War-Winning Capabilities … On Time, On Cost

Digital Engineering 3D Scanned Models for Airborne Instrumentation

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Presenter

- Joseph Lopez
  - JT4 CANIS Design
  - Mechanical Engineer
  - 7 years

- Receiver Simulation Tool
- KC-46 ARASQ
- 419th Bombers B-52H

Overview

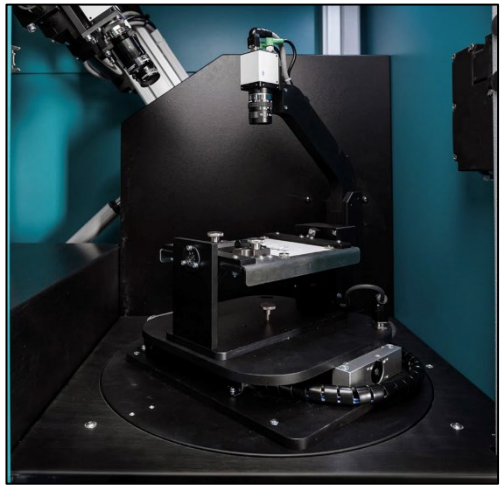
- Need for Digital Models for Instro Design
- 3D Scanners
- Scanned Product to CAD Model
- Aircraft Bay Scans
  - Successes/Benefits
  - Limitations/Lessons Learned
- Concluding Remarks

Need for Digital Models for Instrumentation Design

- The T-2 modification process to instrument aircraft is labor and time intensive, which takes test aircraft away from mission support.
- Utilization of digital engineering tools and processes during the design phase can reduce aircraft downtime, especially for smaller aircraft such as the F-16.
- Accurate 3D scanned models of areas of interest will allow design engineers to perform virtual fit checks without requiring to take aircraft from critical test and training sorties.

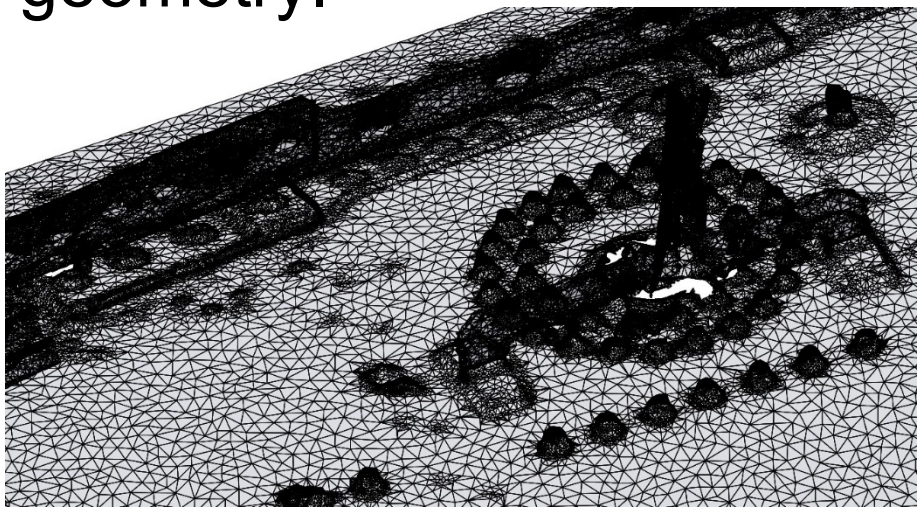
3D Scanners

- Wide variety of products that provide 3D scanned models.



Scanned Product to CAD Model

- Scanner software can export the 3D point cloud data into an Initial Graphics Exchange (IGS) format,
  - Graphics file saved in a 2D/3D vector format.
- Or a Stereolithography (STL) format.
  - A series of linked triangles that describe the surface geometry.



Aircraft Bay Scans

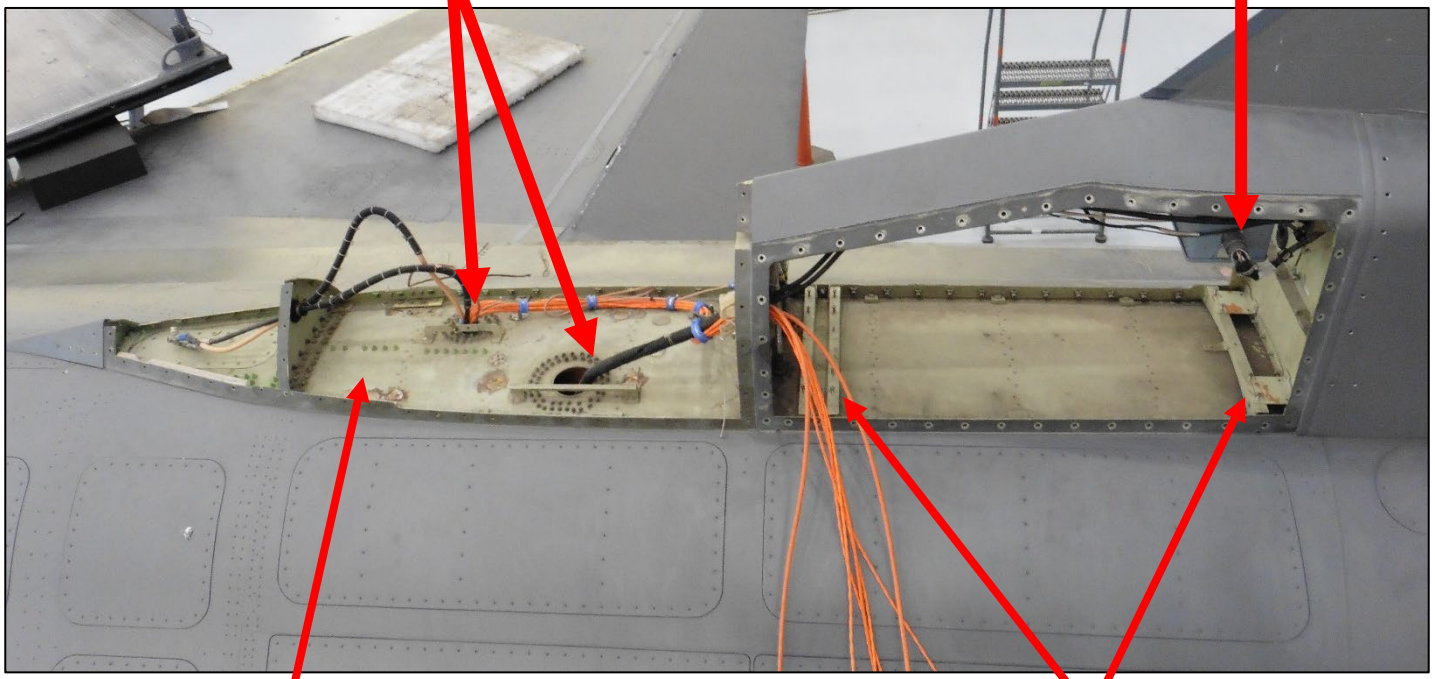
- Recently, 3D point cloud scans of interior bays of the F-16 have been captured and processed.
- The STL files were converted to compatible formats in SolidWorks to import into assembly models.
- The next set of slides feature images of the empty interior bays of the F-16, the scanned products shown in SolidWorks, and the imported assembly model for the installations of each bay.

