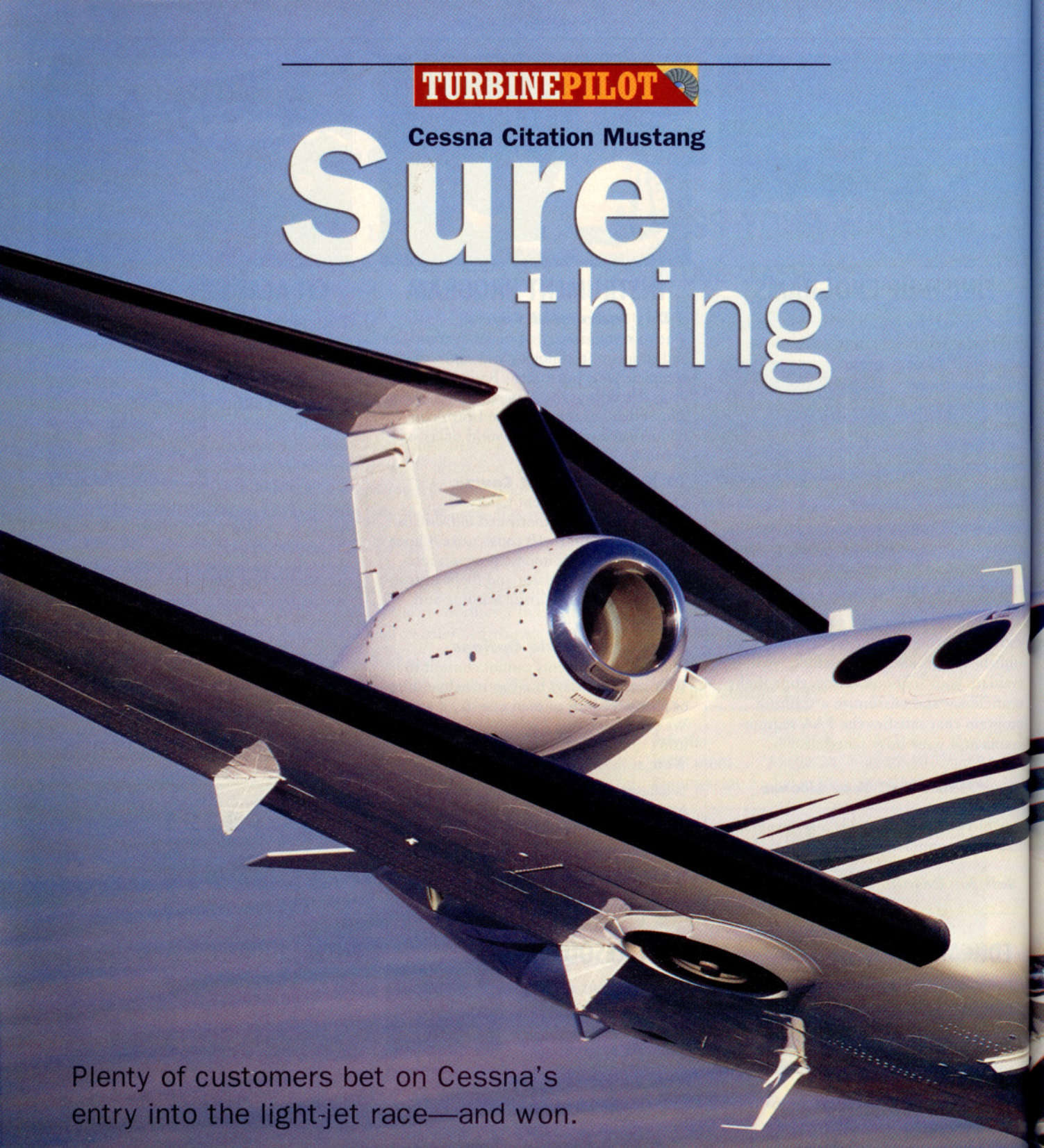
Cessna Citation Mustang

Sure thing



Plenty of customers bet on Cessna's entry into the light-jet race—and won.

