CIRRUS VISION JET

Single-engine SF50 model carves new niche in the owner-flown category

by Matt Thurber

In June 2007, Cirrus Aircraft unveiled the configuration of its new single-engine jet. At the time, it appeared as though Cirrus was jumping on the same bandwagon as other would-be or existing aircraft manufacturers. The apparent market for a single-engine jet, if all the prognostications were to be believed, was going to soar, part of the then-current hype projecting huge fleets of very light jets about to clog up the world's airspace.

The list of would-be single-engine jets was long, yet only a handful have actually flown: the VisionAire Vantage, PiperJet, Eclipse 400, Diamond D-Jet, and Stratos 714. While Stratos's effort has recently seen renewed activity including flight testing, only one—Cirrus's SF50 Vision Jet—has made it into production.

Bringing a new jet into production is a significant challenge. In the midst of the development program in 2011, at a time when funds to see the project through were scarce, Cirrus was sold by its Middle East-based, majority owner venture capital firm Arcapita to China Aviation Industry General Aircraft, a division of Aviation Industry Corporation of China. The new owners were willing to provide the money to see the all-composite Vision jet through certification and into production. Finally, on Oct. 31, 2016, Cirrus announced FAA certification for the SF50 Vision Jet.

In the early days of the Vision program, Cirrus quickly racked up several hundred orders secured by $100,000 deposits. Many of those original buyers stuck with their orders over the years and are now taking delivery of their new jets. Perhaps encouraged by seeing Cirrus overcome the hurdles of certification and initial production, more buyers have stepped up, and the backlog is now greater than 600.

Cirrus is taking its time and not rushing the ramp-up process. As with its SR-model manufacturing, jet airframe components are made in Grand Forks, North Dakota, then shipped to Duluth, Minnesota for assembly. Cirrus expected total deliveries to reach 20 by the end of November. Next year's target is 60 jets, with an ultimate goal of 125 per year.

From the beginning, Cirrus touted the Vision jet as "the slowest, lowest and cheapest jet available," and its projected performance and price targeted owners of single-engine, piston-powered Cirrus SR20s and SR22s who wanted a move-up option in the Cirrus

Cirrus is taking a 'go-slow' approach to ramping up production of its Vision Jet. The company expects to hand over 20 this year and deliver 60 of the single-engine jets next year.

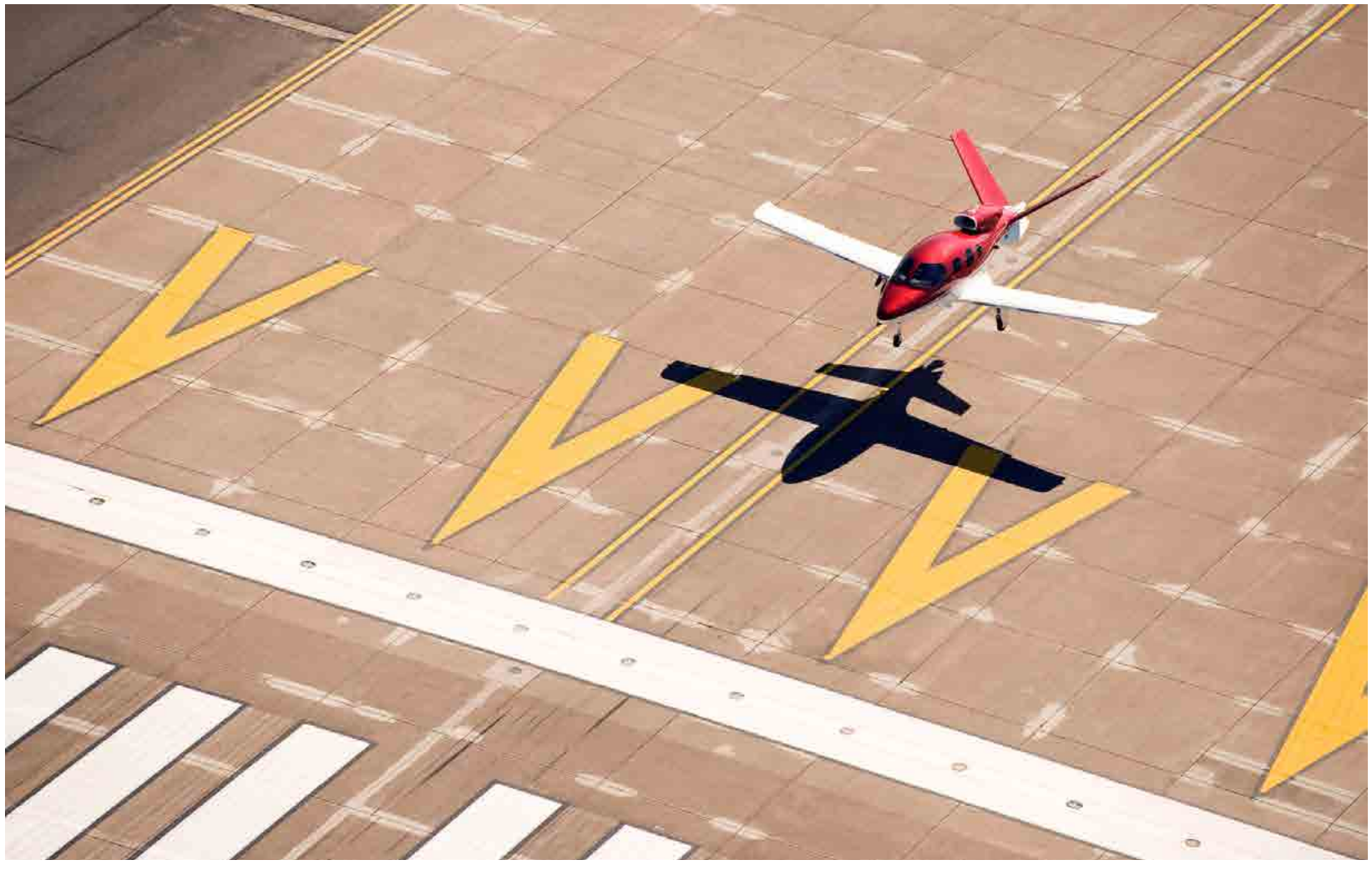
Aircraft Make/Model Specifications and Performance