F-16 Dorsal Bay

Wire route paths with structure

ACFT Production LRU

FWD

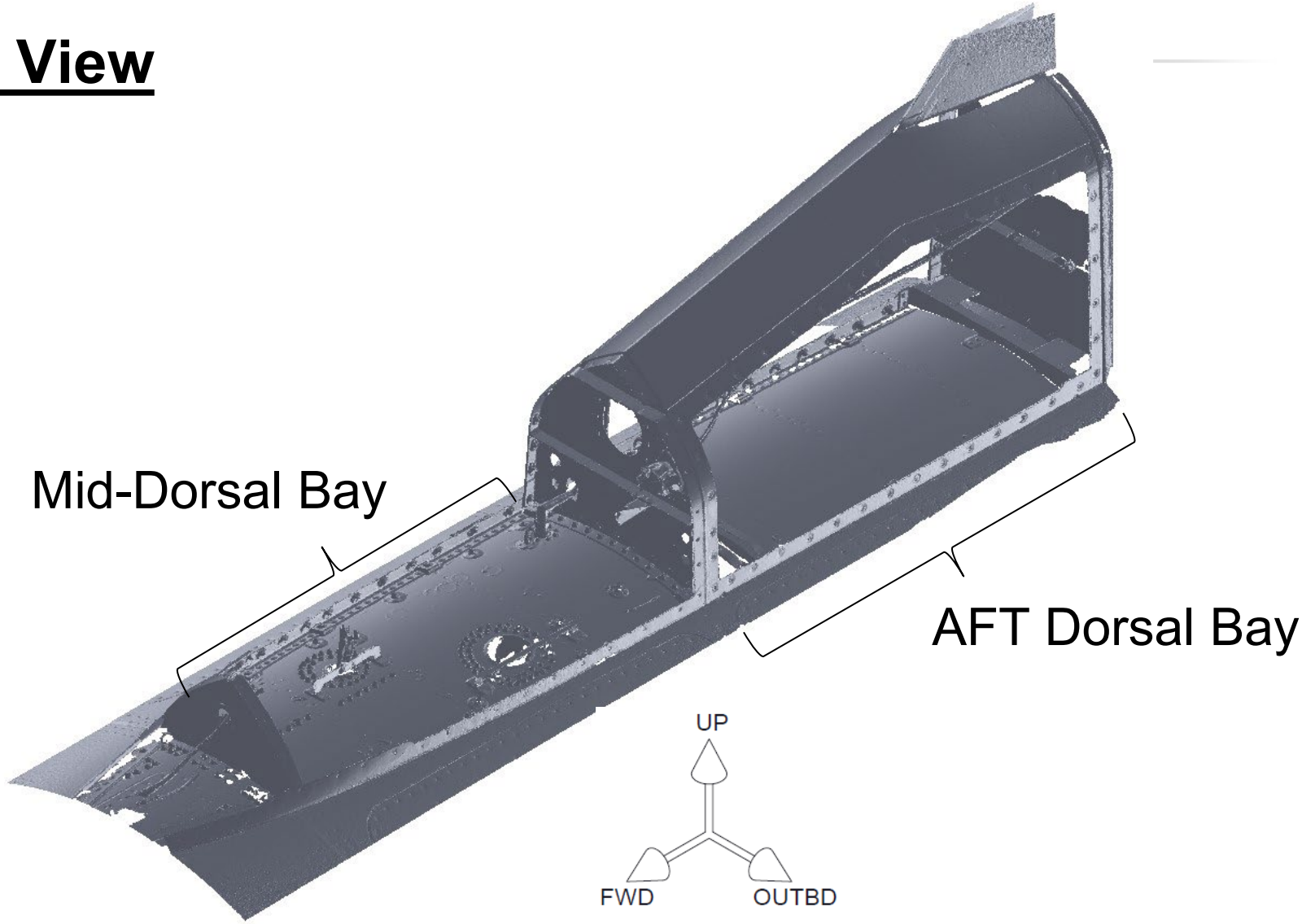


Mid-Dorsal Bay with space to install bonded studs

AFT Dorsal Bay with mounting structure

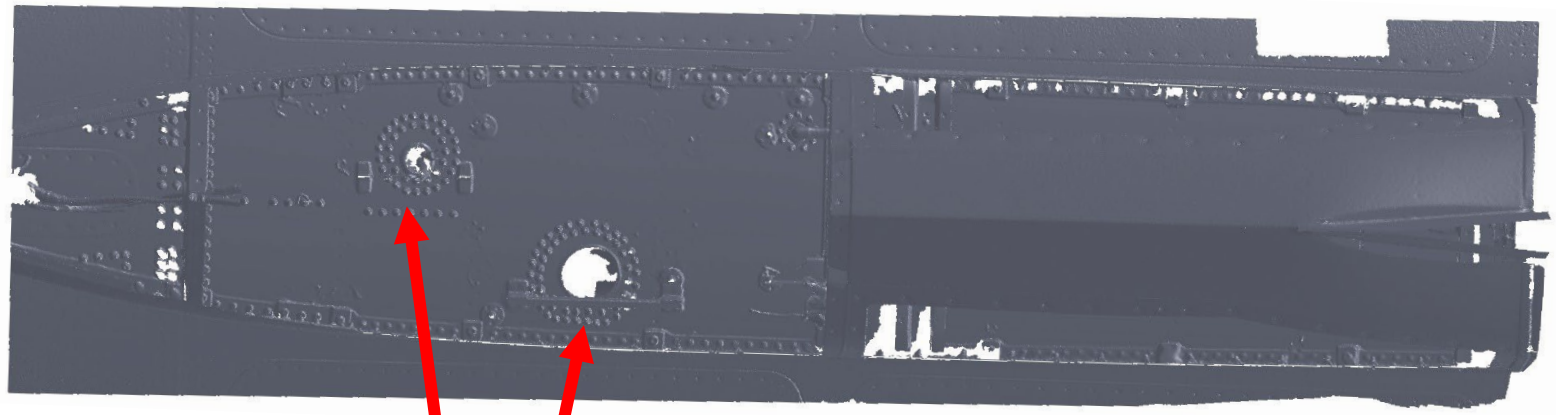
F-16 Dorsal Bay - Scan

ISO View



F-16 Dorsal Bay - Scan

Top View

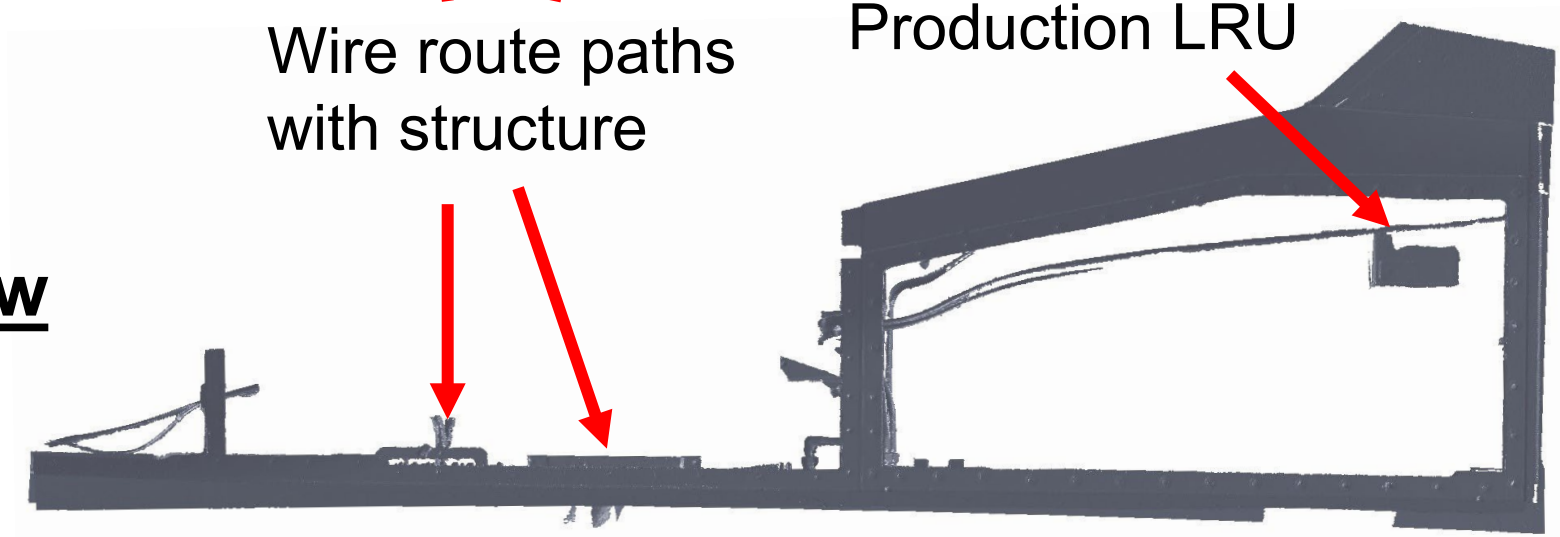


FWD

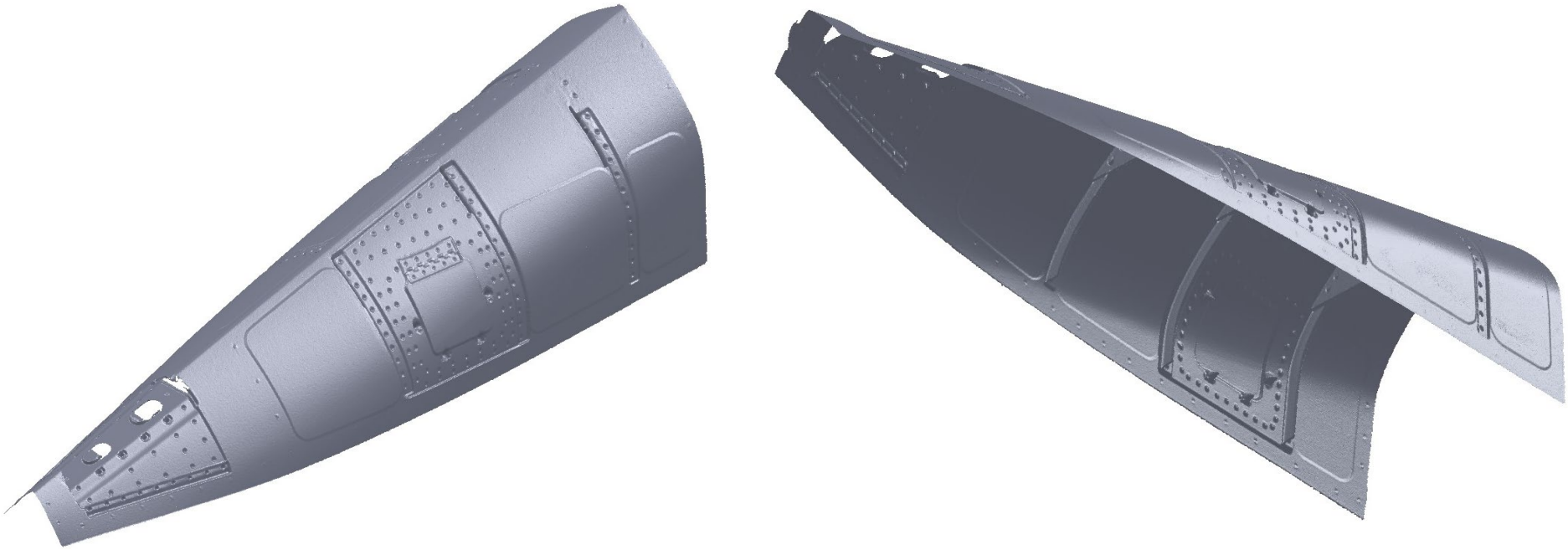
Wire route paths with structure

Production LRU

Side View

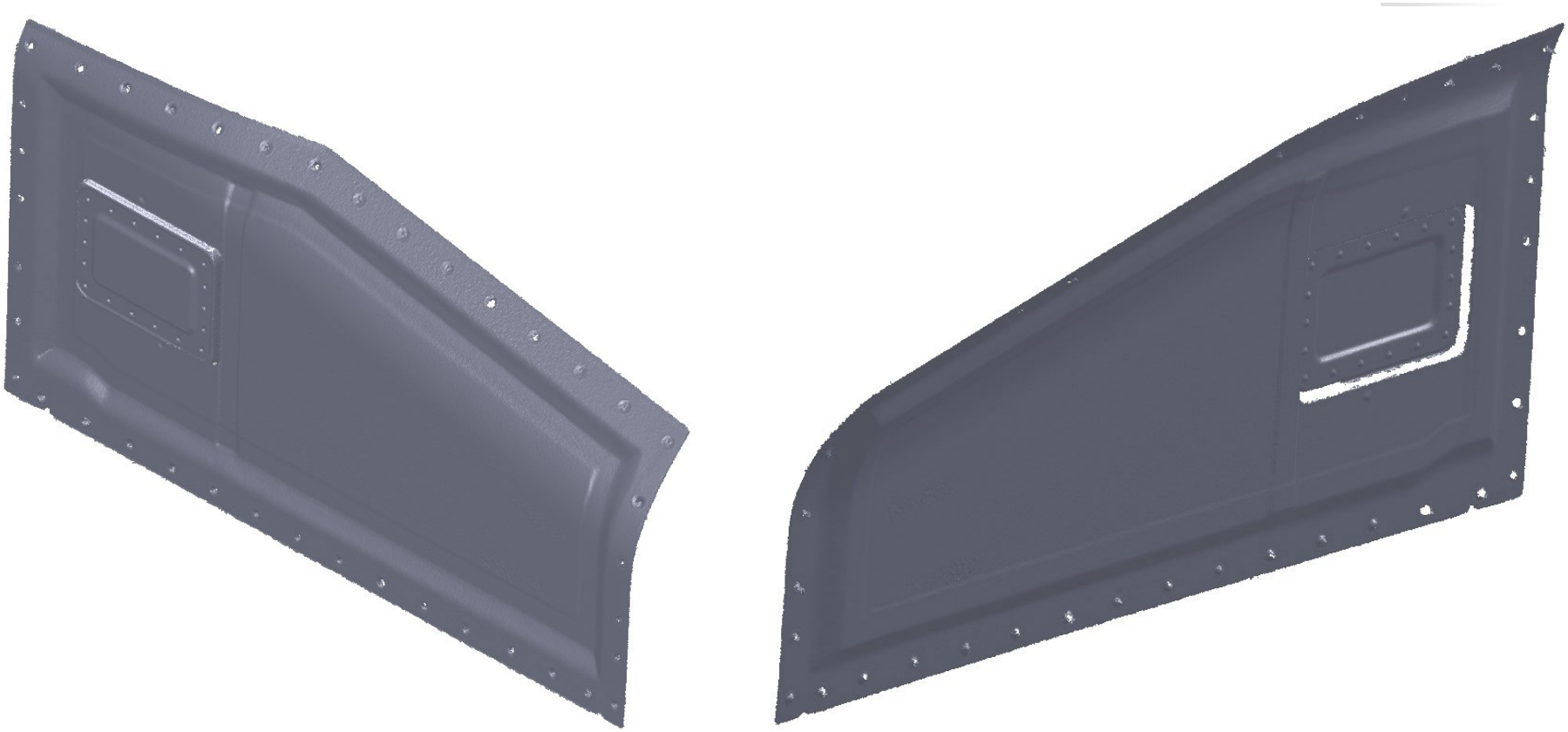


F-16 Dorsal Bay - Scan



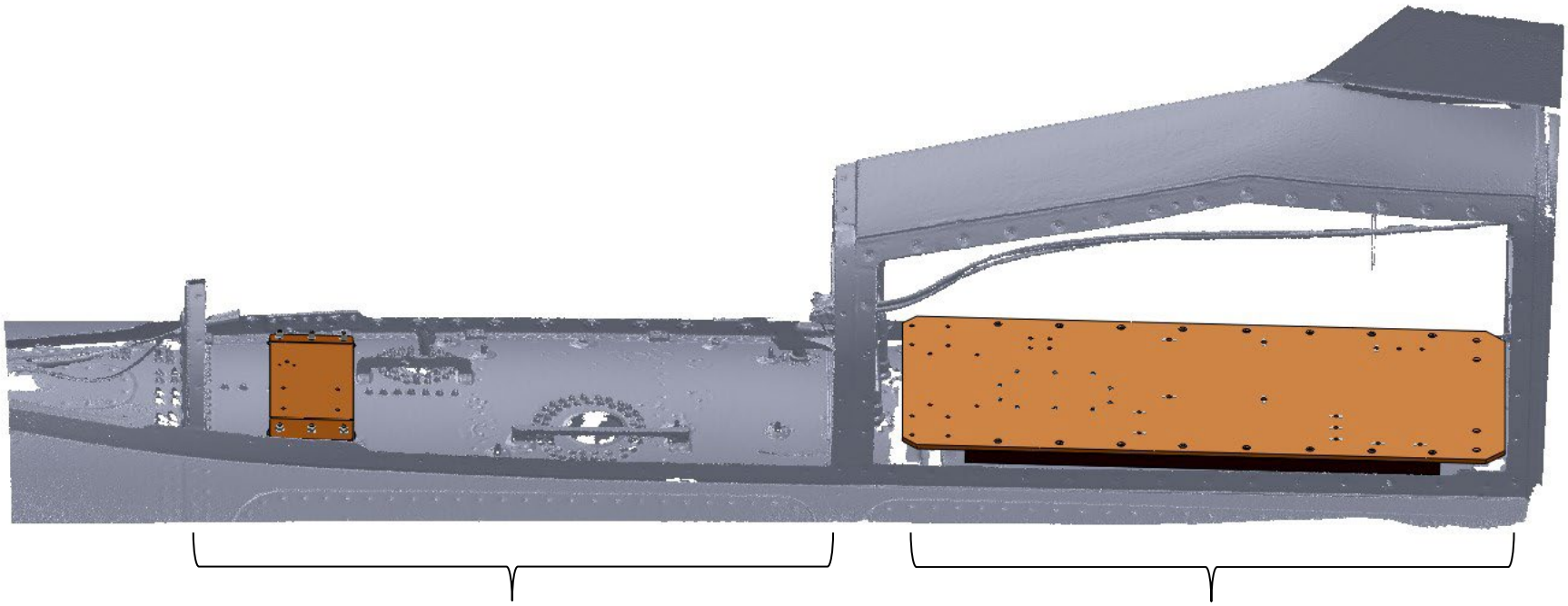
FWD to Mid Dorsal Bay Cover

F-16 Dorsal Bay - Scan



