



Phenom 100

With its entry-level jet, Embraer more than delivers

by Robert P. Mark

Brazilian aircraft maker Embraer is a relative newcomer to the business aviation market. Five years ago the company was best known for producing many regional jets and its only business airplane was the Legacy, a corporate version of the ERJ 135.

In 2005 Embraer decided to build a line of smaller jets—including the “entry-level” Phenom 100—to compete with Cessna and Eclipse Aviation, which a number of observers viewed as a major misstep.

The FAA certified the first of Embraer’s new business jets, the Phenom 100, last December. Since the company’s initial announcement, the Eclipse 500 has disappeared from the market as a potential competitor, leaving the Cessna Mustang and the Citation CJ1+ as the targets on Embraer’s radar. Initially Embraer saw the Mustang as the airplane to beat, but because the Phenom cabin and speeds are closer to those of the \$4.755 million Citation CJ1+ than the Mustang, Embraer now sees the CJ as the airplane to beat.

The company says the Phenom 100 also has a larger cabin than the King Air C90 and burns 12 percent less fuel on a 600-nm trip. The King Air, of course, does not require a hard-surfaced runway, as the Phenom does. Interestingly, the Phenom lists for \$3.6 million against the King Air’s \$3.5 million, while a Cessna Mustang comes in at \$2.76 million. The Citation CJ 1+ runs about \$4.77 million.

The Phenom is single-pilot certified, but Embraer sources said most are expected to be flown with two people in the cockpit. The aircraft’s life limit—35,000 cycles—reflects the company’s extensive experience with high-utilization airliners, so most owners will run out of steam long before their Phenom 100s run out of hours. Four of the aircraft flew nearly 2,000 hours to earn certification from a variety of authorities in Brazil, the U.S. and Europe. The long life should also add to the residual value of the airplane when it does come up for sale. The company promises owners that maintenance trips will be well spread out and that the actual mechanical work will be easy to perform when it is needed.

Delivering on Performance Promises

Embraer seems to have quite a bit to crow about when its pledges for the Phenom 100 are examined against the actual airplane. An Embraer spokesman said the company promised customers a 380-knot aircraft capable of 1,160 nm of range at 41,000 feet, plus a landing distance of 3,000 feet. When it was certified, the Phenom came in at 390 knots and 1,178 nm with a 2,699-foot landing roll. Block fuel for a 1,000-nm trip was initially planned at 1,960 pounds but by certification had dropped to 1,889 pounds. The Phenom’s capacity for baggage is 25 percent higher than originally planned.

The entry-level Phenom 100 sits squarely at the boundaries of two aircraft segments. While not as swift as, say, the pricier 460-knot Hawker Beechcraft Premier II, at 390 knots the Phenom 100 will stay far ahead of the Citation Mustang’s 340-knot top speed. Both the Mustang and the Phenom 100 are certified for operation with a single pilot.

When range numbers are added to the discussion, however, the Mustang’s 1,150 nm compares favorably with the Phenom’s 1,178 nm. The CJ1+ will fly 1,300 nm. Both a Phenom and a Mustang have just enough fuel to fly to Minneapolis nonstop from New York, or to Kansas City from Los Angeles.

The Phenom 100 is powered by the Pratt & Whitney Canada PW617F-E, part of the same series of engines that power the Cessna Mustang, and both aircraft incorporate dual Fadec controls. The Phenom’s engines put out 1,695 pounds of thrust versus the Mustang’s 1,460; both are flat rated at ISA +10 degrees C. The Phenom not only meets Stage 4 requirements but beats them by 33 dB. The Phenom’s cabin pressurization is automatically controlled, delivering a maximum differential of 8.4 psi, which translates to an 8,000-foot cabin at 41,000 feet. Neither the Mustang nor the Phenom offers an APU option to run systems on the ground independent of land-based power sources.

A unique option on the Phenom 100 is “enhanced performance,” a software tweak to the Fadecs that makes the two Pratts put out an extra measure of power in all conditions, improving performance

considerably. The system, already being delivered on all 100s, will become an option sometime late this year, which means that unless a buyer chooses to upgrade to the system—for about \$75,000—the Phenom will not perform as well as the models that have gained Embraer the accolades for exceeding design expectations. It is difficult to imagine why anyone would spend \$3.6 million on a Phenom 100 and not invest an extra \$75,000 in the enhanced performance upgrade.

