# Boeing X-31 Takes Flight Again in New Multinational Program

The X-31 thrust-vectoring aircraft, first used in the 1990s to successfully demonstrate enhanced combat maneuverability, has taken flight again in a new program called VECTOR, focused on demonstrating extremely short- takeoff-and-landing (ESTOL) capabilities.

VECTOR (for Vectoring ESTOL Control Tailless Operation Research) is a joint venture of the U.S. Navy, Boeing, Germany's federal defense procurement agency and the European Aeronautic Defense and Space (EADS) corporation. Boeing is the prime contractor and prime systems integrator for the program.

By demonstrating that thrust vectoring can be used to achieve extremely short takeoffs and landings, the VECTOR program could lead to significant operational and cost benefits, said Gary Jennings, program manager of VECTOR for the Boeing Phantom Works, the company's advanced research and development unit.

"On aircraft carriers, for instance, ESTOL capabilities will reduce wear-and-tear on aircraft and their need for a beefed-up structure. It also will reduce the need for wind-over-deck landing operations, dumping unused stores and fuel before landing, and maintenance on carrier arresting gear and catapults. All this will greatly increase operational flexibility, life cycle savings and safety," Jennings explained.

The first flight of the X-31 VECTOR program was successfully conducted Feb. 24 at Naval Air Station Patuxent River, Md., where the flight test program is taking place. The X-31 was flown by Cmdr. Vivan Ragusa, a test pilot for the U.S. Navy. Ruediger Knoepful of Germany also will pilot the X-31.

In addition to ESTOL capabilities, the VECTOR program will test two versions of an Advanced Air Data System (AADS) designed and built by EADS. The system uses flush pressure ports located around the tip of the nose cone to provide more accurate speed and angle measurements at high angles-of-attack.

The two-year flight test program is being conducted in three phases. Phase I will be for functional checkout, pilot familiarization and thrust vectoring calibration. Phase II will evaluate ESTOL avionics, navigation performance, autopilot and display functions, and the first AADS. Phase III will focus on ESTOL demonstrations and testing the second (miniaturized) AADS.

The VECTOR program is capitalizing on the previous investment made in the development of the thrust-vectoring X-31 for the highly successful Enhanced Fighter Maneuverability (EFM) program, conducted from 1991 to 1995 by the Defense Advanced Research Projects Agency, the U.S. Navy and Germany's federal defense procurement agency.

The EFM program conducted 580 flights - more than any other X-plane program - and demonstrated outstanding controllability and agility over a range of flight conditions, including flying at angles-of-attack up to 70 degrees, well beyond where other aircraft would stall.

For the VECTOR program, the X-31 has been modified with AADS capability, flight control software optimized for ESTOL operations, a combined inertial/differential GPS navigation system for highly precise landing approaches, and an auto throttle system.

The new ESTOL system will allow the X-31 to safely approach a runway at a speed of 100 knots (versus the typical 165 knots) and at angles-of-attack of up to 40 degrees (versus 12 degrees). The test pilot will monitor the performance of the system using both existing and ESTOL-unique cockpit displays, including a view of the approach through a belly-mounted video camera. The $53 million VECTOR program began in January 2000 with the modifications of the X-31 by Boeing in Palmdale, Calif. The aircraft was moved to Naval Air Station Patuxent River in April 2000 and is scheduled to complete flight testing in January 2003.

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