GENERAL DYNAMICS
Armament and Technical Products

F-22A Lightweight Gun System Comparison

NDIA Gun and Missile Systems Conference & Exhibition

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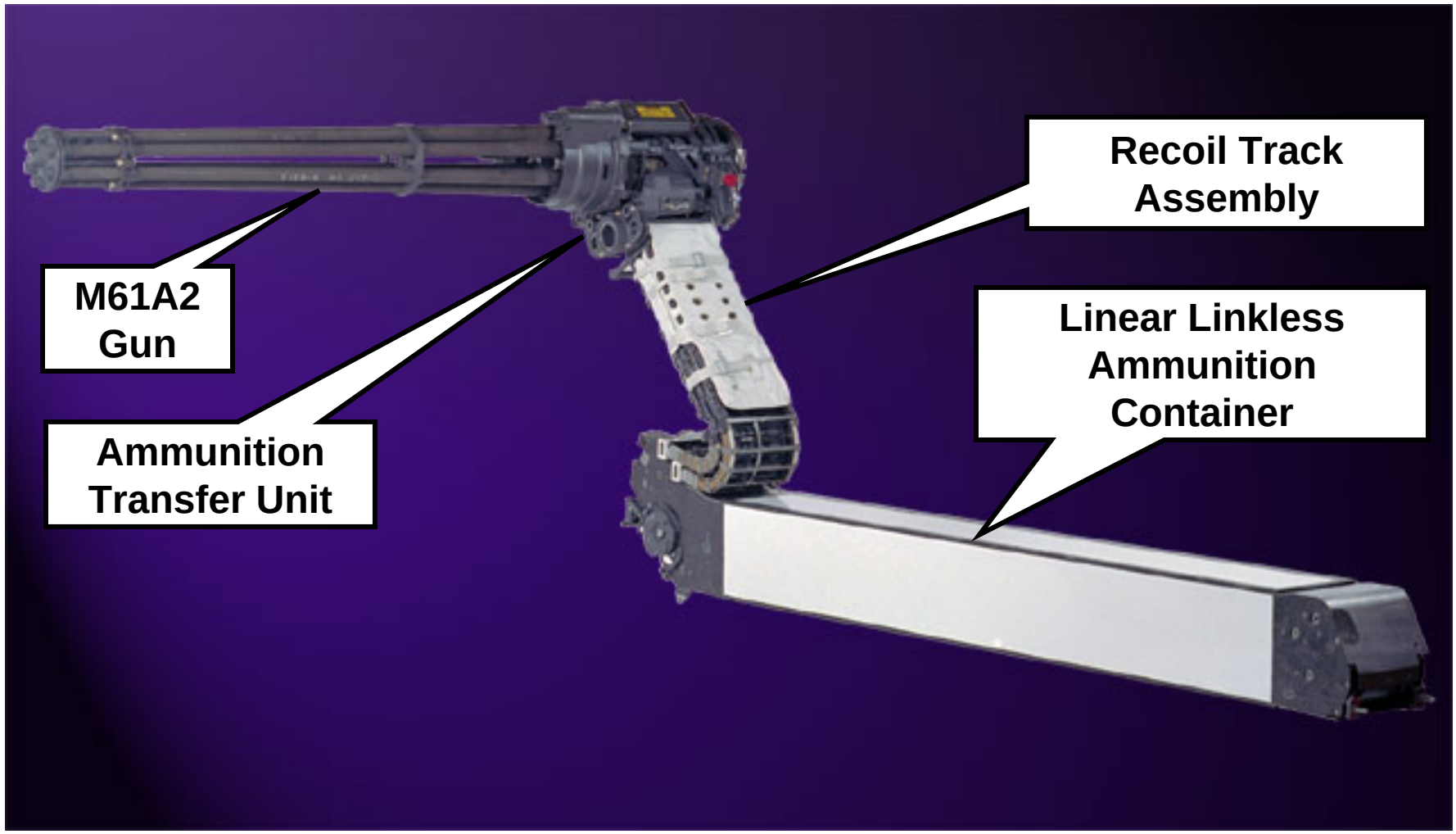
Agenda

- Overview of the F-22A Gun System
- Comparison to Legacy Gun Systems
- Application of Composite Materials
- Lightweight Composite Conveyor Element