The Phenom 100 incorporates cruise control of sorts—called current speed control—that allows the Fadecs as much as a 10-percent variation of engine N₁ to hold a particular airspeed when the

aircraft is in level flight with the autopilot engaged. The 100 also features an automatic thrust reserve that boosts power on the good engine when it senses a failure of the other powerplant. The engine is set never to exceed the upper performance limits of the design, making monitoring by the pilot unnecessary.

On the Tarmac

During a walkaround of a Phenom 100, most pilots will notice the trailing-link gear, which should help even new pilots deliver smooth landings. Rather than the customary black, the pneumatic de-icer boots on the Phenom are silver, making them look like the leading edges of the wings; the leading edges of the horizontal stabilizers are heated. Embraer says it was simply an aesthetic choice.

The 100 employs two batteries for starting; one sits in an easily accessible compartment beneath the right engine while the other sits up front in the nose compartment, which doubles as a small additional baggage section. Since the Phenom does not provide single-point refueling, pilots must be certain all the caps are on tight, although they are key-lockable. The Phenom flaps have three extended settings—16 degrees, 25 and 35 degrees. The Phenoms currently coming off the line, however, are restricted to no more than 25 degrees of flap on landing due to an Airworthiness Directive related to the aircraft’s stick pusher system. A stick pusher is usually found only in a professionally flown airplane and

Embraer Phenom 100

Price (typically completed and equipped)	\$3.6 million
Engines	P&W Canada PW617F-E (two)
Passengers (typical)	1/2 crew + 4/6 pax
Range (w/NBAA reserves, 200-nm alternate)	1,160 nm at Mach 0.70
High-speed cruise	390 ktas/Mach 0.70
Fuel capacity	2,850 lbs
Max payload w/full fuel	735 lbs
Ceiling (certified)	41,000 ft
Cabin altitude at ceiling	8,000 ft
Max takeoff weight	10,472 lbs
Balanced field length at mtow (sea level, standard day)	3,125 ft
Landing distance	2,699 ft
Length	41 ft, 8.4 in
Wingspan	40 ft, 4.3 in
Height	14 ft, 2.6 in
Cabin	
Volume	208 cu ft
Width	5 ft, 1 in
Height	4 ft, 11 in
Length (seating area)	11 ft
Baggage capacity	55 cu ft/353 lbs
FAA certification	FAR Part 23, December 2008
Number built	60

prevents getting even close to a full stall.

After the Phenom 100 was certified, a logic error appeared in the flap system that caused Embraer to worry about an inadvertent activation of the pusher when flaps were extended to 35 degrees, normally close to the ground. While the company worked on a fix, it restricted flaps to no more than 25 degrees for landing, a limitation that increases landing distance slightly. Embraer planned to submit paperwork on the software update to the Brazilian aviation authorities last month and expects resolution of the problem by fall.



The Phenom 100's trailing-link landing gear should help even new pilots deliver smooth landings.

One of the last tasks on the walkaround is a look inside the large, flat-floor baggage compartment in the rear of the airplane. Embraer's numbers show the capacity as 55 cu ft and the weight limitation as 353 pounds. Cessna's data for the Mustang shows 37 cu ft and 300 pounds. The Mustang, however, offers a nose compartment capable of carrying another 320 pounds that the Phenom does not. The CJ1+ claims only 45 cu ft total for baggage.

Embraer says the Phenom's baggage compartment will hold "two pairs of skis, four garment bags, four roll-ons and four laptop-computer bags." The baggage area also includes a door that holds two quarts of spare engine oil, which eliminates the plastic crates pilots always stick in the back to carry these needed items.

Partner Contributions

Embraer likes partnering with other companies that provide the expertise the company lacks. The airframer hired BMW Designworks USA to fabricate the interior of the Phenom 100 and the high-performance car builder returned with a palette of customer options, including five different cabinet finishes, seven options on leather for seats and side panels and seven carpeting choices. An eighth choice is for pure wood flooring. Interior curtains offer seven possible color schemes. The Phenom is delivered standard with a fully

enclosed rear lavatory, and its two huge windows make the area seem much larger than it actually is. The windows also make the rest of the cabin appear larger when the rigid lav door is open. The cabin on the Phenom 100 seats four people, with two more in the cockpit. As an alternative, the airplane can be configured with two extra seats in the cabin—one a belted potty that runs about \$40,000 to \$50,000 and the other a side-facing seat opposite the door.