BY THOMAS B. HAINES

PHOTOGRAPHY BY MIKE FIZER

Cessna Aircraft came late to the very-light-jet (VLJ) party. By the end of 2002 when Cessna announced the Mustang, it seemed that everyone with a CAD program and a roll of fiberglass had announced plans to build a VLJ. These Johnny-come-latelies to the jet world had nothing to lose by promising breathtaking performance at piston-twin prices—ready for delivery at the end of the next quarter. But with its stellar reputation on the line and plenty to lose by over-promising or under-delivering, Cessna needed to tread carefully. You don't get to be an 80-year-old company with a global reputation for quality and service by building schlock, especially in the business-jet market where Cessna has dominated for decades.

What to do?

Leverage your position as the world's authority on designing, building, certificating, and marketing business jets. And Cessna did just that, outlining a plan to build a small, highly capable jet that takes advantage of new powerplant, manufacturing, and avionics technology. Promise a reasonable schedule and then stick to it. Sell it at a believable price that provides real value relative to other larger jets, but still nets the company some profit.

To cut through the hype from all of the unproven designs and companies, Cessna stamped its Mustang marketing material with a brilliantly simple slogan: *Sure thing.*

The two words reminded potential customers that no one has certified and built more business jets than Cessna. Put your trust in a proven company.

It worked. Orders poured in.

And although Eclipse Aviation usually gets the credit for fostering the notion of a very light jet, Cessna's entrance legitimized the market to many buyers.

So with orders in hand, Cessna in late 2002 set about delivering on its promise to build a six-seat jet capable of carrying a single pilot and three passengers at speeds up to 340 knots true airspeed and on trip lengths of 1,150 nm with IFR reserves.

The MFD dominates the Mustang's G1000 panel; here it shows Garmin's Safe Taxi depiction. Engine gauges and EICAS are stacked in two columns on the left side.

Certification was scheduled for the third quarter of 2006.

And in the third quarter of 2006, it did just that, delivering an airplane that exactly met the specs outlined four years earlier. Meanwhile, many of the other companies either don't exist anymore or they are struggling to reach certification or serial deliveries.

A horse is a horse, of course

Cessna Chairman, Chief Executive Officer, and President Jack Pelton doesn't like to call the Citation Mustang a very light jet. Instead, he says, the light jet is simply an extension of the ubiquitous Citation line, of which 4,500 examples have been built over the past 35 years, with fleet flight hours now totaling 20 million.

He's right. The Mustang is Citation through and through, even though it is a completely new design. Although smaller than any other Citation (but not a lot different in scale than the original Cessna 500), the Mustang is classic simple Citation from a flight control and systems standpoint. It is easier to fly than any other Citation, and that's good because most of the 260 orders so far are from those who have little to no turbine time.

From the moment you walk up to it to the moment you touch down on the stout trailing-link landing gear, you get the feeling that this is a robust, sturdy airplane built to be easy to maintain and fly.

It appears larger on the ramp than you might imagine. The T-tail and empennage have the appearance of classic Citation. The wing appears similar to other Citations, but is in fact all new. The fuselage and nose section, however, look quite different from the earlier models. The nose and windshield are more sloped. The door is a constant 24 inches in width, whereas other Citation doors narrow toward the bottom. The Mustang's oval-shape windows mounted high on the fuselage are the most distinctive difference from the rest of the herd. They are placed at eye level for seated passengers, giving the cabin a more open feeling. Traditional Citation windows are taller and more rectangular, but wider in the middle.

Even the doors to jets can be intimidating to open. With the Mustang, from the inside or the outside, it's a one-handed affair. Simply lift the lever and turn. It's feather light.

A nonflushing lavatory is opposite the door—the kind that allows the marketing staff to say it has a lav, but not one you'd probably want to use, especially since it is separated from the cockpit and the cabin by only curtains. Just forward of the lav is a basic refreshment

Six elliptical windows at passenger eye level give the cabin a roomy feel; pleated shades can be raised up to keep the sun out. The cabin fuselage area is a constant 55 inches wide. A four-inch dropped aisle extends for the length of the cabin.

cabinet with storage for charts and other pilot supplies. To the right of the door are four club seats. The two aft-facing seats recline. The two rear seats in a bench configuration are against the aft bulkhead and don't recline. None of the seats articulates away from the sidewalls as seats do in many larger jets. But the fixed seats still seem to provide ample comfort, mostly because the cabin is wider at the bottom, giving passengers more hip and foot room. Other Citations have circular cabins. At 55 inches, the Mustang's cabin is about 3 inches narrower than the CitationJet (CJ), but it doesn't feel that way inside. Similarly, the Mustang's cabin is 3 inches shorter from the bottom of the aisle to the headliner, but again, it feels about the same size as the CJ, except in cabin length. With its small aft baggage compartment, the CJ's cabin is a foot longer. Like its larger cousins, the Mustang has a large nose baggage compartment and an even larger aft compartment that can handle skis.