AFT Dorsal Bay Access Panel

F-16 Dorsal Bay - Install

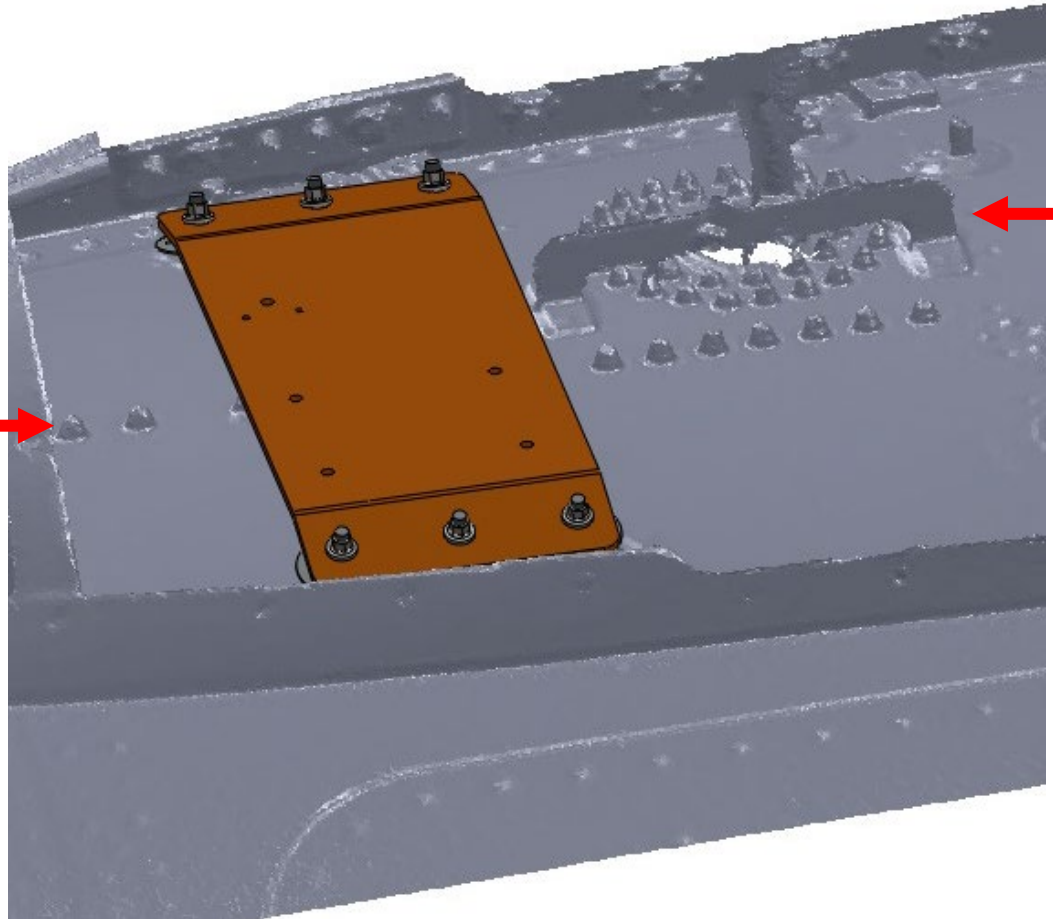


Mid-Dorsal Bay Installation

AFT Dorsal Bay Installation

F-16 Dorsal Bay - Install

Mid-Dorsal Bay Installation

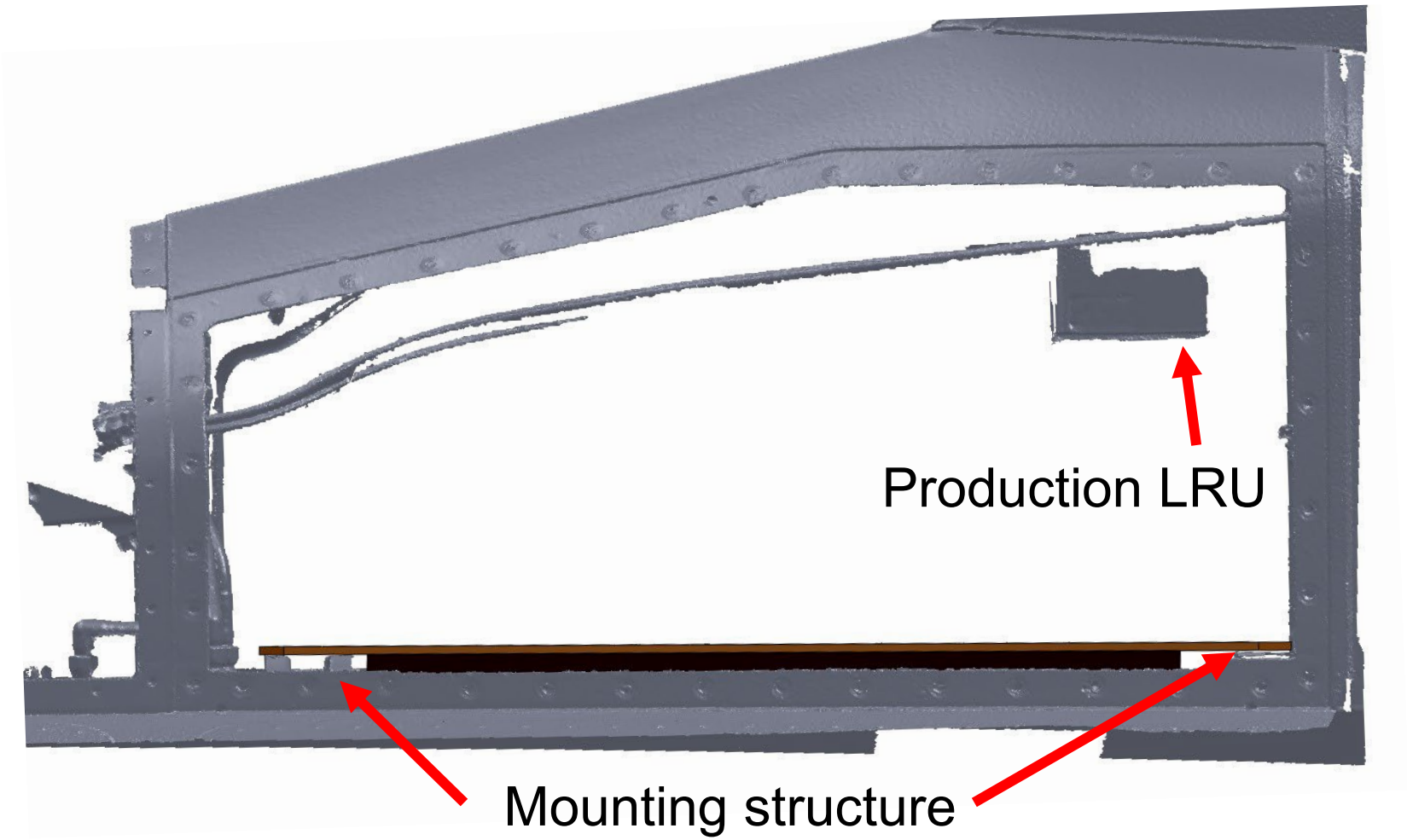


Wire route

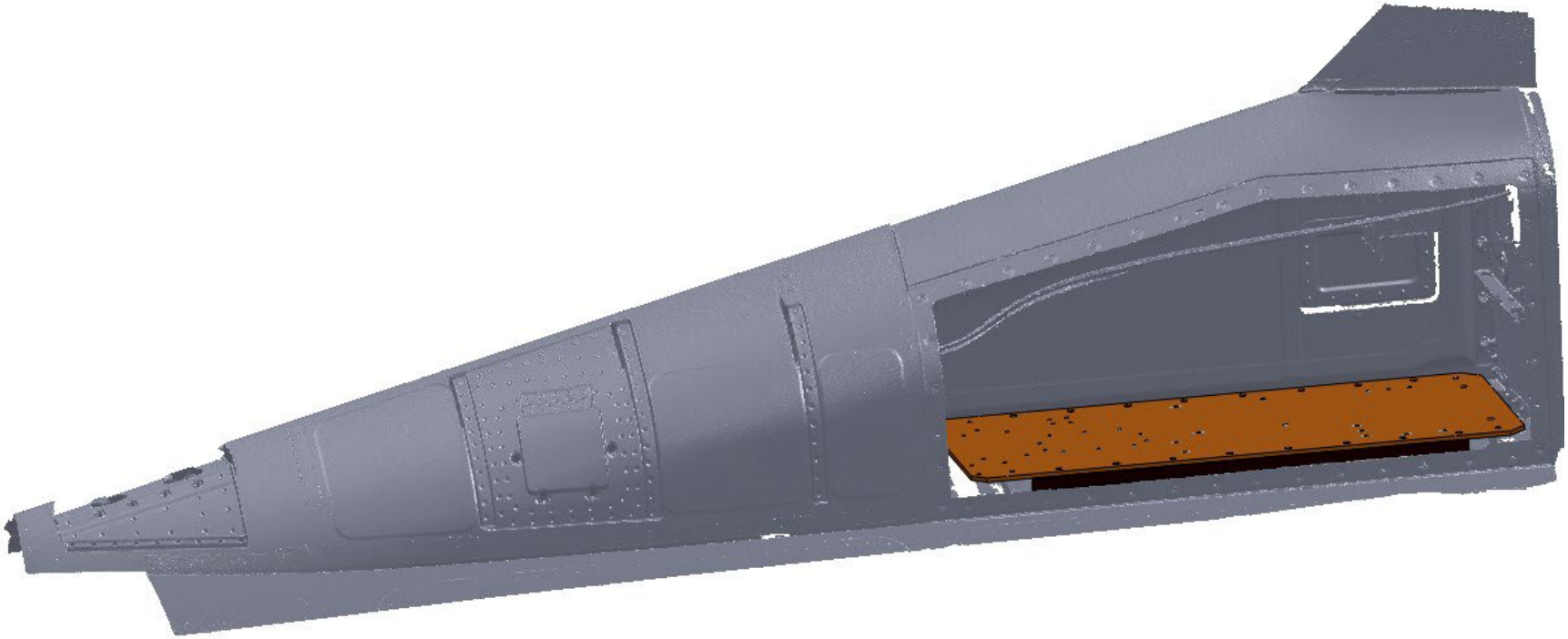
Row of fasteners

F-16 Dorsal Bay - Install

AFT Dorsal Bay Installation



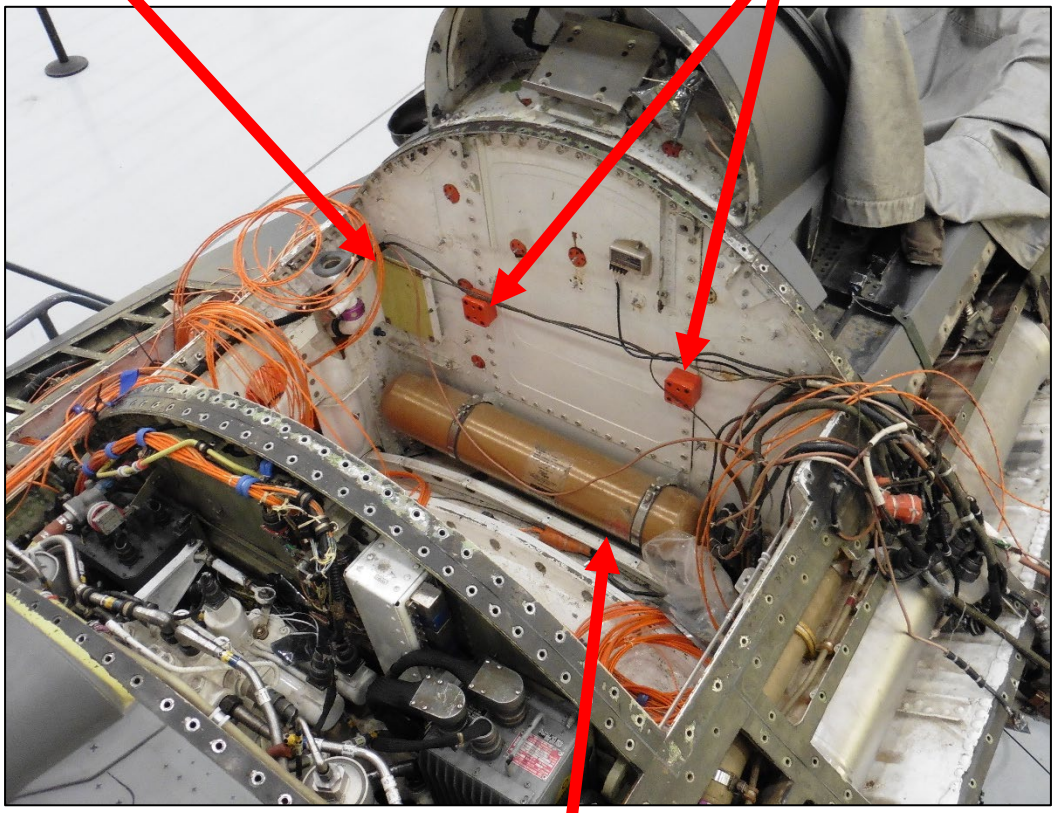
F-16 Dorsal Bay - Install



F-16 Ammo Drum Bay

Production Tray Mount

Structure Mounts

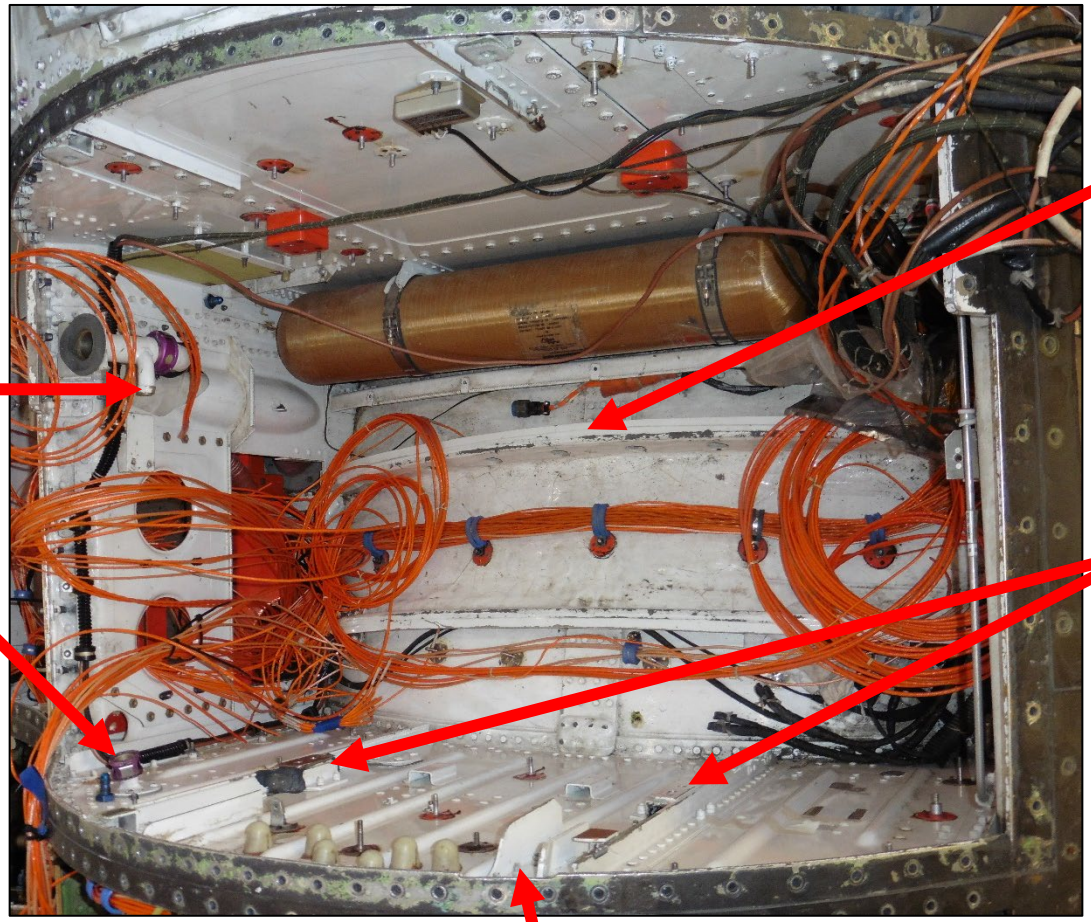


UP

FWD

Nitrogen Bottle

F-16 Ammo Drum Bay



Production Line (not shown)