The entrance to the Phenom cabin gives passengers the sense that they are flying on a much larger aircraft because the 100 has an airstair door as standard equipment. I found the door well balanced and easy to raise and lower. The door features a handrail to ease getting in and out and drops down to within a few inches of the ground, making boarding easy for all passengers.

The seats on the Phenom 100 have caused Embraer some heartburn in the past year. They never quite met the expectations of the company or the owners. Newer, more stylish reclining versions are now being added on the production line and will be retrofitted to aircraft already delivered. The new seats will include armrests and are equipped with 110V AC outlets. Windows as large as those on the E195 bathe the inside of the Phenom 100 in light, giving it the feel of a much larger aircraft. There are also more of them too, four along the left side versus only three on some competitor aircraft.



The avionics suite in the Phenom 100 is the Prodigy, a version of Garmin's popular G1000. The system includes three interchangeable 12-inch LCD screens.

Another Embraer partner is Garmin, which used input from the aircraft manufacturer to develop a special version of the Garmin G1000 system called Prodigy—a G1000 on steroids, according to Embraer. The system installed on the Phenom 100 uses three 12-inch interchangeable LCD screens. On the Phenom

100, Prodigy is a user interface that includes precisely customized system synoptics for electrical, fuel and hydraulics, while offering crew alerting system (CAS) messages for all problems. The CAS prioritizes and does not show the crew messages they are incapable of fixing in the air.

Interestingly, Prodigy includes an automatic back-course selection for those places that still even operate this type of approach. I found the Garmin FMS keyboard high enough on the panel to limit the total up-and-down movements of my head normally needed to make data entries while watching the MFD. The Prodigy is also fully Waas compliant. What the Garmin Prodigy does not offer is an ADF receiver. Although NDBs are disappearing faster than Whack-a-Moles here in the U.S., other parts of the world still depend upon these radio beacons for navigation. Embraer offers an outboard Collins unit for owners who request one.

The Phenom 100 includes a dual attitude and heading reference system (AHRS) as well as a unique set of digital backup flight instruments that include colors and symbology like those the pilot sees while operating the aircraft normally using the PFD and MFD. Embraer's logic here is that the transition to standby equipment will be challenging enough for most pilots without forcing them to change back to steam-gauge information sources.

The standby system also uses a pitot tube, static port and AHRS separate from the two that analyze information for the main PFD on the pilot and copilot instruments. In a pinch, data from the backup instruments can in fact be used to drive the PFD. Although the digital instruments are more expensive than the



The airstair door that comes standard on the Phenom 100 is functional—making entering and exiting easy for all passengers—and aesthetic—giving passengers the impression of entering the cabin of a much larger airplane.

steam gauges, Embraer believes the mean time between failures on the digital backups is 10 times what it is for the old gauges.

Embraer says the Phenom 100 will easily fly 600 hours between visits to the shop due to its high-utilization design. Maintenance tasks have also been simplified to make it easier for work to be performed on the road. One mechanic can replace a windshield in about two hours, with no curing time required before flight. Two mechanics can completely change an engine in less than eight hours. With power-by-the-hour, maintenance costs can be reined in at less than \$1,000 per flight hour. A unique feature of the Prodigy system is its ability to log maintenance issues while in flight. Although the pilots can't see the data in the air, it can all be downloaded to a central computer via Wi-Fi once the aircraft lands.

Embraer partnered with CAE SimuFlite to provide all pilot training for the Phenom. The first simulator in Dallas is expected to be on line by this fall. Until then, type ratings are being conducted in the actual aircraft. Mentor pilots are also available through CAE.

A Little Flying Too

After a visit to the Embraer factory at São Jose dos Campos Airport (SBSJ) in Brazil, it was time to go out and put a few hours on the airplane, PP-XOH. Our Embraer pilot for the trip was company instructor Eloy Bayer, a former Varig Airlines DC-10 captain. The plan was to depart SBSJ and head to the other company airport, Gavião Peixoto (SBGP) about 200 miles northwest, where the 16,000-foot

landing runway was something even I could cope with. We also planned a little air work on the way before the first landing.

Climbing into the left seat is a little tight, but comfortable once you're down and belted. With a GPU plugged in, there is little effort needed to start the engines. With ignitions in auto, turn the spring-loaded start switches to "start." The Fadecs take care of the rest, including monitoring for a hot start. There are essentially no temperature controls to watch and little chance of overboosting the engines even if the power levers are pushed to the stop, unless of course the Fadec should fail.

