50th Annual NDIA Conference
Targets, UAVs & Range Operations
Symposium & Exhibition
Boeing QF-16 Program – Test Results

QF-16 Full Scale Aerial Target
Boeing Global Services and Support
Maintenance, Modifications, & Upgrades

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October 4, 2012
QF-16 Mission Requirements

QF-16 Design meets Mission Requirements

- 4th Gen Threat
- F-16 Maneuverability
- Low RCS
- Countermeasures
- 120nm GRDCS datalink
- Weapon accuracy scoring
- Range Safety – Flt Termination
- Optionally Piloted
- Reliable
- Supportable – Test Equipment
- Growth – Phase II Air Superiority Target (AST)

The QF-16 is designed for Mission Success
Disciplined Systems Engineering approach to ensure all requirements are verified

“Two-way” verification to ensure all test points trace back to requirements

Consistent basis used for Manned Flight Release
Have progressed from labs to aircraft testing and verified installed functionality of all subsystems
QF-16 Test Status

- **System Integration Lab (SIL)**
  - All subsystem interfaces integrated and AFCC software verified
- **Subsystem Qualification Tests**
  - All subsystems completed environmental qualification and EMC except flight termination system and VSS—planned November completion
  - Flight termination system (FTS) being tested to RCC-319-07 tailored for QF-16
- **On Aircraft Ground Testing**
  - 6 test aircraft – 2 Block 30, 2 Block 25 (C-model), & 2 Block 15 (A-model)
  - All Drone Peculiar Equipment (DPE) installations completed within a week
  - Peculiar Support Equipment (PSE) in place and in use
- **Flight Testing**
  - In progress at Cecil Field, Jacksonville, FL
QF-16 System Test Plan

System Verification plan broken up into segments

- All 6 test aircraft to be subjected to hangar system verification test (SVT), ramp SVT, functional check flight (FCF) and GRDCS initial flight
- At least one A-model and one C-model to conduct all tests

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QF-16 System Verification Test (SVT) - Initially run in Hangar, then Ramp

- Started on Schedule - 25 Jan 2012 (Hangar SVT)
- Hangar SVT Philosophy:
  - Verify existing F-16 systems that were affected by the mod were not degraded/damaged in any way
  - Verify newly added systems can be controlled in Manned (Normal and Remote) and NULLO Modes
  - Sequential Build up in complexity culminating in full up flight controls testing
  - Perform Critical (AFCS) Testing first, then checkout Ancillary Equipment
  - Peculiar Support Equipment verified in parallel - software FQT & ATP demo completed
  - Maintenance Demo completed
  - 6 aircraft planned for October completion
QF-16 Ground Testing - SVT (Ramp)

- Ramp Testing
  - Initial GRDCS Comm Checks
  - EMI/EMC Testing (A model in work)
  - URAP GPS live-sky testing
  - GRDCS Comm Checks (Engine ON)
  - High Power Testing
  - Taxi Testing
    - Vector Scoring System (VSS) low speed projectile testing
  - NULLO startup demo
  - 200D engine install and demo
    - PSE PMT testing

- Tests successfully completed

- Scoring system seeing target beyond 100 ft requirement
QF-16 Ground Testing – Taxi Tests

• Low speed tests conducted in two phases:
  • Pilot Controlled taxiing of aircraft on ramps/taxiways/runway
    • GRDCS Communications checks in chocks – Engine ON
    • Pilot performs low speed taxi on predetermined route Verify Normal F-16 Braking and Steering (35 knots max)
    • Verify GRDCS Tracks Drone location accurately during taxi
  • GRDCS controlled low speed taxi tests
    • Conducted on 12,500’ runway
    • Start at Centerline
    • Start at Offset

• Hi/Low Speed Automatic Takeoff Aborts (TOA)
  • Conducted after Low Speed Taxi Tests
  • Verify GRDCS/Aircraft interface acceptable
  • Evaluate remote steering/braking in preparation for auto takeoff/ landings
  • Verify pilot can disengage and control steering/braking during TOA sequence
• Functional Check Flight (FCF)
• Performance and Flying Qualities
• Initial GRDCS Up and Away
• GRDCS Up and Away (AFCS Modes, Preprogrammed Maneuvers, Auto Escape, LOC)
• Takeoff Abort, Automatic Takeoff and Landing

- Testing requires portable GRDCS trailer and antenna setup at Cecil Field
- Provide close-in navigation capability
- Long distance GRDCS controller commands only
- Portable system has created connectivity challenges for the test team
QF-16 Aircraft/GRDCS Instrumentation

- GRDCS Telemetry Data (Displayed and recorded in GRDCS trailer)
- Onboard Instrumentation System (Recording 1553 from DPE—Ampex Recorder)
- Data Transfer Cartridge (DTC) – Standard F-16 GFE recording maintenance data
- HUD Video/ Pilot Audio (8mm tape recorder)
- Data Scribe (FTE) in control station will keep running log of test events during flight
- Pilot Observations
QF-16 Flight Test Results

- Post-Mod FCF – completed
- Performance/Flying Qualities - completed
- TM Survey Flight – completed
- GRDCS Up and Away Flights - Completed
  - Altitude, Mach and Speed Hold modes
  - Verified ADR modes at selected altitudes/airspeeds
    - Airspeed Inc/Dec
    - Pitch Attitude Hold with Roll
    - Auto Escape from S/L flight
    - Pitch, Roll Attitude Commands (Up and Away)
    - Mach Hold Ramp Maneuver
    - Pitch, Roll Step - Landing Mode
    - Speed Hold Ramp, Altitude Hold – Landing Mode
    - Speed/Mach Hold on Pitch
    - G Disconnect Maneuvers (4-7 gs)
    - AOA/G Limiters
  - Visual Augmentation System and Vector Scoring System in-flight verification
  - Takeoff Abort, Auto takeoff and auto landing test buildups in progress

All systems meeting performance requirements
QF-16 EMD Test Plans

Ground Testing
• Payloads EMC testing
• Repeat Ramp SVT & taxi tests

Flight Testing
• AFCS modes verification
• Canned & sequenced maneuvers verification
• GRDCS navigation & formation flying
• VAS, VSS and Payloads verification
• TOA, auto takeoffs & auto landings – manned
• OT testing to include:
  • NULLO missions
  • Live-fire shot and potential FTS
Enhanced Flight Termination System
  • Architecture enables incorporation of RCC-319-07 compliant receiver

GPS Navigation & Autonomous System Operation
  • Accurate aircraft state estimation available during all flight phases
  • Mature navigator used on X-45, Phantom Eye, JDAM, SDB, others

Integration with Navy Common Datalink
  • Communication interface built in

4.5 Gen Performance Enhancements
  • Enhanced maneuvering capabilities
  • Enhanced RCS
  • Enhanced ground station
QF-16 Test Summary

- The Boeing QF-16 Program is in the last stages of completing the pre-EMD phase of the program
- Six aircraft have been modified and tested extensively, and all systems are performing as planned
- The pre-EMD program has been a success at mitigating program and design risks, and we are ready to move into a successful DT/OT test program during the EMD phase
- QF-16 has a great team and a bright future!