The Mustang's cabin with its leather seats, tinted windows, power outlet, 10 cup holders (apparently passengers drink a lot, which may say something about our piloting skills), and two work tables is complete and comfortable, if a bit Spartan by business-jet standards.

The Go button

The cockpit, meanwhile, is a mixture of simple systems and wondrously sophisticated avionics. The two dual-channel full authority digital engine control (FADEC) systems make engine start a snap, for example. Push the start button and as soon as rotation starts, move the thrust lever into the idle position. With that, one of the Pratt & Whitney engines spools up on its own—all carefully monitored by the FADEC.

It is really the new generation of small turbine engines that has made the VLJ movement possible. Cessna chose the P&W Canada PW615F engines to power the Mustang. This newly certificated engine produces 1,460 pounds of thrust at sea level and is flat rated up to 25 degrees Celsius, meaning you'll get that much thrust even on a warm day. The time between overhauls is 3,500 hours right out of the box, which is remarkable for a brand-new engine. Hot-section inspections are not necessary until 1,750 hours and they can be performed without removing the engine from the aircraft.

Lightweight, powerful, and fuel efficient, the engines allow the Mustang to offer good performance at miniscule

SPECSHEET

Cessna Citation Mustang

Base price: $2.64 million

Specifications

Powerplants	Two Pratt & Whitney PW615F, 1,460-lb thrust
Recommended TBO	3,500 hr
Length	40 ft 7 in
Height	13 ft 5 in
Wingspan	43 ft 2 in
Wing area	210 sq ft
Wing loading	41.2 lb/sq ft
Seats	1+5
Cabin length	14 ft 9 in
Cabin width	55 in
Cabin height	54 in
Standard empty weight	5,350 lb
Max ramp weight	8,730 lb
Useful load	3,380 lb
Payload w/full fuel	800 lb
Max takeoff weight	8,645 lb
Max landing weight	8,000 lb
Zero fuel weight	6,750 lb
Fuel capacity	385 gal/2,580 lb
Baggage capacity	
Nose	320 lb, 20 cu ft
Tail	300 lb, 37 cu ft

Performance

Takeoff distance, ground roll*	3,110 ft
Max cruise speed	340 kt, 35,000 ft
Range, NBAA IFR Range	1,150 nm
Max operating altitude	41,000 ft
Landing distance, ground roll	2,390 ft

Limiting and Recommended Airspeeds

V_{FE} (max flap extended) 0 degrees to Takeoff/Approach	185 KIAS
V_{FE} (max flap extended) Takeoff/Approach to Landing	150 KIAS
V_{LE} (max gear extended)	250 KIAS
V_{LO} (max gear operating)	
Extend	250 KIAS
Retract	185 KIAS
V_{MO} (max operating speed) sea level to 27,120 feet	250 KIAS
M_{MO} (max Mach number) 27,120 feet and above	Mach 0.63

For more information, contact Cessna Aircraft Company, PO Box 7706, Wichita, Kansas 67277; telephone 316/517-6212; fax 316/517-5658; or visit the Web site (www.citation.cessna.com).

*All specifications are based on manufacturer's calculations. All performance figures are based on standard day, standard atmosphere, sea level, maximum gross weight conditions unless otherwise noted. *Takeoff distance balanced field length to Part 23 Commuter Category, 15 degrees flaps.*

Unusual in some new models, the Mustang has a manual trim wheel to back up the electric trim. The keyboard is the primary access to the flight management system (far left). The flight control system is managed through the mode controller at the top of the glareshield (left center). The rugged trailing link main landing gear system includes dual rotor steel disc brakes with digital anti-skid protection (above).

fuel burns of around 460 pounds per hour, or about 70 gph total at FL 410.

The Mustang's fuel system is Skyhawk simple; all of the 2,580 pounds of fuel is in the wings. The left tank feeds the left engine and vice versa. No switching of tanks is necessary unless you're flying on one engine. Fuel pumps come on automatically at engine start. A heat exchanger on the oil system automatically warms the fuel in flight, meaning that anti-icing fuel additives are not necessary.