The Phenom tips the scales at 10,516 pounds at maximum ramp weight and at 10,472 pounds for takeoff. With a maximum landing weight of 9,766 pounds, we knew we would not need to be airborne long before we could safely return to the airport and not exceed any limitations. In real life, any pilot would easily choose to land 700 pounds overweight in an emergency. Nosewheel steering is through the rudder pedals. The nose gear can also be disconnected for parking, allowing ground personnel to park the airplane in some pretty tight spots.

The Phenom uses a brake-by-wire system, which means the pressure the pilot applies runs through a transducer that applies the pressure through the hydraulic system. I didn't care for the brakes even after I had taxied for a bit. Your results may vary. On landing, especially since the Phenom has no reversers and no speed brakes, the pilot needs to get a feel for these digital brakes

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before attempting any short-field operations.

Eloy and I used Embraer's easy dispatch software to get a feel for what the weight-and-balance issues and takeoff run might look like. The system said we'd need 3,890 feet for takeoff. Published balanced field length on the Phenom 100 is less than 3,125 feet during standard conditions. At SBSJ, the field elevation is just over 2,000 feet and the single runway is 9,800 feet by 150 feet. With the outside air temperature a toasty 23 degrees C, the numbers for the first takeoff were still quite low: V₁ 99, V_R 101 and V₂ 103. Emergency return speed was set at 125 knots. Apparently the Garmin computer system is not quite sophisticated enough to handle automatic loading of v-speeds, something I find a bit lacking. The planned climbout speed would be about 200 knots up to FL300, which was as high as we would be able to climb on the test flight.

Embraer aircraft use the traditional ram's horn control wheels. These can take a little getting used to for some, especially in tight turns where wrist action is critical. As I pushed the throttles up, I was not disappointed with my earlier impression of the aircraft as a small rocket. Nine seconds after brake release, we were climbing north toward our assigned altitude. The Phenom quickly accelerated to 200 knots, confirming that new pilots are going to have to work at staying ahead of this airplane.

Since we were 2,000 pounds below mtow at takeoff, we reached FL300 in about 17 minutes. A check of cruise fuel flows showed that we were burning less than 400 pounds per hour total. I was really more interested in how the Phenom would handle when it was slow, as well as how long it took to slow down. During preparation for air work, I pulled the throttles to idle and simply held the nose level. The Phenom likes to fly and, with no speed brakes, the 200-knot flap 1 speed and the 180-knot gear extension speed will probably come in handy.

Down lower, with flaps set to 25, I slowed to 100 knots and tried some steep turns. I found the Phenom quick to respond

No Buyer Remorse Here

AIN asked new Phenom owner Ron Gruner—who was due to take delivery of his Phenom S/N 53 last month—if he experienced any buyer's remorse during the three years he waited for his aircraft. "Not once," he replied. He did admit to wondering before he purchased the airplane whether he might be buying an airplane that would turn out to be too much for him to handle, but those worries have disappeared. Gruner built a Web site for Phenom owners to share their experiences at www.jetbrief.com. "Through the Web site, I'm in touch with people who now own and operate the Phenom 100 and they seem pretty happy with their choice." —R.P.M.



The 55-cu-ft baggage compartment at the rear of the airplane provides plenty of room for skis and golf clubs.



Since the airplane entered production, Embraer has improved the seats in the Phenom 100 and will retrofit the older version, above, with a more stylish and reclining option.

although perhaps a tad heavy in roll. It was VFR at Gaviao Peixoto so I tried a screaming-in approach to see how much work a new pilot might experience slowing down to capture the ILS. Despite single-pilot certification, this is a real jet and is going to require new pilots to think far ahead of the airplane. I captured the VASI and planted the wheels in the first 20 percent of SBGP's 16,000 feet of runway, thanks to some excellent coaching from Bayer. I still didn't like the feel of the brakes, though. They stop the aircraft fine, but they seem to require an awful lot of effort considering they are digital.

There is little doubt that Embraer has a real winner with the Phenom 100. Pilots who want to carry lots of people and stuff to destinations quickly will love it, as well as its miserly appetite when the fuel truck arrives. But new pilots will want to arrive for training comfortable with the Garmin system, because the aircraft is simply too fast to make much of a classroom for the poorly prepared. Embraer's comparisons updates were probably correct as well. The Phenom is closer to the performance and handling of the CJ1+ than the Mustang...and for \$1 million less.

The company has orders for 500 Phenom 100s, and a dozen are currently in service. □