Joint Strike Fighter Program Update

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F-35 Lightning II Program Office

Key Messages

- **Vision:** Deliver and sustain the most advanced, affordable strike fighter aircraft to protect future generations worldwide.
- **Mission Statement:** Be the model acquisition program for joint service and international cooperation.
- **Program Priorities:**
  - Finish Development and Deliver Essential Warfighting Capability on Schedule
  - Maintain Affordability as Key Tennant of the Program
  - Implement Sustainment Via Performance Based Outcomes
  - Preserving the Partnership

Agenda

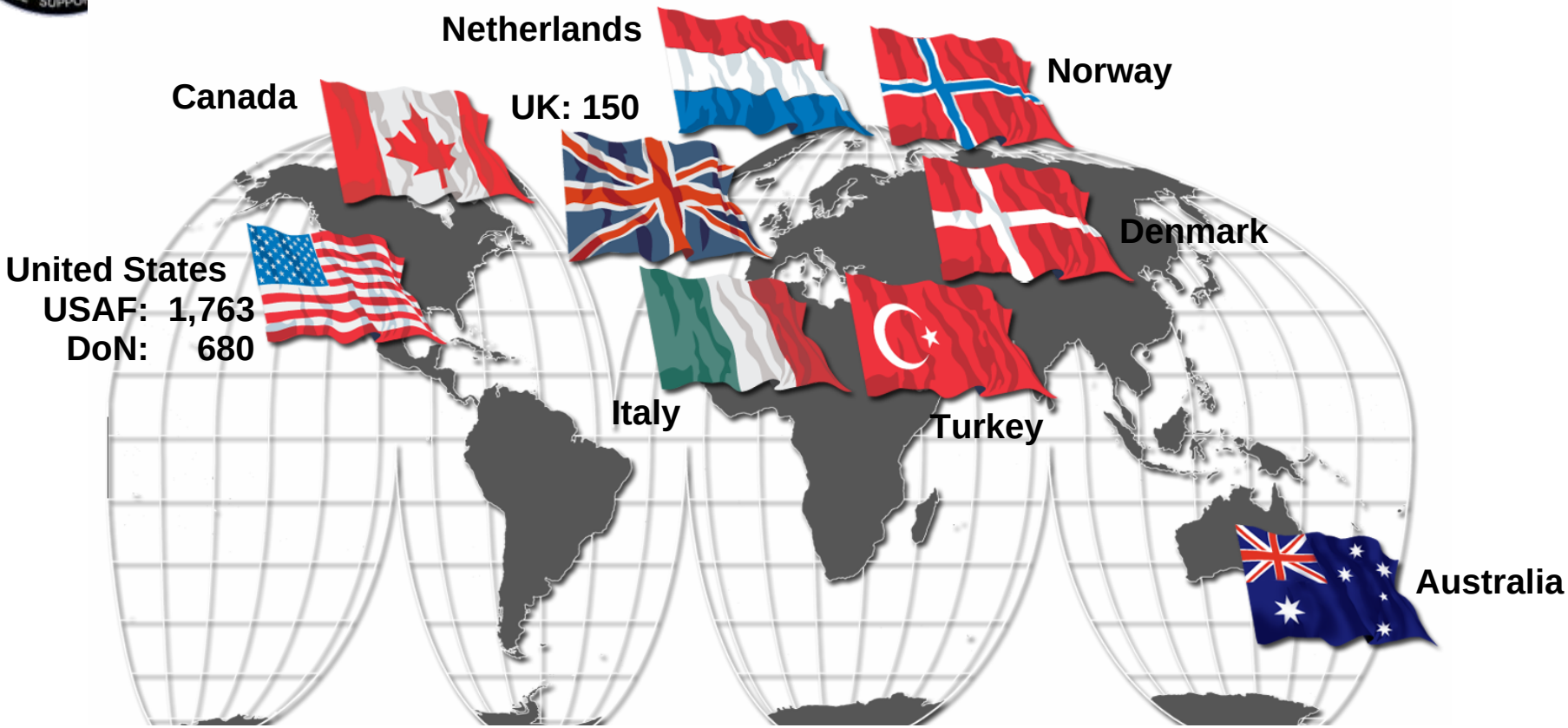
- Background
  - Program
  - Variants
- Air Vehicle
  - Air Frame
  - Sensors
  - Data Links
  - Displays
  - Weapons

Lethal, Survivable, Supportable, Affordable and Connected Node on the Joint Coalition Battlefield

Security Guidelines

- Slides and Discussions are UNCLASSIFIED

Service & International Needs



- **USAF:** Multi-role (primary air-to-ground) fighter to replace F-16 & A-10 & to complement F/A-22
- **USMC:** Multi-role, short takeoff, vertical landing strike fighter to replace AV-8B & F/A-18C/D
- **USN:** Multi-role strike fighter to complement the F/A-18E/F
- **UK (RN and RAF):** Supersonic replacement for Sea Harrier and GR-7

2,593 US/UK JSFs ***> 2,000 International JSFs***

Lockheed Martin JSF Team

NORTHROP GRUMMAN

- Center Fuselage
- Weapons Bay Door Drives
- Arresting Gear
- CV Control and Test
- Radar
- Software
- LO Support System
- Training Courseware and Management Systems

BAE SYSTEMS

- Aft Fuselage
- CV Wing Fold
- Fuel System
- Crew Escape
- Life Support
- EW System
- U.K. Support Center
- Throttle/Side Stick
- Horizontal/Vertical Tails
- Flight Control Computer
- STOVL Control and Test
- U.K. Rqts/Stores/SW

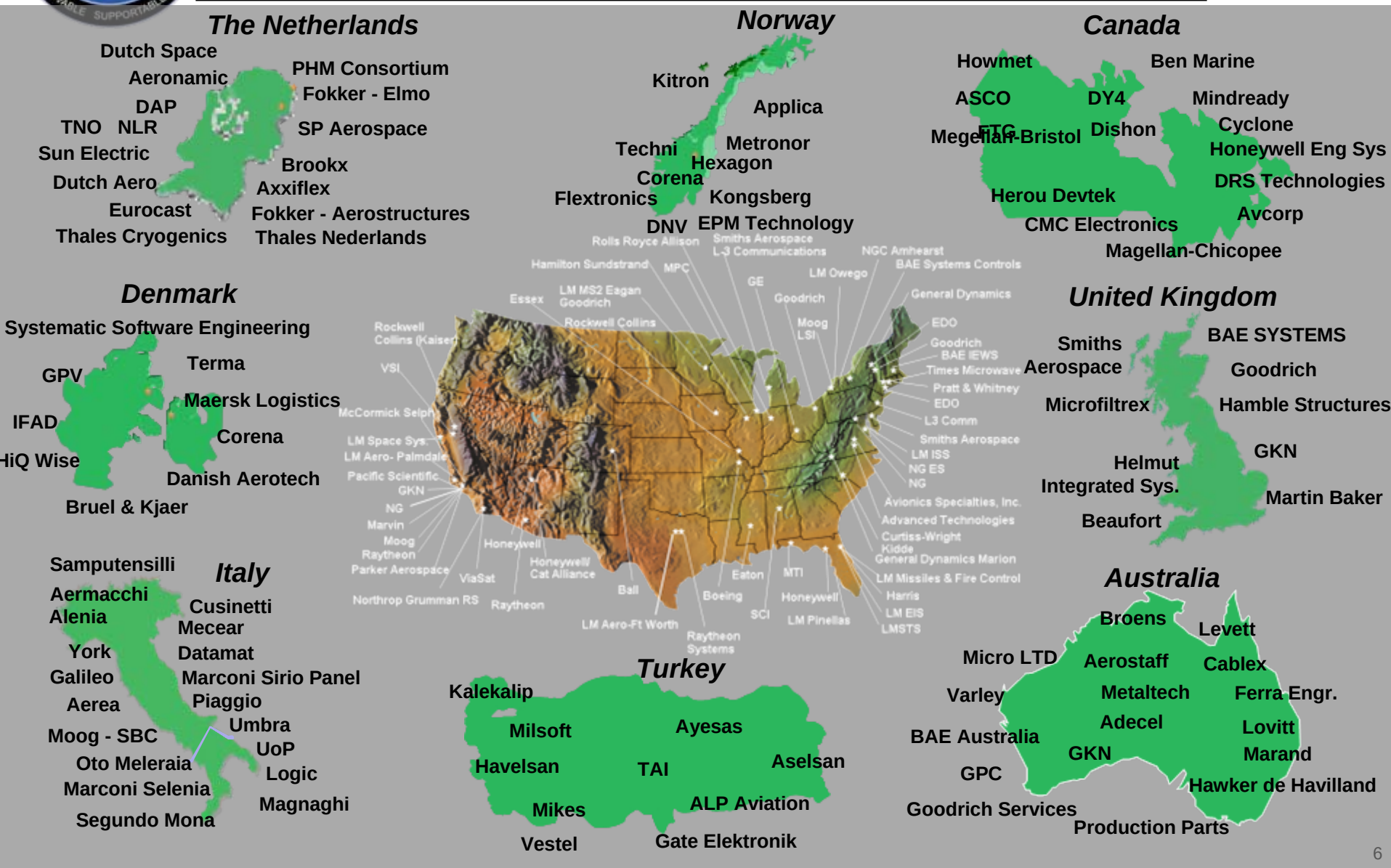
LOCKHEED MARTIN

Prime Contractor

- Air System Verification
- System Integration
- Mate Through Delivery
- Edges & Control Systems
- Autonomic Logistics
- Mission Systems
- Vehicle Systems
- Training System
- Forward Fuselage
- Wing

A Highly Integrated Best Value Team

F-35 Global Supply Sources



JSF System Development and Demonstration Phase

DEFENSE ACQUISITION MANAGEMENT FRAMEWORK

PRE-SYSTEMS ACQUISITION | **SYSTEMS ACQUISITION** | **SUSTAINMENT**

Concept & Technology Development
Decision Review
Concept Exploration — **Component Advanced Development**

System Development & Demonstration
Interim Progress Review
System Integration — **System Demonstration**

Production & Deployment
FRP Decision Review
Low-Rate Initial Production — **Full-Rate Production & Deployment**

Operations and Support
Sustainment — **Disposal**

JSF Master Schedule

FY	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
CY	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015

Major Program Events

Critical Design Reviews
- USAF / USMC
- USN CDR

First Flights
- USAF
- USMC
- USN

Initial Operational Capability
- USMC
- USAF
- USN

Test Completions
- Developmental
- Operational

AA-1 (15 Dec)

CATB (23 Jan)

Low-Rate Initial Production (LRIP)

Production and Sustainment
- LRIP 1 (2)
- LRIP 2 (12)
- LRIP 3 (19)
- LRIP 4 (32)
- LRIP 5 (47)
- LRIP 6 (118)
- LRIP 7 (132)

