GENERAL DYNAMICS
Armament and Technical Products

F-35 Lightning II CTOL Gun System Update

Presented by:

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Presentation Outline

- Technical Overview
- Achievements Since April 2007
- Design Improvements
- Path Forward

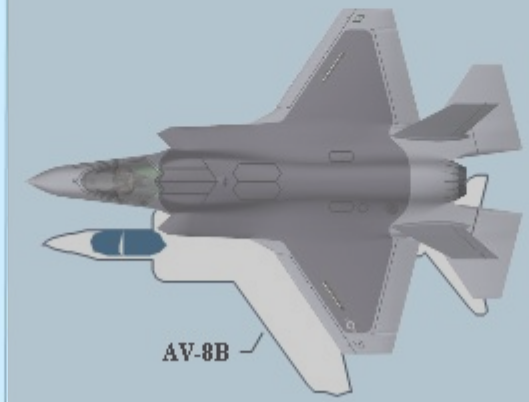
Lockheed Martin F-35 Variants

CTOL

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

STOVL

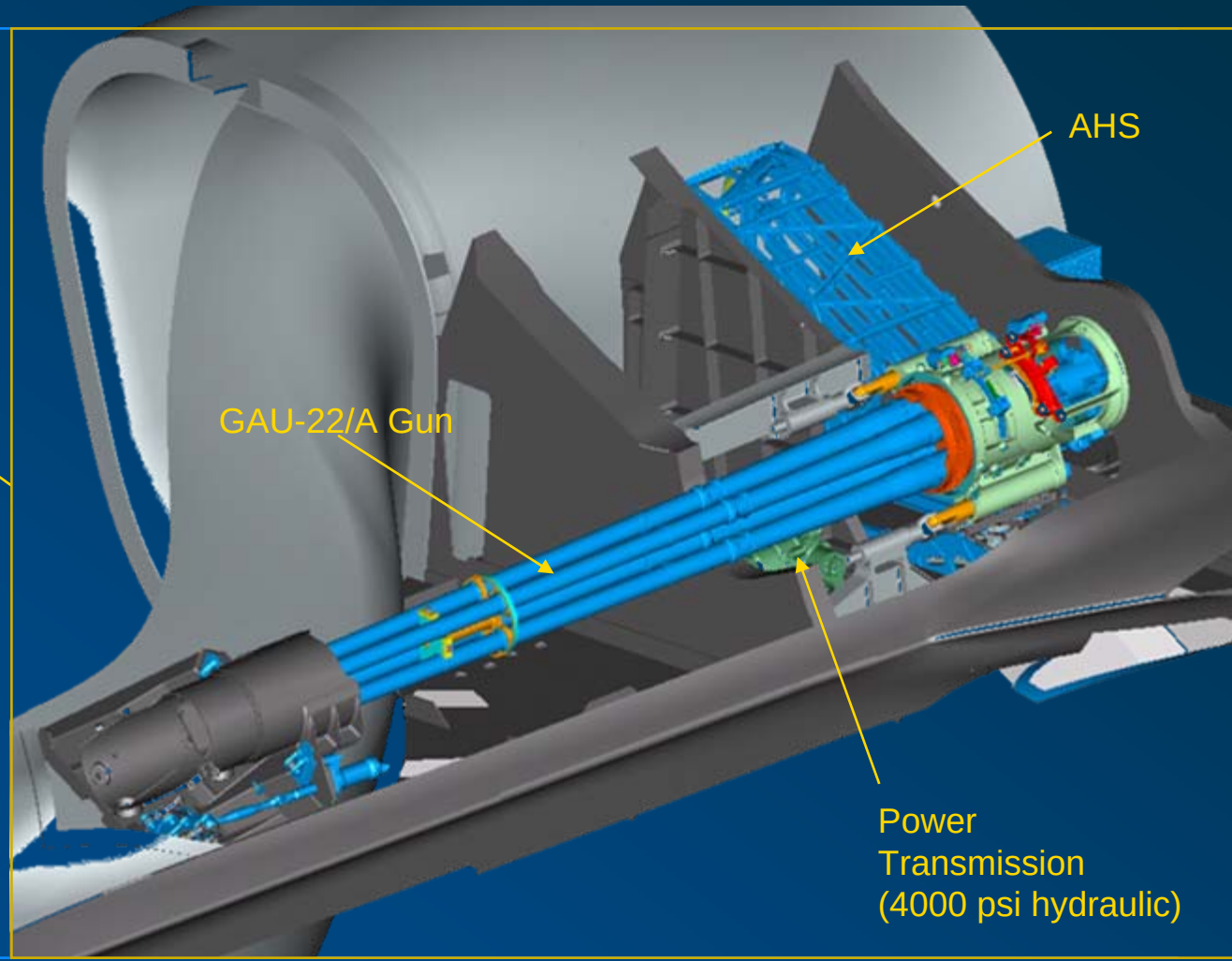
Span (ft)	35
Length (ft)	50.5
Wing Area (ft²)	460



