25mm Gun Systems for the F-35 Joint Strike Fighter (JSF)

Presented by:
Douglas Parker
Lead Mechanical Engineer – Joint Strike Fighter Gun System
General Dynamics Armament & Technical Products
Burlington, Vermont USA
Presentation Outline

- JSF Program Overview
- Key System Requirements
- Technical Approach
  - Internal Gun System (CTOL)
  - Missionized Gun System (CV & STOVL)
- Risk Reduction Testing
- Program Status
- Path Forward
Lockheed Martin F-35 Variants

CTOL

- Span (ft): 35
- Length (ft): 50.5
- Wing Area (ft²): 460

STOVL

- Span (ft): 35
- Length (ft): 50.5
- Wing Area (ft²): 460

CV

- Span (ft): 43
- Length (ft): 50.8
- Wing Area (ft²): 620

Gun Fairing

F-16

AV-8

F/A-18C
Major Program Changes

- Program was replanned due to Aircraft level weight initiatives at LM Aero in 2nd quarter of 2004.
- Gun system weight initiatives include:
  - New 4-barrel gun (implemented)
  - Titanium barrel clamps (under development)
  - Removal of Gun System Control Unit (GSCU) regulated power supplies (implemented)
  - CTOL aluminum access unit (implemented)
  - CTOL composite carriers (under parallel development)
- GDATP entered risk reduction testing with the 5-barrel CTOL system in the 4th quarter of 2004.
Major Technical Requirements

- 25mm 4-barrel gun firing at 3000 spm
- Compatible with the following ammunition:
  - PGU-23/U Target Practice (TP)
  - PGU-20/U Armor Piercing Incendiary (API)
- Linkless Ammunition Handling System
  - CTOL: 180 rounds, STOVL/CV: 220 rounds
- GSCU controls gun functions and operation of doors
- Reverse clearing gun
- 2-level maintenance
- Common loader interface for both system types
Gun System Overviews

CTOL

- Gun Assembly
- Linear Linkless Ammo Handling System
- Power Transmission/Hydrive
- GSCU

STOVL/CV

- Gun Assembly
- Helical Ammunition Handling System
- Power Transmission/Hydrive
- GSCU
- Gun Pod
**Gun Heritage**

**GAU-12U**
- AV-8 gun system
- 25-mm, 4,000 spm system
- Supported at mid-barrel clamp

**4-barrel derivative**
- 3,000 spm system
- Entered design in March of 2004
- Gun mechanism principles retained
- Basic installation geometry retained
- 42 lb weight savings

**5-barrel derivative**
- GAU-12 commonality maximized
- Remote safing incorporated
- Installation requirements
  - Support at muzzle
  - New gun housing

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CTOL - Gun Installation

- GD425 (heavily based off GAU-12 to reduce risk)
- AV-8 derivative transfer unit (power through main rotor gear)
- Power input from Power Transmission through transfer unit
- Manual drive input at rotor gear for system loading
- A/C interface at muzzle clamp (mid-barrel was the interface used for all previous GAU-12 installations)
**CTOL - Ammunition Handling System**

- Linear linkless system in serpentine arrangement – 180 round capacity
- Proven clamshell carrier based on F-15E Design
- Proven gun conveyor identical to AV-8 design
- Elliptically geared Handoff Unit
- Access unit based on AV-8 system
- Positive round control for high reliability
STOVL/CV Gun System

- Forward bulkhead captive fasteners & pin
- Electrical & hydraulic connections
- Aft bulkhead captive fasteners & pin
- Bulb seal
- Drainage collection from A/C
- Weapon Bay Door stops
- Engine Nacelle vent inlet

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STOVL/CV – Pod Structure

- Barrel support Housing & Blast bottle
- Leading Edge Fairing
- Forward Bulkhead
- Load access
- Nosecone
- Lower Fairing Assy
- Aft Bulkhead
- Purge outlet
- GSCU Rack
- Cradle Assy
- Tailcone Assy
STOVL/CV - Ammunition Handling System

- GPU-5A architecture
  - Linear linkless system in helical arrangement
    - 220 round capacity
  - Proven aluminum bucket carrier design
- Access unit is a derivative of the AV-8B
- Positive round control for high reliability
STOVL/CV - Gun Installation

- 90% common with CTOL
  - New transfer unit (feed system differences)
    powered through elliptical gears
  - Recoil adapters run aft (installation differences)
  - Power input through forward rotor gear
    (different Power Transmission location)
Risk Reduction Testing

- CTOL fire test
- 5-barrel hydraulic drive qualification
- STOVL/CV blast bottle single shot testing
- STOVL/CV recoil track characterization (April/May 2005)
Challenges

- Complex STOVL/CV Pod to gun system interfaces
- Short design cycle
  - Base on heritage designs where possible
  - Rapid prototyping for long lead castings
- Aggressive schedule for delivery
  - Release CTOL Units 3 & 4 before Engineering test is complete
- Overlap of CTOL and STOVL/CV schedules
## JSF Gun System Master Schedule

### CTOL
- Detailed Design
- Fabrication & Assembly
- 5K Round Gun Engineering Test
- 10K Round System Engineering Test
- 30K Round System Qualification Test
- Environmental Test
- Delivery

### STOVL/CV Gun System
- Detailed Design
- Fabrication & Assembly
- 5K Round Gun Engineering Test
- Gun Pod SDD #1 Delivery
- 10K Round System Engineering Test
- 30K Round System Qualification Test
- Environmental Test
- Delivery

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Path Forward Prior to the 2006 Guns & Ammo Symposium

**Complete**
- STOVL/CV Critical Design Review
- 4-barrel Gun Engineering Test (10,000 Rounds)
- CTOL 10,000 Round Engineering Test

**Begin**
- STOVL/CV 10,000 Round Engineering Test
- CTOL 30,000 Round Qualification Test
- CTOL Environmental Qualification