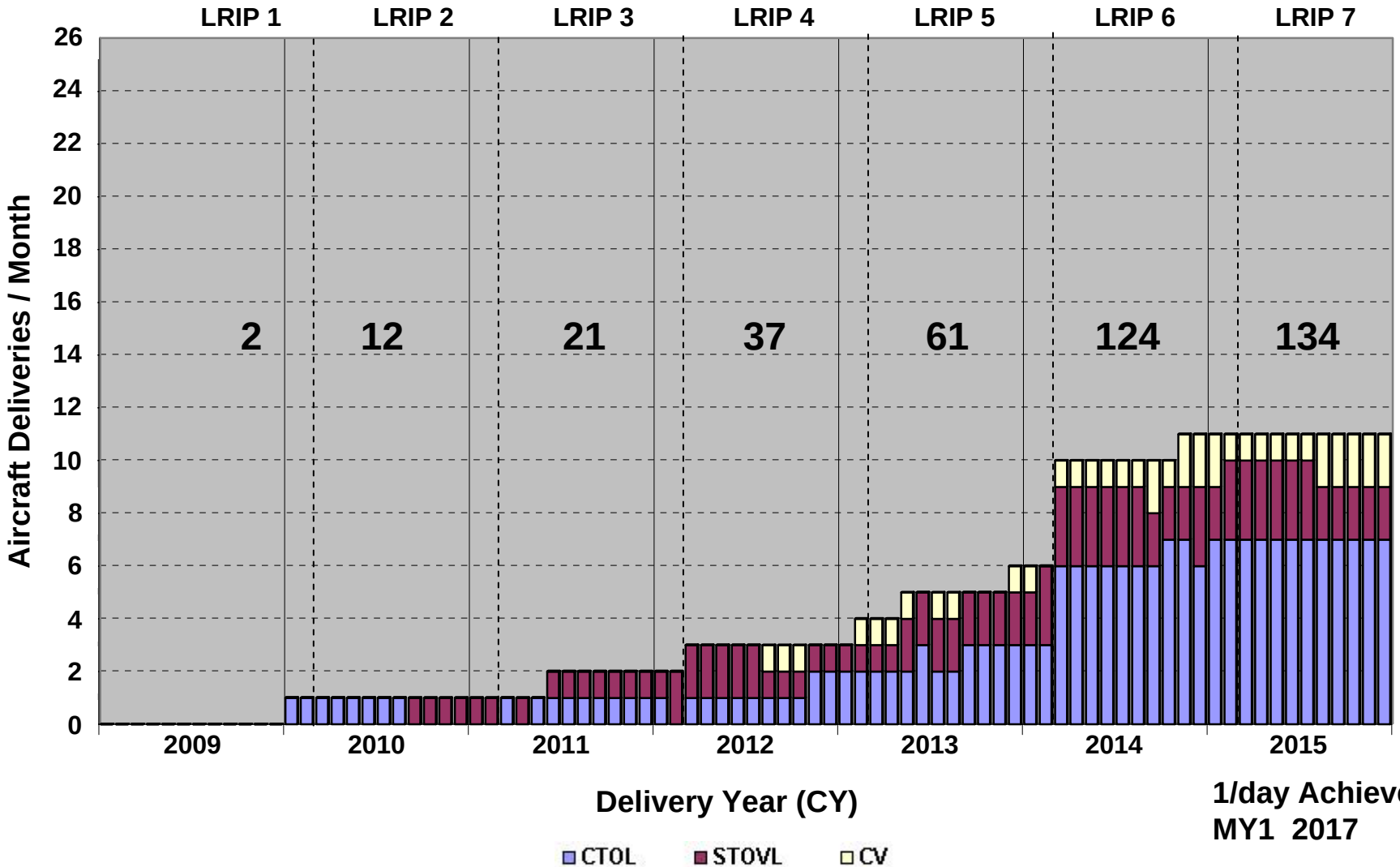
Multi-Year 1 — EOQ — MYP →

Planned U.S. Production and Sustainment
- Air Force 1,763 A/C
- Dept of Navy 680 A/C

Planned International Production > 500

EOQ = Economic Order Quantity *MYP = Multi-Year Procurement*

LRIP Deliveries by Variant



1/day Achieved
MY1 2017

Major Accomplishments

Flight Test

AA-1:
- **62 Total Flights, 99.9 flight hrs**
- **Significant risk reduction (Fuel Dump, Flight Controls, Electrical System, PTMS)**
- **Successful Edwards Deployment (Air Starts, High Fidelity Noise Data, High Sortie Completion Rate)**

CATB:
- **First Flight: 23 Jan 07**
- **37 Total Flights /105.7 Total hours/13.5 Mission Systems hours (INS/GPS integration flights)**

BF-1:
- **First Flight 11 Jun 2008**
- **14 Flights, 13.3 flight hrs (Initial Hover Pit, STOVL Doors Open in Flight, Electrical System, IPP Test)**

BF-2:
- **First Flight 25 Feb 09**

Production

- **All 19 SDD and 2 LRIP Aircraft in production**

Development

- **Autonomic Logistics Information System Operational and Supporting AA-1**
- **61% of all JSF software complete and in test**
- **All three variants tracking to NTE weight growth forecasts and meeting KPPs**

Subsystems

- **All mission Sensors Flown on Test Beds (Radar, DAS, EOTS, EW/CM)**
- **Radar Blk 0.5 software tracked open air targets over Fort Worth from the lab and displayed on PCD**
- **Electro-Optical Targeting System Planar Array Sensor re-designed and delivered to LM**

F135

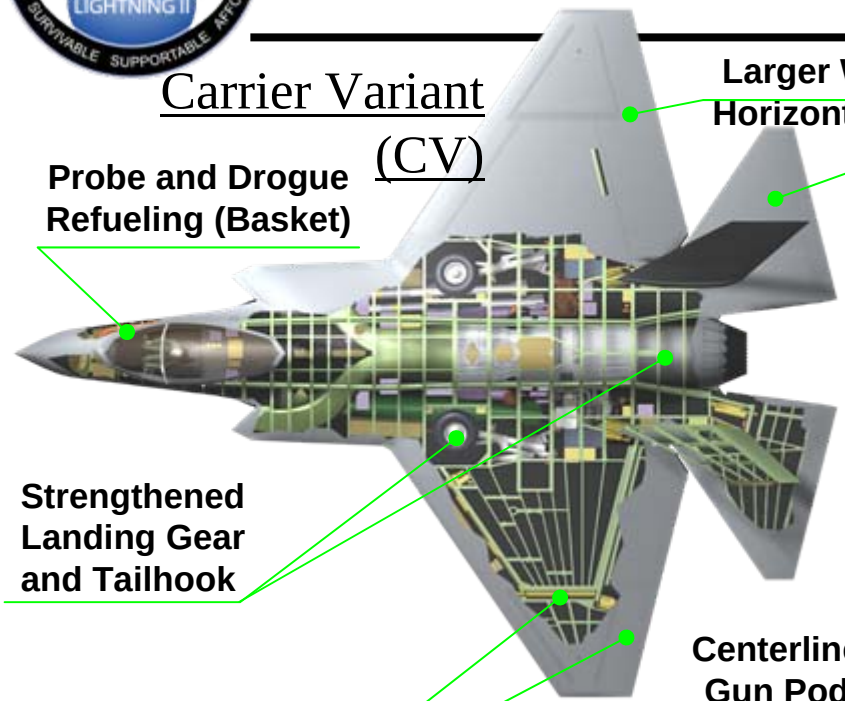
- **10,281 total hours on 13 engines (as of 6 Oct 08)**
- **Supporting AA-1 and BF-1 flight test**
- **STOVL retrofit engine on track for Jan 09 Delivery**

F136

- **712 total hours on 2 engines (002 and 003) (as of 6 Oct 08)**
- **First Engine to Test (FETT) Engine 004 successful light off**

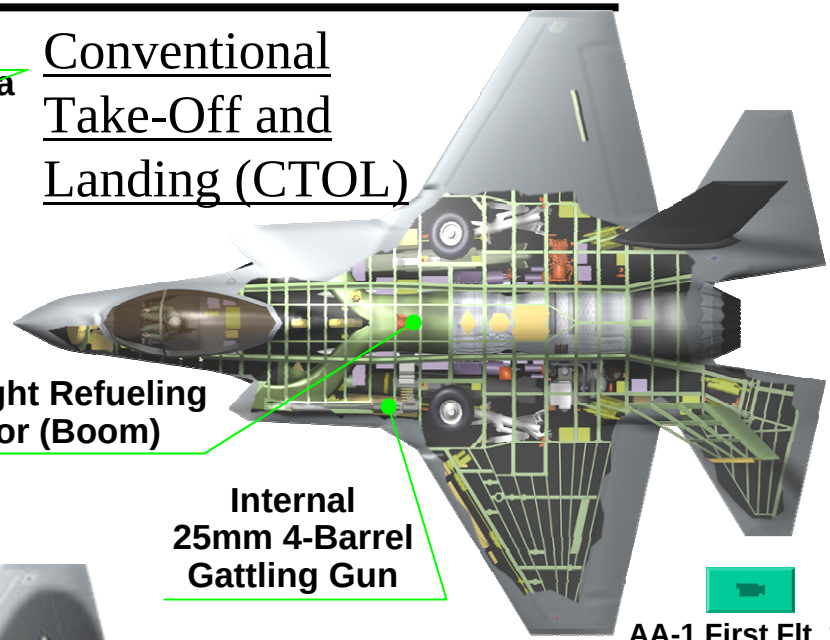
Multi-Service Design

Carrier Variant (CV)



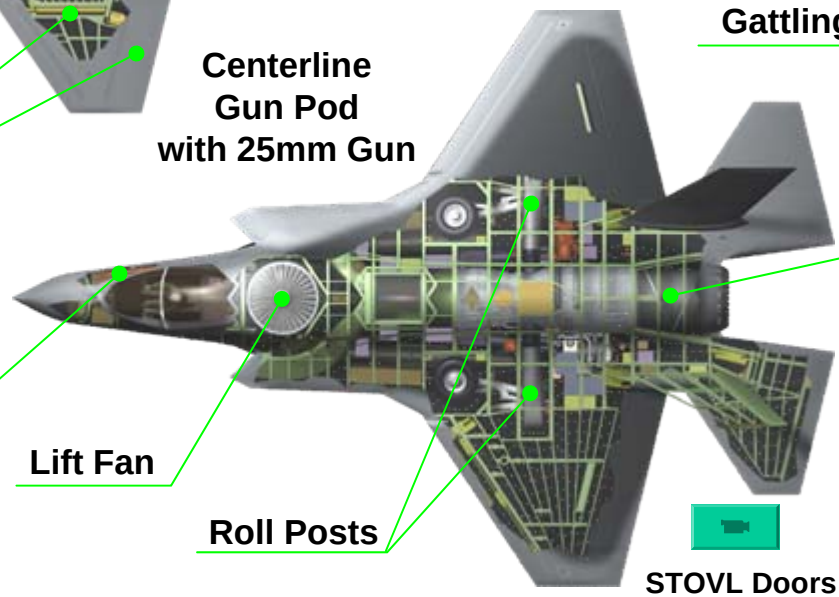
- Larger Wing and Horizontal Tail Area
- Probe and Drogue Refueling (Basket)
- Strengthened Landing Gear and Tailhook
- Wingfold and Ailerons Added

