



With 80th flight, X-48B successfully completes flight testing

Boeing Research & Technology engineers and technicians in California, working closely with NASA researchers, earlier this month successfully flew the unmanned, remotely piloted X-48B Blended Wing Body flight-research vehicle for the 77th, 78th, 79th and 80th times, completing a multi-step flight-test effort that began in 2007.

"We couldn't be more pleased with the results of this project," said Bob Liebeck, BR&T's BWB program manager. "We have proven that a BWB aircraft can be controlled as effectively as a conventional tube-and-wing aircraft during takeoffs and landings and other low-speed segments of the flight regime."

Since July 2007, when the X-48B flew for the first time at NASA Dryden Flight Research Center on Edwards Air Force Base, Calif., Boeing and NASA researchers have methodically pushed the research aircraft to test and validate the BWB data and flight-control system, and gather detailed information on BWB stability characteristics throughout a variety of regimes, including stalling and recovering the aircraft in flight.

"It's truly been a privilege to work with the talented flight-test professionals at Boeing and NASA on the X-48B program," said Mike Kisska, BR&T's X-48B project manager. "We've accomplished a great deal during the 80 test flights, including such maneuvers as power-on and power-off stalls, sideslips, engine-out maneuvering and a successful matrix of departure limiter assaults. Also, we believe the X-48B holds the NASA Dryden Flight Research Center record for the number of test flights performed by a single unmanned X-Plane - doubling the previous record of 40 flights held by the X-45 Joint Unmanned Combat Aircraft."

With a 21-foot wingspan, the 500-pound aircraft is an 8.5 percent scale model of a heavy lift, subsonic airplane with a 240-foot wingspan that possibly could be developed in the next 15 to 20 years for applications such as aerial refueling and cargo hauling.

The X-48B flight-research is a collaborative effort of BR&T's Enterprise Strategic Growth organization, NASA and the U.S. Air Force Research Laboratory. Two X-48Bs were built for Boeing by Cranfield Aerospace Ltd., in the United Kingdom in accordance with Boeing's requirements and specifications. Boeing Defense, Space & Security's Phantom Works organization has been closely monitoring the research based on the BWB's potential as a flexible, long-range, high-capacity military aircraft.

"My congratulations go out to the entire flight-test team for the 100 percent successful and safe flights on a small-scale BWB aircraft," said David Whelan, BDS's chief scientist and vice president of Strategic Innovation for BDS Phantom Works. "Our plan is to continue to build on this hard work, with the goal of someday creating a large-scale BWB demonstrator for military applications."

"This project is a huge success," added Fay Collier, NASA's Environmentally Responsible Aviation project manager overseeing the X-48B project. "The NASA, Boeing, Cranfield, Air Force Research Lab team working with the X-48B has very effectively addressed the low-speed flight controls with this four-year effort. Bottom line: the team has proven the ability to fly tailless aircraft to the edge of the low-speed envelope safely."

Unlike a traditional airplane design in which a tube-like fuselage is fitted with wings, the BWB merges the fuselage with the wing. The result is a cross between a conventional aircraft and a flying wing such as the B-2 stealth bomber. The blending of the wing into a wide, flat tailless fuselage helps to get additional lift with less drag than an airplane with a circular fuselage.



Boeing and NASA researchers believe the design offers such potential benefits as increased volume for carrying capacity, efficient aerodynamics for as much as 20 percent reduced fuel burn compared to traditional tube-and-wing aircraft and significant reductions in noise because of the way the engines are integrated into the vehicle - on top of instead of underneath the wings.

During the "Phase 1" flight-testing, the X-48B team focused on three main technical objectives: flight-envelope expansion, aircraft performance characterization, and validation of flight-control software limiters.

The first objective - envelope expansion - was met during the first 20 flights, when the team put the aircraft through a variety of maneuvers intended to define the overall flight capabilities and discern the general stability and handling characteristics of the aircraft. When these flights were completed, the team had a good understanding of a preliminary flight envelope adequate for transition to higher-risk testing.

The second objective - aircraft performance characterization - was accomplished during 52 flights that took place between July 2008 and December 2009 involving stall testing, engine-out maneuvering, and parameter identification flights. Stall characterization maneuvers helped define the boundaries beyond which normal controlled flight is not possible. Engine-out maneuvers were used to assess the

controllability of the aircraft if one or more of the aircraft's three engines malfunctioned and the aircraft could not provide symmetric thrust. The parameter identification maneuvers allowed the performance of the aircraft to be evaluated through pre-planned flight-control surface movements. Computer commands to the flight-control surfaces allowed engineers to measure how quickly the plane responded in flight to those inputs, helping them to quantify the dynamic response.

The third objective - validation of flight-control software limiters - was met during the eight flights this year. Tests validated that the flight-control computer's software could keep the aircraft in controlled flight even as the pilot attempted to deliberately exceed the defined boundaries of controllability. Flight characteristics such as angle of attack, sideslip angle, and acceleration software limiters were "assaulted." The flights validated the programmed limiters and gave the team confidence that a robust, versatile, and safe control system could be developed for such an aircraft.

Kisska said the X-48B currently is undergoing major maintenance, including the installation of a new flight computer. More parameter identification flights are slated for later this year during the project's "Phase 1.5." This new phase will be the introductory flights for NASA's new Environmentally Responsible Aviation Project, aimed at reducing noise, greenhouse emissions and fuel consumption in aircraft.

A modified version of the Boeing X-48B, given its own X-plane designation by the U.S. Air Force in August of last year as the X-48C, also soon will be tested. Configured with two turbofan engines instead of three and with twin canted fins mounted on the aft body section, the X-48C will be used to evaluate the impact of noise shielding concepts on flight characteristics.

According to Dhar Patel, BR&T's X-48C project manager, the X-48C is expected to take to the air in late 2011.

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