

# FIRST IN CLASS

First fully fly-by-wire bizjet | BY SARAH BROWN

**EMBRAER EXECUTIVE JETS** introduced full fly-by-wire flight controls to the midsize business jet market with the first flight of the Legacy 500 on November 27, 2012. Embraer touts the 3,000-nautical-mile jet as the first fully fly-by-wire business jet below \$50 million, and the only in its class. While software issues with the fly-by-wire flight control system delayed the first flight from an earlier projection of the second half of 2011, Embraer Executive Jets President Ernie Edwards said those issues have been resolved.

"That was all just a bad dream now," Edwards said. When supplier Parker Aerospace had issues

with the fly-by-wire system, Embraer sent engineers to help, and Parker subcontracted with BAE Systems to help with software development. Embraer evaluated the system in the "Iron Bird" flight controls integrated test facility, which links a fly-by-wire cockpit with other aircraft systems to test the controls, before the aircraft enters flight testing.

Test pilots were able to cover a significant flight envelope on the maiden flight, which lasted for an hour and 45 minutes, because the company had conducted extensive simulation and ground testing. Deliveries of the first aircraft are expected to begin in 2014,





## SPEC SHEET

### Legacy 500

BASE PRICE: \$19.875 MILLION

#### SPECIFICATIONS

Range (NBAA reserves, 200 nm alternate, long range cruise, 4 passengers) | **3,000 nm**

Range (NBAA reserves, 200 nm alternate, Mach 0.80, 8 passengers) | **2,800 nm**

High speed cruise | **Mach 0.82**

$M_{MO}$  | **Mach 0.83**

Balanced field length (max takeoff weight, international standard atmosphere, SL) | **4,600 feet**

Landing distance (4 passengers, NBAA IFR reserves) | **2,400 feet**

Max operating altitude | **45,000 feet**

Time to climb to FL 370 | **14 min**

Propulsion | **Honeywell HTF7500E**

Avionics | **Rockwell Collins Pro Line Fusion**

Seating Configuration (Crew + Standard Passengers/Max Passengers) | **2 + 8/12**

Max Height | **6 feet**

Max Width | **6 feet 10 in**

Length | **26 feet 10 in**

Baggage capacity | **External 110 cubic feet; interior 40 cubic feet; total 150 cubic feet**

External dimensions | **Height 22 feet 1 in; wing span 66 feet 5 in; length 67 feet 4 in**

filling a gap in Embraer's product line between the Phenom 100/300 and the Legacy 600/650.

Instead of conventional flight controls, which use cables and pulleys, the fly-by-wire system processes pilot and sensor inputs with an onboard computer to command the flight control surfaces. This saves weight and allows the flight control system to offer envelope protection.

Embraer's control laws apply soft limits at the outside of the operational flight envelope—up to 33 degrees of bank, plus-30 or minus-15 degrees pitch,  $V_{MO}$ , and down to  $1.1 V_S$ . A pilot can exceed these limits—even do a roll, theoretically—but must keep the sidestick deflected, or the airplane will return to the normal flight envelope. Outside the normal flight envelope, a pilot is operating in the “limit flight envelope,” which has hard limits for maximum speed, maximum sideslip, maximum angle of attack, and structural limits.

The system will limit the angle of attack rather than push forward like a conventional stick pusher, allowing for reduced margins over stall speed. In case of wind shear or controlled flight into terrain avoidance, a pilot can give full aft stick and the aircraft will climb as steeply as it can without exceeding its G limit or angle of attack limit. The system compensates for system failures, so in the event of an engine failure, the pilot would feel the nose drift only slightly to one side, a cue to adjust the rudder trim. Embraer opted to leave this task to the pilot in order to keep him or her engaged in the solution, but the airplane will continue onward even if the pilot does nothing.

Embraer is banking on the fly-by-wire system to pay off in setting the Legacy 500 apart in its class, but it also establishes a core competency for use in other products. The company will employ the system in the Legacy 450, a “mid-light” jet for which the company is pursuing a common type rating, and the technology can be employed in the KC-390 military transport followed by Embraer's commercial models.

The company gave a first look at the newly painted Legacy 500 prototype, the first of three completed, at its São José dos

Campos, Brazil, headquarters. The rear of the aircraft was packed with flight test data recorders, in contrast to the spacious interior—complete with wet galley and vacuum lavatory—that will be offered to customers when the aircraft enters service. No one was talking about a six-foot stand-up cabin with a flat floor for an aircraft in this class when Embraer launched the Legacy 500, Edwards said, but the decision of competitors to follow suit has validated the market the company identified.

Embraer set out a vision in 2005 to become a major player in the business-jet industry in the next 10 years. At the time, the company had only one business jet, based on the platform of the ERJ 135 regional jet. With the introduction of the Phenom 100 and 300, Embraer gobbled up market share; the Legacy 450 will mark its fourth clean-sheet business jet design.

The company has achieved its objective already, with years to go, Edwards said. Embraer cut the first metal on a Legacy 450 prototype in August, with an expected first flight in the second half of 2013 and entry into service a year after the Legacy 500. **ACFA**

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