

## F-35 Joint Strike Fighter (JSF)

**T**he F-35 Joint Strike Fighter (JSF) is a joint, multi-national program for the Air Force, Navy, Marine Corps, and eight cooperative international partners: the United Kingdom, Italy, the Netherlands, Turkey, Canada, Australia, Denmark, and Norway. The JSF Program's objective is to develop and deploy an affordable air system that satisfies the warfighter's requirements.

The air system consists of a family of highly common and affordable strike fighter aircraft designed to meet an advanced threat (year 2010 and beyond) and a logistics system to enable the F-35 to be a self-sufficient unit or an integrated part of a multi-system and multi-Service operation. This family of strike aircraft will consist of three variants: conventional takeoff and landing; aircraft carrier suitable; and short takeoff and vertical landing (STOVL). The System Development and Demonstration (SDD) phase is a 126-month block development program to develop, acquire, and test the F-35 JSF in a series of block upgrades. To accommodate the phased integration of capabilities and functionality, the Integrated Test Force and the operational test agencies will test interim blocks. Block 3 aircraft will be Joint Operational Requirements Document threshold-compliant. As SDD progresses, the users are expected to develop requirements for additional capabilities for future block upgrades to respond to new threats.

Biennial operational assessments will determine potential operational effectiveness and suitability with a focus on programmatic voids, areas of risk, testability of requirements, significant trends in development efforts, and the ultimate ability of the program to support an adequate period of evaluation during the dedicated OT&E. Operational assessments will not replace the independent period of dedicated operational testing necessary to support decisions on full-rate production.

The F-35 JSF requires both lethality and vulnerability LFT&E. The F-35 JSF program will conduct full-up, system-level live fire testing of the STOVL variant using one of the flight-test aircraft from the SDD phase that has reached the end of its operational flight lifetime.

### TEST & EVALUATION ACTIVITY

DOT&E participated in F-35 JSF OT&E and LFT&E planning activities since June 1995. The Integrated Product Team held meetings to coordinate the integrated program of developmental test and evaluation, OT&E, and LFT&E planned during SDD phase. The Combined Test Working Group provides a single forum for the member services, OSD, and the weapon systems contractors for all test and evaluation related matters.

The Air Force Operational Test and Evaluation Center and the Navy's Operational Test and Evaluation Force conducted an early operational assessment (EOA) of the JSF in support of the air system Preliminary Design Review. The EOA report found that the JSF program is making satisfactory progress toward being an effective and suitable system.

DOT&E approved the Test and Evaluation Master Plan update to reflect the impact of contractor selection in July 2003. The revised Test and Evaluation Master Plan reflects the additional fidelity of requirements and resources now available following the selection of the SDD contractor.



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The F-35 JSF Air System Preliminary Design Review was closed in June 2003 and the F-135 Engine and F-136 Engine critical design reviews were closed in October 2003.

The following LFT&E test series were conducted during fiscal year 2003

Replica fuselage tank/inlet duct damage control tests (December 2002).

Canopy spall ballistic tests (December 2002).

Man-portable air defense system characterization tests (February 2003).

STOVL lift fan shaft & coupling ballistic tests (May 2003).

Fuel tank hydrodynamic ram mitigation ballistic tests (June 2003).

STOVL three-bearing swivel duct nozzle ballistic tests (July 2003).

Aft Boom man portable air defense system test (September 2003).

## TEST & EVALUATION ASSESSMENT

The findings from the EOA were beneficial to the JPO in identifying areas of risk that could impact potential operational effectiveness and suitability, program documentation and testability of user requirements, programmatic voids, and the ability of the program to support operational test and evaluation. The F-35 JSF Integrated Product Teams worked the areas of risk identified by the EOA report and resolved, mitigated, or refined the issues in support of the air system Preliminary Design Review.

Weight growth is a significant risk for all three variants of the F-35 JSF. Aircraft weight is not a key performance parameter, but weight does impact the aircraft's ability to satisfy key performance requirements. No variant of the F-35 JSF design exceeds the weight at which key performance parameters predictions are breached; however, the STOVL design remained consistently above target weight projections. The JPO has been aggressively pursuing weight reduction initiatives. Additional aircraft weight reductions are required, particularly in the case of the STOVL variant, to satisfy all key performance parameters and preserve sufficient weight reserve for post SDD block upgrades.

The F-35 JSF Program SDD schedule is aggressive and aircraft weight reduction efforts have eroded a significant portion of available development time. The first flight of the U.S. Air Force conventional takeoff and landing variant will be in 2005, followed by the STOVL variant. This schedule is very challenging. The F-35 JSF Program should remain event driven with continued weight reduction efforts and design optimization before producing SDD test aircraft. The decisions the JPO face at this point in the program are significant drivers to cost and performance limitations through the life cycle of an aircraft.

Planning for dedicated OT&E includes 14 low-rate initial production flight-test aircraft in Block 2 configuration plus several ground test articles. While this large number of aircraft is adequate for the conduct of a thorough operational test, it is not excessive since three different aircraft configurations must be tested in the accomplishment of a variety of missions. In Block 3, six additional jets - two of each variant - will be added to allow for additional operational test requirements.

Live fire tests of candidate fuel tank liner concepts were conducted using expected threats against test panels. Based on the test results, a successful liner concept was identified that produced fuel leakage rates substantially lower than engine fuel ingestion tolerances, thus increasing aircraft survivability.