CV

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

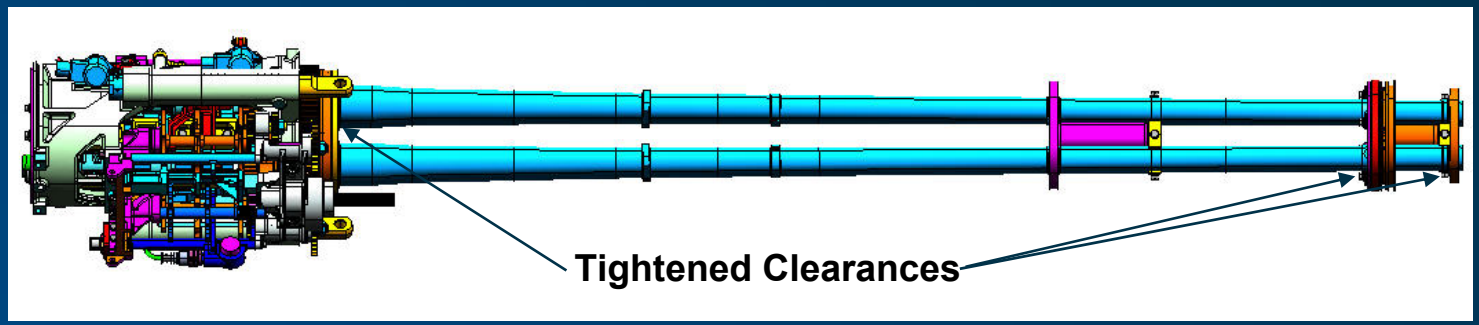
CTOL Gun System



Achievements since April, 2007

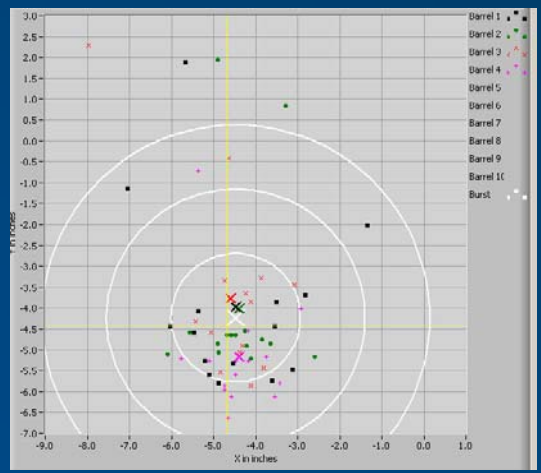
- Dispersion Improved
  - Tightened clearances between barrels and clamps
- Completed 28,000 rounds out of a planned 36,000 Round Durability Qualification Test
  - No stoppages to date in either Engineering or Qualification testing
  - Dispersion requirement (1.4 mr one sigma) met for all standard complements
  - System power has remained within acceptable limits
  - One lifetime (18,000 rounds) demonstrated (no parts replacement)
  - Several design improvements incorporated based on test results
  - Issues with hydraulic drives delayed completion of test
- Completed 90% of Planned Vibration Qualification Test
  - Load Access failure
  - Mounting Bracket wear

Dispersion Solution



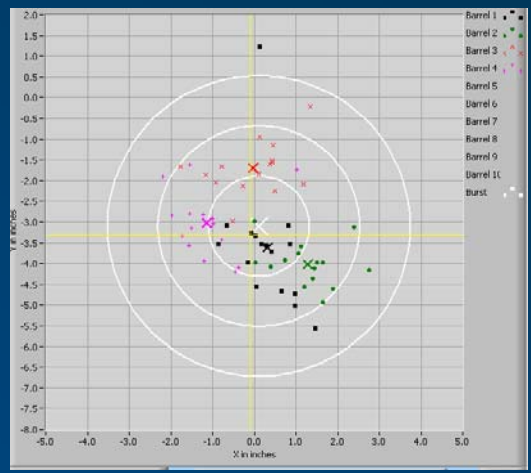
By tightening key barrel clearances, a significant improvement in dispersion was obtained