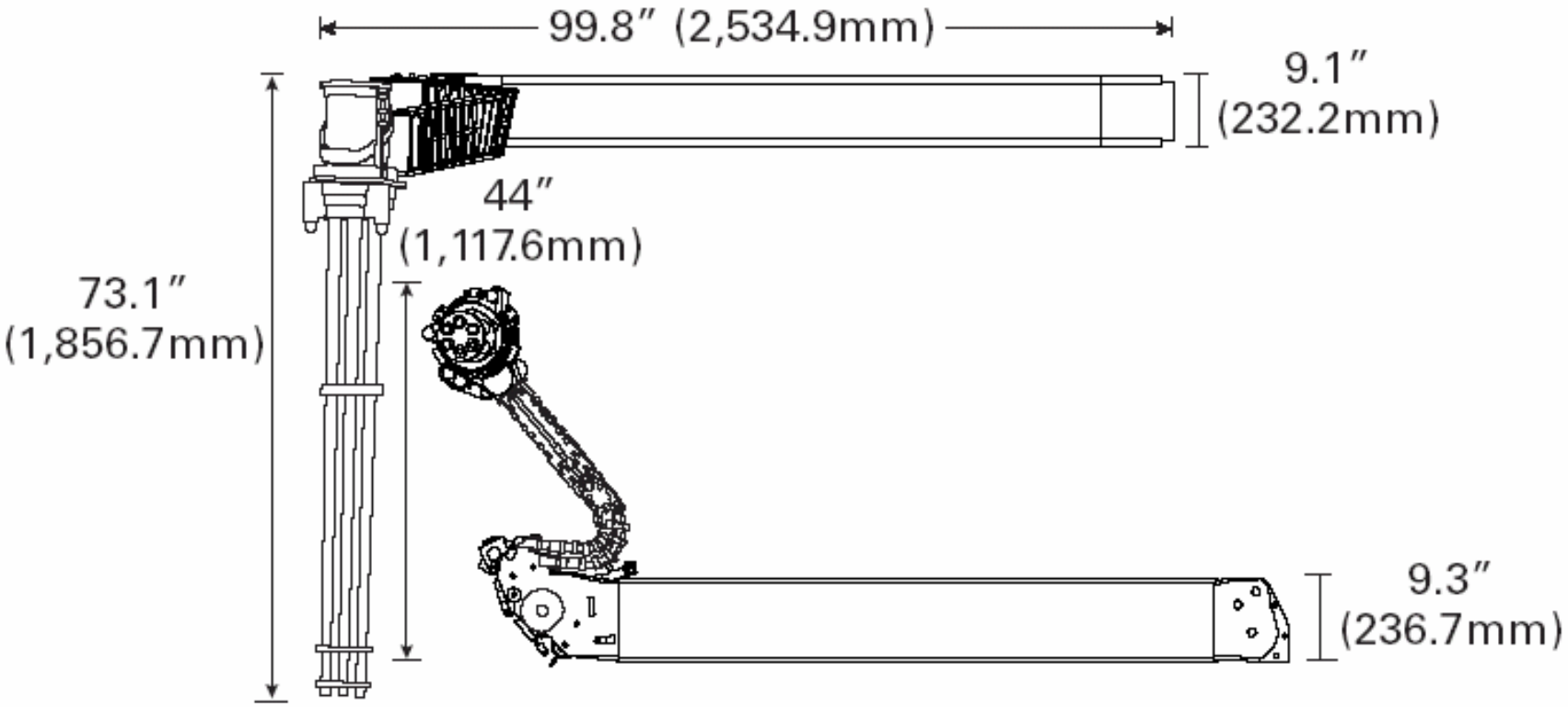
Background Information

- Developed for Lockheed Martin during the mid-1990s.
  - ➢ Low weight and tight envelope requirements
  - ➢ High stiffness requirement – container supported at the ends
- Incorporated new technologies
  - ➢ Extensive use of composite materials
  - ➢ Semi-flexible recoil track; single conveyor stores & transfers ammunition to/from the gun
  - ➢ Lightweight composite conveyor element

