

X-35 Cross



**Takeoff from Edwards AFB,
California**

**A hear
Fort W**

s Country



**Landing at
NAS Patuxent River,
Maryland**

**ty welcome,
orth, Texas**

STRIKE FORCE

X-35C flown across the country; Carrier suitability testing completed

Lockheed Martin's naval Joint Strike Fighter demonstrator, the X-35C, "came aboard" at NAS Patuxent River, Md., on February 10, completing the first ever transcontinental flight of an X-series aircraft under its own power. The X-35C test team then used the extensive test and evaluation facilities at Pax River for simulated carrier landings and approaches, flying qualities analysis, and additional performance testing at sea level that was completed March 10.

The supersonic JSF carrier variant, designed to meet United States Navy requirements, arrived at the Naval Air Warfare Center Aircraft Division facility after a two-day cross country flight that began at Edwards AFB, Calif., and included a stop at Lockheed Martin Aeronautics Company's facility in Fort Worth, Texas.

Company test pilot Joe Sweeney, a former Navy carrier pilot who flew the X-35C on its first flight from Palmdale, Calif., on December 16, flew the aircraft from Edwards to Fort Worth. Marine Corps Maj. Art Tomassetti then flew the aircraft from Texas to Maryland.

At Pax River, the X-35C was flown 35 times, including as many as six sorties a day. A total of 250 field carrier landing practice tests were flown. Eight different team and service pilots flew the X-35C. The aircraft is now in light storage at Pax River.

The X-35C features a larger wing and control surfaces for carrier suitability, but it retains a high degree of commonality with the other Lockheed Martin JSF variants.



AMT complete; Countdown to first STOVL flight

The JSF propulsion team was nearing completion of accelerated mission testing (AMT) for the X-35B demonstrator's short-takeoff/vertical (STOVL) landing propulsion system as this issue went to press in early April. AMT is one of the final steps before full flight-certification.

During the testing, the propulsion system was subjected to more than double the operating time and events expected during the X-35B STOVL flight demonstration program, in terms of total accumulated engine cycles, total system operating time, and total number of lift fan dynamic clutch engagements.

The joint Pratt & Whitney, Rolls-Royce, and Lockheed Martin team of engineers and technicians conducted the STOVL propulsion system flight qualification tests at P&W's West Palm Beach, Fla., facility.

Remaining tasks for STOVL propulsion system hardware flight certification include system teardown, inspection, and final flight clearance documentation. STOVL software flight qualification testing is now under way, with completion expected

in early May. STOVL propulsion system flight certification is anticipated for late May.

The X-35B's STOVL flight test program is expected to start by early summer. Initial testing will take place at Lockheed Martin's facility in Palmdale, Calif., before shifting to the Air Force Flight Test Center at nearby Edwards AFB.

Debut of *Strike Force*

Welcome to the first edition of *Strike Force*, the official Lockheed Martin Joint Strike Fighter Team newsletter. *Strike Force* is designed to highlight recent developments on the X-35 test program; update the efforts of the Lockheed Martin, Northrop Grumman, BAE Systems, and Pratt & Whitney team; and to note significant events in the overall JSF program. *Strike Force* will be published on a regular basis and will soon be available online as well.

X-35B hover pit testing complete

The short takeoff, vertical landing (STOVL) version of the Lockheed Martin Joint Strike Fighter, the X-35B, powered up its revolutionary propulsion system on a specially designed "hover pit" at the company's Palmdale, Calif., facility for the first time on February 21. The tests, the first steps in the aircraft's STOVL flight test program, were completed in early March.

The X-35B is designed to demonstrate JSF STOVL requirements specified by the U.S. Marine Corps and the United Kingdom's Royal Navy and Royal Air Force.

During the tests, the airplane was fixed atop a ground-level metal grate over the hover pit — a large rectangular basin with special ducting that pulls away the propulsion system's downward rush of air and engine exhaust. A test pilot then put the propulsion system through every operation it will encounter during actual flight.

The X-35B completed most of its up and away flight testing during the X-35A's conventional takeoff and landing (CTOL) flight test program last fall. Both variants use the same airframe with identical external dimensions and up and away performance characteristics. The X-35A became the X-35B when the STOVL propulsion system was fitted in late December.

Unlike direct-lift (Harrier) that redirects uses a drive shaft to c



Late last year, the short-driven lift fan was installed in the X-35B short takeoff, vertical landing demonstrator at Lockheed Martin's Palmdale, Calif., facility. The lift fan installation includes the fan, a vectored nozzle, clutch, and all actuation and service systems in an integrated unit.



Mounted on restraining fixtures substituting for landing gear, hover pit testing of the X-35B was completed in early March.

X-35A test program

In just 28 days after flight testing began, test pilots flying the Lockheed Martin X-35A Joint Strike Fighter (JSF) concept demonstrator completed all of the aircraft's conventional takeoff and landing (CTOL) flight test objectives.

After weeks of preparation and final checks last fall, Chief Test Pilot Tom Morgenfeld took off on the X-35A's first flight at 9:06 a.m. PDT on October 24. Flying from the Lockheed Martin Aeronautics Company facility at Palmdale, Calif., he landed at the Air Force Flight Test Center at nearby Edwards AFB approximately 30 minutes later.

The initial flight profile included checkouts of the on-board systems and handling characteristics.

During its 10th flight on November 7, Air Force test pilot Lt. Col. Paul Smith, the first Air Force test pilot to fly the X-35, executed a series of four airborne refuelings.



The conventional takeoff and landing portion of the Lockheed Martin JSF flight test program was completed in late October as the X-35A takes to the air for the first time.