Before



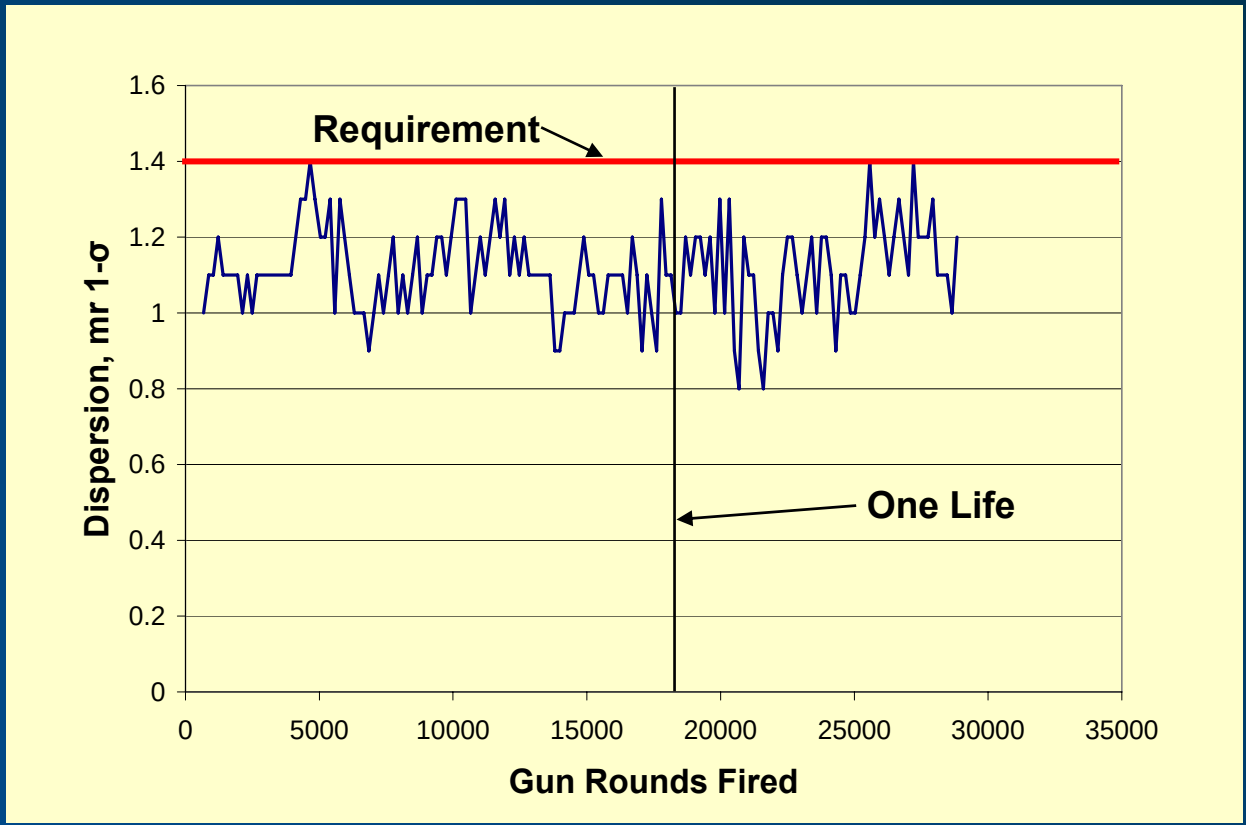
B146 1.54 mr

After



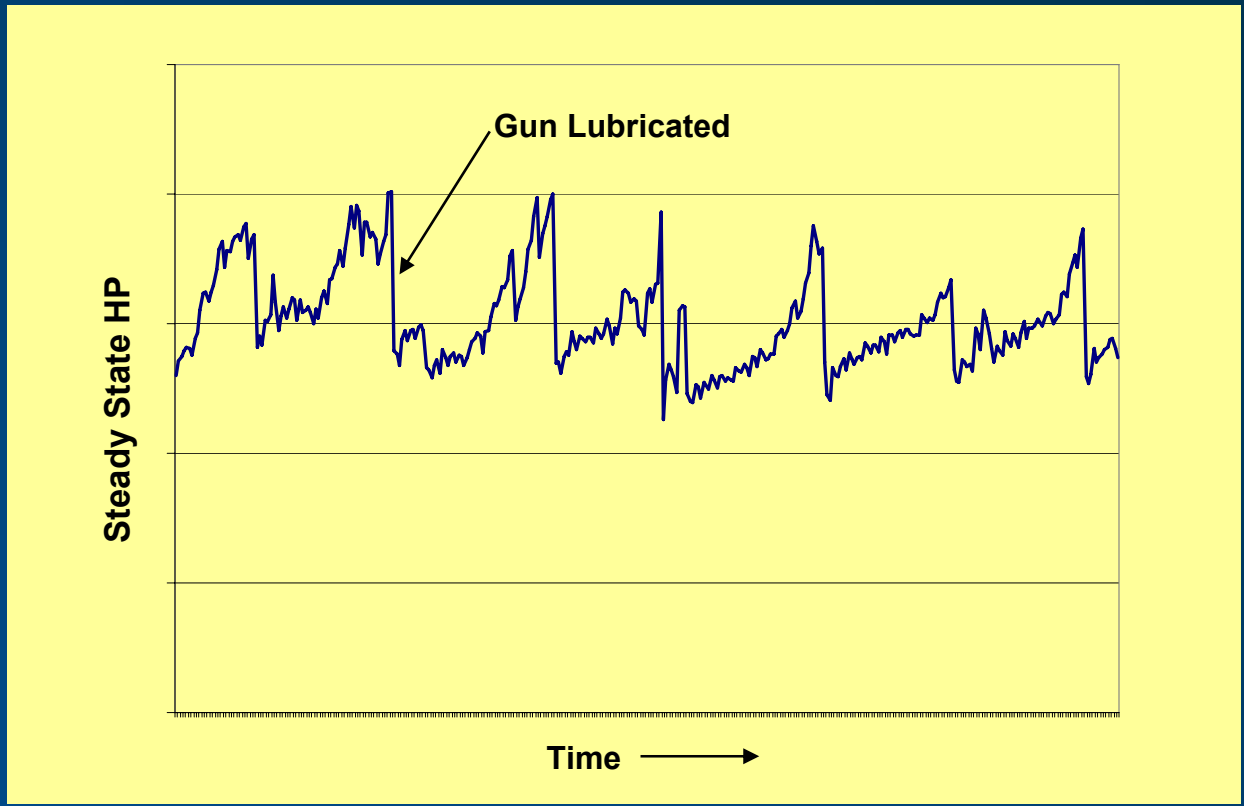
C140B1 1.21 mr

Dispersion History



Dispersion Has Remained on Track for Well Over one Gun System Lifetime

System Power History



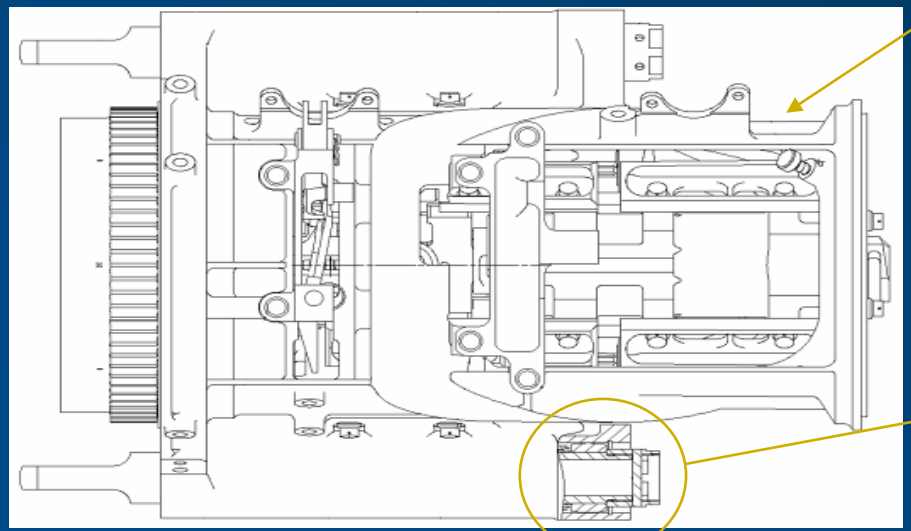
System Power Did not Increase Over the Life of the Gun System

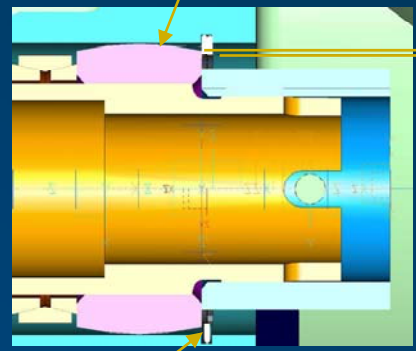
Design Improvements Resulting from Qualification Testing

- Increased engagement of Recoil Spindle Bushing with retaining ring
- Increased software time-out thresholds for safing and clearing
- Modified software clearing routine to prevent long clears
- Increased Stiffness of Load Access Door Latch Spring
- Modified AHS Lower Mounting Bracket to reduce wear

Recoil Spindle Bushing Improvement

- The Recoil Spindle Retaining Ring worked its way out of the groove during the first few complements of qualification testing.
- The bushing was re-designed to improve engagement.