M61A2 20mm Gun and F-22A Lightweight Linear Linkless Ammunition Handling System



LLAHS Overall Size



F-15E, F-16, and F/A-18 E/F Gun Systems

F-15E

Linear Linkless, Closed Loop Ammunition Handling System

Mainly Metallic Construction

F-16

F-16 & F/A-18 E/F

Rotary Linkless, Closed Loop Ammunition Handling System

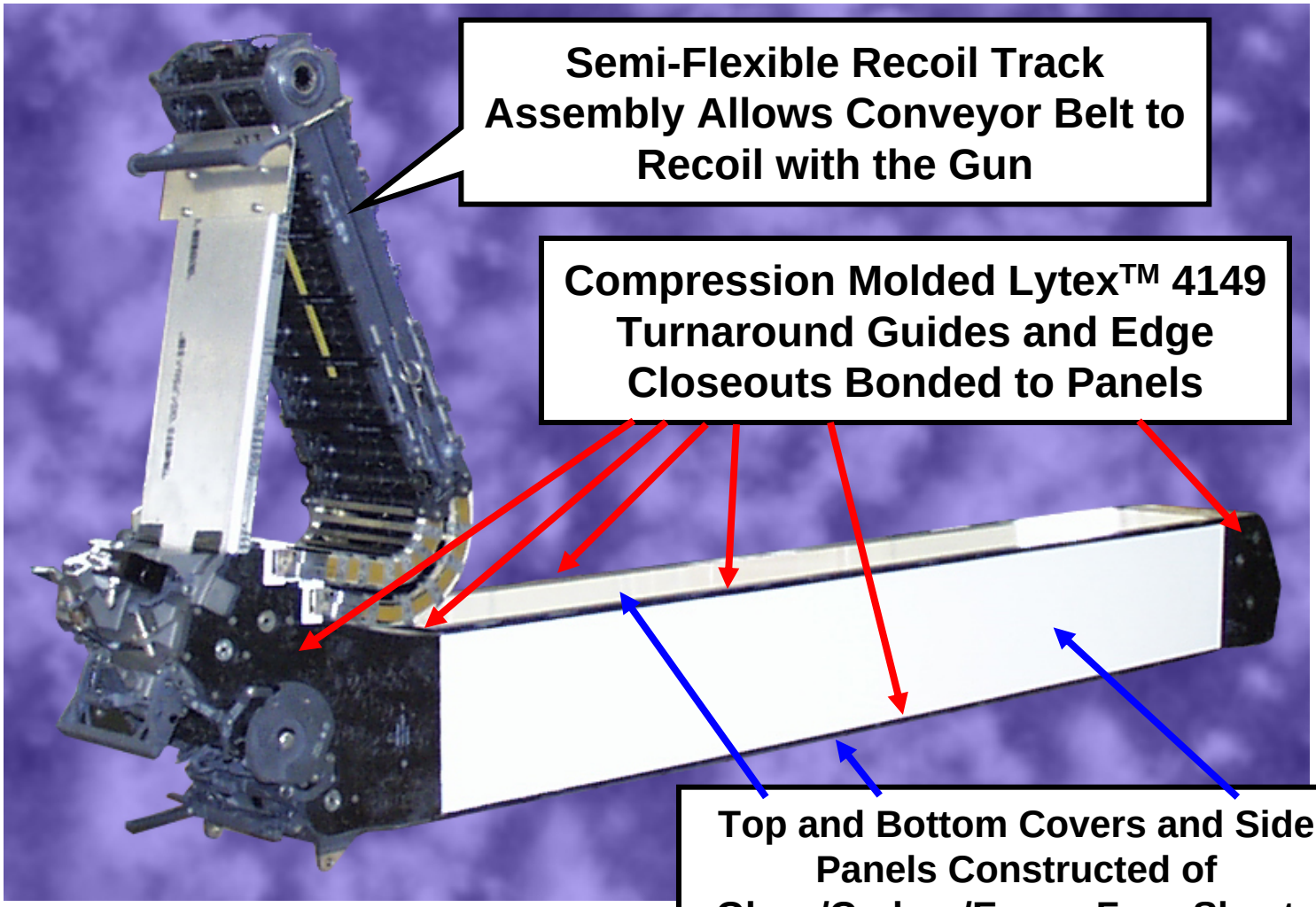
Mainly Metallic Construction

F/A-18 E/F

Specifications and Weight Comparisons of 20mm Aircraft Gun Systems

SYSTEM DESIGNATION:	***F-22A***	***F-15E***	***F-16***	***F/A-18 E/F***
Feed System Type (closed loop)	Linear Linkless	Linear Linkless	Rotary Linkless	Rotary Linkless
Ammunition Capacity	480	500	511	412
Gun Type	M61A2	M61A1	M61A1	M61A2
Firing Rate (shots/minute)	6000	4000/6000	6000	4000/6000
Empty System Weight (pounds)	378	484	506	451
Gun Weight	202	248	248	202
Feed System Weight (pounds)	176	236	258	249
Feed System Weight Delta from F-15E (pounds)	***-60***	0	+22	+13
System Specific Capacity (lbs/rd)	***0.79***	0.97	0.99	1.09