Conventional Take-Off and Landing (CTOL)



- In-Flight Refueling Door (Boom)
- Internal 25mm 4-Barrel Gattling Gun

AA-1 First Flt 15 Dec 06



- Centerline Gun Pod with 25mm Gun
- 3-Bearing Swivel Nozzle
- Probe and Drogue Refueling (Basket)
- Lift Fan
- Roll Posts

STOVL Doors inflight

Short Take-Off and Vertical Landing (STOVL)

BF-1 First Flt 11 Jun 08

IBIT

CTOL Comparison

Length	**49.7 ft**
Span	**31 ft**
Wing Area	**300 ft^2**
Internal Fuel	**7,162 lb**

Length	**50.5 ft**
Span	**35 ft**
Wing Area	**460 ft^2**
Internal Fuel	**18,307 lb**

Length	**62.1 ft**
Span	**44.5 ft**
Wing Area	**840 ft^2**
Internal Fuel	

STOVL Comparisons

Length	**56 ft**
Span	**37.4 ft**
Wing Area	**400 ft2**
Internal Fuel	**10,800 lb**
Spot factor	**1.0**

Length	**50.5 ft**
Span	**35 ft**
Wing Area	**460 ft2**
Internal Fuel	**13,400 lb**
Spot Factor	**1.09**

Length	**47.4 ft**
Span	**30.3 ft**
Wing Area	**239 ft2**
Internal Fuel	**7915 lb**
Spot Factor	**.82**

Carrier Comparison

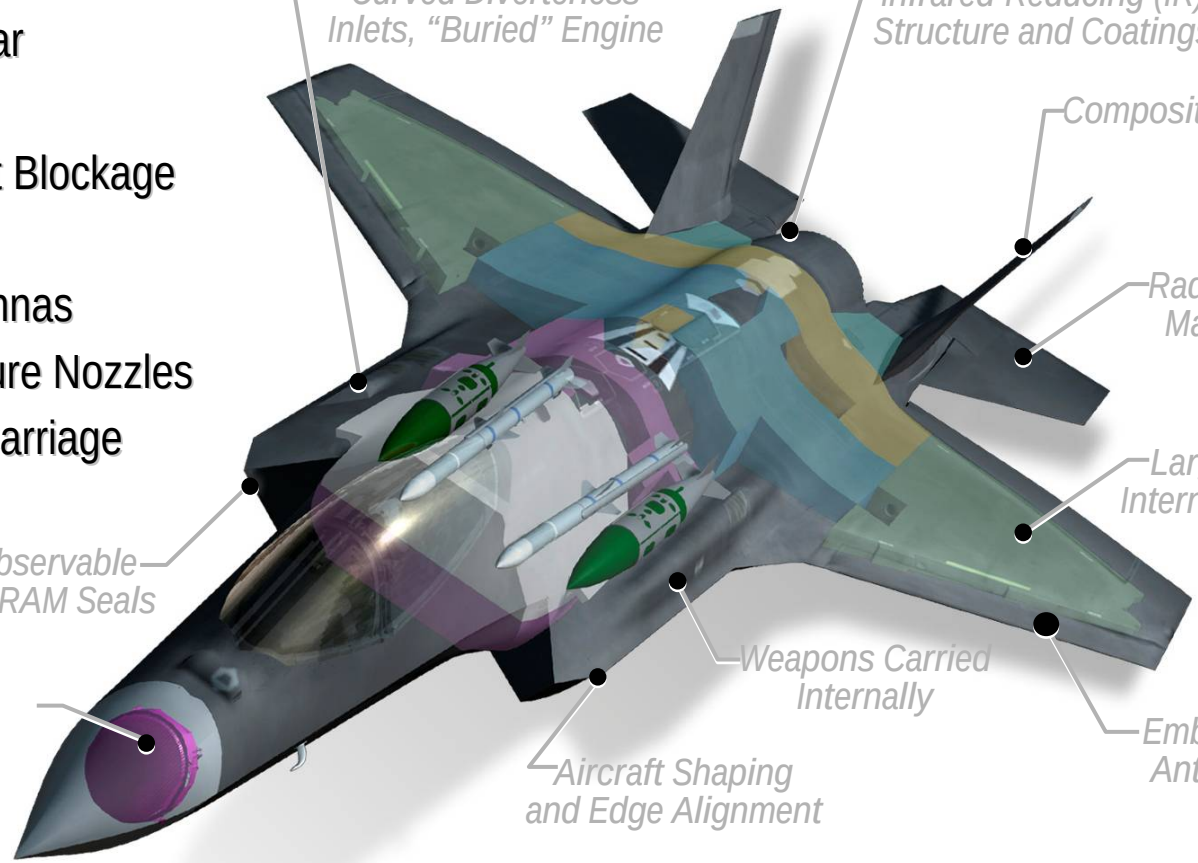
Length	56 ft
Span	37.4 ft
Wing Area	400 ft^2
Internal Fuel	10,800 lb
Spot Factor	1.0

Length	50.8 ft
Span	43 ft
Wing Area	620 ft^2
Internal Fuel	19,145 lb
Spot Factor	1.11

Length	60.38 ft
Span	42 ft
Wing Area	500 ft^2
Internal Fuel	14,708 lb
Spot Factor	1.24

VLO Stealth Design

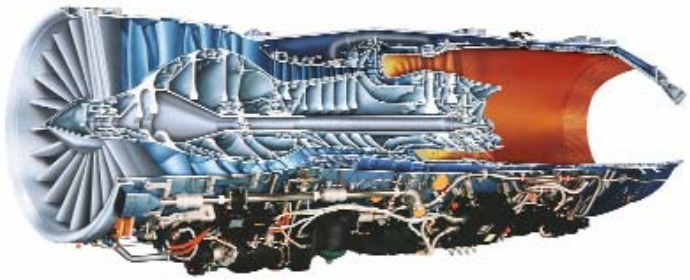
- Internal Fuel Tanks
- Fixed Array Radar
- Engine Inlets
- Full Line-of-Sight Blockage
- Aligned Edges
- Embedded Antennas
- Reduced Signature Nozzles
- Internal Stores Carriage



Fundamental 5TH Design Features Can Not Be Retrofitted

JSF Engine Interchangeability

- **Physically and Functionally Interchangeable**
- **Any Aircraft Able to Use Any Engine**
- **Common JSF Autonomic Logistics System Interfaces**



PRATT & WHITNEY F135

GE AIRCRAFT ENGINES/ ROLLS ROYCE F136

JSF Engines - - Common Core for Aircraft Variants, Competition in Production

F-35 Integrated Avionics

Full Spherical Coverage by RWR & Distributed Aperture System (DAS)

360° Coverage

Electro-Optical Targeting System (EOTS)
- **Saberliner**

RWR Antennae

DAS Apertures

Active Electronically Scanned Array (AESA)

Radar
- **BAC-111**

Electronic Support Measures

Emitter Locating
- **Sphyraena ESM Flight**

All Aspect Stealth – Low Observable

Mission Systems Test
- **CATB 1st Flight Dec 07**
- **BF-4 1st Flight Mar 09**

Network Connectivity
- **Link-16, VMF, MDL**
- **SINCGARS**
- **Wide Band Tactical (TTNT/WNW)**
- **NEW**
- **SATCOM (Voice/Data/IBS)**

Validating Mission Systems in Flight

QF-4

EO DAS

Sabreliner

EOTS

BAC-111

Radar, EO DAS, INS, GPS

Systems in Test	Flight Hrs	Lab Hrs
HMD	97.6 Hrs (AA-1/BF-1)	14456
Radar	227 Hrs (BAC-111) 1 Hr CATB	18000
EO DAS	245 Hrs (F-16, BAC-111, QF-4) (CATB – 1Q ’10)	25282
EOTS	152 Hrs (Sabreliner) (CATB – 4Q ’09)	10680
Integrated CNI	109 Hrs INS/GPS: AA-1/BF-1 126 Hrs INS/GPS: BAC-111 35 Hrs RALT 20 Hrs CATB	12000 (Supplier) 8155 (MSIL)
EW/CM	101 Hrs (CATB –1Q ’09)	28842