Curved Duct and extrusions

Structure Mounts

Structure Flanges

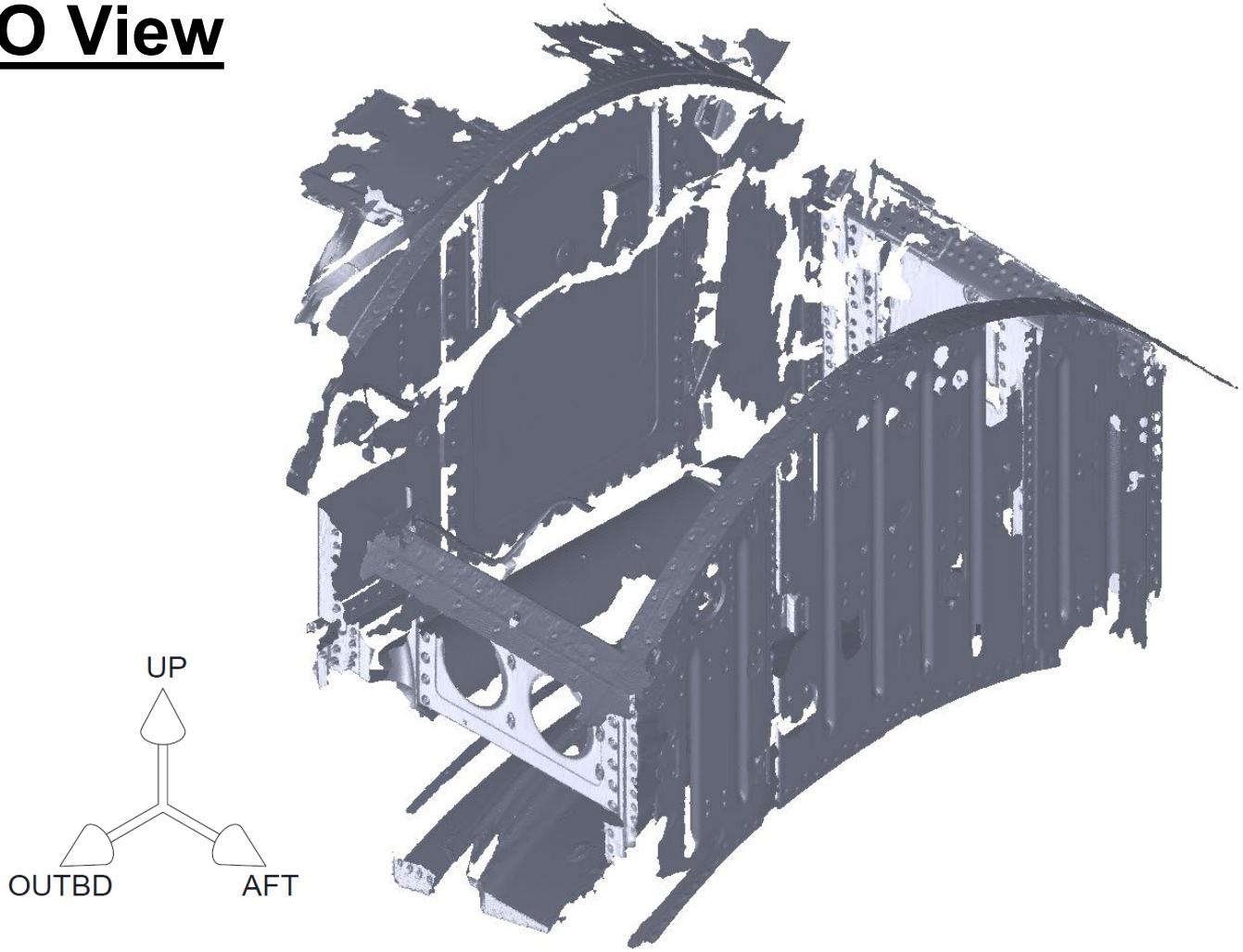
FWD

OUTBD

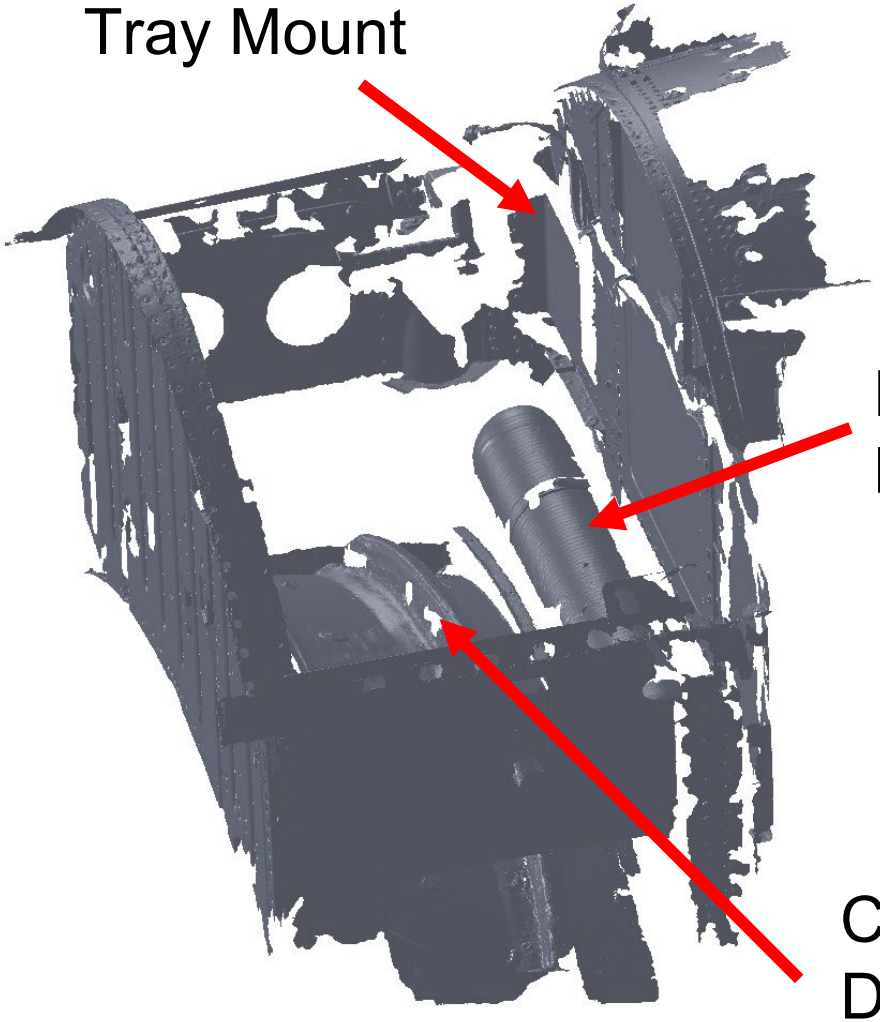
VIEW LKG DOWN

F-16 Ammo Drum Bay - Scan

ISO View



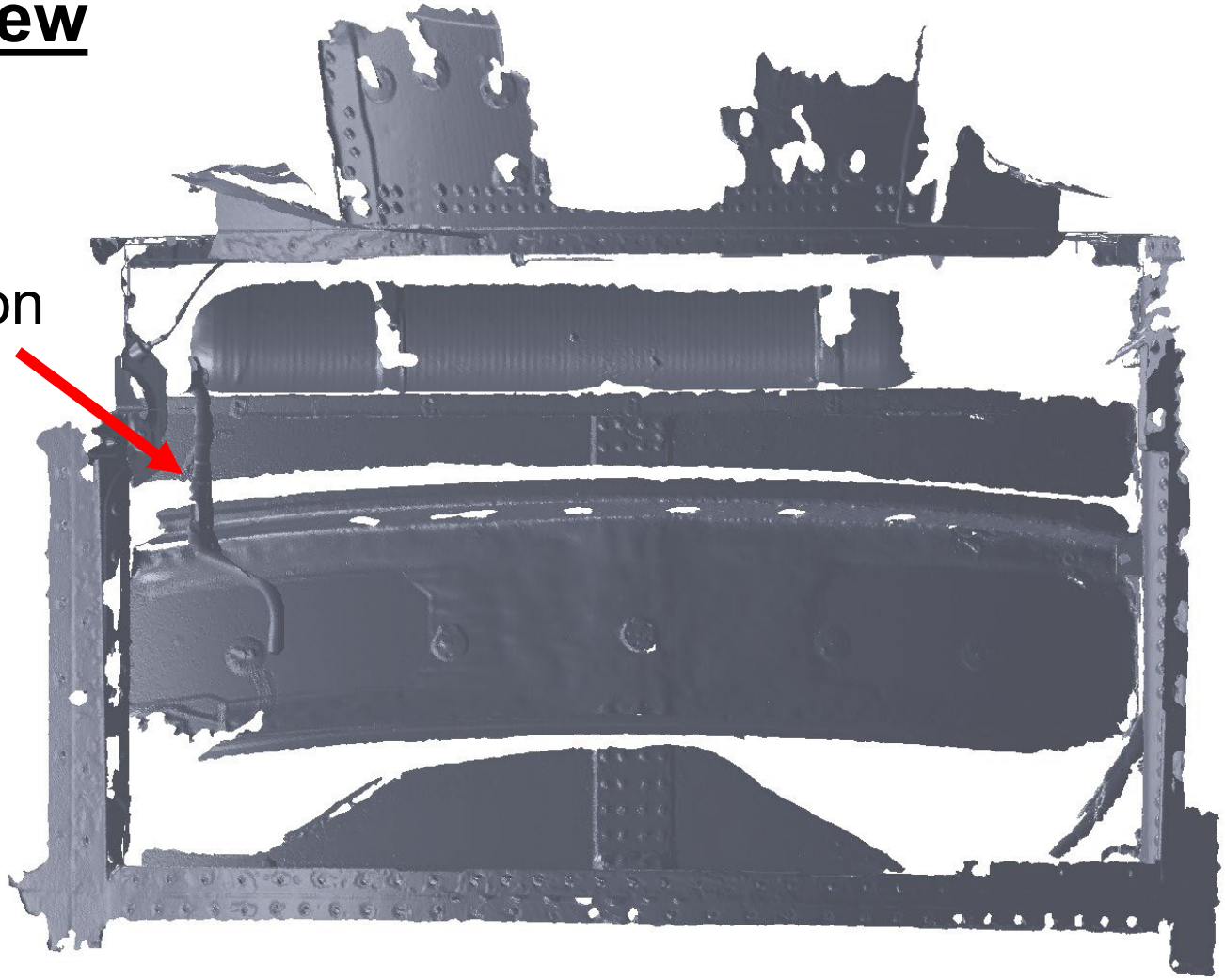
F-16 Ammo Drum Bay - Scan



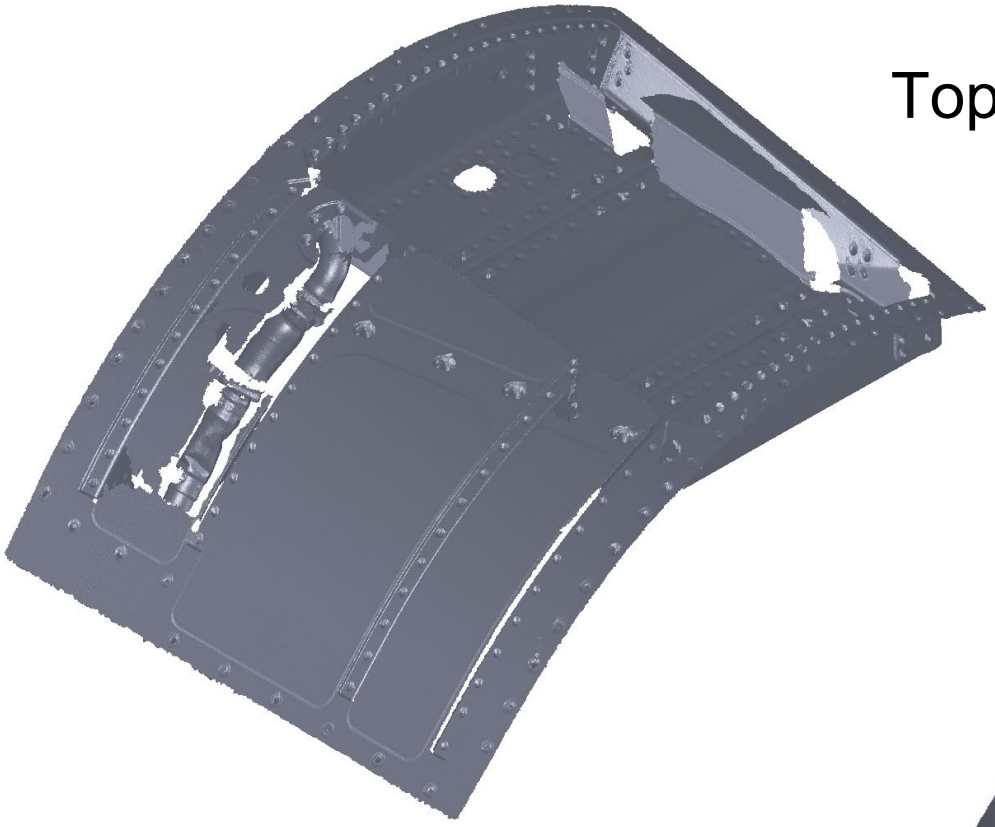
F-16 Ammo Drum Bay - Scan

Top View

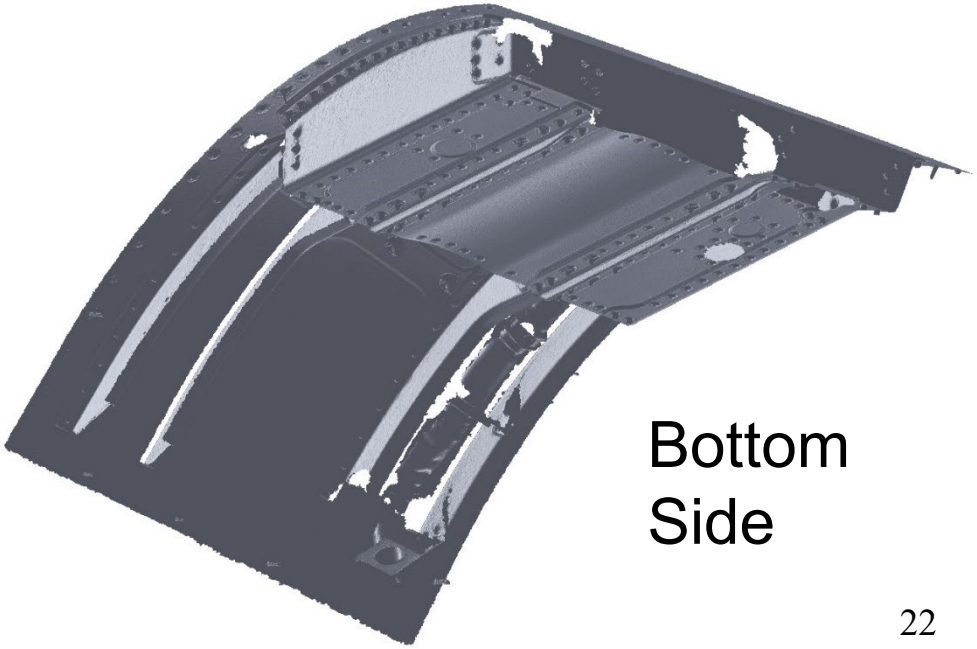
Production Line



F-16 Ammo Drum Bay - Scan



Top Side