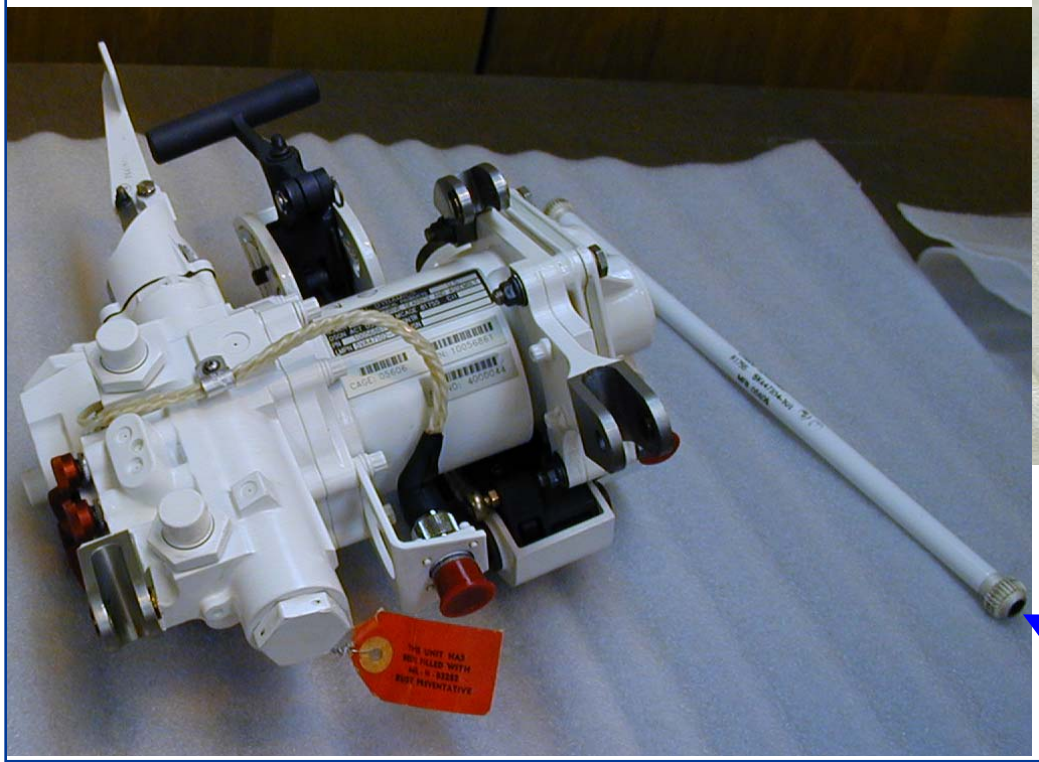
F-22A Ammunition Container Assembly Line Replaceable Unit (LRU) Makes Extensive Use of Composites