F-16

DAS, EW CM

F-35 AA-1

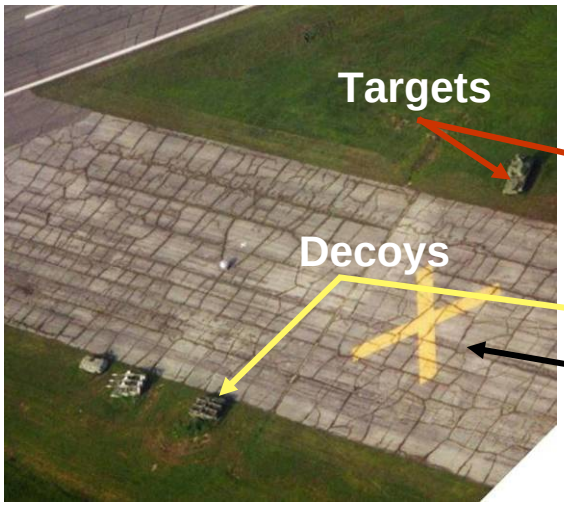
HMD **MFD**

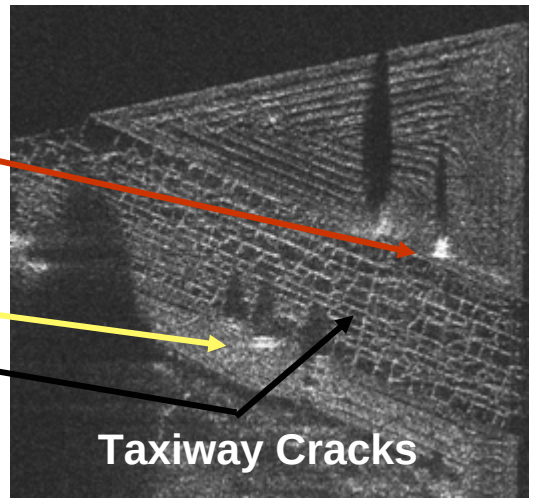
CATB

Fully Integrated MS

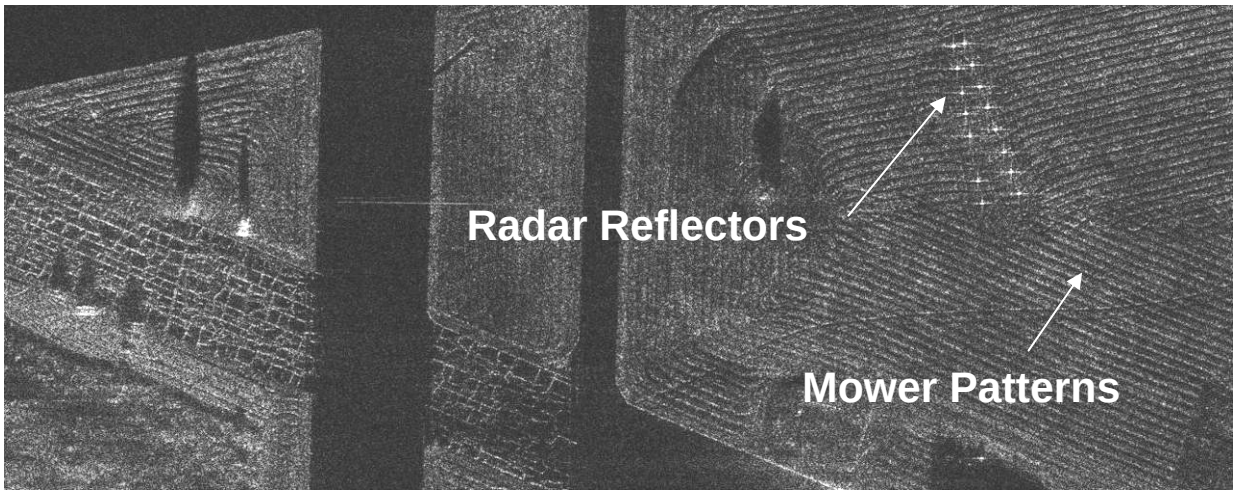

CATB
COOPERATIVE AVIONICS TEST BED
N35LX
LOCKHEED MARTIN
NORTHROP GRUMMAN
BAE SYSTEMS
F-35
AA-1

APG-81 Advanced Electronically Scanned Array (AESA) Radar



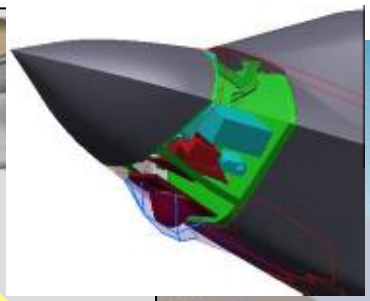


APG-81 Ultra High Resolution SAR Imagery



Electro Optical Targeting System Operational Capabilities

EO Targeting System



- Internally Mounted
- Long Range, High Resolution
- NAVFLIR, Targeting FLIR, IRST Functions
- Digital Continuous Zoom

Long Range A-A IRST

Air-to-Surface Targeting FLIR

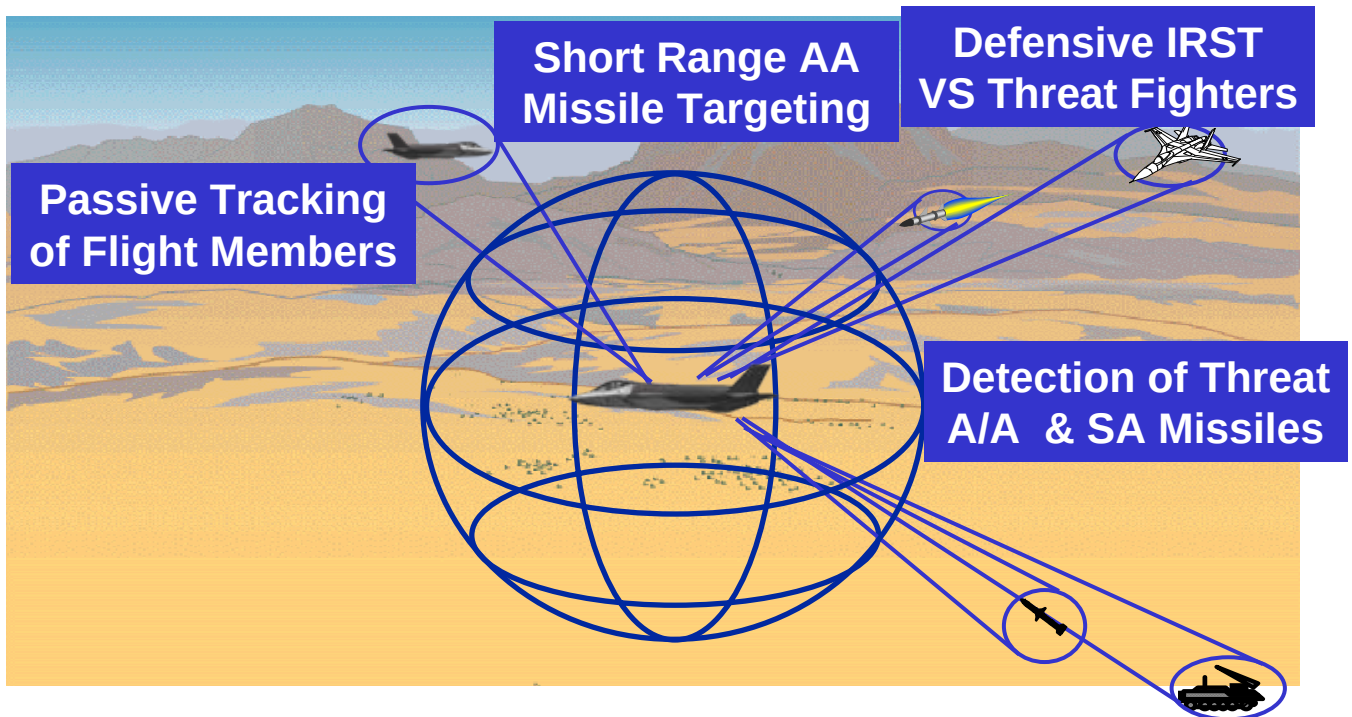
Laser Designation

Laser Spot Tracker

The Advanced EOTS Provides Passive Multi-Spectral A/A and A/G Capabilities As Well as Enhanced A/G Target ID Capability

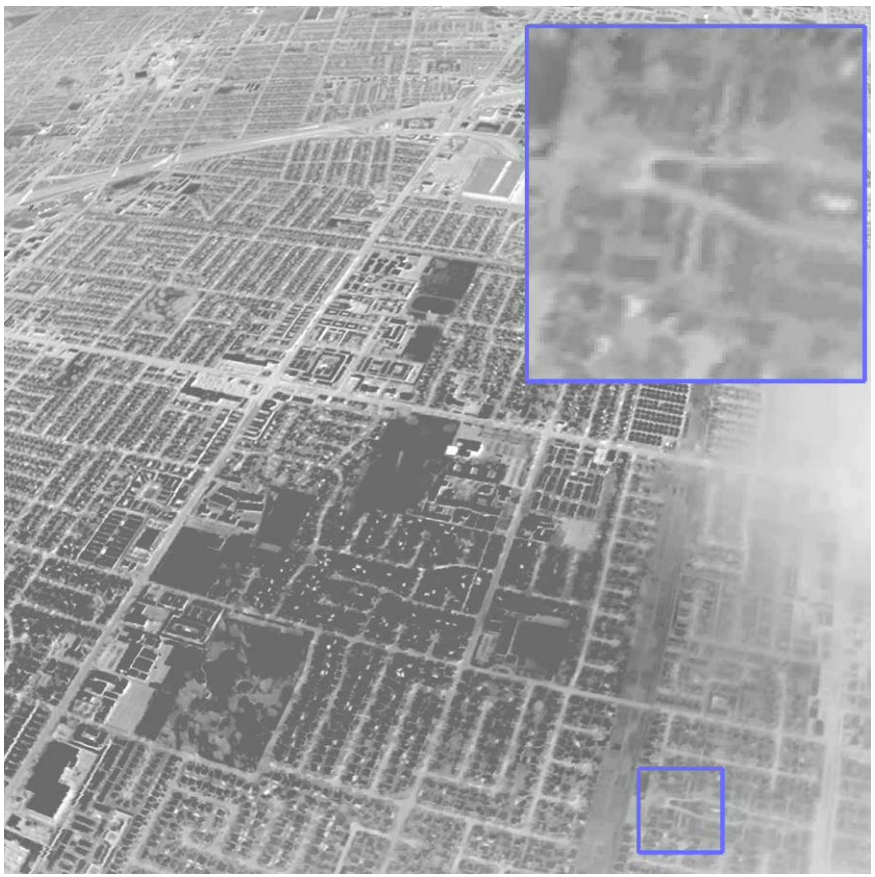
Distributed Aperture System (DAS)

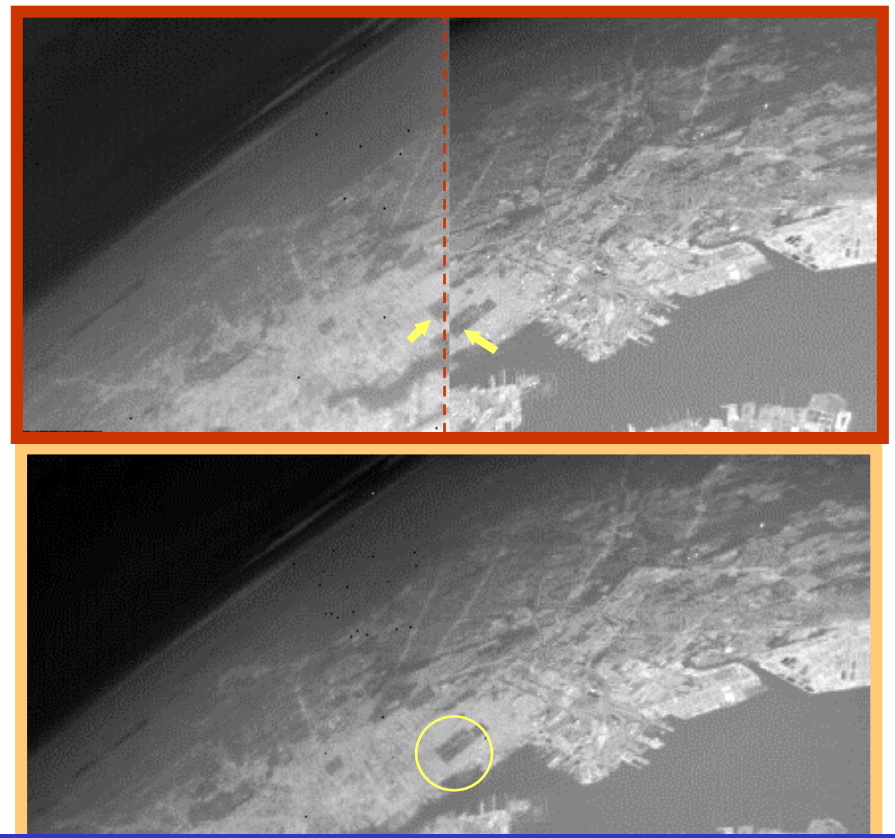
- **Total Situational Awareness Around Aircraft**
- **Track Wingmen & Threat Aircraft**
- **Missile Launch Detection**
- **NAVFLIR Functions**
- **Integrated with HMD**



EO Distributed Apertures Flight Demonstration

JSF Generates 6 Continuous Images….