An electric motor powers the hydraulic system for landing-gear actuation and the brakes. For safety purposes, none of the hydraulic lines passes through the pressure vessel. The electric anti-skid braking system allows the pilots to stomp on the brakes upon landing while the computers sort out the rest. The speed brakes on the top of the wings and the flaps also are electrically actuated.

Thanks to precise control by the FADECs, the engines produce minimal thrust at idle, meaning that no thrust attenuators are necessary. The original CJ needed thrust attenuators to taxi because it did not have FADEC. Without FADEC, its Williams International engines produced too much thrust during taxi, requiring excessive braking by the pilots.

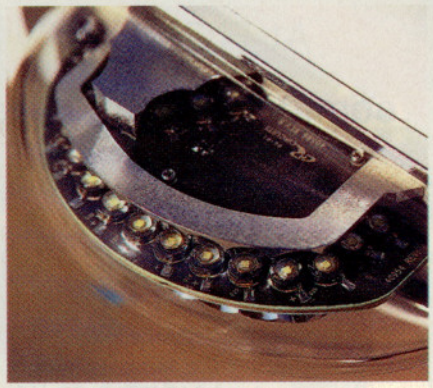
Engine bleed air prevents icing of the Pratt engine inlets. Pneumatic boots protect the wing and tail areas from ice. Boots may seem like a low-tech solution, but they work and the new versions are easy to repair and replace. In addition, the boots contribute to the Mustang's climb performance because they don't rob power from the engines as bleed-air systems do on many other jets. And they apparently work well because the Mustang, with its all-new type certificate, has to meet the latest very stringent icing requirements. The windshield is electrically heated, which makes the cockpit much quieter than that of other Citations, which use a noisy, heavy, and complex hot air system to provide windshield defog.

The flight controls are all mechanical, using pushrods and bellcranks. Unusual for a jet, the controls are routed through the panel to a yoke—like in single-engine Cessnas— rather than up through the floor. The result is easy access to the cockpit seats. There is nothing to block your feet when getting in and out. In addition, the center pedestal does not go completely to the floor, allowing your feet to slide underneath it during access and egress.

The highly capable Garmin G1000 system holds center stage on the panel. A 10.4-inch primary flight display (PFD) in front of each pilot seat provides attitude and heading information. Dual solid-state attitude heading reference systems tell the rest of the pack which way is up and provide the precision necessary for reduced vertical separation minimums (RVSM) required for operation in the upper flight levels.

In the center a giant 15-inch multifunction display provides all of the other information the pilot needs, including moving map, XM weather overlays, traffic and terrain depiction, flight planning, and engine indication and crew alerting system (EICAS). EICAS replaces the plethora of annunciators found on older jets. Instead, EICAS quietly monitors the systems, alerting the crew via text messages on the MFD only when something is awry.

All of the navigation and communication radios are managed through the knobs and buttons around the perimeters of the displays or by the alphanumeric keypad on the pedestal. The Garmin GFC 710 flight control system is



Eight locking pins and a passive blade-type pressure seal protect the Mustang's constant-width door. A folding two-step entry stair provides easy access (above). Cessna uses low-power and long-life LEDs for the wingtip strobes and nav lights (above, center). The Pratt & Whitney PW615F engines have a 2.8:1 bypass ratio with three compression stages and two turbine stages, producing 1,460 pounds of thrust at sea level (above right).

managed through the knobs and buttons at the top center of the stack.

To give you a sense of the capabilities of the Garmin G1000 system installed in the Mustang, which is significantly more sophisticated than the G1000 in simpler airplanes, the "Flight compartment, instrumentation and avionics" section of the Citation Mustang Specification and Description book eats up six of the 24 pages. By contrast, the electrical, pressurization, environmental, and oxygen-system descriptions all fit on one page. Regarding pressurization, that's managed by the G1000 too, with the pilot only having to put in the elevation of the destination airport. The system pressurizes the cabin to a maximum differential of 8.3 pounds per square inch, providing an 8,000-foot cabin at the maximum cruise altitude of 41,000 feet.

