RDECOM

Malcolm Baldrige National Quality Award 2007 Award Recipient

ARMAMENT RESEARCH, DEVELOPMENT AND ENGINEERING CENTER PICATINNY ARSENAL, NJ

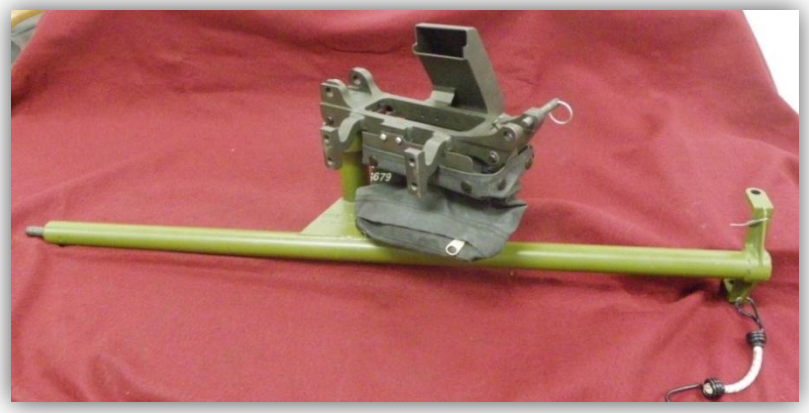
TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

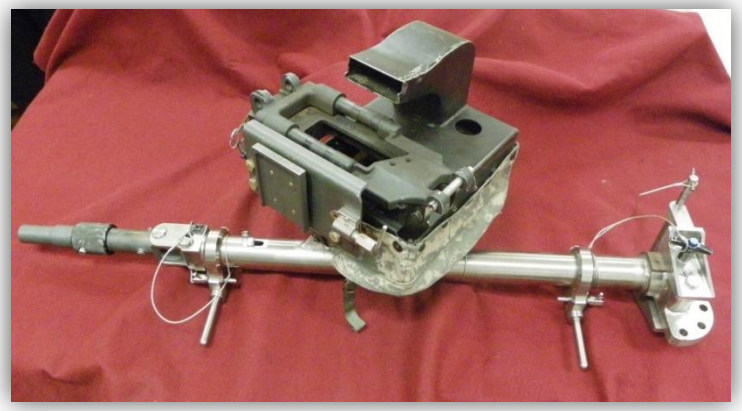
Development of a Moveable Weapon Mount System for the CH47 Helicopter

Michael Colonnello
1 September 2011

Background – M24E1 Program

- The current machine gun mount for the CH47 is the M24 – a stationary bar mount that mounts in the door and window of the aircraft and accepts the M240H machine gun.
- A need arose for a new mount to eliminate some deficiencies that are present in the M24.