….Seamlessly Stitched Together For Full 360 Degree Imaging Capability

Aircraft Communications Capability

- Funded
- Planned

Identification/Surveillance

- Mark XII Transponder and Interrogator
  - Modes 1, 2, 3/A, C, 4, 5
- Mode S (transponder only)
- Mode S (interrogator)

Voice Communications

- UHF/VHF Clear/Secure
- HAVEQUICK
- Survival Radio Comm
- Link 16
- MADL
- SATCOM (DAMA/MUOS)

Data Communications

- Link 16 (J-Series)
- VMF (K-Series)
- MADL (intra-flight data link)
- P5 CTS
- IBS (TIBS/TDDS)
- Streaming Video (Rover format)
- Tactical Wide Band IP based DL
- SATCOM (DAMA/MUOS)

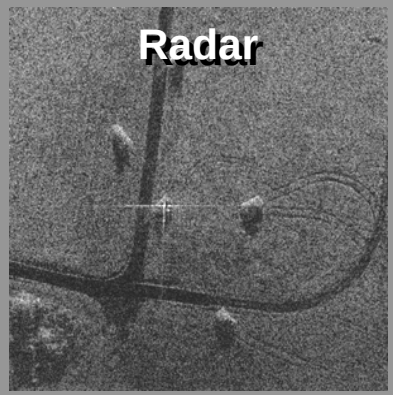
Navigation/Landing Aids

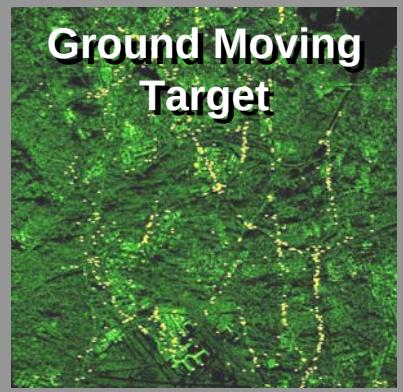
- INS
- GPS
- ILS
- TACAN
- ICLS
- JPALS (partial)
- JPALS (full)

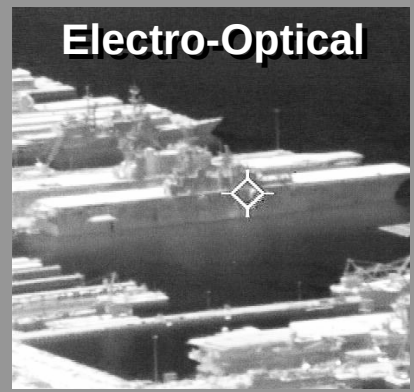
Weapons

- X-band (AIM-120, AIM-9X)
- NEW (Link-16 network enabled weapons: JSOW, SDB-II)

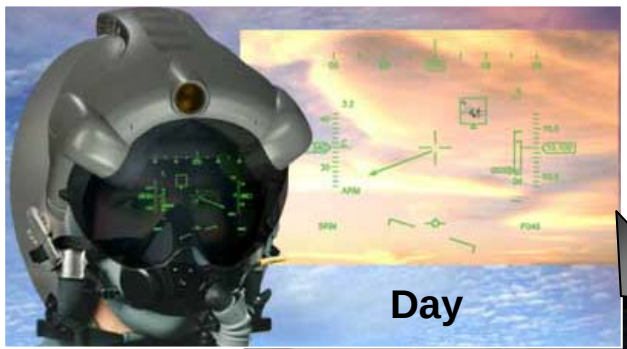
Enhanced Sensor Fusion & Information Displays Total Situational Awareness



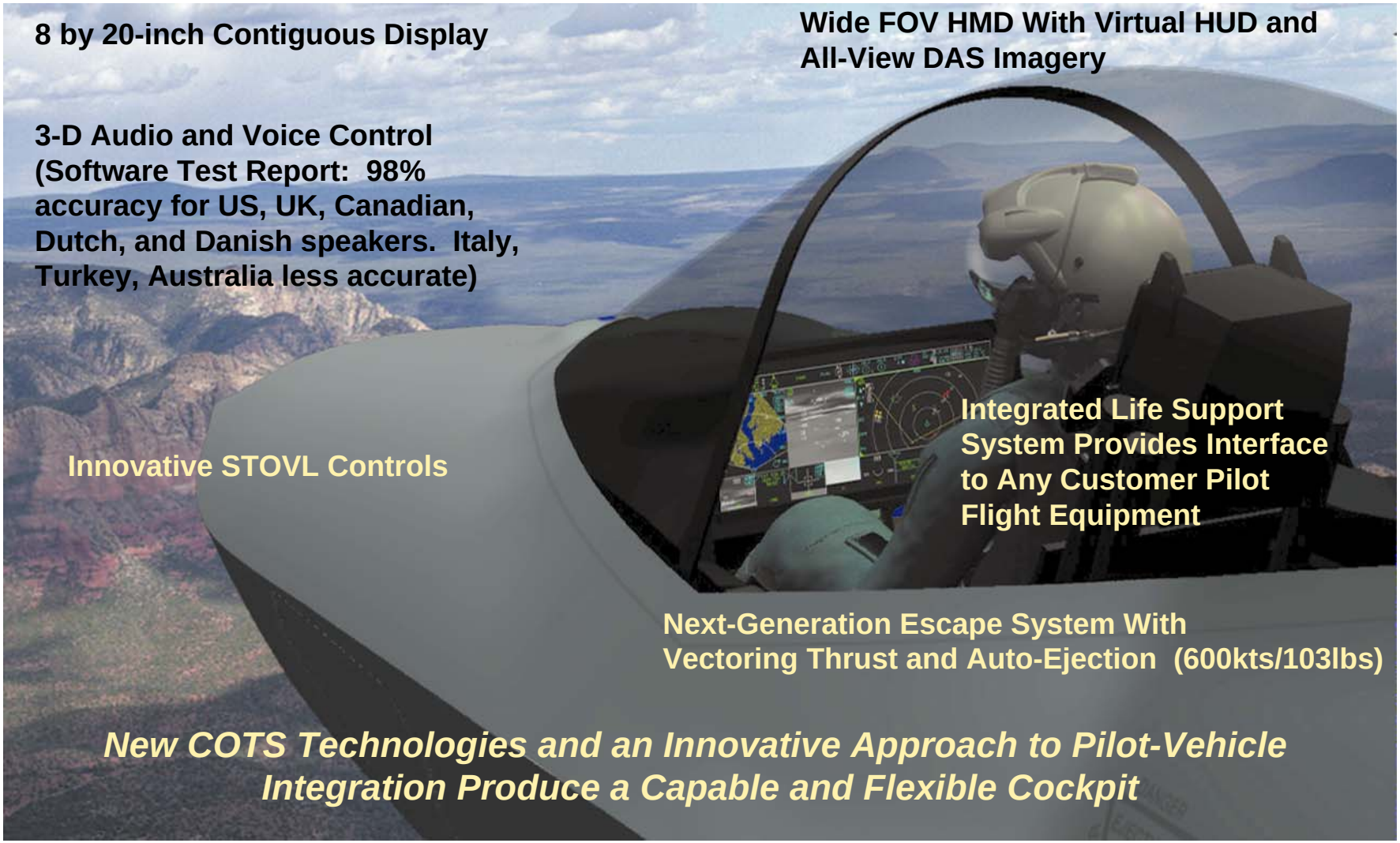




Fused Tactical Information Managed & Displayed To The Pilot



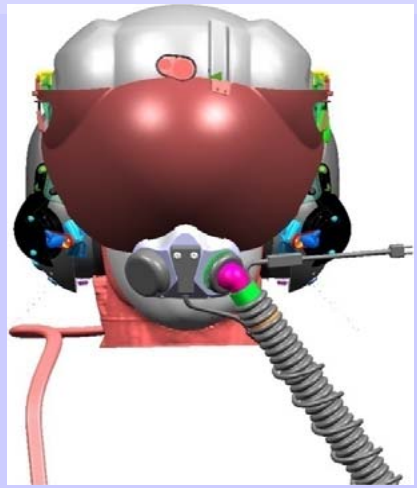
JSF Crew Station

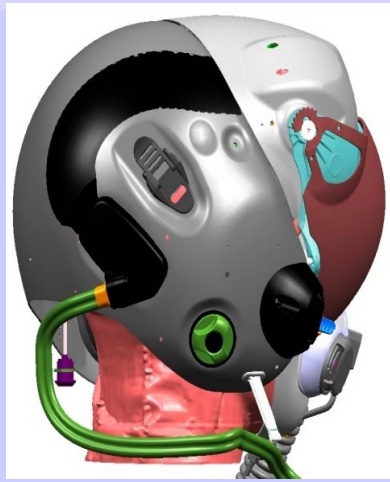


HMDS

DESCRIPTION

- **Provides head protection, virtual HUD, video stream and night camera for F-35 pilots**
- **HMDS components include**
  - **Display Management Computer (DMC/H)**
  - **Head-tracker Transmitter Unit (HTU) – on seat**
  - **Fixed Camera – above glare shield**
  - **Helmet Assembly Unit (HAU) – helmet, ANR ear cups, HVI and modified MBU-23/P**
  - **Helmet Display Unit (HDU) – display source, optics, visors (2), head-tracker receiver unit (HRU)**



