacement of 214 cubic inches. The result, with an equally modest 8.7:1 compression ratio, is 130 hp at 3300 rpm. In terms of weight, the 350iS all up—including exhaust and induction systems, oil cooler, oil and electronics—weighs 173 pounds, about 7 pounds less than the Jabiru 3300 but 32 more than a Rotax 912S. In the ballpark, in other words, and significantly less than a Continental O-200 or Lycoming O-233.

Zenith claims an empty weight of 695 pounds for the CH 650 B wearing the Jabiru 3300A, but the added systems for the UL Power bring it up to 770 pounds. (Some of the weight comes from the comprehensive equipment aboard, including a nice interior. This is probably an empty weight most 650 builders should expect.) If you factor a full load of fuel—24 or optionally 30 gallons carried in prefabricated aluminum tanks that screw onto the wing leading edge and make up the inboard D section—the LSA-legal 650 still can carry 375 to 410 pounds in the cabin. Better yet, because of the generous headroom and 44-inch-wide cabin, that pair of 200 pounders (give or take) will actually fit.

At least those two won't be elbow-jabbing each other over powerplant

ZENITH CH 650 B

Kit price	$23,450
Estimated build time	500 hours
Number flying	100
Powerplant	UL Power UL350iS, 130 hp @ 3300 rpm
Propeller	Fixed-pitch
Powerplant options	Continental O-200, Rotax 912, Jabiru 3300, alternative

AIRFRAME

Wingspan	27 ft
Wing loading	10.0 lb/sq ft
Fuel capacity	24 gallons
Maximum gross weight (E/AB and LSA)	1320 lb
Typical empty weight	695 lb
Typical useful load	625 lb
Full-fuel payload	485 lb
Seating capacity	2
Cockpit width	44 in
Baggage capacity	100 lb

PERFORMANCE

Cruise speed	160 mph (139 kt) TAS @ 8000 ft @ 75% of max-continuous, 6.9 gph
Maximum rate of climb	1200 fpm
Stall speed, landing configuration	44 mph (38 kt) IAS
Stall speed (clean)	51 mph (44 kt) IAS
Takeoff distance	550 ft
Landing distance	500 ft

Specifications are manufacturer's estimates and are based on the configuration of the demonstrator aircraft.

management. Automotive-style electronic controls—a fully mapped, open-loop fuel-injection system and a variable-timing ignition setup—are standard for the entire line of UL Power engines. So equipped, the airframe has to make a few compromises. An integral 30-amp alternator—fitted inside the spidery flywheel/starter ring gear on the back of the engine—provides the juice, though UL Power says that higher-capacity alternators are in development. There is currently no simple way to mount an additional alternator, though some builder will likely find one. A single ECU (engine control unit) manages the four pulse-type fuel injectors and two coil packs. Twin batteries supply redundant power. It's worth noting that the UL Power installation comes with prefabricated engine wiring to ease assembly.

In the iteration of the 650 I flew in late 2011, the oil cooler was mounted behind the engine, inside a monkey-bar arrangement of engine-mount tubes, and fed by a duct on the pilot's-side cowling. The current and production setup has a smaller oil cooler just beneath the prop spinner. A novel approach to switching fuel tanks appears on the factory's CH 650 B. Instead of a duplex fuel valve, a part necessary because the injection system needs a dedicated return line, Zenith uses an electric solenoid to choose both the supply and return tanks. The switch and fuse for the system are prominent in the cockpit, but there's no annunciation; you don't know if the way the switch is pointing is the way the fuel is moving unless you watch the fuel gauges carefully.