Malcolm Baldrige National Quality Award 2007 Award Recipient

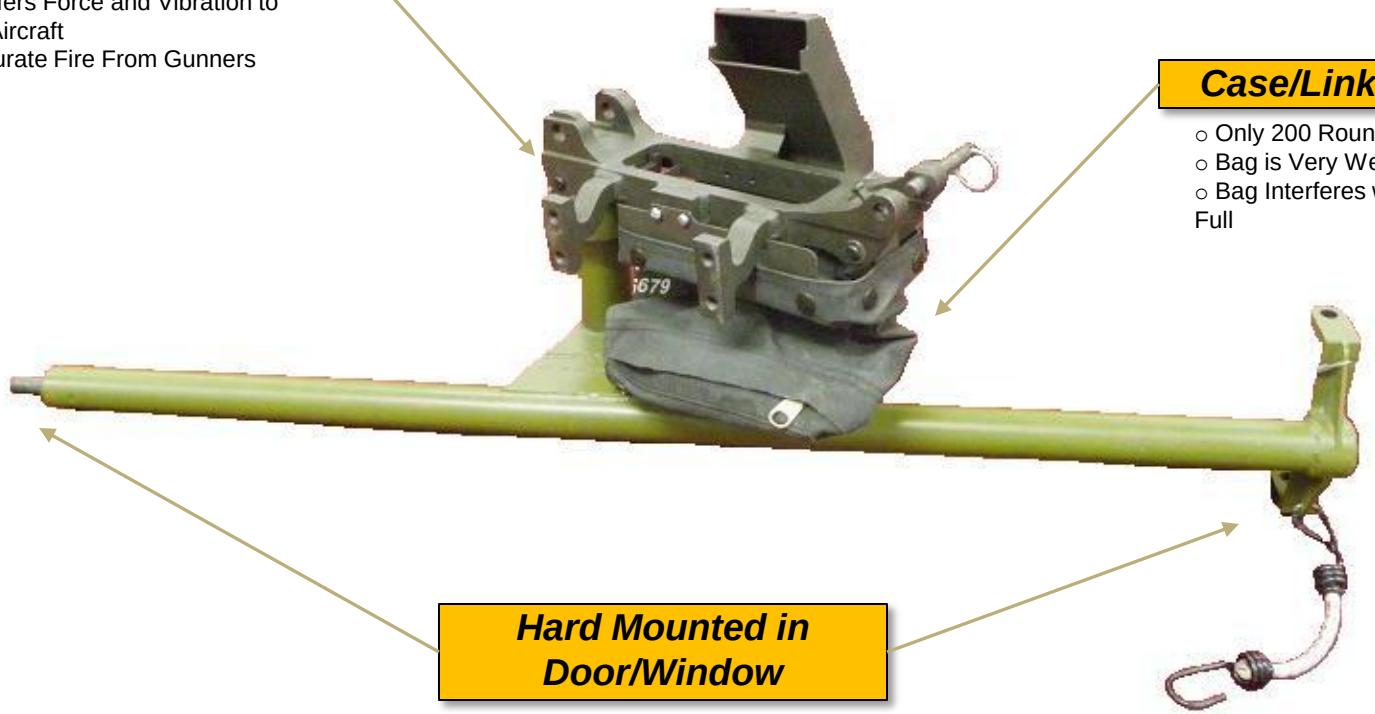
M24 Machine Gun Mount - Deficiencies

Ammunition Capacity/Retention

- Only 200 Round Capacity Per Can
- Can Held in Place by Bungee Cord

Rigid Cradle

- Cradle is Solid Steel
- Transfers Force and Vibration to Mount/Aircraft
- Inaccurate Fire From Gunners



Case/Link Collection

- Only 200 Round Capacity
- Bag is Very Weak – Tears Easily
- Bag Interferes with Bar When Full

Hard Mounted in Door/Window

- Makes Egress Difficult
- Makes Hot Refueling Impossible Without Removing the Mount
- Puts Soldiers at Risk in Emergency Situations

Malcolm Baldrige National Quality Award 2007 Award Recipient

M24E1 Machinegun Mount

Flex-Mount Cradle

✓ Cradle Features Buffers That Flex with Weapon Recoil
✓Allows Gunners to be More Accurate