Completed

STOVL systems (such as used on the F-35) connect the engine to a counter-rotating lift fan, located aft of the cockpit.

The fan generates a column of cool air that produces nearly 20,000 pounds of lifting power, and is combined with an equivalent amount of thrust from the downward-vectoring engine exhaust to lift the aircraft. A smaller roll post duct in each wing supplies lateral control as well as additional thrust.

The patented Lockheed Martin lift fan design, was developed and produced by Rolls-Royce at its facility in Indianapolis, Ind. Rolls-Royce also builds the three-bearing swivel duct to channel engine thrust during STOVL operations.

Because the lift fan extracts power from the engine, exhaust temperatures are reduced by about 200 degrees compared to direct-lift systems, and exhaust velocity is significantly lower. The result is a more benign ground environment.

The X-35's single Pratt & Whitney JSF119-611 engine, which shares its core design with the F-22's engines, is the source for the nearly 40,000 pounds of STOVL thrust.



From the Cockpit *by Tom Morgenfeld, X-35 Chief Test Pilot*

Editor's Note: The first flight of a new aircraft is always a momentous occasion and the maiden voyage of the X-35 Joint Strike Fighter demonstrator from Palmdale, Calif., to nearby Edwards AFB, was certainly no exception. Here "Hat Trick 1" ("Hat Trick" is the radio call sign the X-35 pilots are using) gives his impressions of what it was like on that day last fall when the aircraft took to its element for the first time.

Last October 24, I had the extreme good fortune to fly the X-35A on its maiden flight. This flight marked the culmination of literally years of hard work and sacrifice on the part of many Lockheed Martin employees as well as that of our industry and government teammates. It was indeed an honor and privilege to be the one to showcase all their good work to the world!

The first impression you get on entering the X-35's cockpit is one of utter simplicity. The cockpit, even though it's made up of components from many different aircraft, is exceptionally straightforward. It is a pleasant place to work.

There are very few switches, as the primary pilot interface is through an easy-to-use up front control panel. A head-up display provides the primary flight references and two multi-function displays provide head-down information.

Getting the airplane started and out of the chocks is very easy. Once electrical power is brought up, the APU is started and that, in turn, starts the engine. After the usual checks are completed, it is ready to taxi. Typically, the whole process takes less than 15 minutes.

The initial takeoff was performed in military power followed by a gear down climb at 250 knots to 10,000 feet. Although the takeoff was performed in MIL power, the acceleration was on the

order of contemporary fighters in afterburner. Rotation speed was 140 knots, and the airplane lifted off smoothly in less than 3,000 feet of ground roll. Even with the gear down, the climb angle required to maintain 250 knots was in excess of 30 degrees. That had the F-16 chase pilots using afterburner to maintain position. Needless to say, the trip to 10,000 feet didn't take very long.

While there is a bit of buffet in this configuration, the airplane's handling qualities during the climb and level off were excellent - instant response coupled with complete predictability.

The X-35 is the sort of airplane that pilots warm up to immediately.

Following the gear down test points, I performed the initial gear retraction. As the gear came up, all of the buffet disappeared and the airplane started to accelerate away smoothly. This required a substantial power reduction to remain at 250 knots. The airplane really loves to fly!

Unfortunately, one of our gear door microswitches was slightly out of adjustment and that precluded the tire doors from closing completely even though the gear were up and locked. This glitch was fixed before the next flight and all the subsequent gear swings have been successful. At any rate, prudence dictated lowering the gear and completing the flight.

The straight-in approach and landing at Edwards AFB was remarkable in its ease. Both airspeed and glideslope were extremely easy to control with the airplane continuing to exhibit a rare combination of good response coupled with exceptional controllability. Pilot workload was very low throughout the approach and landing. Pitch control was very precise in the flare resulting in a smooth touchdown right at my intended point of landing...really!

The X-35 is the sort of airplane that does exactly what you want it to do and, hence, really makes the pilot look good!



The X-35's "front office"

Team successfully completed

Joint Strike landing

Maj. Art Tomassetti became the first Marine to fly the JSF X-35 on November 10 - the 225th anniversary of the founding of the Marine Corps.

X-35 Flight Test Summary

(As of 12 March 2001)

X-35A (CTOL): 27 Flights; 27.4 Hours

X-35B (STOVL): Shaft-driven lift fan installed; ground testing underway

X-35C (CV): 73 Flights¹; 58 Hours

¹ Testing of the conventional takeoff and landing version completed. Aircraft converted into X-35B short takeoff, vertical landing demonstrator.

² Carrier variant testing includes 38 flights at Edwards AFB, Calif., and one ferry flight (split into two segments) from Edwards to NAS Patuxent River, Md.

the Lockheed fall. Here, October.

Two pilots from the United Kingdom stepped into the cockpit on November 18, as BAE SYSTEMS pilot Simon Hargreaves and Royal Air Force Squadron Leader Justin Paines made separate flights.

Morgenfeld took the aircraft to 25,000 feet on November 21 and accelerated to 1.05 Mach on the aircraft's 24th flight. The next day, he flew the aircraft back to Palmdale where the process to convert the aircraft to the X-35B short takeoff, vertical landing (STOVL) configuration began.

STRIKE FORCE

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On the Front: Company test pilot Joe Sweeney and Marine Corps Maj. Art Tomassetti made the first ever transcontinental flight of an X-series (experimental) aircraft under its own power on February 9-10, flying from Edwards AFB, Calif., to NAS Patuxent River, Md.

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Strike Force, an official publication of the Lockheed Martin, Northrop Grumman, BAE SYSTEMS JSF Team, will soon be available online at: www.jsf2.lmtas.lmco.com



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