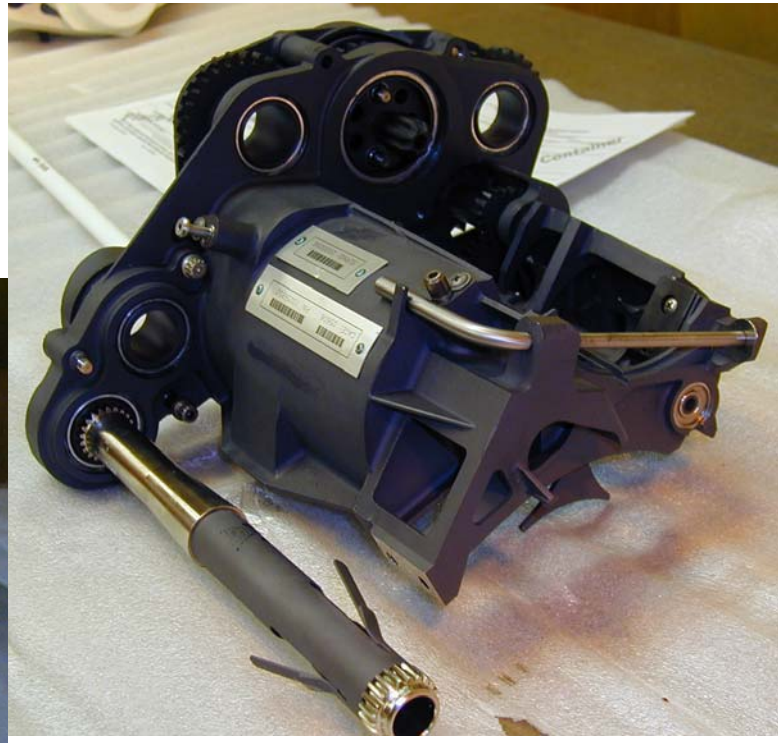


Hydraulic Drive, Container Drive Shaft, and Transfer Unit LRUs

These LRUs Use Conventional Metal Construction

Hydraulic Drive Assembly



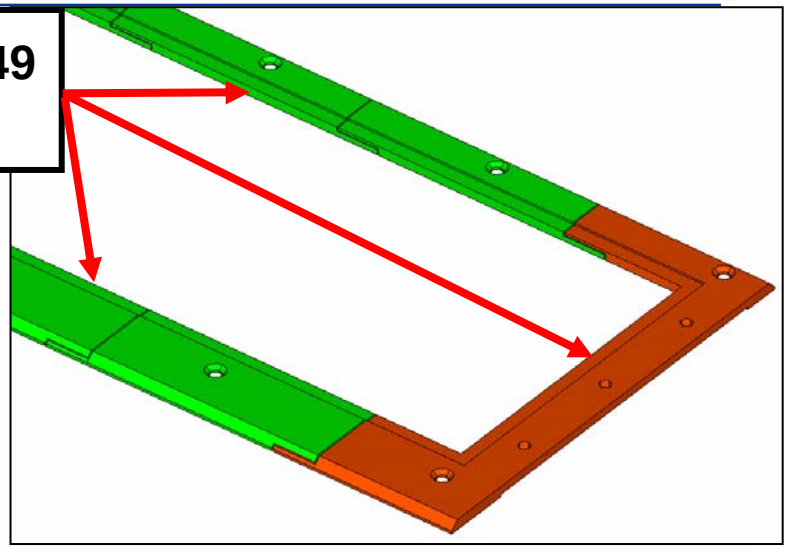


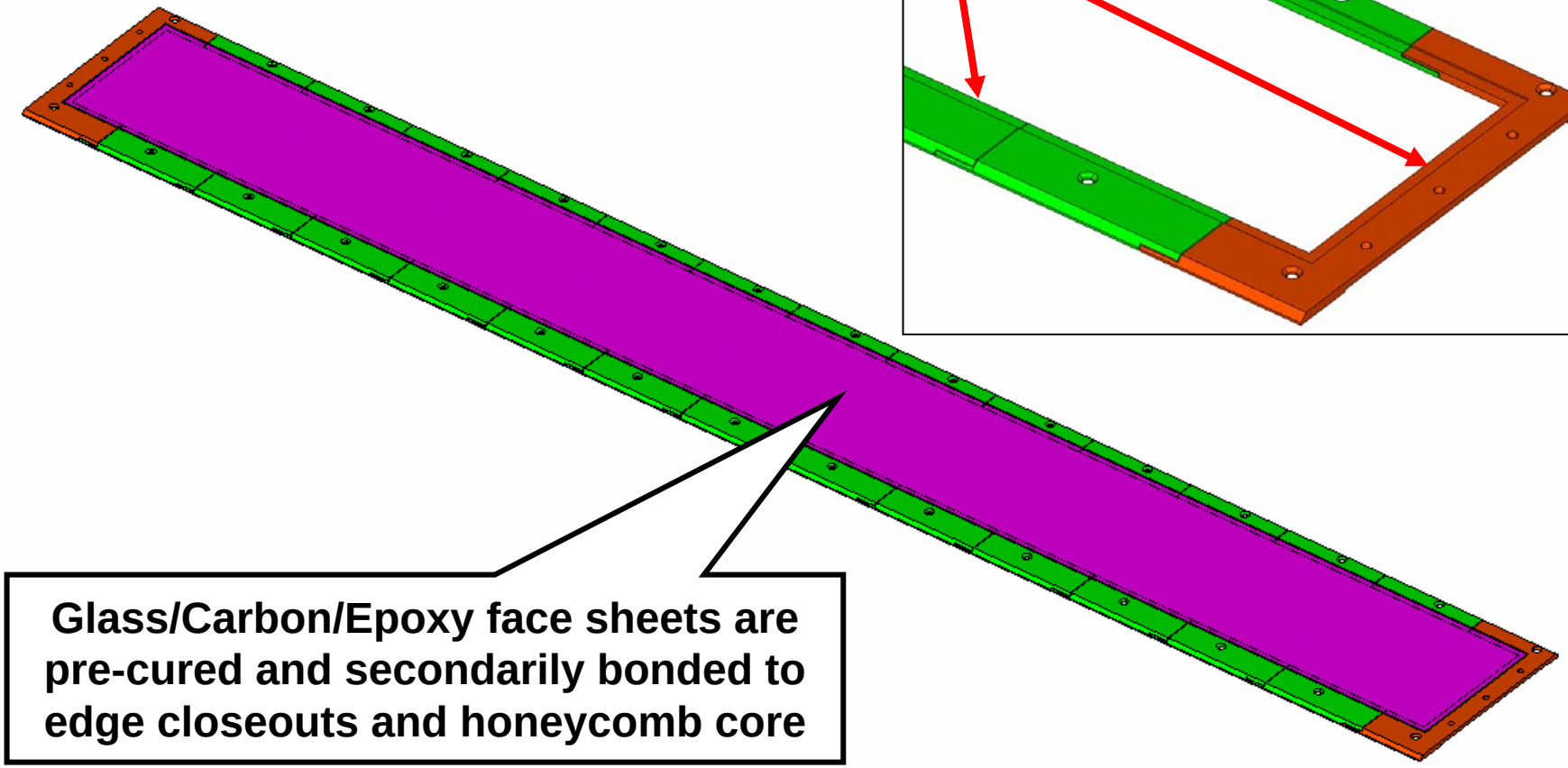
Transfer Unit Assembly

Container Drive Shaft

Compression molded Lytex™ 4149 Edge Closeouts Form Panel Perimeter