Lightweight Construction

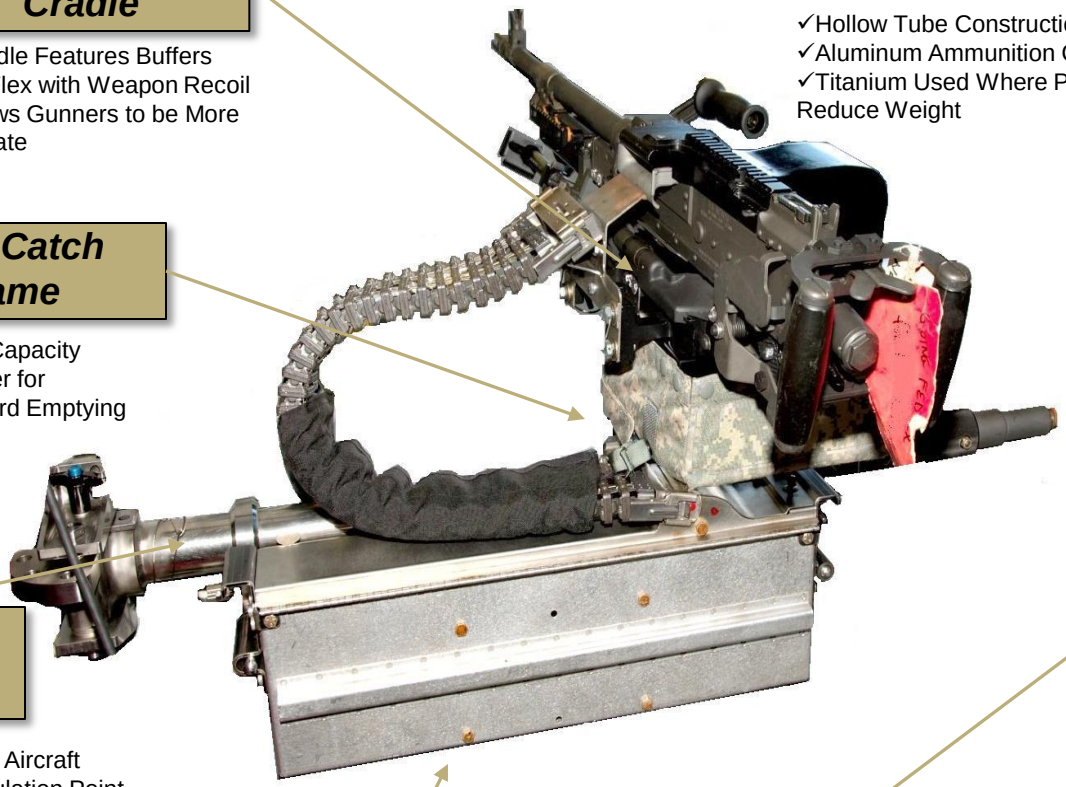
✓Hollow Tube Construction
✓Aluminum Ammunition Cans
✓Titanium Used Where Possible to Reduce Weight

Modular Design

✓Mounts in Existing Mount Points
✓ Improved Field of Fire
✓Two Ammunition Can Choices – Cradle Mounted and Cross-bar Mounted
✓Only Four Bolts Need to be Removed to Change Ammo Can Type

Improved Catch Bag/Frame

✓ 450 Case/Link Capacity
✓Reversible Zipper for Outboard or Inboard Emptying



Pivoting Cross-bar

✓Cross-bar Pivots into Aircraft
✓Quick Breaking Articulation Point
✓Allows Easy Egress and Ingress
✓Can be Pivoted into Aircraft with Weapon Installed

Cross-bar Mounted Ammunition Can

✓ 400 Round Capacity
✓Anti-Siphon Spring
✓Opens up Gunner's Field of View on Left Side of Weapon
✓Smooth Functioning Nobles Ammunition Chute

Cradle Mounted Ammunition Can

✓ 400 Round Capacity
✓Anti-Siphon Spring
✓Fewer Components
✓Fast Loading
✓Fast Ammo Can Swap

M24E2 Future Improvements:

✓Inboard and Outboard Articulation
✓Fold-Flat Inboard Articulation
✓Decreased Number of Moving Parts

Malcolm Baldrige National Quality Award 2007 Award Recipient

Flex Mount Cradle

Rigid Cradle

- Standard Aircraft Cradle
  - -Steel Construction
  - -Rigid – Transfers all shock to mount, aircraft, gunner

Flexible Cradle

- **FN Manufacturing**, LLC, Columbia, SC
  - -FN is also the designer of the M240H
  - -Cradle features spring damper system to dampen recoil
  - -Aluminum construction
  - -Positions ammunition can mounts, case collection system, weapon in the same location as rigid mount