Price (typically completed and equipped)	$2.30 million
Engines (two)	Williams International FJ33-5A, 1,800 lbs thrust
Avionics	Garmin-based Cirrus Perspective Touch
Passengers (typical)	1 crew + 4 pax (plus two child seats)
Range (w/NBAA IFR reserves)	1,200+ nm at 240 ktas
High-speed cruise	300 ktas
Long-range cruise speed	240 ktas
Fuel capacity	2,000 lbs
Max payload w/full fuel	468 lbs
Ceiling (certified)	28,000 ft
Cabin altitude at ceiling	8,000 ft
Max takeoff weight	6,000 lbs
Takeoff distance at mtow over 50-ft obstacle (sea level, standard)	3,192 ft
Landing ground roll	1,628 ft
Length	30.7 ft
Wingspan	38.7 ft
Height	10.9 ft
Cabin	Volume: 170 cu ft
	Width: 5.1 ft
	Height: 4.1 ft
	Length (seating area, including cockpit): 11.5 ft
Baggage capacity	23.5 cu ft (added 3.9 cu ft optional)/300 lbs
FAA certification	FAR Part 23, 10/31/2016
Number built	20 (11/30/2017)

family. Until the jet came along, their upgrade choice was either a multiengine piston twin such as the Beechcraft Baron or Piper Seneca; a Piper, TBM or Pilatus PC-12 single-engine turboprop; or a light jet.

But Cirrus has built a unique product line, in general aviation terms wildly successful, but also different from other typical light aircraft. The SR20 and SR22 have attracted new entrants into general aviation, likely because Cirrus designers recognized that light airplane design had stagnated and that buyers with plenty of money to spend didn't have a satisfying product available. Cirrus brought not only modern luxury automotive styling to the general aviation market, but also high performance in a simple, fixed-landing-gear design and, controversially, adding a whole-airplane parachute system that could save the occupants in case of an emergency.

The reason the parachute was controversial has a lot to do with pilots' egos; few pilots like to admit they can't handle an emergency situation. But the fact that whole-airplane parachutes have saved hundreds of lives and Cirrus's recent focus on teaching pilots to use the parachute in almost any emergency have proven the benefit. The parachute is such an important element of Cirrus's design DNA that it became an essential part of the Vision jet. For those who claim they aren't comfortable flying a single-engine airplane, the parachute offers an additional and proven layer of safety. Some pilots who fly multi-engine



business jets have said that the parachute is almost like having a second engine, so perhaps the Vision jet will find a market for professionally flown transportation apart from the owner-flown niche.