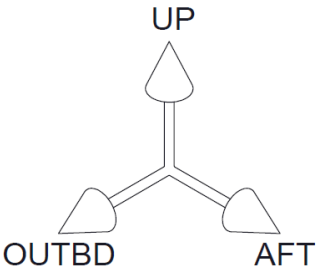


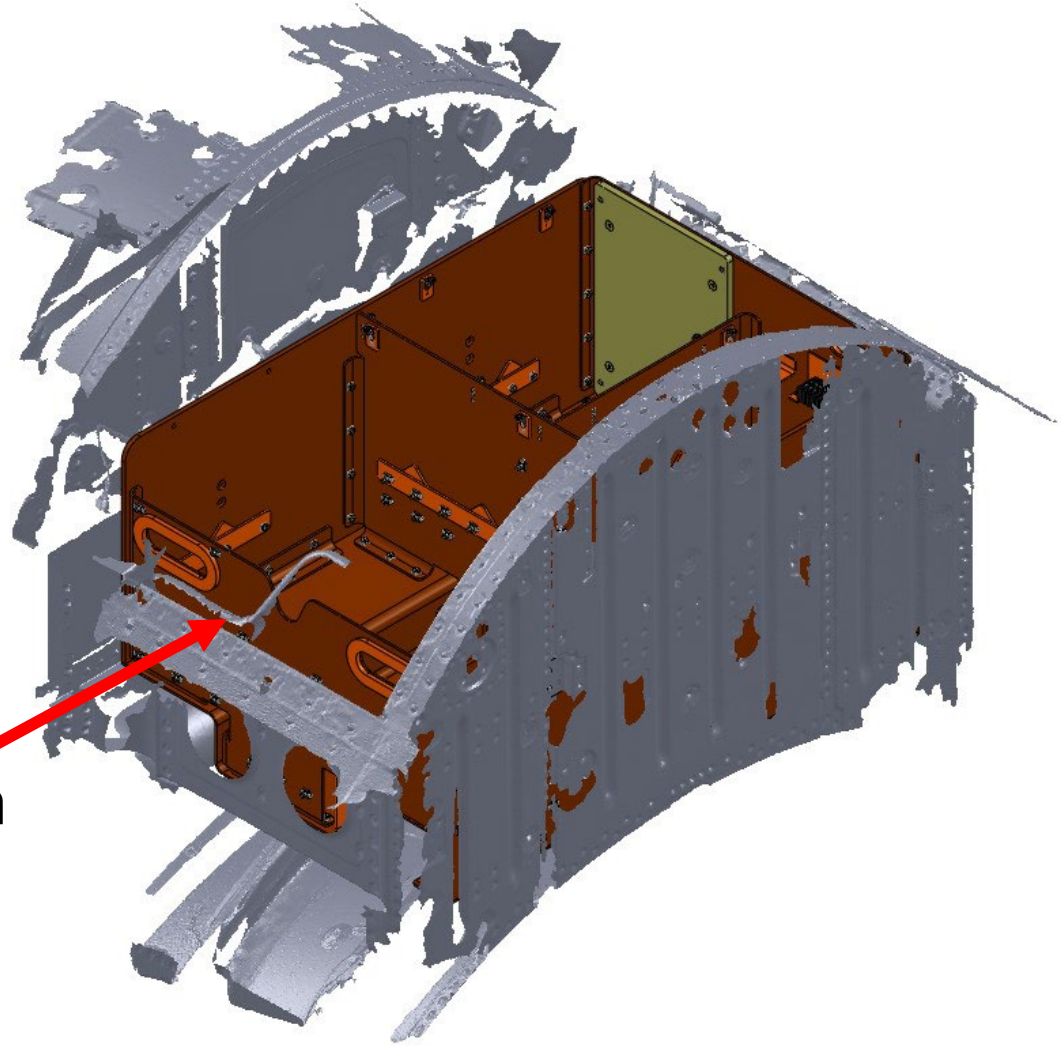
Bottom Side

Ammo Drum Bay Cover

F-16 Ammo Drum Bay - Install

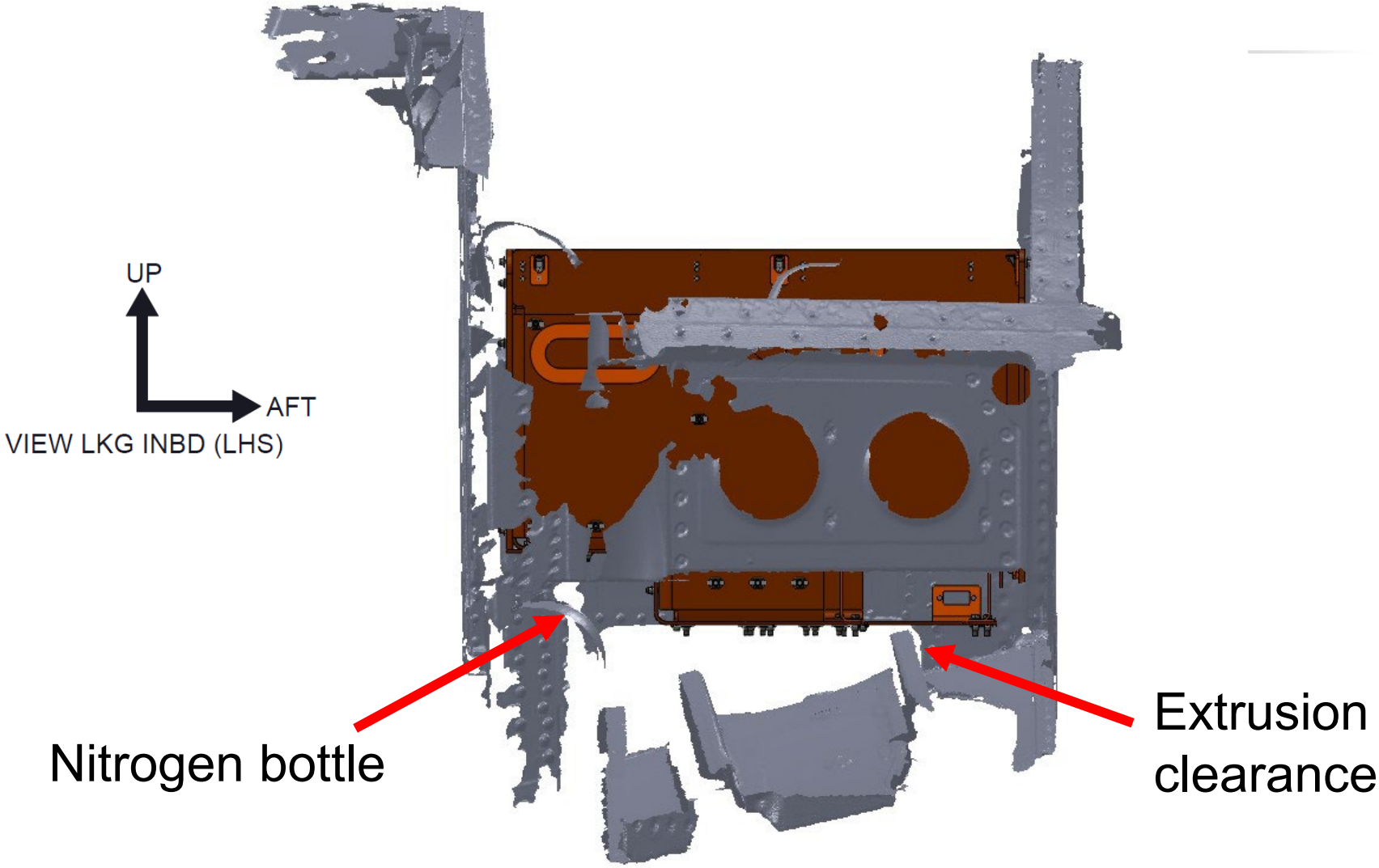
ISO View



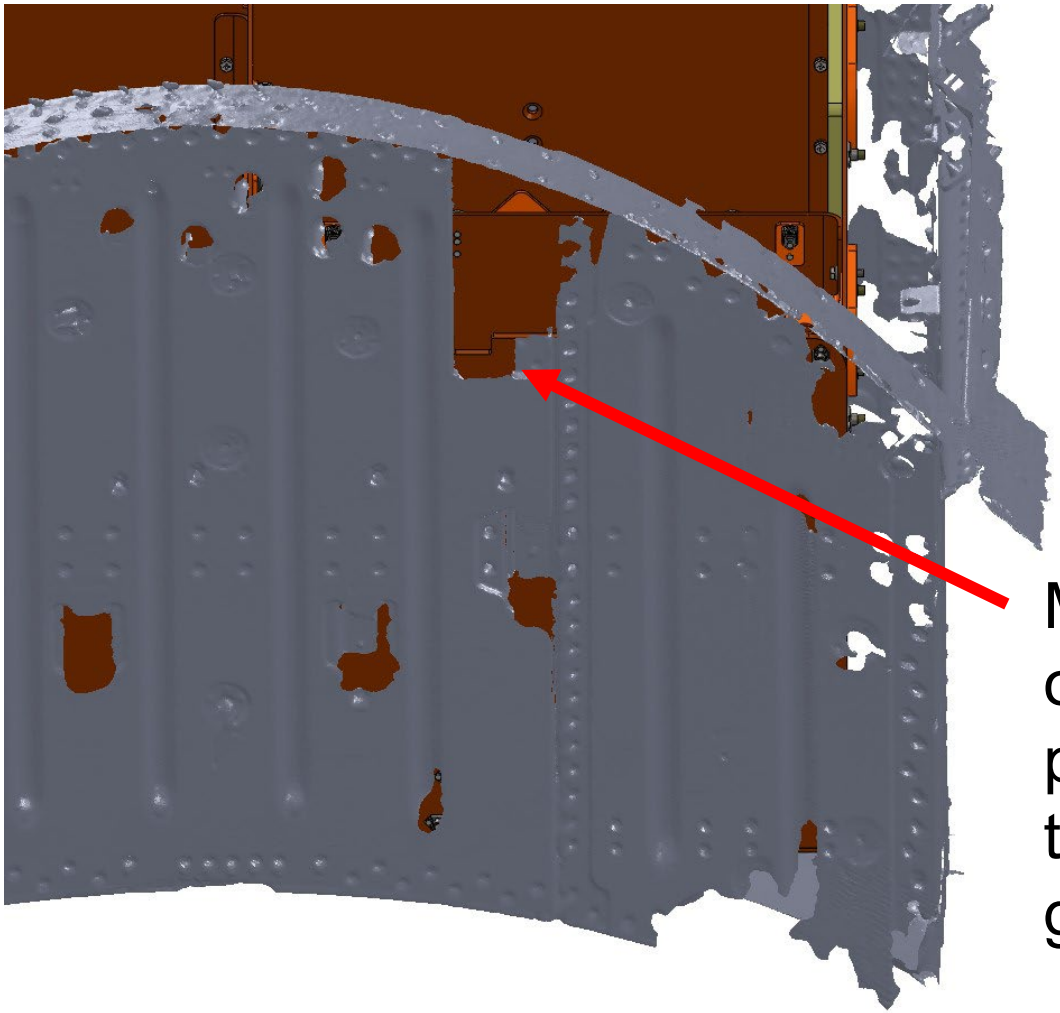


Production Line

F-16 Ammo Drum Bay - Install



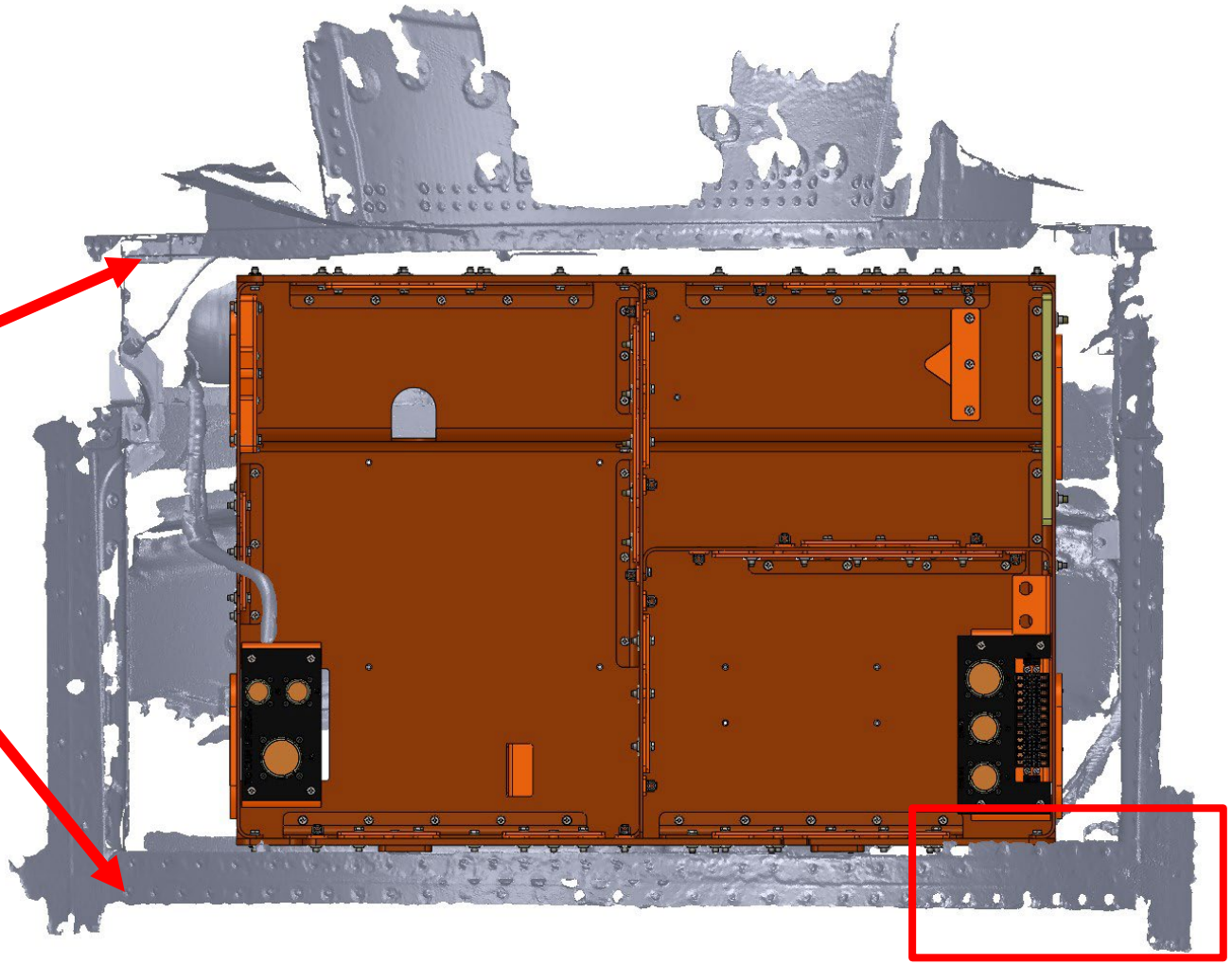
F-16 Ammo Drum Bay - Install



Missing patch of data, possibly due to white glossy paint

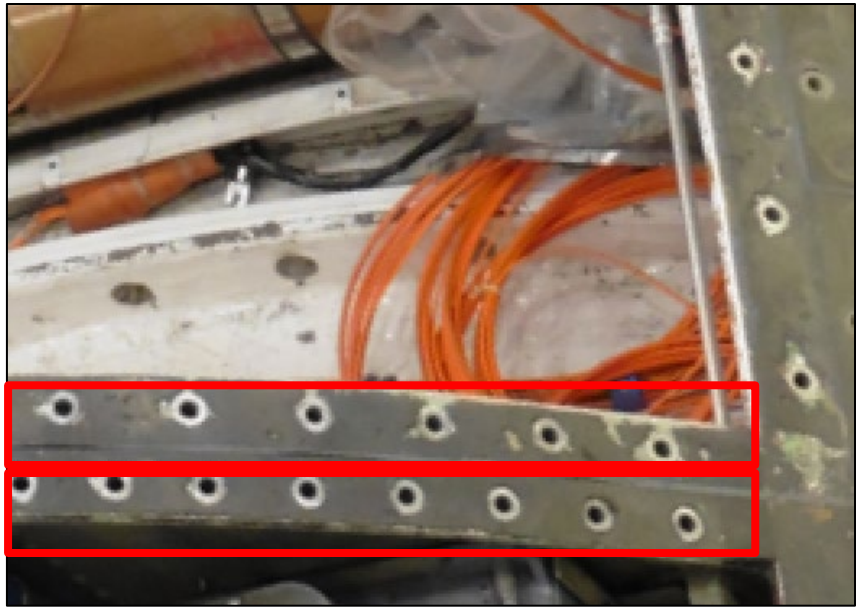
F-16 Ammo Drum Bay - Install