Malcolm Baldrige National Quality Award 2007 Award Recipient

M24E1 Machine Gun Mount

Malcolm Baldrige National Quality Award 2007 Award Recipient

Operation – Articulation

1) Pull Aft Hinge Pin

2) Pull Safety Pin

Malcolm Baldrige National Quality Award 2007 Award Recipient

Operation – Articulation

3) Slide Handle to Release

4) Swing Mount Inside Aircraft

Malcolm Baldrige National Quality Award 2007 Award Recipient

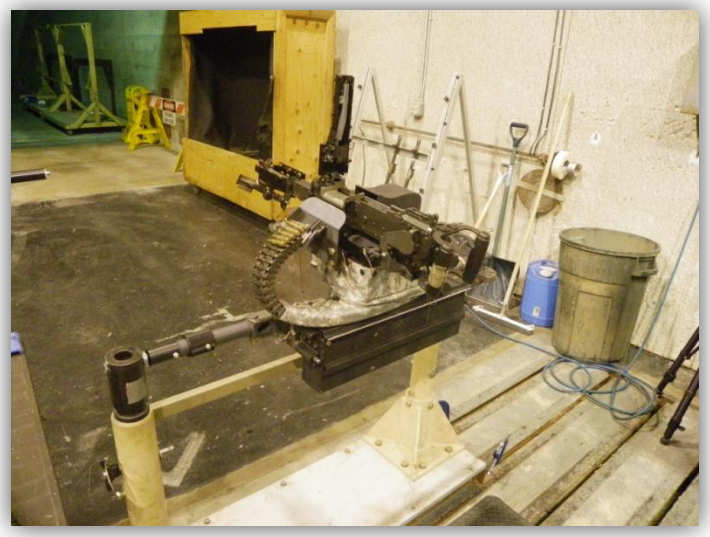
Operation – Articulation

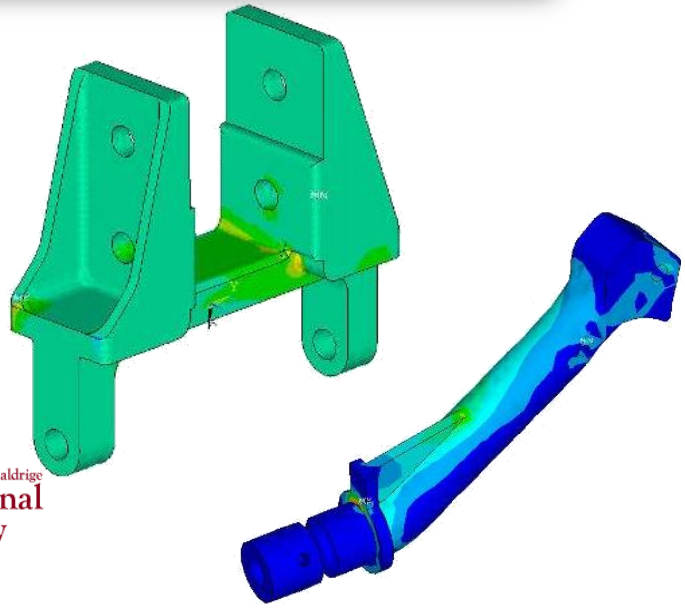
Just a few simple steps to go from Deployed to Open to Stowed

Locking Pin

Malcolm Baldrige National Quality Award 2007 Award Recipient

Analyses and Testing – M&S, Range Testing





- Finite Element Analysis (FEA) was used to ensure that the M24E1 was structurally sound
  - -8 G crash loads in positive and negative X, Y, Z directions
  - -Recoil loads simulated in worst case position to predict fatigue of critical components
- Extensive testing performed at Picatinny's Armament Technology Facility to ensure reliability of the M24E1 system
  - -Ammunition Can Loading Configurations
  - -Blank Firing
  - -Integrity of the Structure
  - -Operation of Recoil Mount

Malcolm Baldrige National Quality Award 2007 Award Recipient

Analysis and Testing – Ft. Rucker and Ft. Drum

- Flight Test at Ft. Rucker
  - -Vibration
  - -System reliability through flight operations
- Ft. Drum/Ft. Indiantown Gap Operational Testing and Evaluation.
  - -Traveled to Ft. Drum/Ft. Indiantown Gap throughout the process as upgrades and changes were made to get Soldiers to test them