A Typical Trip

To demonstrate the Vision jet's capabilities, Cirrus took a different tack than most OEMs when it comes to pilot-report flights. Typically, I travel to the OEM's headquarters for a flight that originates and returns to that location; some flights don't involve landing at other airports, while others include an out-and-return flight, but always during the same day.

Matt Bergwall, Cirrus product line manager for the Vision jet, likes to show how the jet performs on a typical owner-flown trip. He flew from Cirrus's new Knoxville, Tennessee service, training, and delivery center to meet me at Morristown Airport in northern New Jersey. We decided on a flight to Bar Harbor, Maine, where we would stay overnight then return the following morning.

I had been flying an SR20 with the latest Cirrus Perspective avionics suite, and I wanted to see how it felt to transition into the Vision jet. I had high expectations for the jet, and I found that it easily exceeded my expectations; the jet's handling, ergonomics, comfort, and performance all delivered on Cirrus's promises, and, overall, the jet delivers as natural a transition from one airplane to another as I have ever experienced.

Although the jet skips Cirrus SR owners over the turboprop phase directly into a turbofan-powered airplane, I found the jet far simpler to operate than a single-engine turboprop. Although the FAA doesn't require a type rating for pilots flying turboprops that weigh less than 12,500 pounds, any airplane powered by a turbojet or turbofan engine, for some unaccountable reason, does require a type rating.

The Cirrus type rating course lasts about 10 days, or less for professional pilots with turbine experience. Training is done in a flight training device and in the airplane at Cirrus's Duluth headquarters. Once Cirrus puts its new CAE-built Vision jet full flight simulator into service in 2018, training will shift to Knoxville. Cirrus also plans to offer a Flight Operations Manual and online training similar to the excellent training material now available for the SRs.

Insurance requirements for the Vision jet are similar to those for the SR series, according to Bergwall, but hull value coverage will be higher due to the jet's higher cost. Depending on the pilot's experience, the insurer may require a period of mentorship with a more experienced pilot.

What sets the SR piston singles and the Vision jet apart are some subtle differences. Of

course the jet is an entirely different airplane, with significantly better performance, but from the pilot's perspective, there are many familiar elements.

The jet's Perspective Touch avionics suite remains a Garmin system, but with G3000-type touchscreen controllers. There are three GTC 580 touchscreen controllers arranged in landscape format instead of the typical portrait mode found in other G3000 implementations. One of the GTC 580s (the left-side unit) doubles as a backup display, so there is no need for separate backup instrumentation. The GTCs are arranged under the main displays, which turns out to be more natural than side- or console-mounted controllers, because the touching action is physically closer to what's happening on the two PFDs and single MFD (all measure 14.1 inches).

Standard avionics includes the GFC 700 autopilot, synthetic vision, GTX 33 mode-S transponder, ADS-B Out and Sirius XM weather/radio receiver. Optional equipment, which most buyers will likely want, adds enhanced vision (infrared), TCAS-1, TAWS-B, ADS-B In, GWX 70 weather radar, Iridium transceiver and Wi-Fi datalink.

Switch placement is much the same as the SR models, so again, familiar and expected.

The Garmin-based cockpit of the Vision Jet will feel familiar to pilots of the SR22. In the jet, however, the Perspective Touch employs G3000-based touchscreen controllers.

A welcome change for the Vision jet is the sidestick flight control, one for each pilot. While the stick is in about the same place as in the SR—on the pilot's left side and right-seater's right side—the jet's control is a true sidestick, not the side yoke in the SR.

A side yoke travels fore and aft (toward the panel and away) for pitch and pivots side to side for bank. It's not unnatural, but is something new SR pilots need to get used to. A true sidestick like the jet's pivots forward and backward for pitch and sideways for bank, which means the pilot doesn't have to move an arm when pitching; all control movement happens with wrist movement, which I find far more comfortable.

SR pilots will find the jet's ground steering familiar, because to keep the airplane simple, Cirrus opted for a fully castering nosewheel, so taxiing requires the use of brakes for steering.

Comfortable Cabin

From the outside, the Vision jet doesn't look big, but up close it revealed its status as a new class of airplane, what I'll call a compact cabin-class single-engine jet.

The jet's wingspan is just a few tenths of an inch greater than the SR22's, and the jet is longer by about four feet. The jet is also about two feet taller than the SR22. Most hangars that accommodate an SR22 will be able to fit the jet, according to Bergwall.