To the flight levels

Settled into the left seat with Mustang demonstration pilot Charles L. Brammeier in the right seat, I hit that right Start button and moved the right thrust lever to the idle position. The right engine was soon humming. A push of the button for the left side and nudge of the left thrust lever brought the other side online. The avionics were already humming and Brammeier had put in a flight plan for Independence, Kansas, 84 nm southeast of Wichita Mid-Continent Airport. Some Mustang subassemblies are built in the Wichita plant and other Cessna facilities, but assembly is done at the Independence plant next to the single-engine piston airplanes. Of course, we wouldn't get to Independence the direct way; we would head west first, climbing to altitude to see how the Mustang flies.

As we left the Cessna ramp, N510KS weighed 8,160 pounds, 485 pounds below the maximum takeoff weight of 8,645. This airplane, with some test gear still on board, weighs 5,750 empty, which is a little higher than typical. We added 400 pounds for the two passengers and just over 2,000 pounds of fuel. So this would be a fairly typical short-trip configuration—four on board and enough fuel for a trip of a few hundred miles.

V-speeds were amazingly low: V_1 and V_R 91 KIAS, and V_2 97 KIAS. With a couple of twists of knobs and pushes of buttons, I set the airspeed bugs on the PFD.

Taxiing out, I noticed it took a fair amount of thrust to get the airplane rolling. The temperature was 21 degrees C with the winds out of the south at 25, gusting to 36. Welcome to Kansas. On the runway, I clicked the thrust levers up to the Takeoff setting, noted that the G1000 annunciators agreed, and away we went. V_1 and V_R arrived quickly; a little tug on the yoke and we were climbing away at more than 3,000 fpm. I pulled the levers back to the climb detent and turned toward the west. Wichita's cooperative controllers allowed us to climb straight to altitude. We passed Flight Level 350 in just 13 minutes. At FL380 the climb rate was

You get the feeling this is a robust, sturdy airplane built to be easy to maintain and fly.

At FL350 and with the cabin at a comfortable 6,800 feet, the speed settled in at 354 knots true, well above the book speed.

down to about 700 fpm. The trick is to climb at 170 KIAS until reaching Mach 0.45 and then climb at that speed. I flipped on the autopilot because RVSM requirements mandate that the autopilot handle all level-offs above FL290. Air traffic control doesn't want hamfisted pilots busting altitude when only 1,000 feet separates aircraft.

After a total of 26 minutes, 30 seconds in the climb, we leveled off at FL410. We had burned 420 pounds since engine start. The temperature there was 4 degrees above standard. I clicked the FADEC back to the cruise setting while the airplane accelerated. The airspeed soon settled in at 324 knots true while burning 470 pounds per hour.

Brammeier noted that in the case of a rapid depressurization all we would have to do is don the oxygen masks, yank the thrust levers back, and put out speed brakes and landing gear. The autopilot, sensing the depressurization, would turn the airplane 90 degrees to get it off an airway and begin a rapid descent to 15,000 feet, managing the pitch all the while so as to not overspeed the airplane. With any luck we'd wake up at 15,000 feet if we didn't quite get the masks on. Few of even the highest-end autopilots have such sophisticated features as an emergency descent mode. If only the Learjet carrying golfer Payne Stewart had had one.

To see whether the Mustang would meet its promised 340 KTAS at mid-cruise weight, we descended to FL350, where the temperature was right at standard. There the speed settled on 354 KTAS, well above the book speed. Fuel burn increased to 660 pph. Meanwhile, the cabin was a comfortable 6,800 feet.

With a turn back to the east, Brammeier set up for the GPS 17 approach to Independence. The vertical navigation planning had us descending from FL350 to 2,500 feet at a point five miles from the airport. A caret on the vertical-speed-indicator tape showed us when to start the descent.

During the descent, the system calculated a landing weight of 7,260 pounds and a V_{REF} of 89 knots, about what I fly in my Beechcraft Bonanza. I dialed the minimums into the G1000 for the approach, which set a bug on the altimeter. Turning into the wind on final, it felt like we stopped, but soon the runway appeared underneath and I plunked the airplane down on the pavement between gusts. The trailing-link gear softened the impact significantly.

Time for bonding

Besides the new generation of small, efficient engines and the lower-cost but very capable avionics, the other thing that makes the Mustang more affordable than your traditional Citation is the manufacturing process. As Mustang Program Manager Russ Meyer III pointed out during a briefing, the Mustang takes full advantage of everything Cessna has learned about building jets. Although some older models of Citations are still built using a lot of bent aluminum and rivets, the Mustang is mostly made from formed aluminum skins bonded to structure, providing an amazingly smooth finish. In metal bonding, a chemical bonding agent (glue, but the engineers don't like to call it that) is applied to the components to be joined and then the parts are mated under pressure and heated in an autoclave for a period of hours.