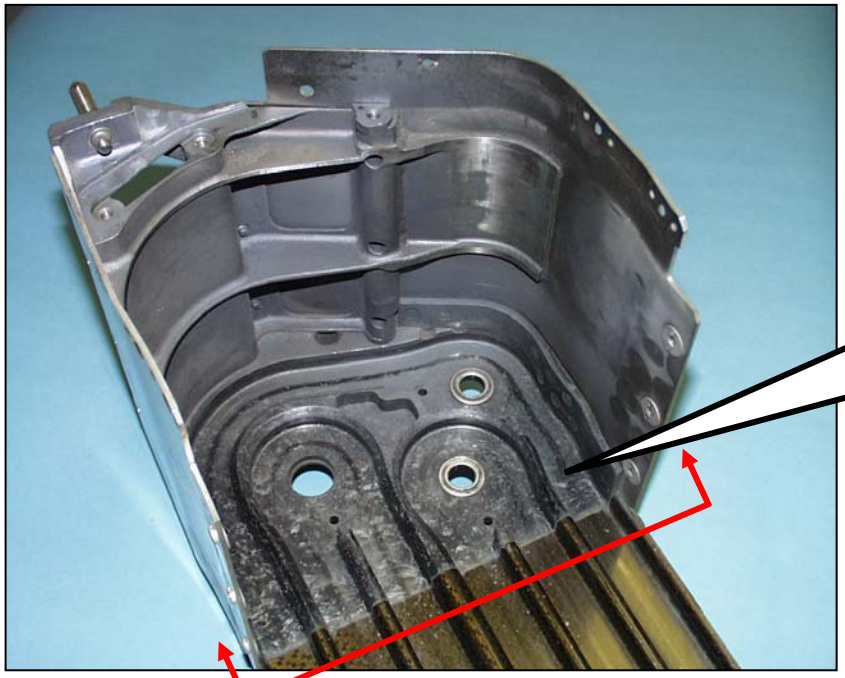
Compression Molded Lytex™ 4149 Edge Closeouts





Glass/Carbon/Epoxy face sheets are pre-cured and secondarily bonded to edge closeouts and honeycomb core

View Inside Showing Ammunition Container Side Panel with Serpentine Path



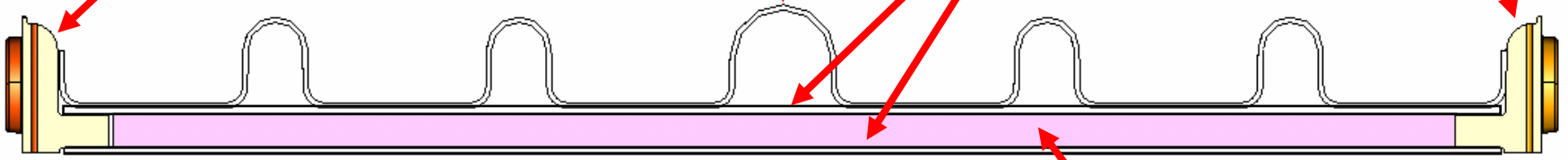
Compression Molded Lytex™ 4149 Turnaround Guide is Bonded to a Composite Track Panel