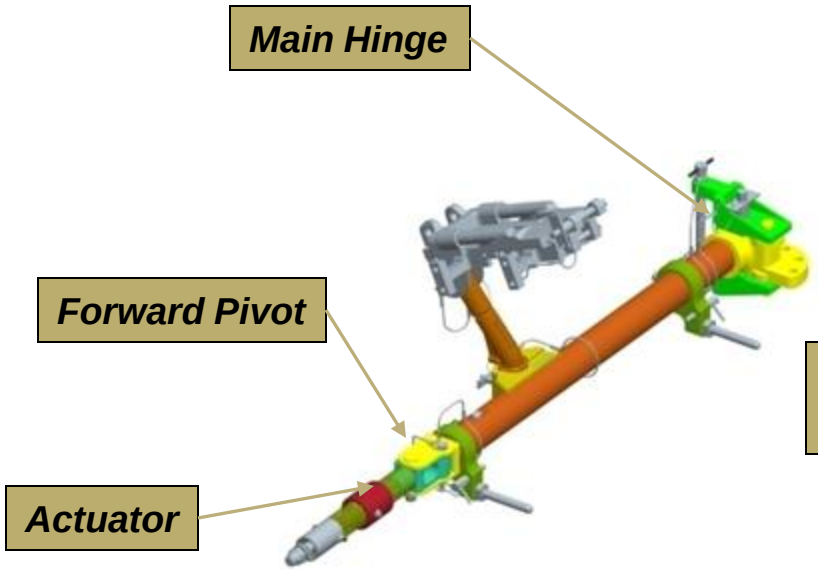
Malcolm Baldrige National Quality Award 2007 Award Recipient

Production Information

- Production of M24E1 currently complete and Operational Evaluation has begun
  - Imperial Machine and Tool, LLC is the prime contractor
    - Located in Columbia, NJ
    - Manufactured the prototype mounts
    - Have expertise in titanium machining, welding
  - 120 Shipsets (240 Mounts), and applicable spare parts and assemblies manufactured
- In Theater Operational Evaluation
  - Beginning In December 2010, Units deploying to Theater have been outfitted with these mounts
  - Each Unit going into Theater will be fully equipped, trained, and outfitted with the M24E1 system
  - Throughout their Tour, they will be asked to use this system and provide feedback to the design team, which will be used to help tune the design of the M24E1Mod1, which will go into production in FY2012