Slightly slanted from one another

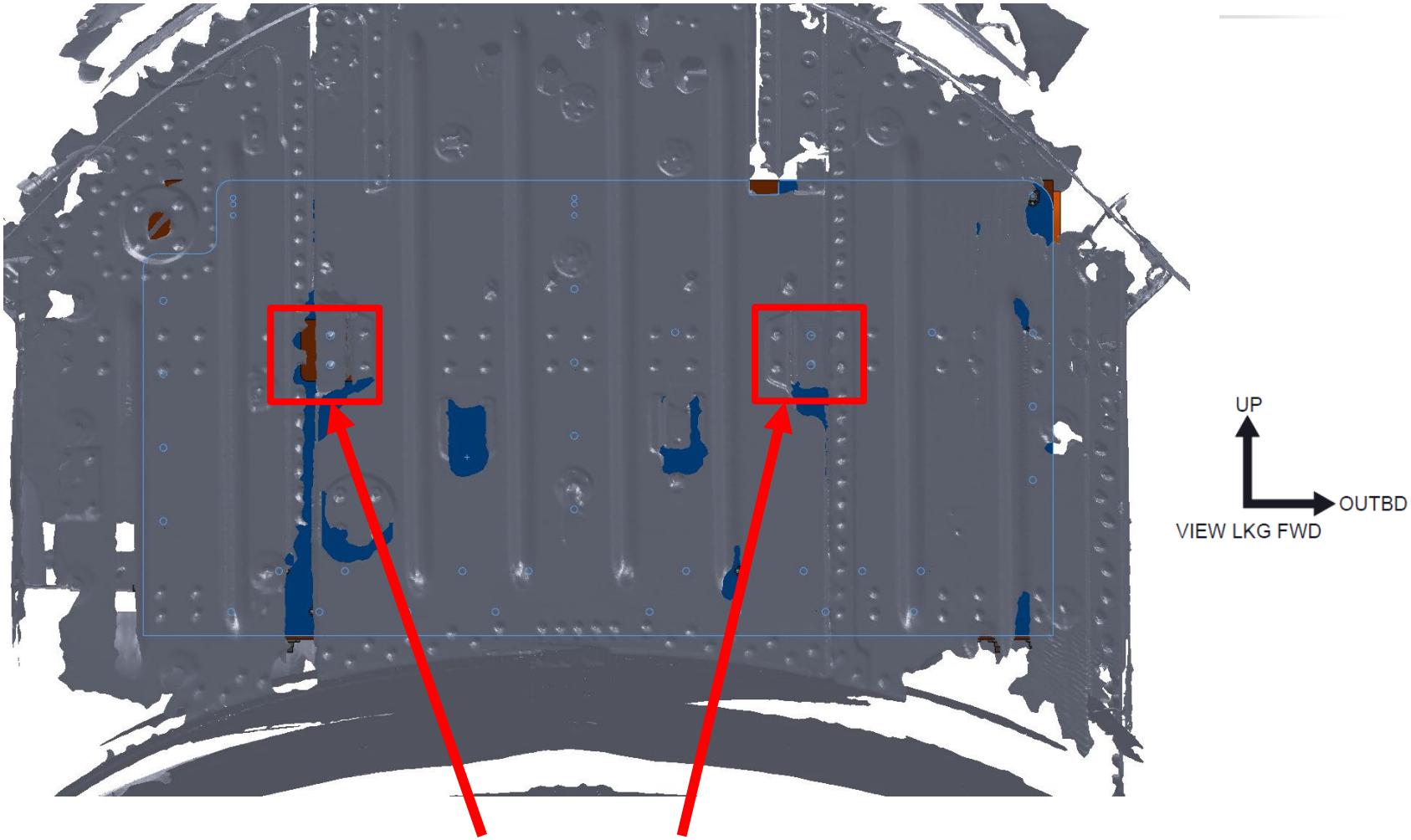


F-16 Ammo Drum Bay - Install

Extra row of fasteners

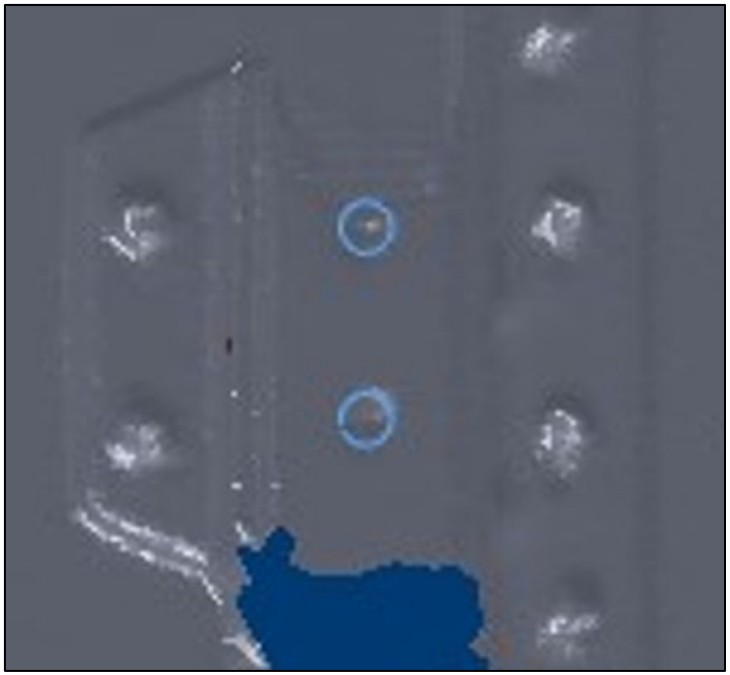


F-16 Ammo Drum Bay - Install

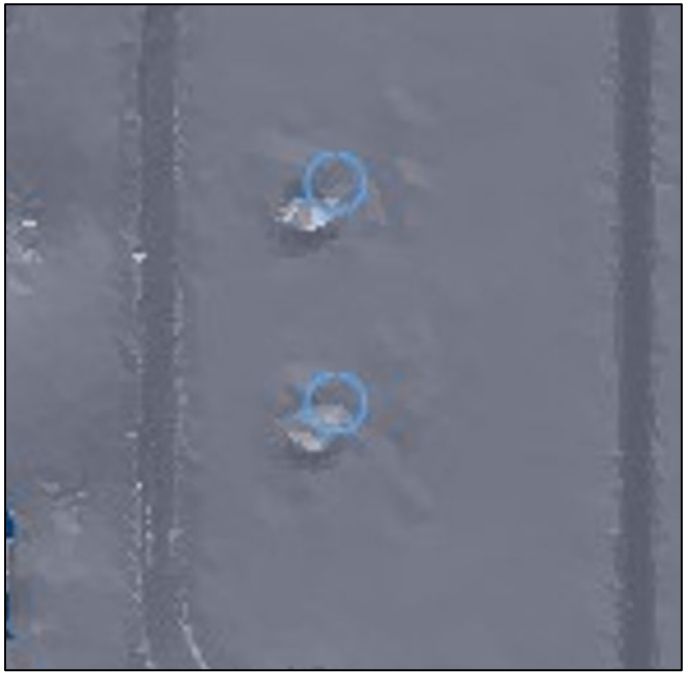


AFT Wall Structure Mounts

F-16 Ammo Drum Bay - Install



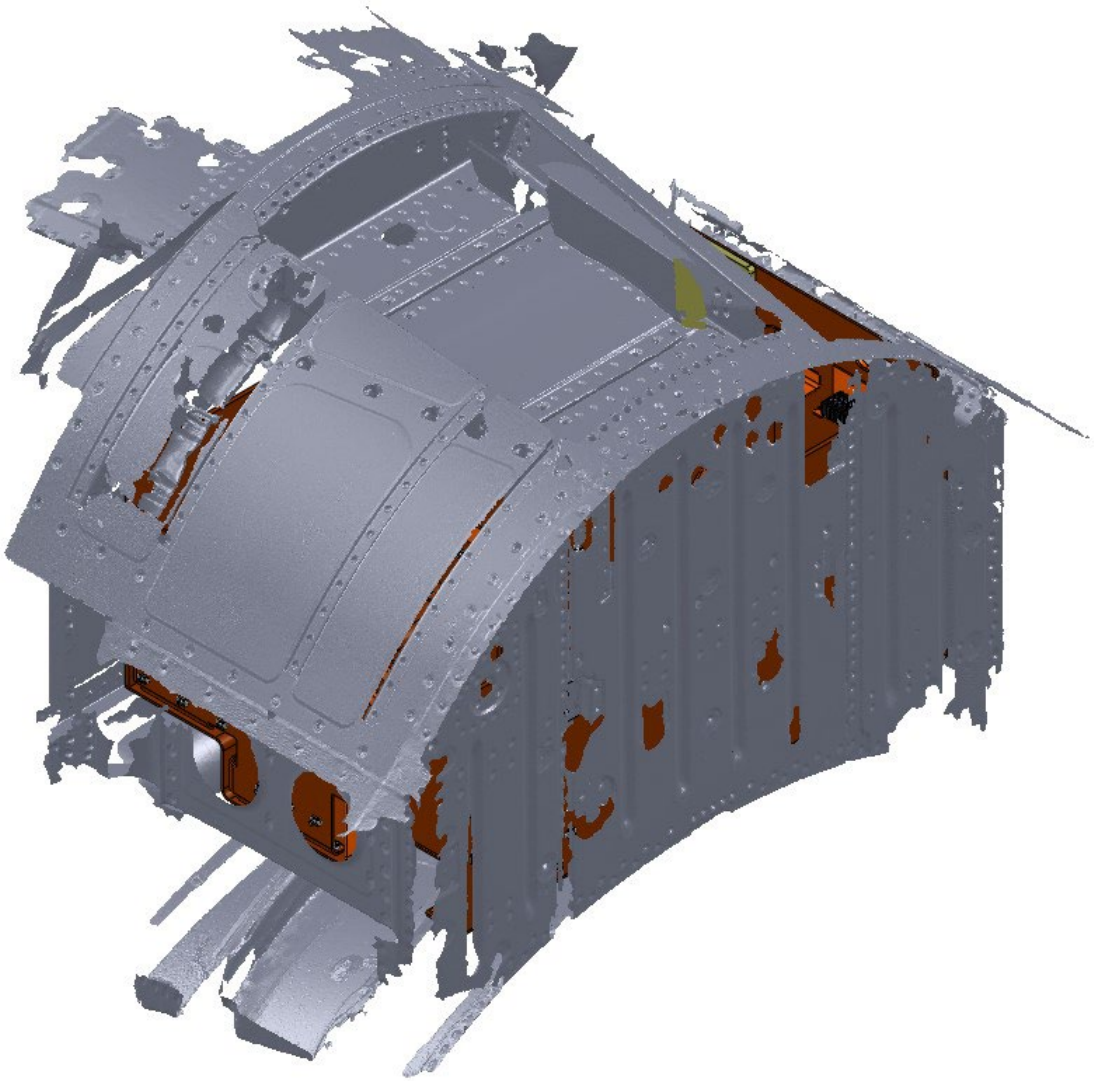
AFT Wall

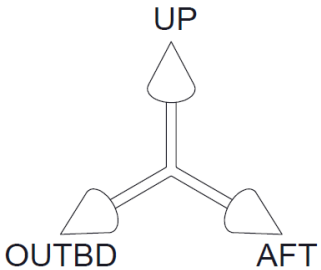


FWD Wall

FWD Wall mounting hole deviation approximately .125” x .125”

