

## F-35B Initial Ship Trials Presentation Abstract

### 2012 National Symposium of the Society of Experimental Test Pilots

The test pilots of the Patuxent River F-35 Integrated Test Force (ITF) propose to make a presentation at the Society of Experimental Test Pilots (SETP) East Coast Symposium regarding the planning and execution of the F-35B Initial Ship Trials aboard USS Wasp (LHD-1) during October 2011. During the trials, two F-35Bs (BF-2 and BF-4) completed 72 Short Takeoffs (STOs) and Vertical Landings (VLs) while simultaneously evaluating the suitability of the F-35B for maintainability aboard LHDs. Ultimately, all shipboard envelope expansion goals were met which included clearing STO and VL wind envelopes as robust as AV-8B within the environmental conditions and landing spots tested.

The ship trials were a combined effort between the Patuxent River ITF, USS Wasp, and Naval Sea Systems Command (NAVSEA) requiring the embarkation of nearly 250 personnel and 140,000 lbs of specialized support equipment. Over a year of detailed planning was required to accomplish the trials. Unique elements of the trials are listed below and will be discussed during the presentation:

- Planning – The herculean planning and coordination effort was unprecedented. Two dedicated conferences were held in Norfolk, VA along with weekly meetings at the ITF to discuss preparations.
- Training – Training fell into three categories. First, a four month long control room team training plan was developed that utilized twice weekly simulator events to get every team member familiar with shipboard operations. Towards the end, ship personnel were also incorporated into the simulator events. Second, pilot training consisted of completing pre-requisite STOVL landings. Finally, a three-day Field Carrier Landing Practice (FCLP) was conducted at NAS Patuxent River with the entire flight deck crew on a specially prepared expeditionary airfield.
- Divert Planning – The team developed a phased approach to divert planning that allowed the ship to work in a progressively larger operating area. Although not ultimately required due to exceptionally good weather during the at-sea period, the team was prepared to operate from New Jersey to Florida.
- Personnel – The ITF handled the deployment of personnel in much the same way that the military prepares for deployments. This included a flight deck training syllabus, ship familiarization presentations, family readiness planning, and a day-in-the-life exercise. This was especially important given the limited shipboard experience of many of those on the detachment.
- Security – Taking a 5th Generation fighter aboard a ship necessitated multiple security inspections and certifications along with a quarantine of the areas around the aircraft. The detachment also included Italian and UK personnel which required sequestration of data and separate control rooms to meet ITAR and other security requirements.
- Control Rooms – Atlantic Test Range (ATR) personnel created two control rooms aboard the ship to allow constant monitoring of the flights. This involved the most complex integration of control rooms ever aboard a ship for at-sea testing.

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- Aircraft Modifications – Both aircraft underwent extensive modifications to ensure their ability to operate at sea. Modifications included lift fan and landing gear instrumentation and fuel dump purge system installation along with several weeks of Electromagnetic Interference (EMI) checks at the Patuxent River Naval Electromagnetic Radiation Facility (NERF).
- Ship Modifications – In addition to external environmental sensors, the Wasp was modified through several shipyard periods which included “flipping” the tramline, repositioning in-deck lighting, and removing /instrumenting deck edge equipment.
- External Environmental Data Collection – This effort was spearheaded by NAVSEA and involved acoustic, thermal, and outwash instrumentation embedded on the ship to determine effects on both personnel and equipment. Most interestingly, the two F-35Bs were tasked with completing minimum separation vertical landings to validate NAVSEA deck heating models. Ultimately, the actual data closely matched NAVSEA models and showed no significant impact to deck structure. Additionally, NAVSEA evaluated an experimental coating called thermion at landing spot 9 which performed extremely well under high temperature and may have applications across the entire fleet.
- Flying Qualities – Deck handling and cockpit field of view proved excellent during flight deck taxi operations. Flying qualities throughout most of the envelope were as expected although there were a few issues found which necessitated changes to the aircraft control laws. These observations were quickly incorporated upon completion of the trials into the next flight control software release and will be further evaluated during the DT-2 period.
- Vehicle Systems Issues – Overall vehicle systems functioned as expected. The team continues to test systems that will need to be addressed prior to fleet release.
- PVI / Human Factors Issues – We will discuss the positioning of the STO rotation line and pilot perception with regards to stick and button STO inputs in relation to it. Additionally, we will discuss STOVL-related cockpit displays.
- Propulsion – Hot gas ingestion testing as well as hover crosswind testing will be discussed.
- Mission Systems Evaluations – BF-4 was tasked primarily with the mission systems evaluations. Electromagnetic compatibility, TACAN approaches, Distributed Aperture System (DAS), and the Helmet Mounted Display (HMD) were evaluated and will be discussed.
- F-35 Ground Support Equipment – The team planned for and got certification for F-35 specific support equipment for use aboard ship. In some cases already existing fleet equipment was utilized or modified.
- Autonomic Logistics Information System (ALIS) – ALIS is the backbone of F-35 operations, and the test team accomplished the first at-sea use of this critical system. Several workarounds were created to allow maintenance and flight operations personnel to function prior to the permanent incorporation of ALIS hardware aboard ship. Lessons learned from this experience are being incorporated in future fleet software releases.
- Logistics – Dedicated helicopter support (SAR and logistical) was provided by both the USN and USMC and proved to be extremely valuable during the high tempo test operations at sea.

- Maintenance – The F-35s proved to be very maintainable at-sea. The test team’s lessons learned about maintaining the jet in the maritime environment are already being incorporated into maintenance technical data for fleet use.
- Distinguished Visitors (DV) – Due to the high level of interest in the ship trials, several DVs including the Secretary of the Navy and Commandant of the Marine Corps visited the Wasp during the trials. This was coordinated by the embarked Expeditionary Strike Group 2 (ESG-2) staff.

While this is an extensive abstract, most of these issues will be mentioned briefly so that the 30 minute timeline is honored. We feel that it is important to convey the complexity of the entire test evolution to those in attendance who may be challenged with organizing a high profile flight test event in the future.

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