Put to the Test

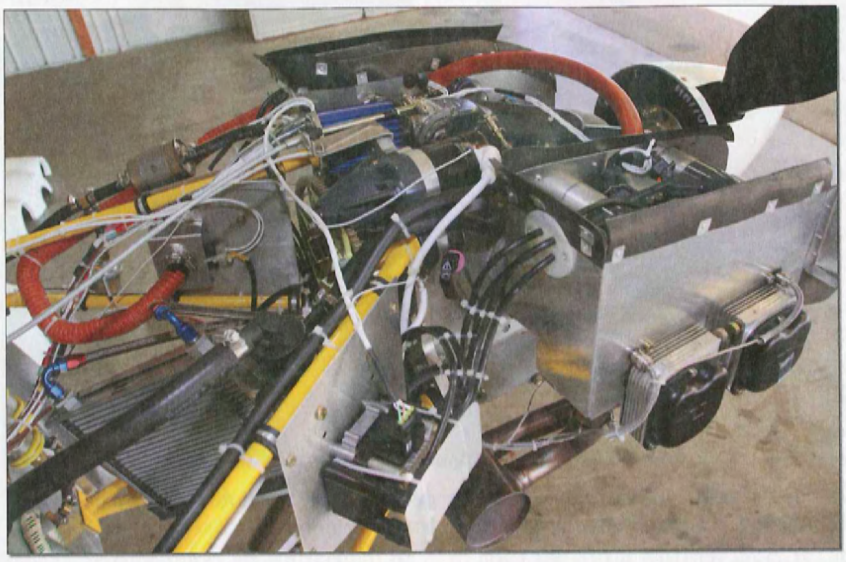
My flight in the factory ship took place in late October, a month of quick-changing weather in Mexico, Missouri, where Zenith is based. As such, the first afternoon, reserved for some flying and photography, gave us temperatures in the 70s and clear skies. The next day was cold and blustery. Great opportunities to test the UL Power installation.

The startup procedure couldn't be easier. Turn on the master, listen for the fuel pumps, pull the throttle to idle, and then crank with the key. Every start I tried—cold in moderate weather, heat soaked only minutes after a flight, dead cold on a 50° morning—turned out the same. *Tick-tick-tick* for three blades and the engine was running at a steady idle. No drama.

Such a positive initial impression continues as you taxi to the runway. Zenith

A near-full-span trimtab graces the left elevator. Simple sheet-metal surfaces are meant to be as light and easy to assemble as possible.

New for the CH 650 B is a canopy that provides excellent visibility even for tall pilots.



The low installed weight of the UL Power 350iS dictates a long engine mount. In the foreground is one of the two coil packs.

Electronic fuel injection means there's no carb to spoil the cowling's clean lines.

set up the demonstrator aircraft as it does most of its planes: throttle on the left side of the instrument panel with a flat pitch-trim rocker just inboard and a simple toggle switch to move the flaps just above that. The UL Power's automatic system means no mixture control or carb heat, and there's no need for a choke knob, either. Instead, you trundle out to the runway, guiding the airplane across the concrete with small movements of the rudder pedals, watching the temperatures come up on the Dynon display. Turning a two-blade, 65-inch-diameter WhirlWind prop, the UL Power is very smooth, with a steady idle and excellent throttle response; you won't often overshoot the desired thrust setting or runup rpm. Speaking of which, there's not much to it besides checking the independent ignition channels that will each run the engine.

Blink and you'll miss it. Zenith gave the 650's rudder more sweep than the 601's for a modern look.

Power Is Good. More Is Better

More power means greater thrust, which provides the expected outcome: thrilling performance. The 650 enjoys a fair bit of wing—132 square feet, resulting in a wing loading of 10 pounds per square foot—and generously sized flaps, so a short takeoff run (estimated at 550 feet without trying hard) quickly turns into an energetic climb. On the warmer day, we saw 1200 fpm initially, even as I allowed the nose to drop and airspeed to climb after the 60-mph rotation. With the Missouri countryside in the window, thanks to a climb speed of around 85 mph indicated, the CH 650 B continued uphill at 900 to 1000 fpm.

The last Zenith I'd flown was the CH 750, fitted with the Jabiru 3300, an engine prone to wide EGT (exhaust gas temperature) spreads at high power. What a delight to see the UL Power's EGTs in almost perfect alignment. Cylinder temps were moderate in climb and cruise; none ever got past 320° that I saw. During the climbout, I continued to adjust the throttle in an attempt to catch the UL Power's ECU behind current events. I failed. With each change in throttle position, the engine responded smoothly and predictably, and all of the measured parameters tracked in the right direction and to an expected degree. This is the rare case of a computer flying the engine the way savvy and dedicated pilots would—if they had nothing better to do, like, ah, fly the airplane. What's more, the four-banger is smooth in this installation, with low vibration levels at high power and no noticeable shudder even during power-off approaches. Nice.