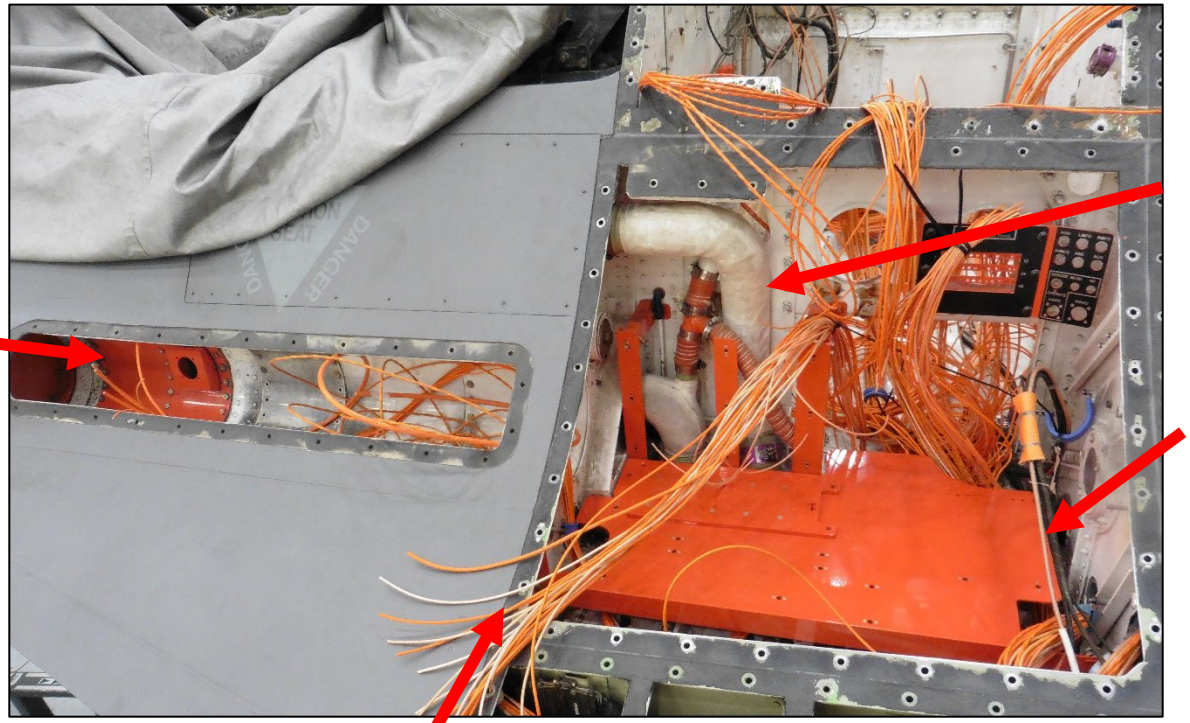
F-16 Ammo Drum Bay - Install





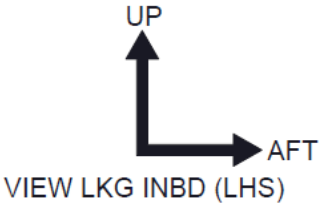
F-16 Gun Breech & Trough

Curved Surface Mount

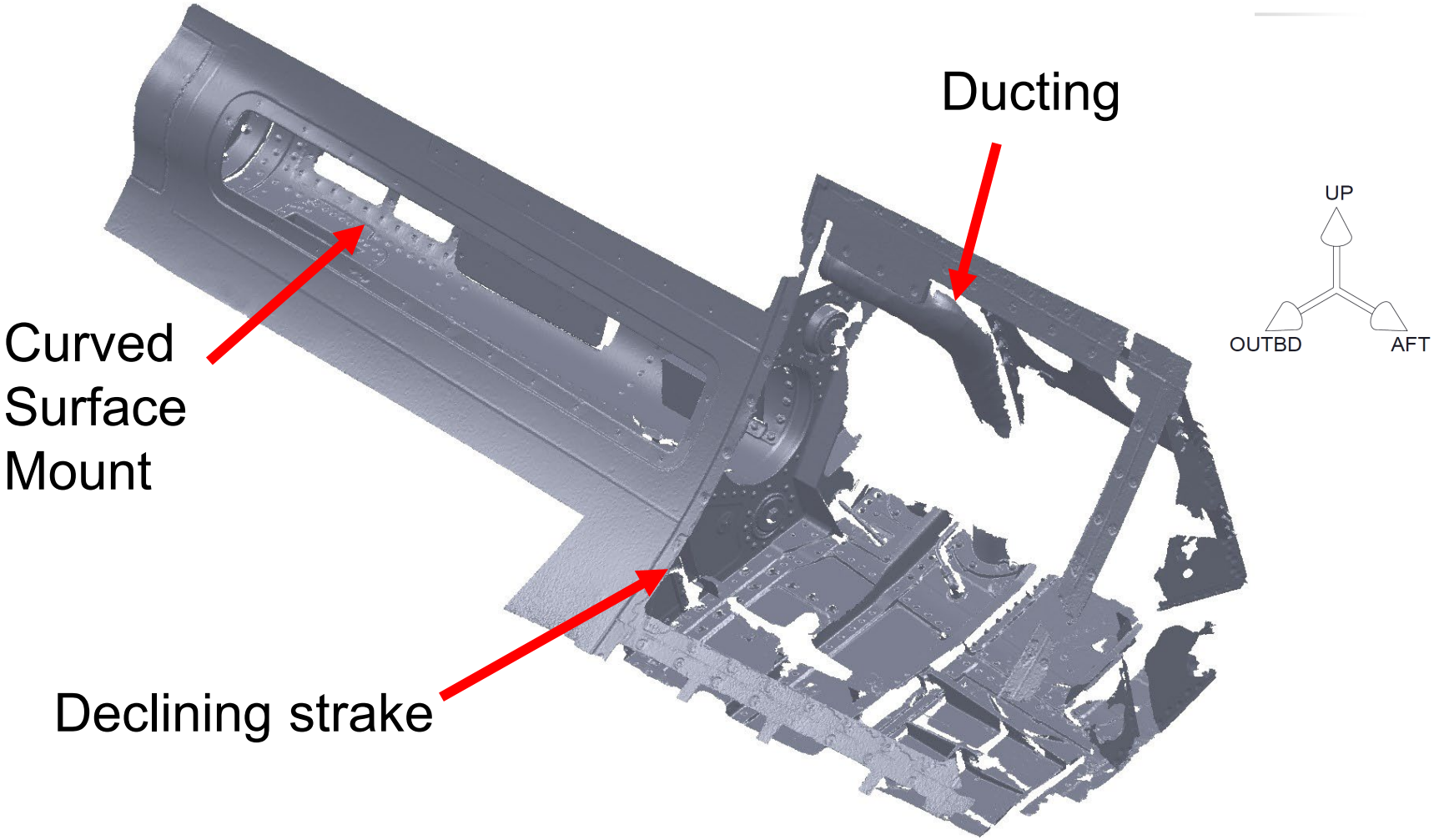


Production ducting and structure attachment points

Limited space due to declining strake



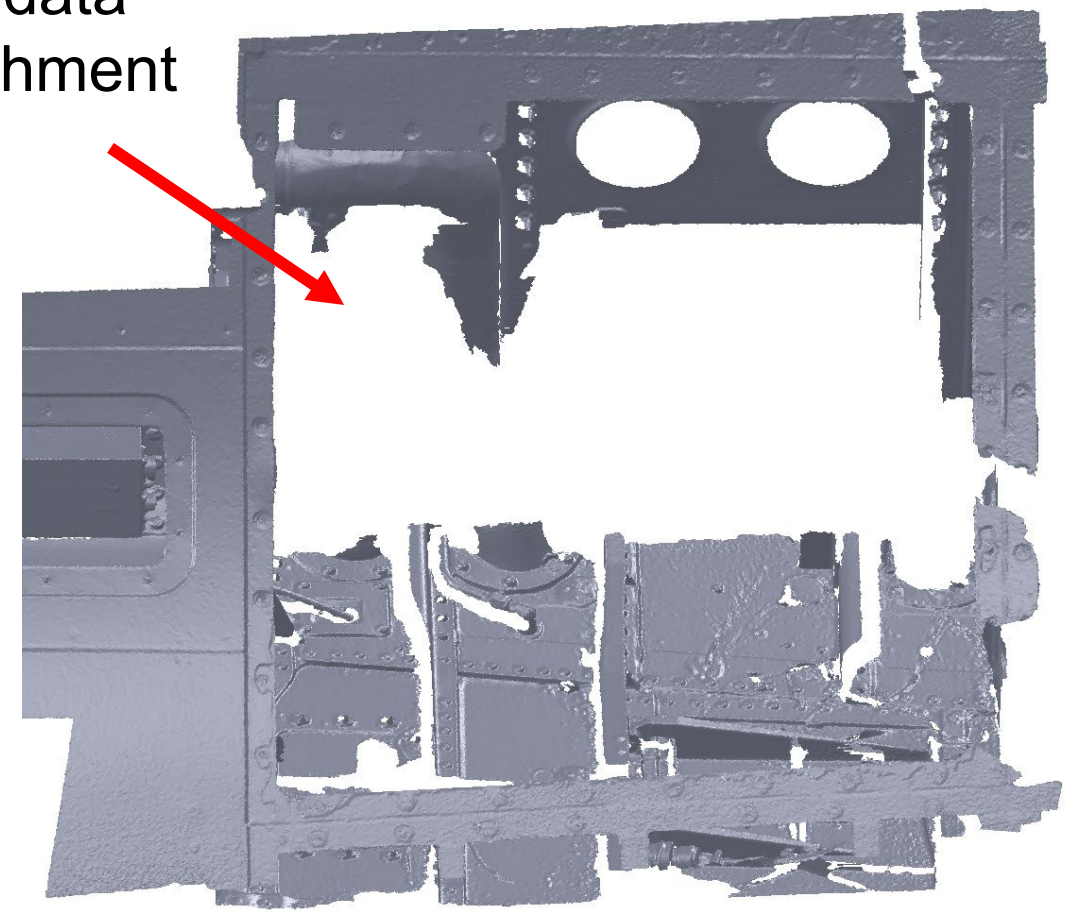
F-16 Gun Breech & Trough - Scan



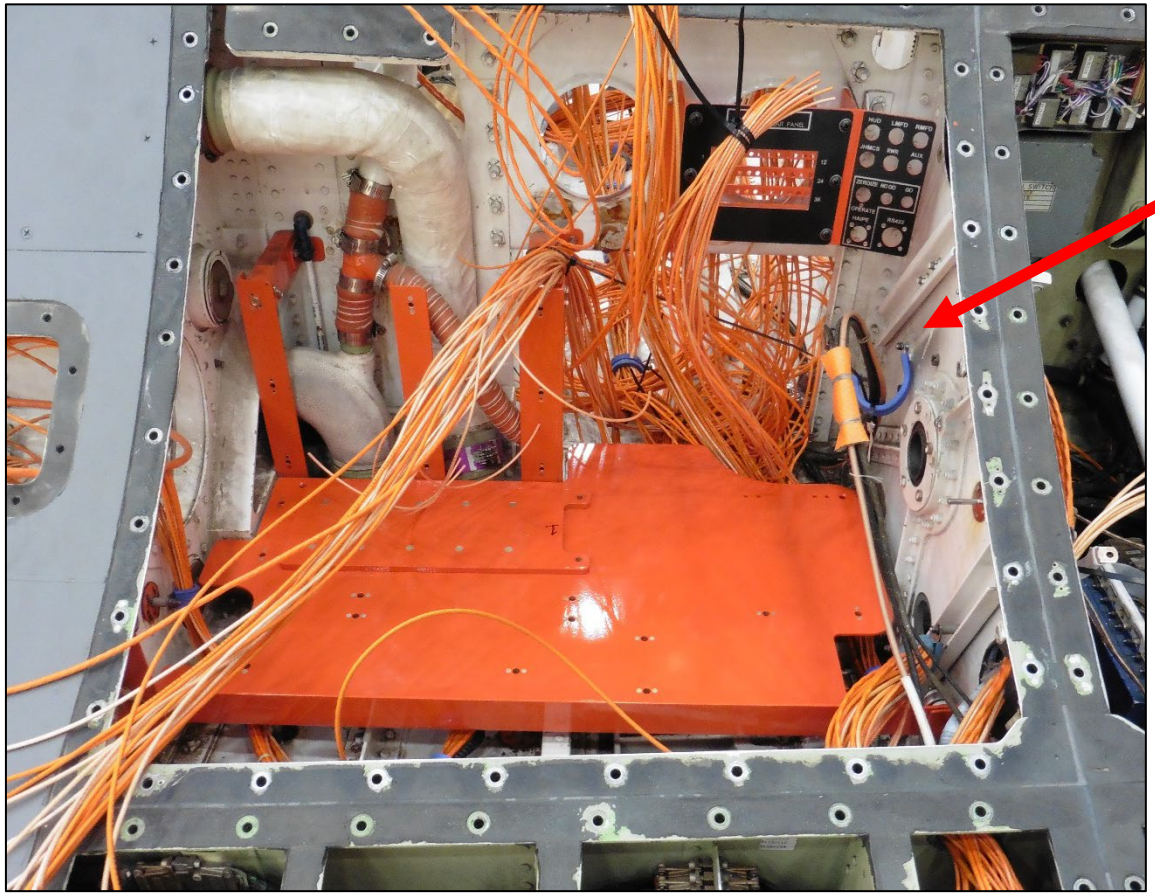
F-16 Gun Breech & Trough - Scan

Missing data for attachment points

FWD

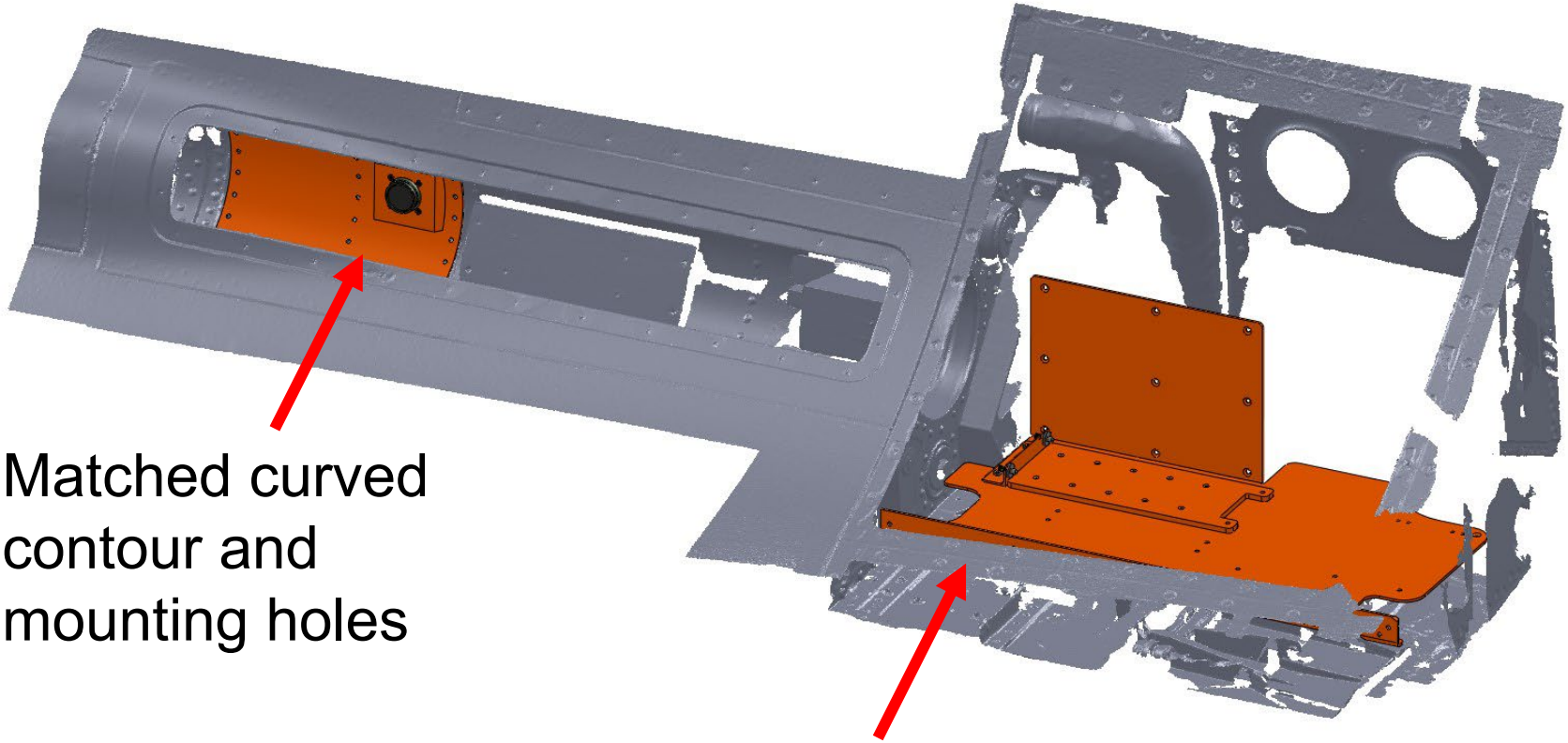


F-16 Gun Breech & Trough - Scan



White glossy finish could be the cause of missing point data

F-16 Gun Breech & Trough

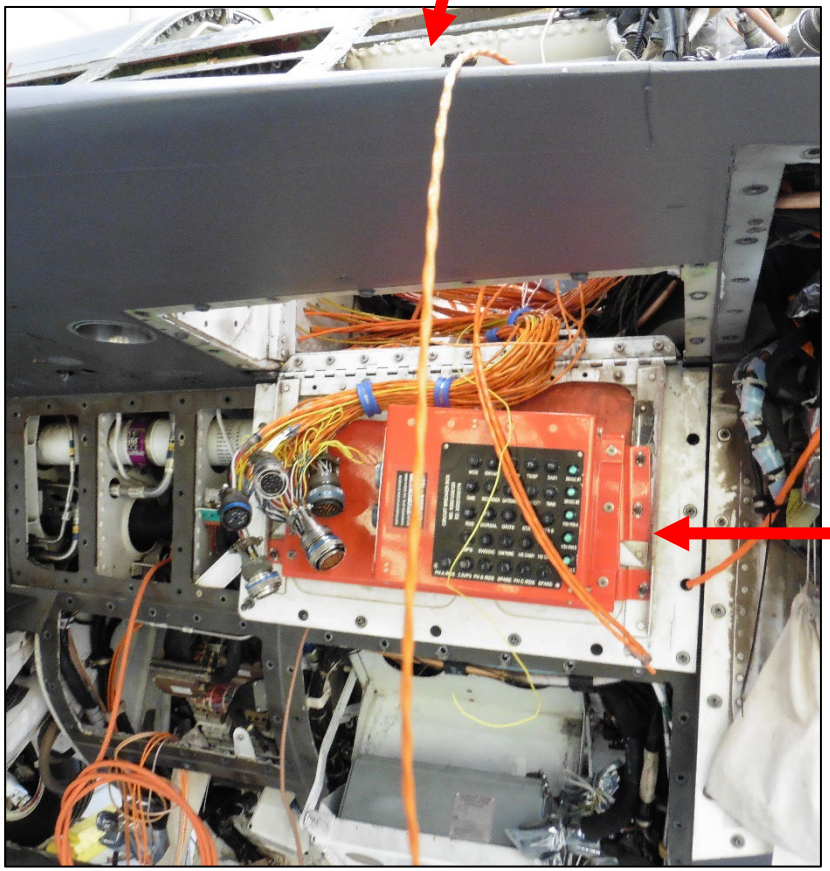


Matched curved contour and mounting holes

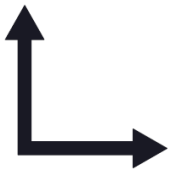
General sense of available space

F-16 Right Hand Strake

Access point to scan while panel is closed



Drop down panel attachment points and structure

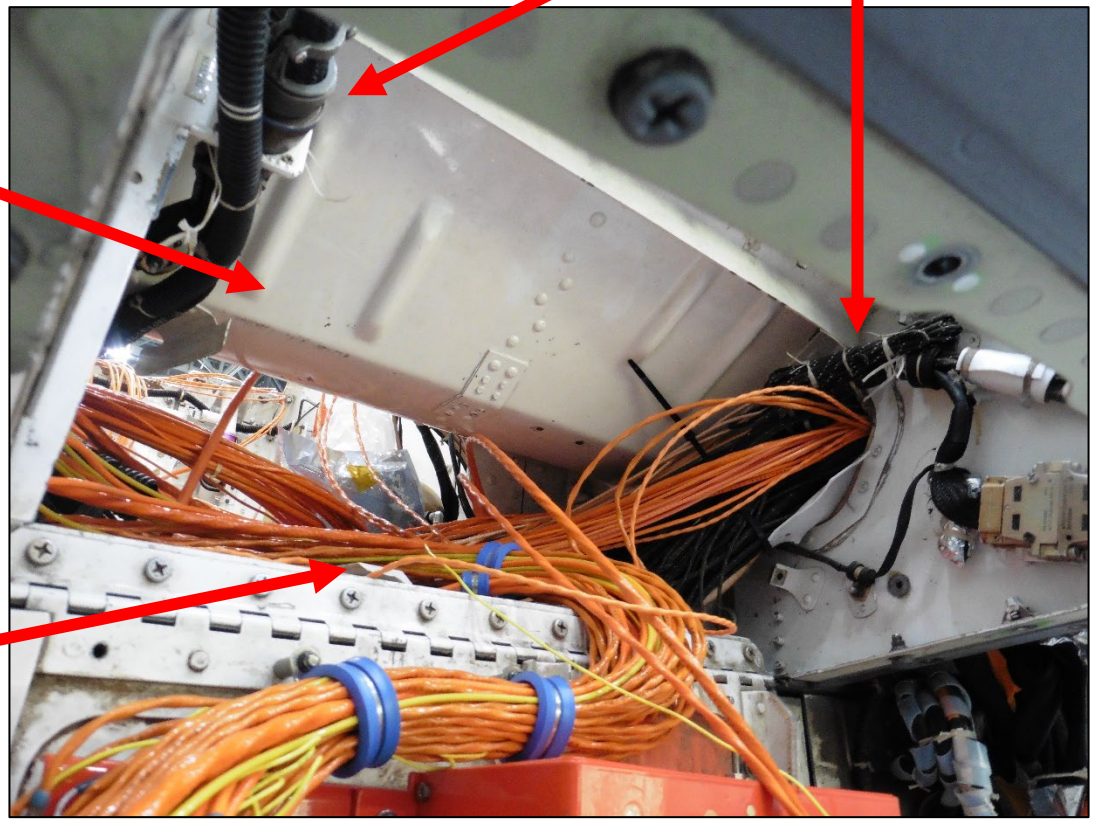


VIEW LKG INBD (RHS)