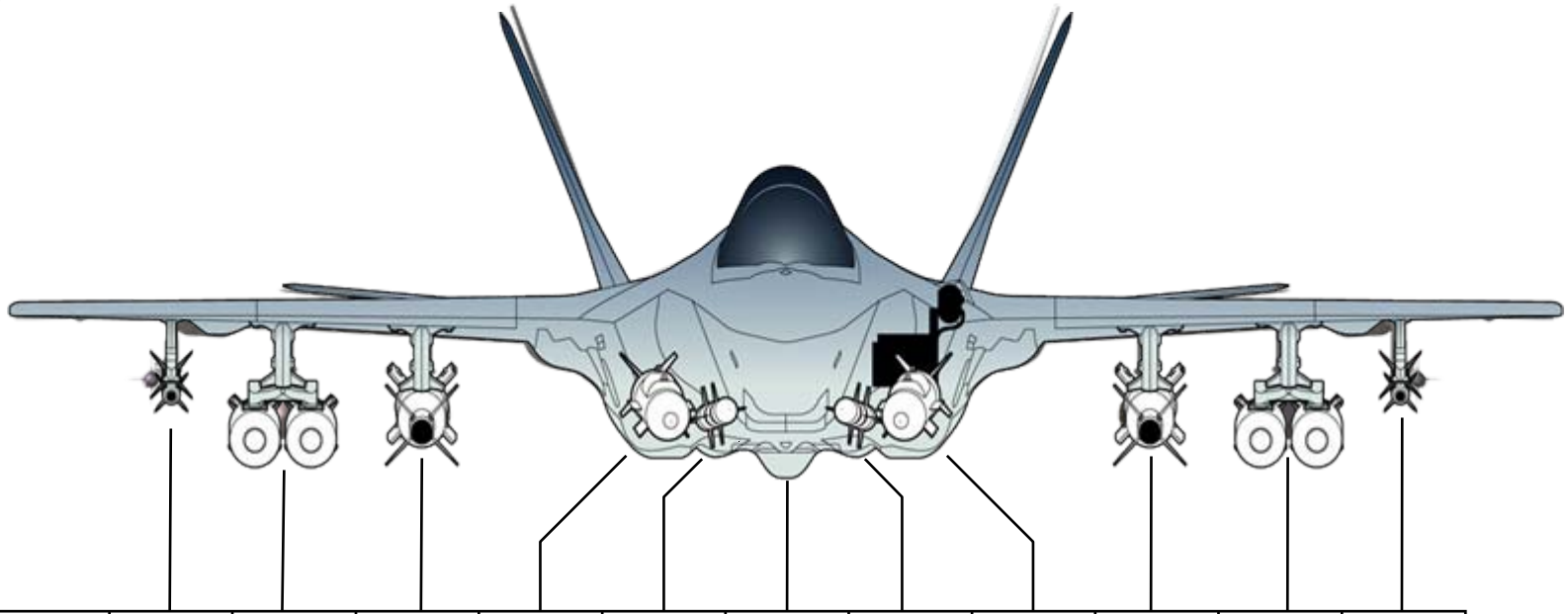


Panoramic Cockpit Display

DESCRIPTION

- 8 x 20 AMLCD Head Down Display
- Single Piece of Glass
- 12 operator selectable portals, or two 7x10 portals
- Touch Screen Interface
- Provides virtual Keypad for system control
- Function Action Bar (FAB) for time critical system controls

Weapons Stations

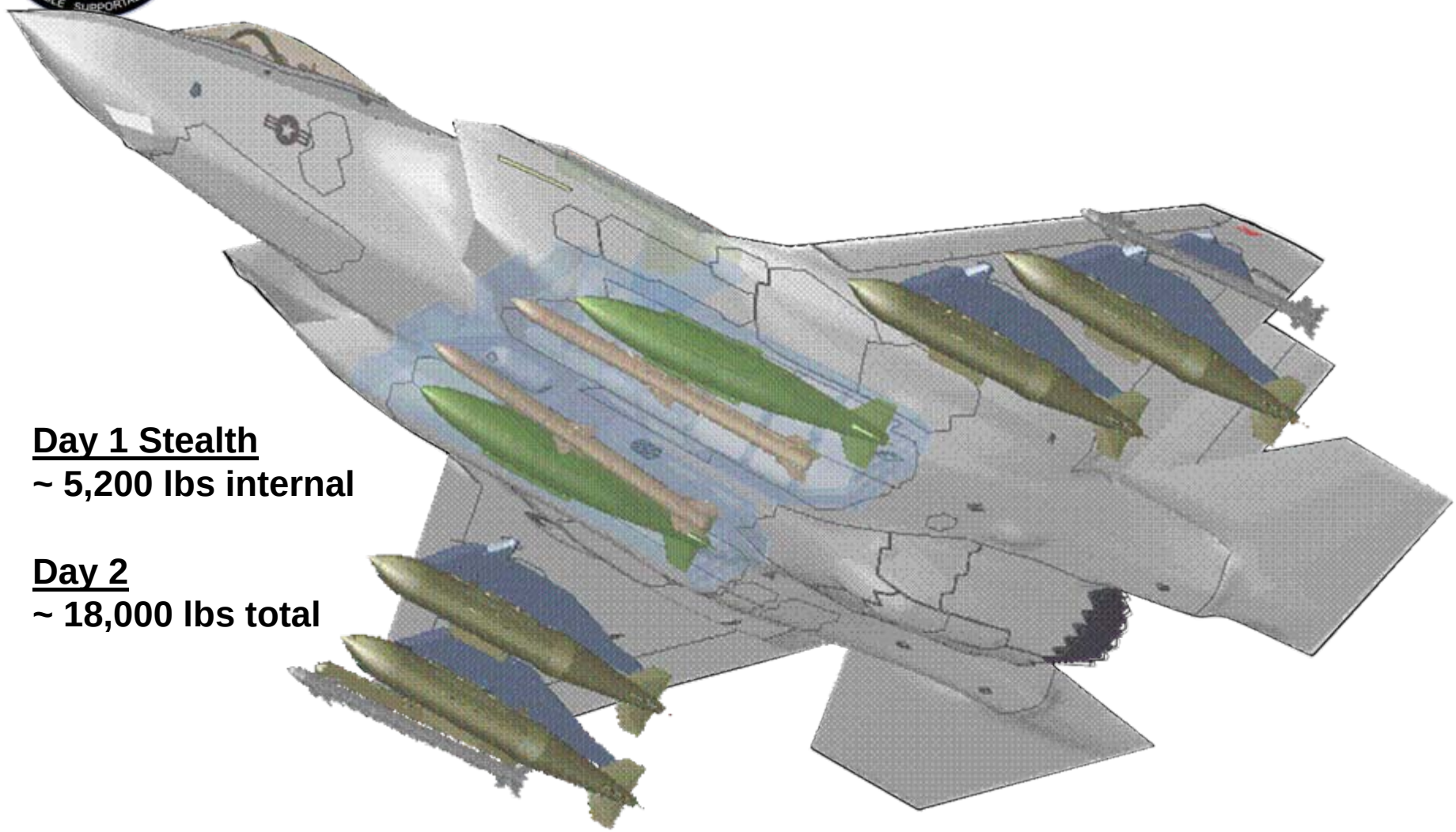


Station	11	10	9	8	7	6	5	4	3	2	1
Store	A/A	A/A, A/S	A/A, A/S	A/A, A/S	A/A	A/S	A/A	A/A, A/S	A/A, A/S	A/A, A/S	A/A
Weight	300	2,500*	5,000	2,500*	350	1,000	350	2,500*	5,000	2,500*	300

- **Over 18,000 Lbs Ordnance Capacity**
- **Non-pyrotechnic Suspension and Release**