The door on the left opens next to but slightly aft of the pilot's seat, and to make entry easy, the seat slides far enough forward to allow plenty of room for back-seat occupants to climb aboard. Then the seat slides back to give the pilot the space needed to enter. The door is a clamshell, with separate upper and lower halves and steps in the lower half.

The Vision jet probably wouldn't have attracted as many sales if Cirrus designers hadn't added the larger cabin, which has a volume of 170 cu ft. Seven seats may seem improbable in an airplane of this size, but it is possible to fly with that many, as long as the two aftmost right- and left-side passengers are small enough (each can hold a person weighing up to 90 pounds).

The cabin is spacious, stretching to a maximum interior width of 61 inches at the middle seats, and tapering to about 50 inches at the rear, with a length of 137.8 inches. All of the seats can be removed to create even more space. An optional potty is available and takes up one of the center seat spaces, but this is not a permanent installation and is easy to move in and out. The seats each have a cupholder, a 2-amp USB outlet and a headphone connector.

The externally accessible baggage compartment measures 23.5 cu ft, and an optional extender adds another 33.9 inches and 12 inches in height (3.9 cu ft) along the bottom of the 35-inch long compartment.

Bar Harbor-bound

With the pilot's seat slid forward, Bergwall easily stepped into the cabin behind the left seat and then into the right seat. After moving the left seat back, I stepped in then closed the bottom door and the top.

Setting up the flight plan to Bar Harbor with the touchscreen controller is simple, almost like using an iPad app. Garmin's interface is, in fact, a lot like its Pilot app. The weather was benign, some high clouds and gentle winds, nothing that would offer any complication to the trip.

The fuel tanks were loaded with 243 gallons of jet-A, 53 gallons less than the 296-gallon maximum. With just the two of us onboard, our weight was 5,271 pounds, 729 pounds below the 6,000-pound mtow. Our calculated ground roll was 2,607 feet and runway required was 4,082 feet to clear a 50-foot obstacle.

Taxiing the Vision jet felt a lot like taxiing a Cirrus SR. It didn't take too much power to get moving, and idle power didn't push the jet along too quickly, so I didn't need to ride the brakes. Steering with the brakes didn't present any challenges, and I like this feature on a personal airplane because it makes maneuvering in tight quarters easier. There are also no nose-gear tow limits, which makes it safer for line personnel to move the jet on the ground.

Cirrus is big on electronic checklists, and I've gotten used to them on the SR20, including the important pre-takeoff briefing that includes the plan for using the parachute. This

The Vision Jet has plenty of fuel-capacity for the short trips typical of business travel. With a full load of full (296 gallons) it can carry almost 500 pounds of payload, offering plenty of capacity for two average-size people and their bags.

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is part of Cirrus's effort to train pilots to tamp down their egos and use the parachute anytime it can help preserve the lives of occupants.

The Cirrus Airframe Parachute System (CAPS) is somewhat different in the jet because of the heavier airframe weight and higher speeds. Unlike the rocket that extracts the parachute from aft of the cabin in the SRs, a much smaller rocket in the Vision jet blows the parachute free from its housing in the nose, then inflators push the chute up and over the engine inlet so it can inflate without hitting the airframe. The chute then supports the airframe from a three-point harness; one harness is attached to the forward pressure bulkhead and the other two near each wing root.

The jet must be in a specific flight condition for the parachute to deploy, below 135 kias and 145 ktas. If these conditions aren't met, pulling on the handle won't deploy the parachute until after the autopilot automatically engages and levels the wing, pitches the nose up and pulls the throttle to idle. After deployment of the CAPS, the jet will descend at 1,560 fpm.

While the parachute offers additional backup for those wary of flying with just one engine, the jet's glide ratio adds another layer of safety. At 14.7:1, from its 28,000-foot maximum altitude the jet can glide more than 50 nm. At one point on the flight off the Maine coastline, we had nine airports to choose from in case of a complete loss of power.

Before lining up on the runway, I set flaps to the 15-degree or 50-percent setting.

Taking Off

The Williams International FJ33-5A's 1,800 pounds of thrust ramped up quickly when I pushed the power lever all the way forward for the takeoff on Morristown's Runway 23. I checked power output as the Vision jet accelerated and at 90 knots, pulled back a little on the stick. The jet eased off the runway with no need for a big rotation move on the controls, just a five-degree pitch-up on the attitude indicator.