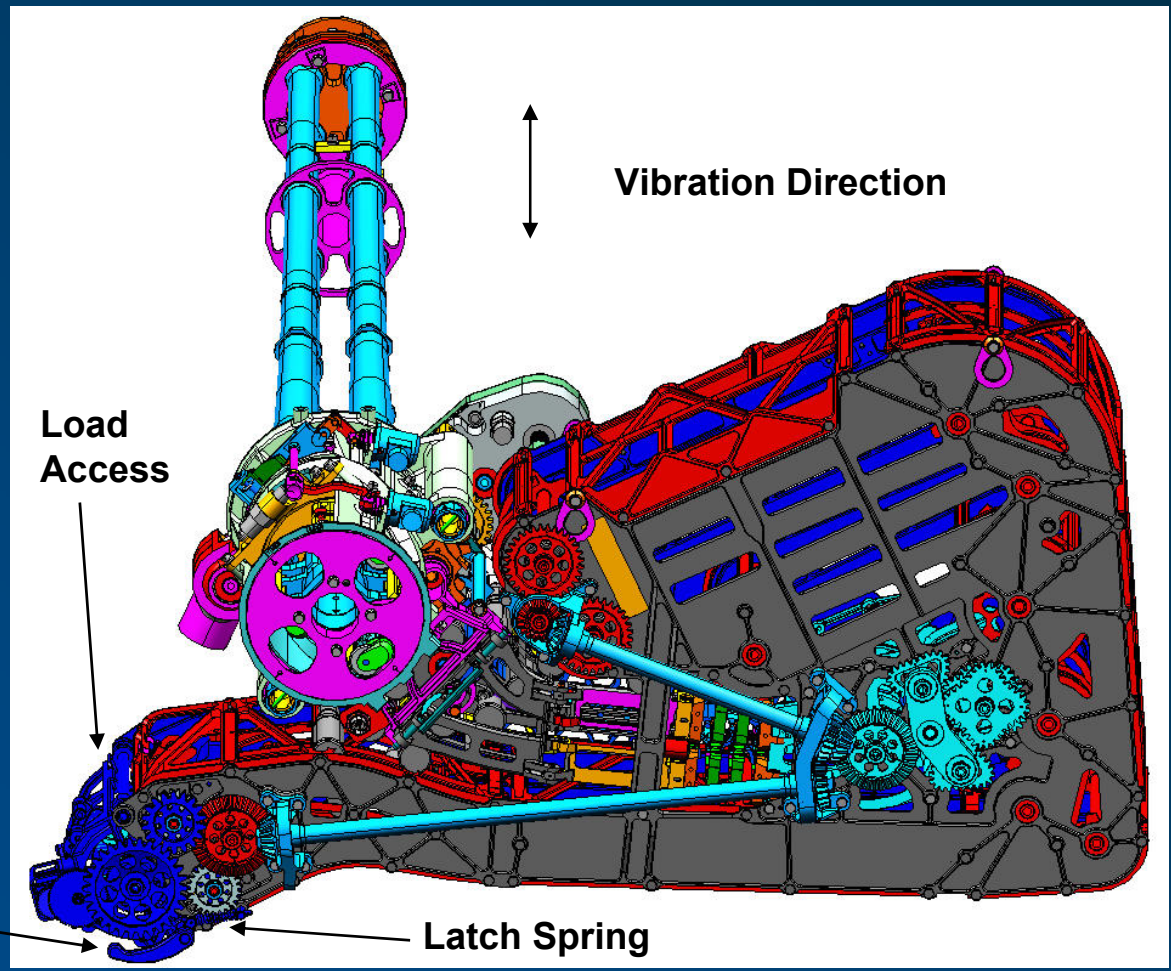
This Problem Has not Recurred in 28,000 Rounds of Qualification Testing.