*** STOVL Stations 2/10 & 4/8 Reduced to 1,500 (SWAT)**

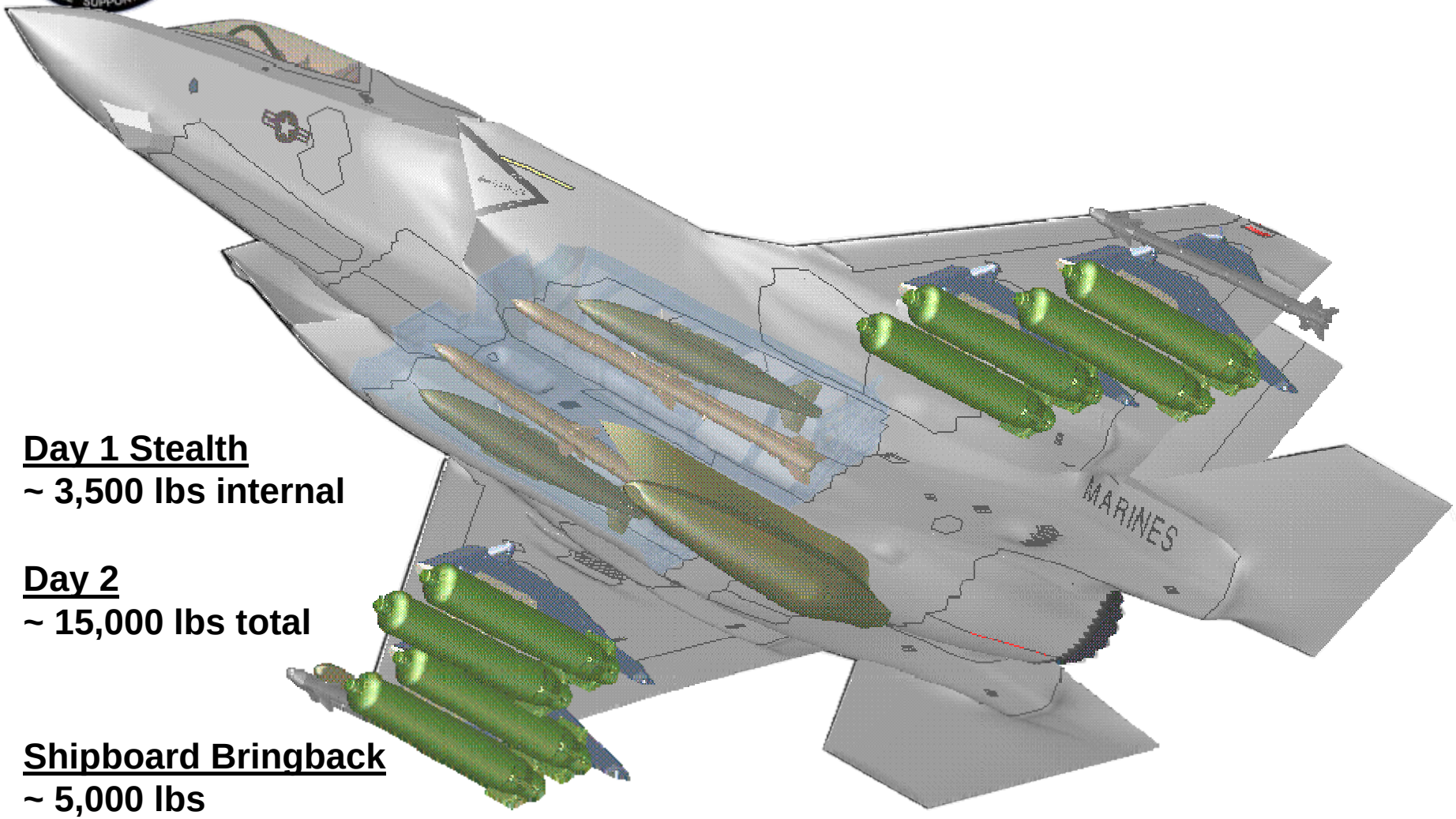
CTOL Loading



Day 1 Stealth
~ 5,200 lbs internal

Day 2
~ 18,000 lbs total

STOVL Loading

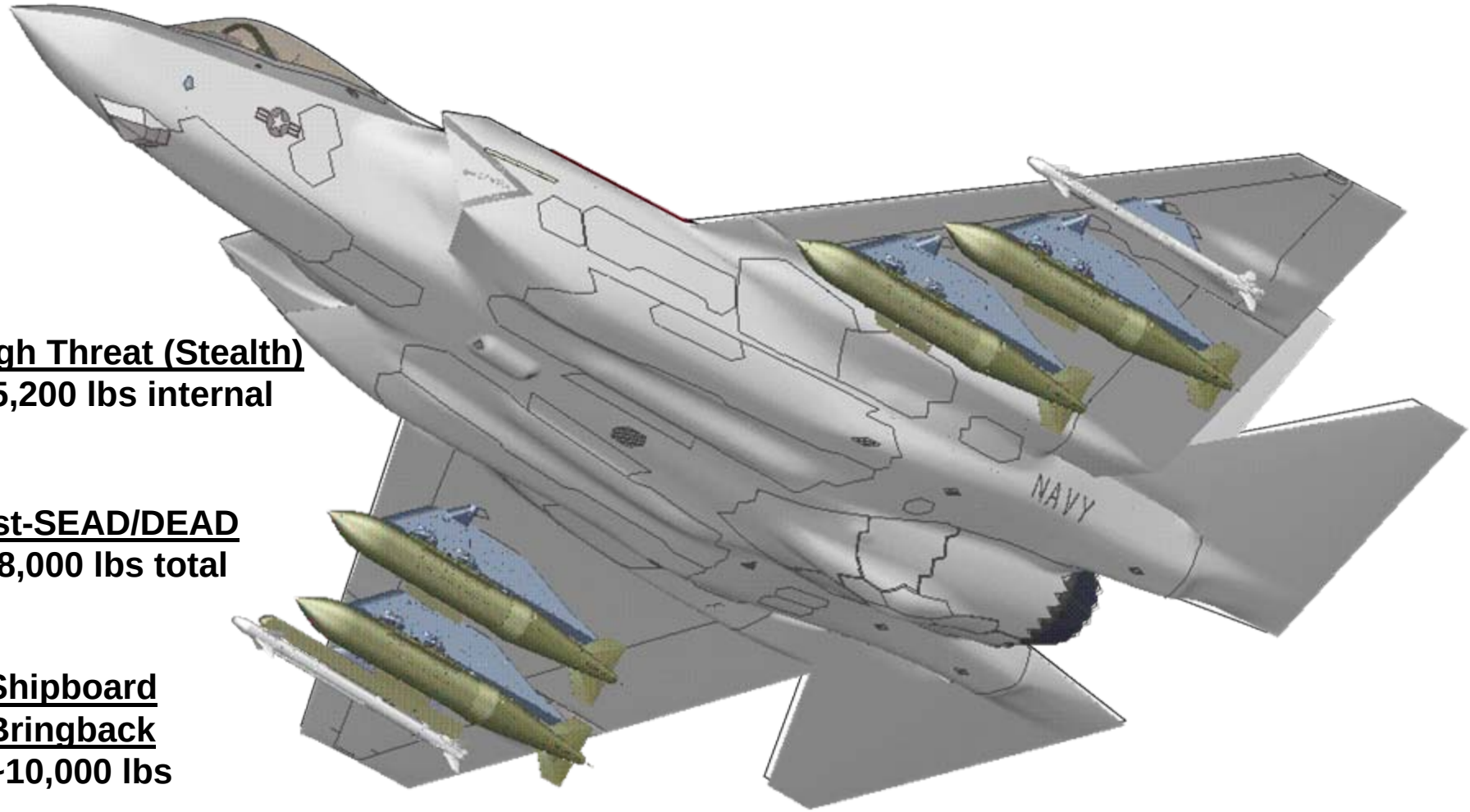


Day 1 Stealth
~ 3,500 lbs internal

Day 2
~ 15,000 lbs total

Shipboard Bringback
~ 5,000 lbs

CV Loading



High Threat (Stealth)
~ 5,200 lbs internal

Post-SEAD/DEAD
~ 18,000 lbs total

Shipboard Bringback
~10,000 lbs

CTOL & CV Weapons Carriage Requirements

Store Fully Certified During SDD

EXTERNAL WEAPONS

426 -Gallon Wing Tank

Stormshadow

GBU-38 JDAM 500-lb (MK-82 Warhead)

AGM-158 JASSM

MXU-648/CNU-88 Baggage Pod

AGM-154A/C JSOW Glide Bomb

AIM-120B/C AMRAAM

GBU-31 JDAM 2,000-lb (MK-84 Warhead)

AIM-9X Sidewinder

GBU-32 JDAM 1,000-lb (MK-83/BLU-110 Warhead)

BDU-57/58/60 Laser-Guided Training Round

GBU-31 JDAM 2,000-lb (BLU-109 Warhead)

Missionized Gun

Brimstone/Joint Common Missile

MK-76/MK-58/BDU-48

INTERNAL

GBU-32 JDAM 1,000-lb (MK-83/BLU-110 Warhead)

GBU-12 Paveway II 500-lb LGB (MK-82 Warhead)

GBU-31 JDAM 2,000-lb (MK-84 Warhead)

AGM-154A/C JSOW Glide Bomb

CBU-103/105 WCMD

GBU-38 JDAM 500-lb (MK-82 Warhead)

Brimstone/Joint Common Missile

GBU-31 JDAM 2,000-lb (BLU-109 Warhead)

AIM-120C AMRAAM

AIM-132 ASRAAM

Weapons Currently Under Development

UK 500# PGB

Phase I SDB

EXTERNAL WEAPONS

GBU-10 Paveway II 2,000-lb LGB (MK-84 Warhead)

GBU-24A/B Paveway III 2,000-lb LGB (MK-84 / BLU-109 Warhead)

GBU-16 Paveway II 1,000-lb LGB (MK-83 Warhead)

MK-83 BLU-110 LDGP 1,000-lb LDGP

MK-83 BSU-85 HDGP

MK-84 2,000-lb LD/HDGP

MK-84 BSU-50 Ballute 2,000-lb HDGP

GBU-12 Paveway II 500-lb LGB (MK-82 Warhead)

MK-82 500-lb LD & HD

CBU-99/100 Rockeye II Cluster Munition

CBU-103/105 WCMD

AIM-132 ASRAAM

STOVL Weapons Carriage Requirements

Store Fully Certified During SDD

EXTERNAL WEAPONS

426 -Gallon Wing Tank

Stormshadow

GBU-38 JDAM 500-lb
(MK-82 Warhead)

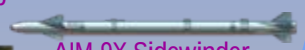
AGM-158 JASSM

MXU-648/CNU-88 Baggage Pod

AGM-154A/C JSOW Glide Bomb

AIM-120B/C AMRAAM

GBU-31 JDAM 2,000-lb
(MK-84 Warhead)

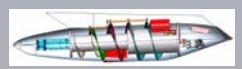


AIM-9X Sidewinder

GBU-32 JDAM 1,000-lb
(MK-83/BLU-110 Warhead)

BDU-57/58/60
Laser-Guided Training Round

GBU-31 JDAM 2,000-lb
(BLU-109 Warhead)



Missionized Gun

Brimstone/Joint
Common Missile

MK-76/MK-58/BDU-48

INTERNAL

GBU-32 JDAM 1,000-lb
(MK-83/BLU-110 Warhead)

GBU-12 Paveway II 500-lb LGB
(MK-82 Warhead)

CBU-103/105 WCMD

GBU-38 JDAM 500-lb
(MK-82 Warhead)

Brimstone/Joint
Common Missile

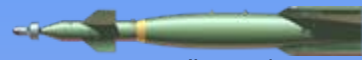
AIM-120C AMRAAM

AIM-132 ASRAAM

EXTERNAL WEAPONS

GBU-10 Paveway II 2,000-lb LGB (MK-84 Warhead)

GBU-24A/B Paveway III 2,000-lb LGB (MK-84 / BLU-109 Warhead)



GBU-16 Paveway II 1,000-lb LGB (MK-83 Warhead)

MK-83 BLU-110 LDGP 1,000-lb LDGP

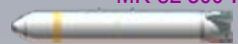
MK-83 BSU-85 HDGP

MK-84 2,000-lb LD/HDGP

MK-84 BSU-50 Ballute 2,000-lb HDGP

GBU-12 Paveway II 500-lb LGB
(MK-82 Warhead)

MK-82 500-lb LD & HD



CBU-99/100 Rockeye II
Cluster Munition

CBU-103/105 WCMD

AIM-132 ASRAAM

Weapons Currently Under Development

UK 500# PGB

Phase I SDB

Weapons Integration Progress

Design Integration

Completed 3200+ Stores WT Testing
AMRAAM, JDAM and JSOW Simulators
Delivered for SW Integration & Testing

CTOL Gun System Testing

Fired 60,000+ Total Rnds on CTOL
36K Qual Test Complete
5000 Rnds fired on STOVL gun pod