Those 10 hp over the Jabiru don't really show up as cruise speed. We tooled around at 3000 feet MSL and allowed the airplane to wrap up to 140 mph true on just shy of 7 gph. According to Zenith, which has committed much more detailed data acquisition (and with the new cowling), the sweet spot is 125 mph IAS at 2650 rpm, which yields a 145-mph TAS cruise speed on less than 6 gph. The factory calls peak cruise 160 mph TAS at 8000 feet. On my demo flight, the throttle was pulled well back to achieve 2750 rpm at 3000 feet MSL, so it's reasonable to think there's plenty of altitude performance to spare. Remember, too, that the WhirlWind is a ground-adjustable prop, so it affords fine-tuning for

What's in the Box

Zenith produces the CH 650 B in a variety of configurations, including scratch-built if you like. A set of drawings and the manual on CD-ROM costs $495. If you want to build from a kit, you start with the Airframe Kit for $14,275, which includes all of the structure including factory-built spars, welded and finished steel parts, standard fuel tanks and the manuals/drawings. Next is the Finishing Kit for $4225, which includes the landing gear, wheels and brakes, canopy, seat belts, electric trim and finishing hardware. From there you must purchase the firewall-forward kit. For the UL Power 350i and iS, that's $4950, and includes the engine mount, oil cooler and cowling (among other things). The engine itself ranges from $22,950 for the 130-hp 350iS down to $17,290 for the 97-hp 260i. (The FWF package is $500 less expensive for the 260 than for the 350 engines.) As usual, paint, interior, avionics, electrical system and propeller are additional.

—M.C.

Inside the gold-anodized flywheel/starter-gear assembly is a motorcycle-style, permanent-magnet alternator rated for 30 amps.

regional differences, something owners in Leadville, Colorado, will appreciate. In fact, Zenith's Sebastien Heintz says the UL350iS might even be slightly too much engine for the airframe—perish the thought!—and the lower-compression 350i or even the UL260iS might work just as well for everyday users.

In the Details

I tried to pay attention to the airframe after slobbering all over the new engine, not an easy task. What stands out in the 650 B, besides the dramatically better visibility—from the new canopy and a slight increase in the wing's angle of incidence—is its solidity. It could just be an artifact of knowing the structure is stronger, but the 650 felt much more stable to me, far less willowy than the last 601 I flew. It is still slightly quirky, thanks to the center Y-topped stick that makes you do things with your shoulder that your pitching coach wouldn't approve of. The rudder friction presents as the need to lead the airplane into and out of turns; it's not a feet-in-the-carpet handler. But the forces, though relatively light, are well balanced in roll and pitch, with the

The UL Power's injection system called for electric fuel-tank switching in the 650.

controls in both axes plenty powerful. When trimmed for a specific airspeed, the 650 B sticks to it well enough that even low-time pilots are unlikely to be chasing the needle. The stick moves quite a distance in pitch, which is a good form of feedback for the pilot, but landing with a strong right crosswind, where you would want to use a lot of right stick, requires some coordination with your passenger. Sorry, didn't mean to jab you. Just wanted to keep the wing down.

Landings are dramatically easier with the 650's improved forward visibility. Approaching at 60 to 65 mph with full flaps, the airplane is pitched to give you a good view of the runway, so there's no tendency, as there is in the 601 XL, to increase speed for a glimmer of the tarmac. Charles Lindbergh was comfortable flying blind. Modern pilots less so.

I flew on a relatively calm day and, the next, with the wind blowing strongly down Mexico's north-south runway, all roily and cranky with the affairs at hand. Both sets of landings were better than I've ever done in the 601 XL and, what's more, the blustery conditions on day two seemed to upset the 650 B relatively little. Yes, it has fairly low wing loading, but it is stable and tracks predictably enough that the bouncing scores no greater than annoying. Control of the airplane was never in doubt. Once you've calibrated your feet for the rudder interconnect, you're fine. Actually, it's very much like a Piper Cherokee in the last phase of the landing, where you must momentarily release rudder input as the nosewheel touches so the airplane doesn't dart for the runway lights.

The Next Steps

Thoroughly updating the Zodiac into the CH 650 B and pressing forward with a promising new powerplant are two strong indications of Zenith's corporate philosophy and resilience. And that's not all. At a time when many kit companies are slowing research and development, putting the brakes on new ideas and generally hoarding cash, Zenith is gradually moving forward. It has recently invested in new machinery for the shop, and is in the process of building a second prototype of a new design you'll likely see this summer in Oshkosh. I can't tell you now if it's a radical or incremental update. As with the CH 650 B, you'll have to look close and decide for yourself. +

For more information, call 573/581-9000 or visit www.zenithair.com. Find a direct link at www.kitplanes.com.