Software Improvements

- During Low Temperature (-70F) testing, some functions occurred more slowly than anticipated by software
  - The Safing Pin took up to 0.169 ms to engage vs a SW timeout threshold of 0.130 ms
  - Threshold increased to 300 ms
  - Reverse Clearing took slightly longer than the 1.1 second SW timeout threshold. Threshold increased to 2.0 seconds.
- A timing scenario occurred that resulted in inaccurate rounds count during clearing, resulting in a long clear.
  - Clearing algorithm improved to eliminate this

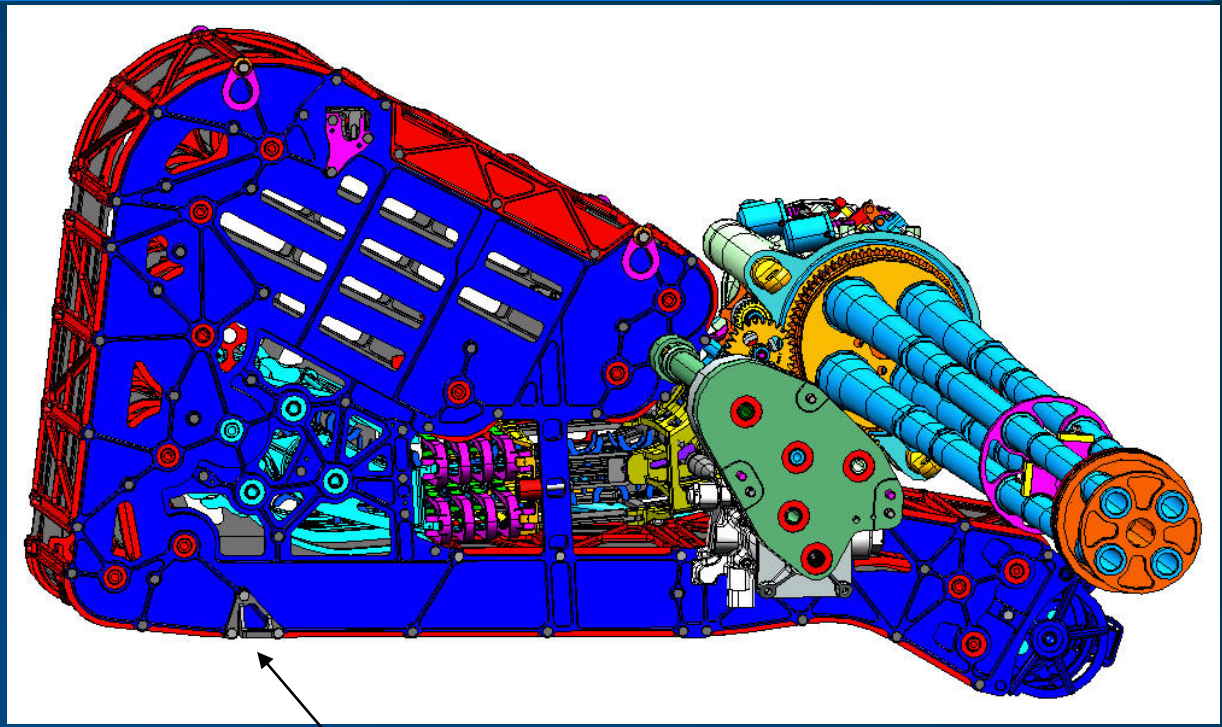
Load Access Door Latch Spring

- During vibration testing, the Load Access Release Lever vibrated to the open position.
- The load access opened up and dummy ammunition was ejected.
- This was corrected by increasing the stiffness of the Latch Spring
- Design change verified in re-test.



AHS Lower Mounting Bracket

- During the vibration test, wear was observed on the interface between the aircraft mounting pin and the lower mounting bracket.
- The bracket was redesigned to increase contact area and use a harder material.



Lower Mounting Bracket

Hydraulic Drive Motor Issues

- Excessive Flow
  - Problem: Several readings exceeded the 18.5 GPM max allowable
  - Status: Issue traced to errors in flow measurement
- Uncommanded Motion
  - Problem: Uncommanded motion occurred twice with newly installed drive, apparently due to air entrapped when drive was installed.
  - Status: Options for corrective action are being investigated
- Shaft Seal Leakage
  - Problem: Unexplained, recurring leakage from shaft seal
  - Status: Under investigation

Path Forward

- Complete 36,000 Round Qualification Test
- Complete CTOL Vibration Test
- Deliver SDD Systems 3 and 4
- Begin LRIP

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