Lytex™ 4149 Edge Closeout

Glass/Graphite/ Epoxy Track Panel

Glass/Graphite/ Epoxy Face Sheets

Lytex™ 4149 Edge Closeout

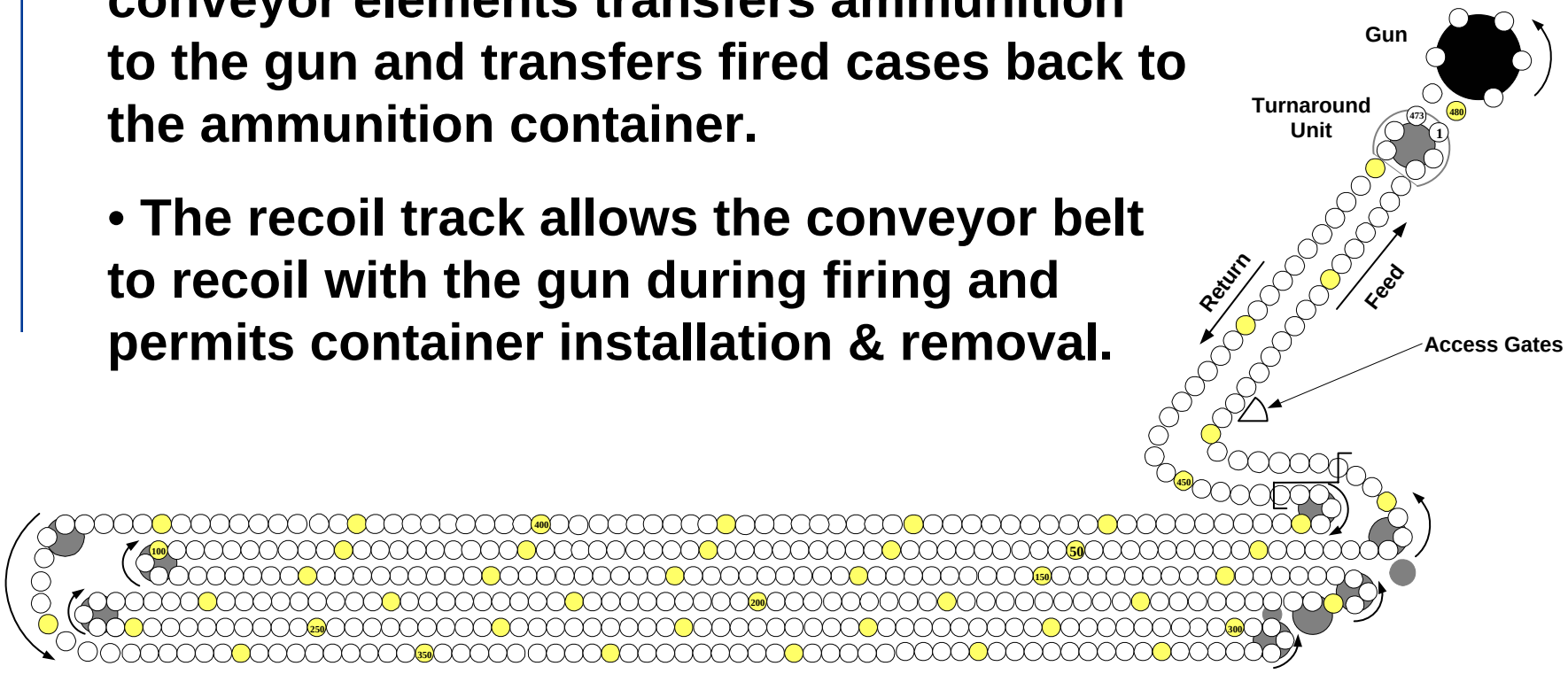


CROSS SECTION OF TRACK PANEL

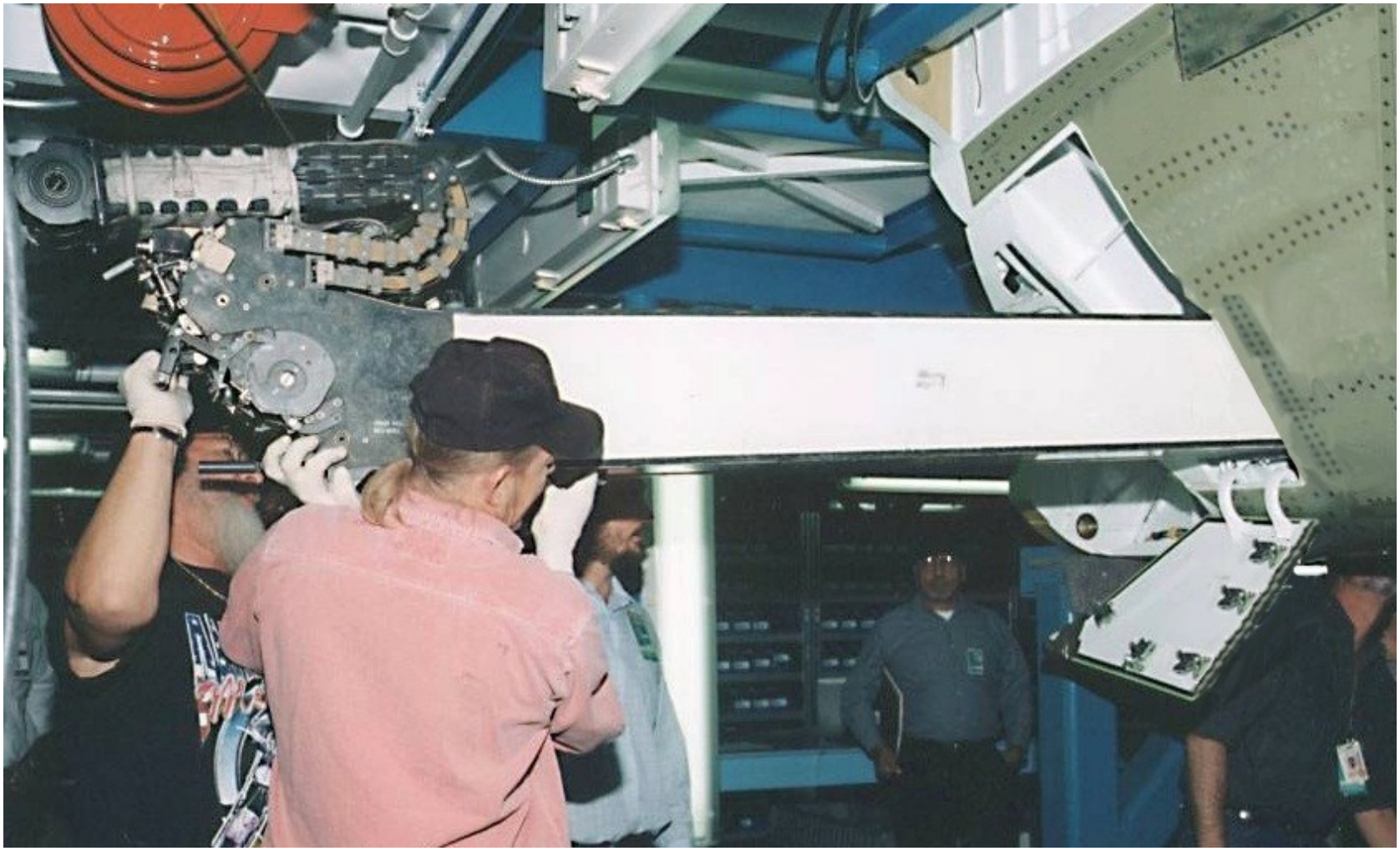
Aluminum Honeycomb Core

Ammunition Storage and Transfer Schematic

- **A continuous conveyor belt with 473 conveyor elements transfers ammunition to the gun and transfers fired cases back to the ammunition container.**
- **The recoil track allows the conveyor belt to recoil with the gun during firing and permits container installation & removal.**



Recoil Track Collapses onto Container to allow Installation and Removal



Injection Molded Conveyor Elements PEEK™ with 30% Carbon Reinforcement

View of top row of conveyor belt in ammunition container with cartridges

Key Suppliers of Composite Components

Photo from Parkway Products

- Quantum Composites – Bay City, MI
  - ➢ Supplier of Lytex™ 4149 material
- Parkway Products Inc. – Erlanger, KY
  - ➢ Lytex™ 4149 compression molded parts
- Midwest Plastic Components – Minneapolis, MN
  - ➢ PEEK™ with 30% carbon fiber injection molded conveyor elements
- Neptune Precision Composites – Jacksonville, FLA
  - ➢ Fabrication of composite panel assemblies
- GDATP – Saco, ME
  - ➢ Structural and final assembly

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