S&RES Testing

S&RES Qual Testing Complete
Rack Compatibility Tests Complete
for all SDD Stores

SMS Testing

Fuselage Remote Interface Unit Qual
Testing Complete, Installed on BF-1

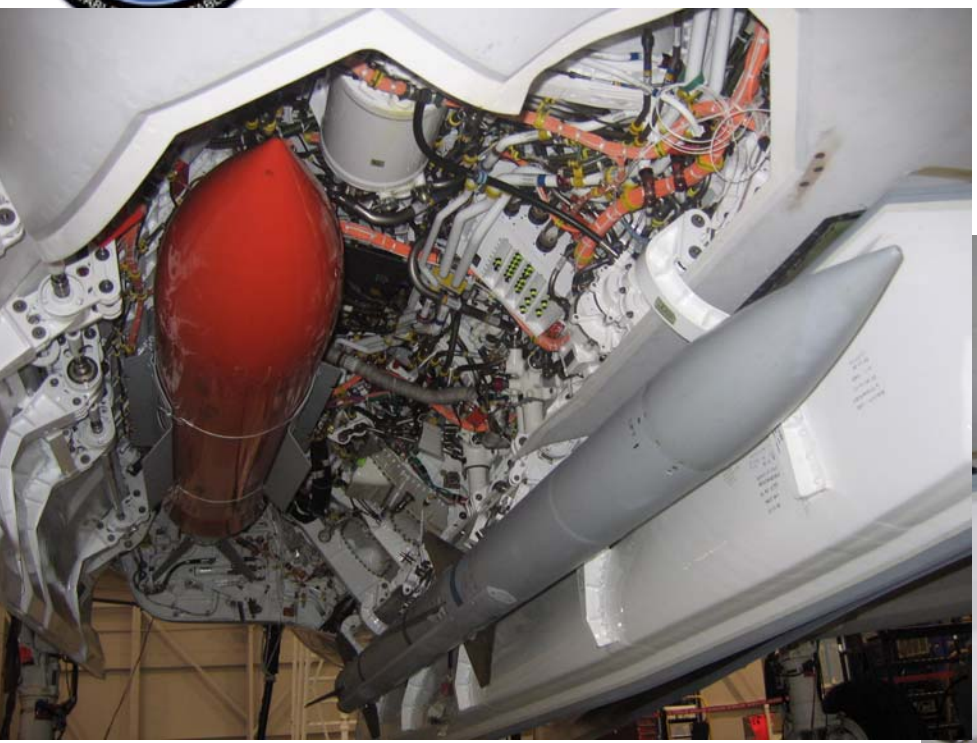
AME Hardware

BF-1 AME Complete - SCT/GVT With
AMRAAM, GBU-32 & Ext AIM-9X Completed

Flight Clearance

AA-1 Cleared for Captive Weapon Carriage

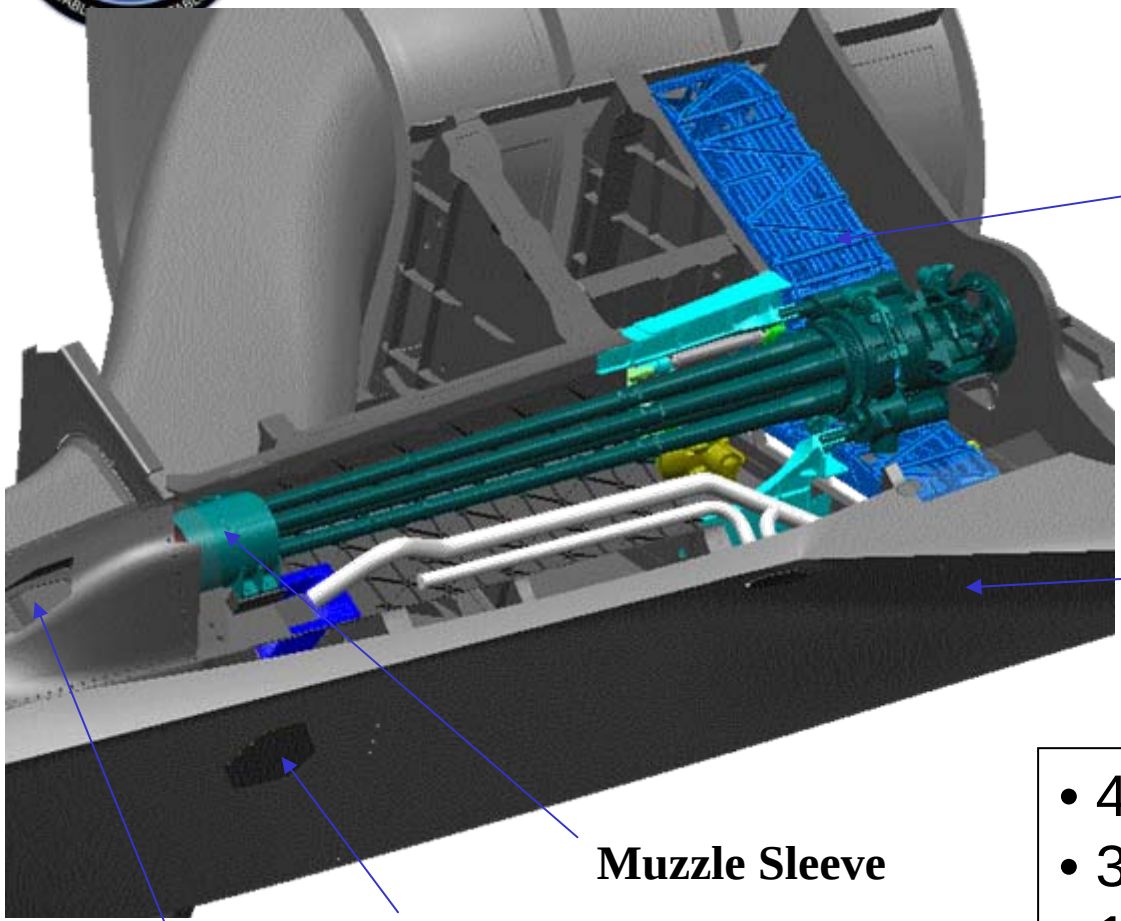
Weapons Installed/Flown on AA-1



Loaded Inert AMRAAM & GBU-31/32

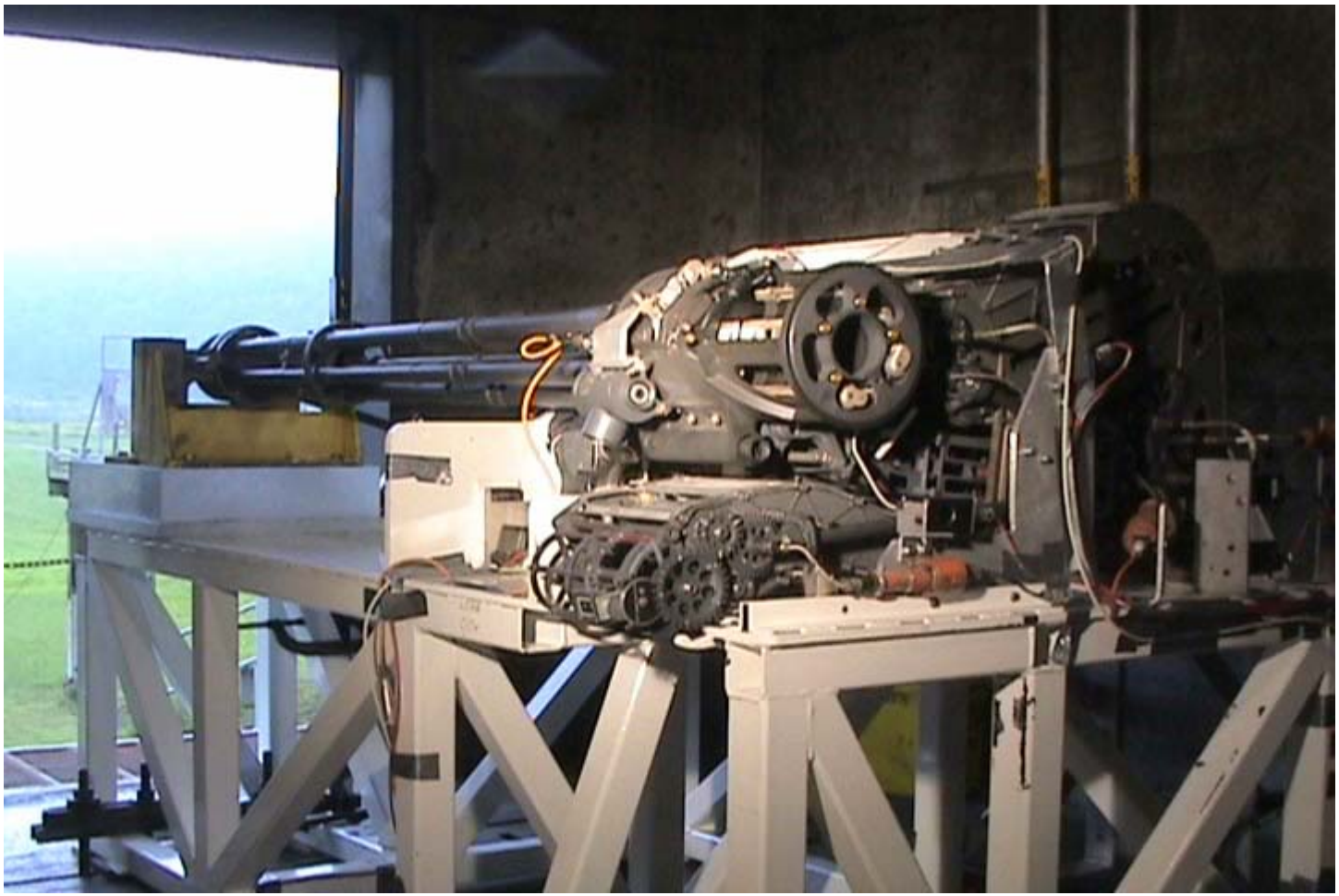
BF-1 Fit Check: 1000lb JDAM, AMRAAM

CTOL Gun System Installation
General Dynamics GAU-22 25mm Gun



- 4 Barrel 25mm Gatling gun
- 3000 SPM firing Rate
- 182 Rounds PGU-20 (DU)
- Hydraulic Drive

GAU-22; 30 Round Burst



Questions?

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Director, Air Vehicle
F-35 Lightning II Program Office
John.martins@jsf.mil

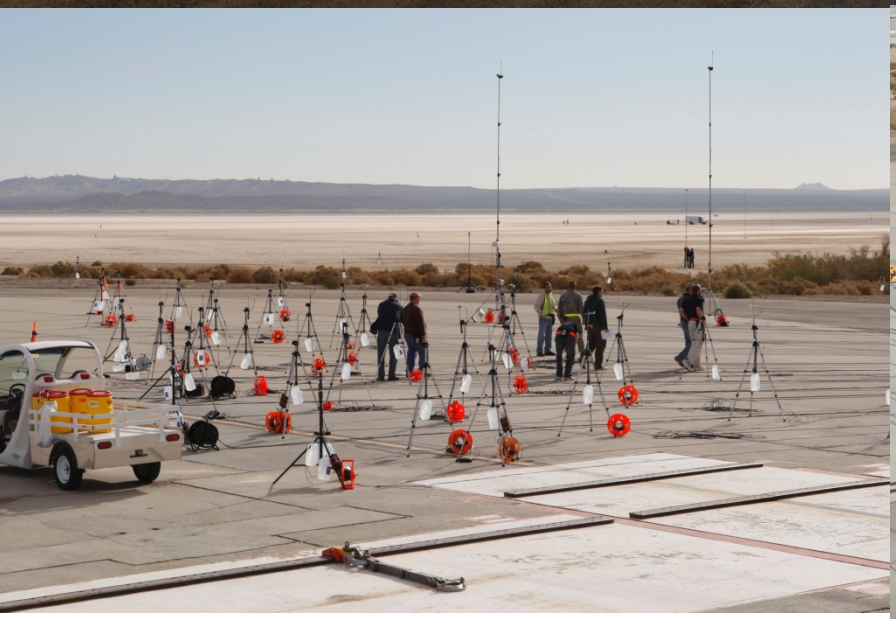
JSF Flight Test Video

JSF Program Video


STOVL
F-35


BF-02

Edwards Noise Testing
Ground Run-Up Photos



Edwards Noise Testing
Flyover Photos