I trimmed for the climb at 155 kias and pulled power back to maximum continuous thrust. Climb rate was better than 2,000 fpm, and I delayed turning on the autopilot so I could get more of a feel for the flight controls, which are well harmonized between pitch and roll at low and high speeds. In the SR20, I find the pitch and roll control not as closely coordinated, and sometimes I would tend to cause the airplane to move abruptly when changing attitude. By contrast, the jet's controls make hand-flying more pleasant, and I didn't feel as compelled to use the autopilot as I do in the SR.

Climbing through FL180, the jet still made more than 1,000 fpm while the engine burned 67 gph. It took 27 minutes to climb to FL270, where the temperature was ISA + 17 degrees C. True airspeed settled at 295 knots (Mach 0.48) with fuel flow of 61 gph at max continuous

thrust. Cabin altitude was 7,540 feet (maximum pressure differential is 6.4 psi). The left and right sides of the windshield fogged up a little at high altitude, but cleared up when we descended.

Most modern turboprops and jets have an emergency descent mode (EDM), and this is true of the Vision jet. Above 14,900 feet with the autopilot engaged, EDM will kick on if a CAS message warning that cabin altitude is too high remains on for at least 15 seconds. The cabin pressure control system also must not indicate that a manual cabin dump is under way. When EDM activates, a servo moves the power lever to idle, altitude preselect is set to 14,000 feet, and the nose is lowered to a target speed of 10 knots below Vmo. Once reaching 14,000 feet, power is set back to 83 percent N1.

EDM is just one of the protections in the jet. At high speeds, the Garmin Electronic Stability & Protection system (ESP) pulls the nose up automatically to prevent exceeding Vmo. At high angles of attack, when pitch reaches three degrees above stall-warning attitude, ESP will push the nose down to one degree below that attitude. This happens with the autopilot disengaged. The jet also is equipped with a stick shaker and pusher.

In bank and pitch, ESP nudges the controls back to a safe section of the flight envelope.

This starts at 20 degrees pitch, then at 25 degrees the pitch servo pushes the nose back to 17 degrees then disengages. Once reaching 45 degrees of bank, the roll servo starts ramping up torque to a maximum at 50 degrees then returns the bank to under 30 degrees and disengages.

ESP can be switched off, for example, when practicing steep turns. For situations where the pilot is confused about the airplane's attitude, the blue LVL button on the mode controller panel instructs the autopilot to take over and fly straight and level.

All too soon, it was time to descend to Bar Harbor where the weather was clear with 12-knot surface winds from the southeast, straight down Runway 22. I took over from the autopilot after lining up on the final approach course for the ILS approach and flew the glidepath down to the runway.

As in the SR, in the Vision jet there are three flap settings, up, 50 and 100 percent, the latter two equating to 15 and 40 degrees. I first set flaps 50 percent after making sure speed was below 190 knots, then lowered the landing gear before reaching the final approach fix, and finally set flaps to 100 percent. VREF speed was 85 kias, about a half dozen knots higher than the SR's and leaving plenty of margin above the 67-knot stall speed. The Perspective avionics showed the landing distance as 1,669 feet and 2,787 over a 50-foot obstacle, at a density altitude of 8,000 feet.

Bergwall recommended flying the approach at VREF+10, then slowing to VREF at 500 feet and carrying about 30 percent N_1 until the flare. I didn't notice any adverse effect from the jet's V-tail ruddervators, although the yaw stability augmentation system, which actuates devices hinged to the ventral fins, helps manage lateral/directional stability, and the handling was perfectly natural during the approach and landing.

Keeping the nose pointed at the runway, I barely had to pull up to level off, and the jet touched down gently on the trailing-link main gear legs, then the nose eased down. The jet is equipped with Beringer wheels and brakes, which automatically manage brake pressure to help the pilot keep from locking a wheel or applying too much pressure on one side. The jet rolled out straight while I braked and quickly slowed to a comfortable taxi speed.

We still had 144 gallons of fuel remaining after landing, and landing weight was just over 5,000 pounds.

Trip Home

After spending the night in Bar Harbor (and yes, I did introduce Bergwall to a traditional Maine lobster dinner), we awoke to dense low fog, which cleared by the time we arrived at the airport. FBO Columbia Air Services took good care of us, and added enough fuel to bring the level to 255 gallons for this leg. One important note: fuelers must be instructed

to add no more than 75 gallons at a time through the wing filler necks to prevent excessive lateral imbalance, according to Cirrus.