F-16 Right Hand Strake

Production wire routes

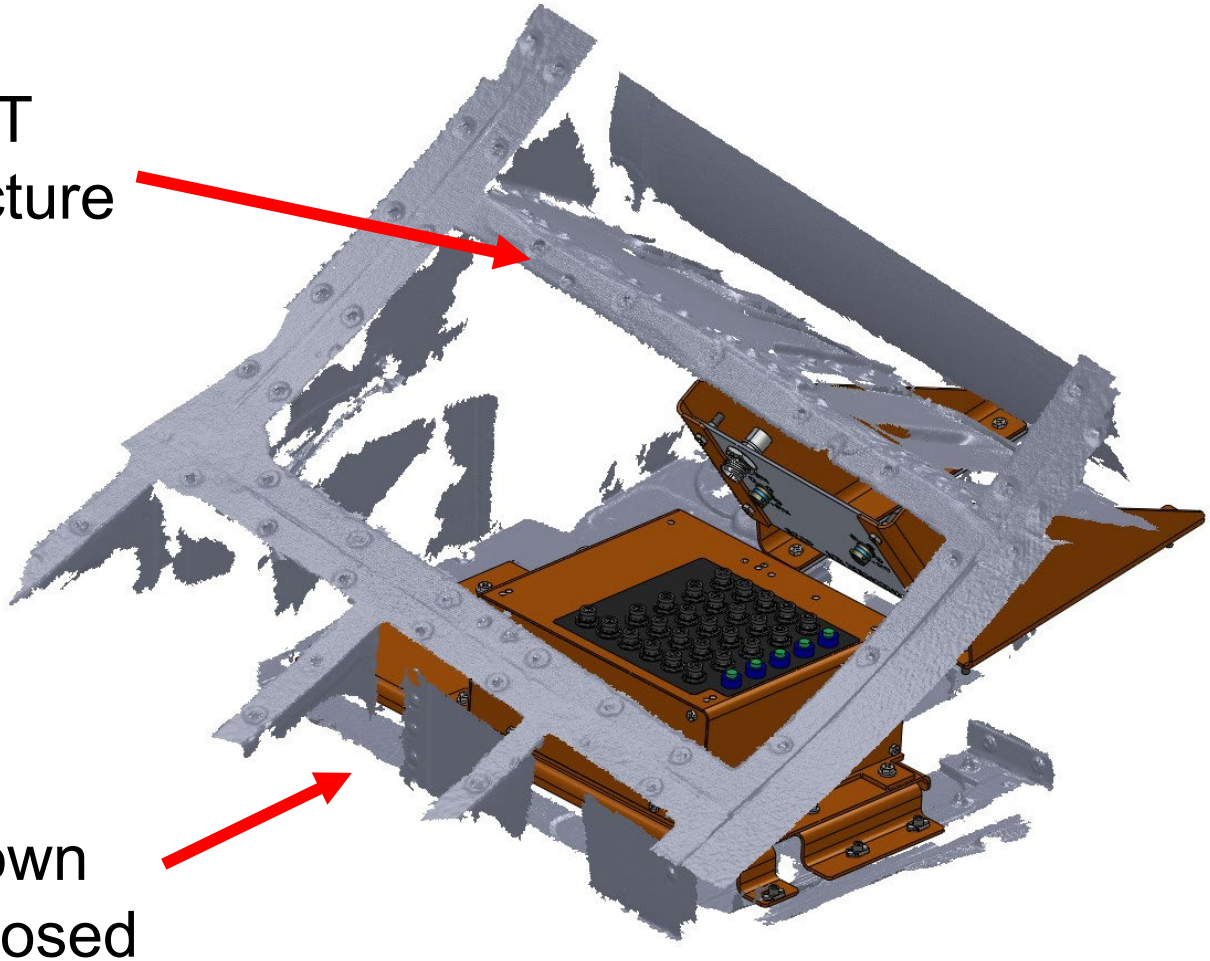
ACFT structure



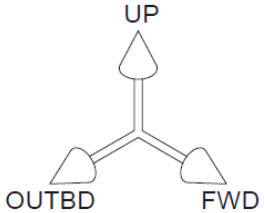
Structural mounts

F-16 Right Hand Strake - Install

ACFT structure

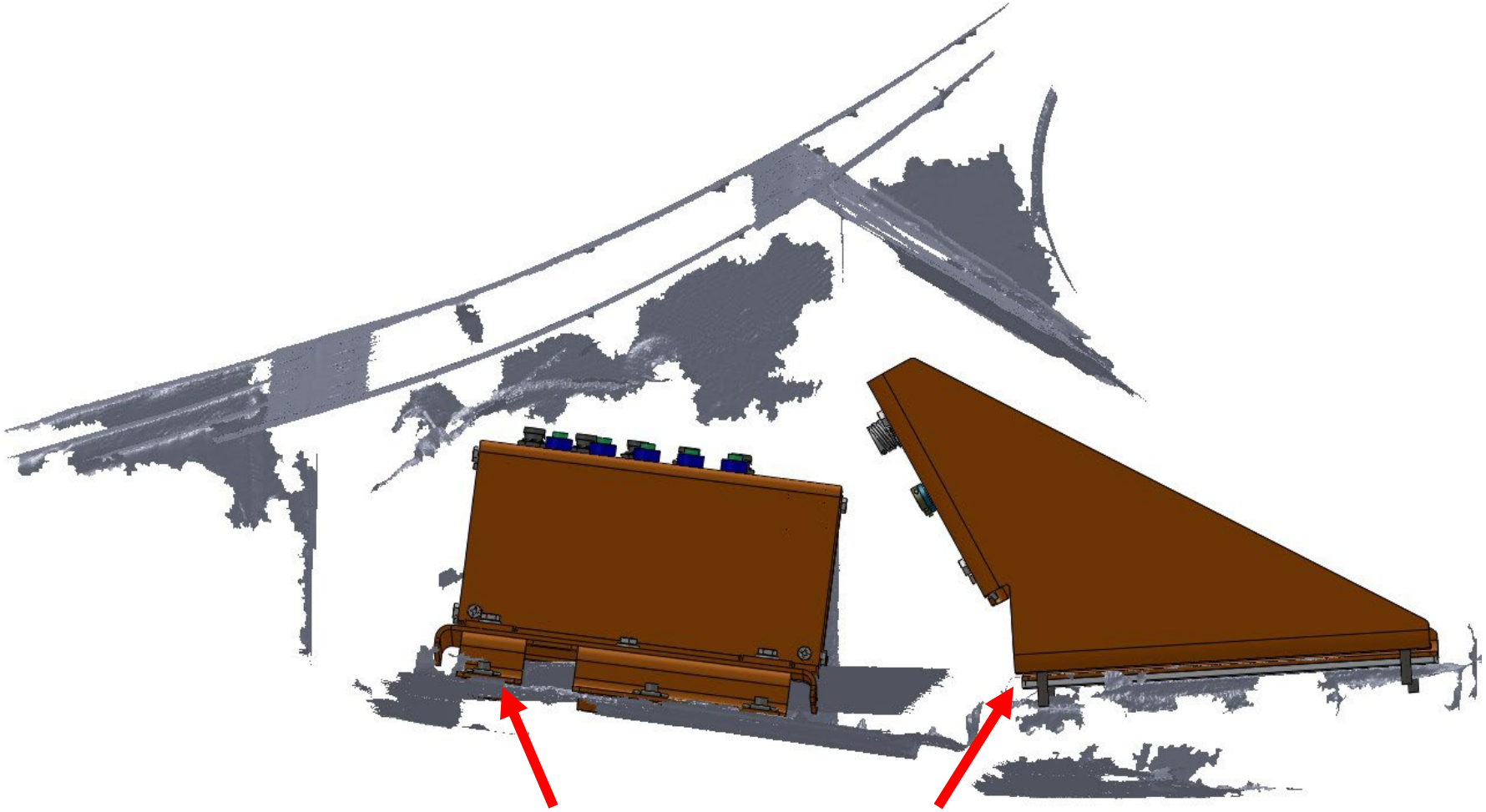


Drop down panel closed



Unsatisfactory amount of data collected due to limited space for 3D scanner

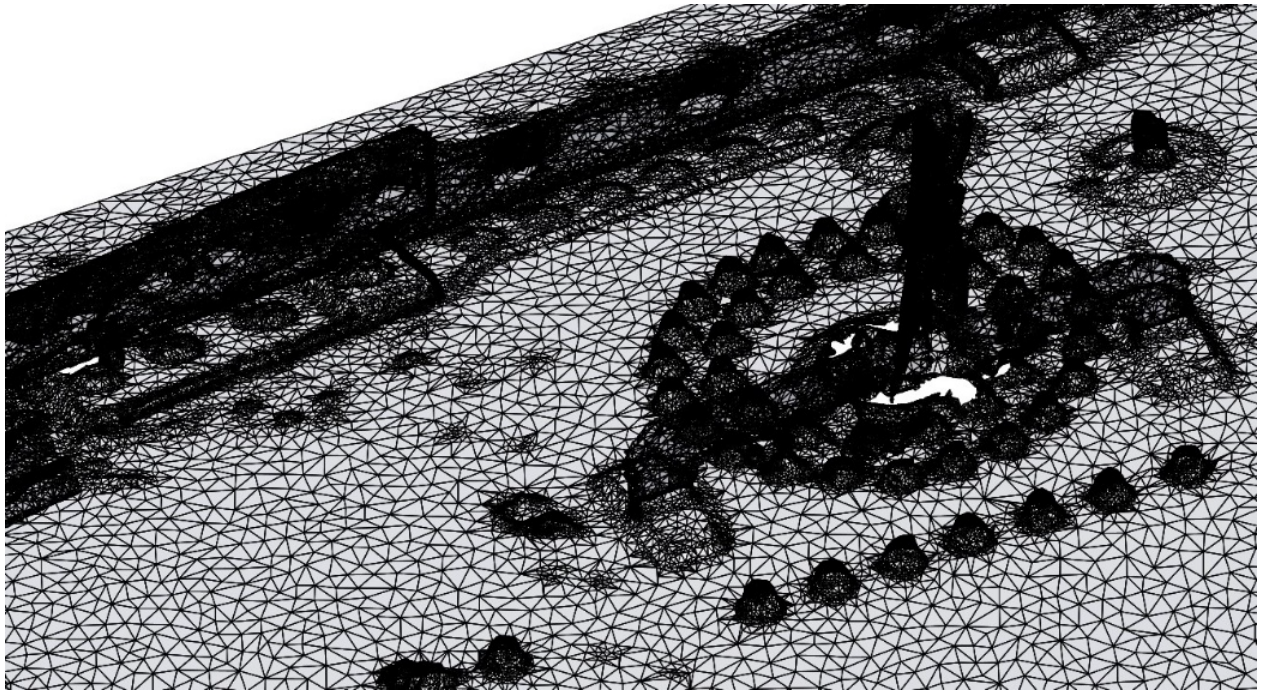
F-16 Right Hand Strake - Install



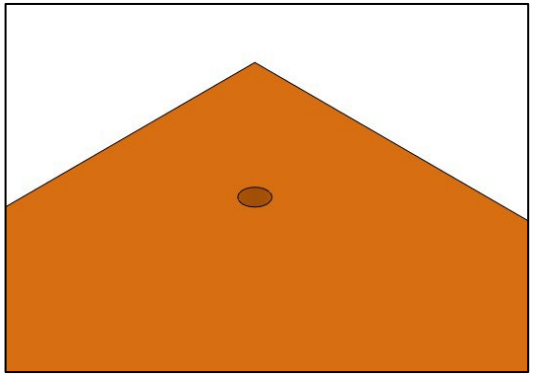
Could not determine attachment locations

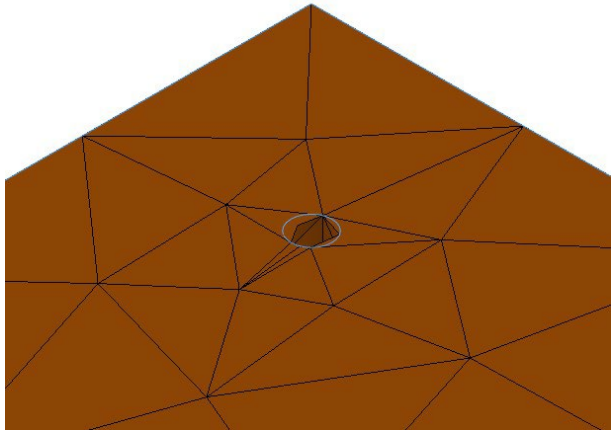
Relevant Remarks

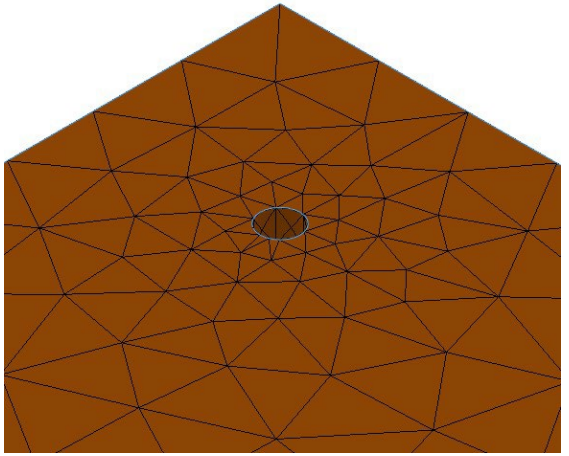
- A high-fidelity scanned model uses more computing processing power, similar to a finite element model.

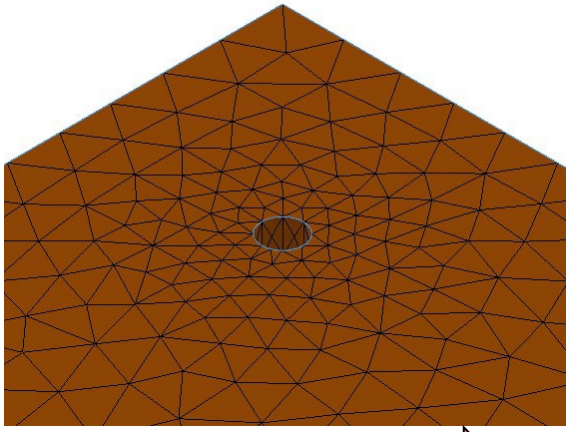


Relevant Remarks









Coarse mesh

Less processing

Middle ground?

Fine mesh

More processing

Concluding Remarks

- Acquired scanned models of certain areas can be used for future instrumentation designs without requiring to bring down the aircraft or remove any equipment.
- Be aware of 3D scanner's capabilities and limitations.
- Be aware of constraints in the areas of interest, such as but not limited to material finish and tight spaces.

QUESTIONS???