One fuselage tool at the Independence plant holds the side skins in place with a vacuum and then moves the two sides inward to mate with the floor and its associated ribs while the aft bulkhead is moved forward, bringing all of the pieces together just right. External skins come together leaving neat and tidy seams of 20-thousandths of an inch, meaning no hand fitting and filling are required. A routerlike tool cuts the door and window openings in the fuselage skins, again, ensuring a perfect fit.

As of mid-March, Cessna was building about one Mustang a week, but plans to eventually increase that to about four a week, wicking away at that 260-order backlog. As of mid-April, only three Mustangs had been delivered—two for use by Cessna as demonstration airplanes and one to a retail customer. The first retail customer is David Goode, a former U.S. Ski Team member and president of Goode Ski Technologies. Goode moved up to the Mustang from a Cessna 310.

A glitch in the G1000 software held up Mustang deliveries while a fix was developed and flight-tested. Deliveries were ramping up by late April; the com-

Cessna Citation Mustang estimated operating cost
For a typical 500-nautical-mile trip

	3-Year Average In Warranty	Out of Warranty
Average speed (knots)	313	313
Average fuel flow	95	95
Labor hours (per flight hour)	0.60	0.90
Operating cost per flight hour		
Fuel ($4 per gallon)	$380	$380
Maintenence		
Labor ($80 per hour)	$48	$ 72
Parts	$ 50.13	$78.64
Engine reserves	$165.66	$183.60
Total cost per flight hour	$643.79	$714.24
Cost per nautical mile	**$2.06**	**$2.28**

pany hopes to deliver 40 aircraft this year and 100 next year.

Flying the transition

As we piled back into the airplane for the return to Wichita, it dawned on me that even on flight two I was already feeling more at home with the airplane. I have a Garmin GNS 530W in my airplane, so the operating logic is similar to the G1000's. With the simple engine start procedure and simple engine management, thanks to FADEC, and the somewhat familiar cockpit architecture, I was believing I could actually get this going and back to the ranch without busting it.

We blasted off into the terrific headwind, climbing away effortlessly to 17,000 feet. On the way up I experimented with the flight controls and racked the airplane around. Throughout the flight envelope, the airplane flies like a much smaller airplane—more like a Cessna 210 than a jet—especially regarding the V-speeds, yet it retains all of the nice, stable handling characteristics of the rest of the Citation line.

Any reasonably competent pilot used to flying light twins or high-performance singles, especially one with any time behind the G1000, will easily transition into the Mustang. It is in many ways simpler to fly than a piston twin, especially from a systems standpoint. And with Cessna's estimate of $2.06 per nautical mile in direct operating costs, it is less expensive to operate than many turboprops.

Those transitioning into the Mustang will do so by taking a course at FlightSafety International, which in April certified its all-new Mustang simulator. FSI also provides a cockpit simulator to help pilots master the G1000. Unlike FSI's traditional courses, which are for the most part by the book, the Mustang program will be customized to the needs of the customer. Recognizing that about 90 percent of Mustangs will be owner flown and many owners will have little turbine time, Cessna and FSI worked together to develop a new approach. Customers will complete a "proficiency index," basically a thorough survey of their flying skills and proficiency. FSI will then build a curriculum to get the pilot up to speed in the Mustang. According to insurance experts, pilots completing the FSI course should have little trouble obtaining coverage through a number of aviation insurers.

Cessna designed a new high-lift airfoil to give the Mustang low stall speeds and low drag and pitching moments. The leading edge sweeps back 11 degrees.

Cessna has developed several services in support of Mustang customers new to turbine operations and who likely don't already have flight departments. ProTech, for example, is a new initiative that will provide a host of services, including navigation database management. For maintenance, Mustangs will be serviced right alongside other Citations at Cessna's string of company-owned Citation Service Centers. They've thought of it all.

When you look at the complete Mustang package, it's easy to see why "sure thing" brought in so many eager customers. AOPA

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Links to additional information about Cessna Mustangs may be found on AOPA Online (www.aopa.org/pilot/links.shtml).