After a smooth departure from Runway 22, I climbed to 8,000 feet for some steep turns before we resumed the climb to FL280. I made the mistake of trying to muscle the controls beyond the 45- to 50-degree ESP bank limits. That just wasn't productive, because it's hard to maintain a constant angle while trying to push against the autopilot servo that's working to lower the bank angle. Bergwall switched off the ESP, and the steep turn to the right was more satisfying, revealing the jet's solid handling.

At FL280 heading back to Morristown via Albany, New York, at ISA +12 degrees C, true airspeed settled at 293 knots and fuel burn 60 gph.

After passing Albany, ATC dropped us down, first to 13,000 feet, then 6,000 and 4,000 as we neared Morristown. Keeping the jet from speeding up too much was no problem, and the autopilot easily handled the descents using the vertical speed mode. The Williams engine responded relatively quickly to power lever inputs, and I always felt like I was able to keep up with the airplane.

I hand-flew again and lined the jet up with the Runway 23 ILS, slowing with gear and flaps down to VREF+10 then VREF at 500 feet. With a slight left crosswind, I had no trouble keeping the jet pointed straight down the runway as I nosed down until it was time for a small pull on the stick to level off, then the main wheels touched and we were on the runway and braking to a stop.

Although I've become familiar with Cirrus products after flying the SR20, I don't have that many hours logged as a Cirrus pilot. But when it came to flying the jet, that didn't matter; it is so easy to fly that it hardly seems that pilots need much training.

After the two cross-country legs in the Vision jet, I came to appreciate the huge wraparound windshields. Visibility is not only the best of any business aircraft I've flown, but even better than most piston airplanes. The glareshield above the instrument panel barely intrudes into the view outside, and even in a steep climb I could see the sky ahead.

The jet's systems are relatively simple, and Cirrus took full advantage of the Garmin capability of displaying system synoptics on the big center MFD.

Fuel is contained in the wings and automatically balanced anytime there is more than a two-gallon difference.

The 28-volt electrical system won't be unfamiliar to Cirrus pilots used to flying with two generators and two batteries. The jet's starter-generator delivers 270 amps and the alternator 72 amps. Both batteries are lead-acid, the main a 25-amp-hour unit and the second battery rated at 13.6 amp-hours. Lead-acid batteries, while a known and reliable product,

are heavy, and I can't help wondering whether Cirrus might at some point offer a much lighter lithium-ion option.

Ice protection is a combination of deicer boots on wing and empennage leading edges, bleed air heat for the engine inlet, electric heat for pitot probes, angle-of-attack vane, and engine Pt2/Tt2 probes, and windshield and radome protected by ice-protection fluid spray via a windshield spray bar and radome nozzle.

Market Fit

A big part of the appeal of the Vision jet is not just its price ($1.96 million base, $2.3 million typically equipped), but where it fits in the general aviation marketplace. As yet, there is nothing that competes with the Vision jet's unique price/performance niche. The airplane is capable of flying more than 1,000 nm at 300 ktas or 1,200-plus nm at 240 ktas (NBAA IFR range), but most owners will probably fly much shorter trips and carry small loads, which is typical of business aircraft travel. With a full load of fuel, the jet can carry almost 500 pounds of payload, plenty for two average-size people and baggage.

For comparison, the current competition for Cirrus's jet is likely the Piper Meridian/M500/M600, TBM 700 through 930 and Pilatus PC-12, all aircraft that potential jet buyers either bought or might have considered while waiting for Cirrus to finish the jet. Epic's soon-to-be-certified E1000 and eventually Textron Aviation's Cessna Denali single-engine turboprops will also offer high-performance alternatives for the owner-flown market.

The price range for these single-engine turboprops starts at about $2.25 million (M500) and tops out at nearly $5 million (PC-12 and Denali). Each airplane offers its own benefits, especially blazing fast speed in the TBMs and E1000, and massive load-carrying in the PC-12 and Denali. But for the money, none of these airplanes offers the combination of simplicity of operation, a roomy cabin and performance that Cirrus's new jet does.

Having delivered more than 6,700 SR piston-singles, and with more than 600 orders for the jet, Cirrus clearly has figured out how to tap a loyal market for the expansion of its product line. The typical missions for business airplanes up through the Citation Mustang are ideal for the Vision jet, Bergwall said, with just a few occupants and relatively shorter flights.

While the owner-operator is the target for the Vision jet, some buyers are already using their jets for corporate transport. "It does connect people," he said. "It's a business tool; and a personal tool." ■