M24E1Mod1 – Added Features

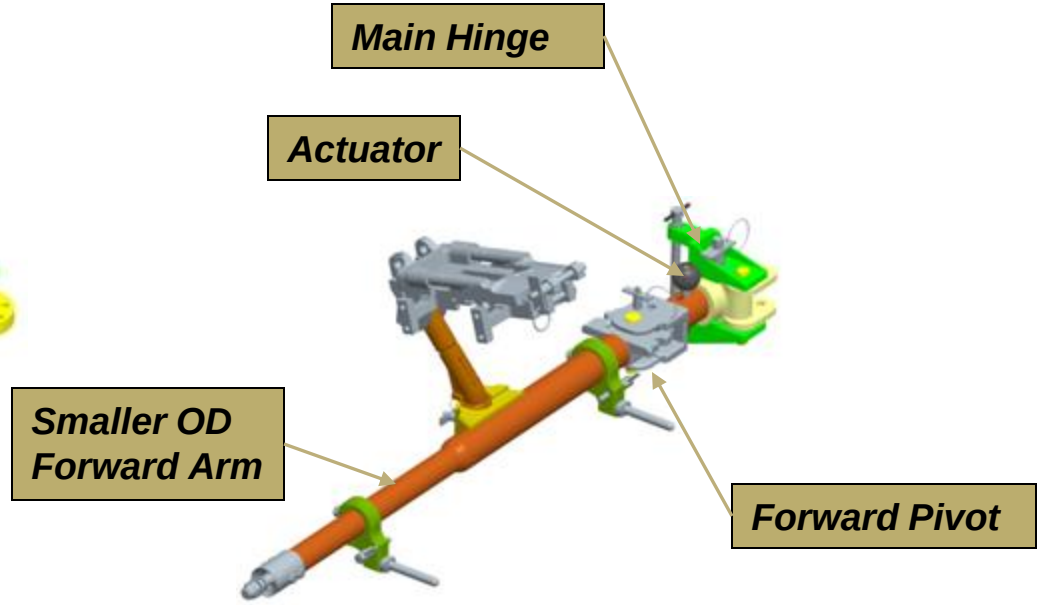
M24E1



M24E1

Rotates Into Aircraft

M24E1Mod1



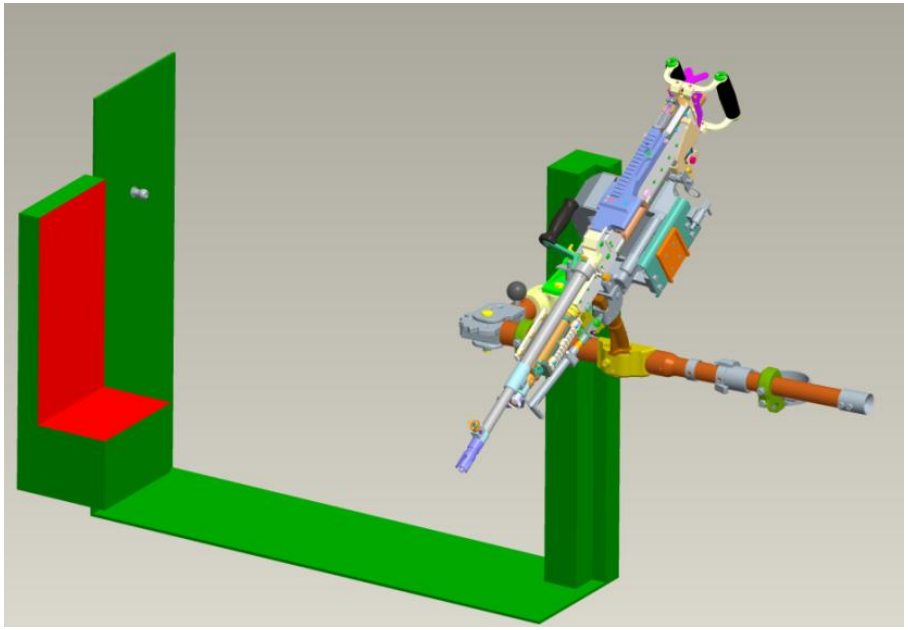
M24E1Mod1

Rotates Into Aircraft

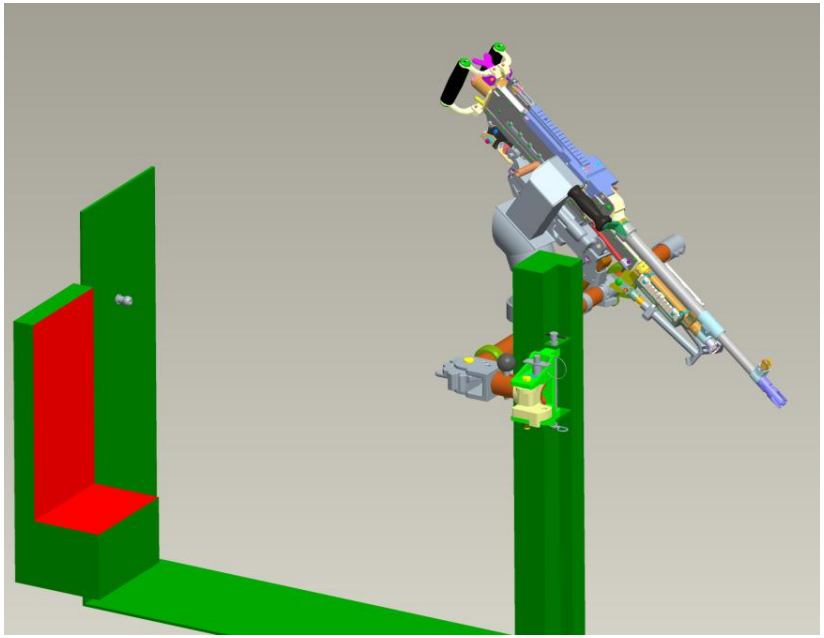
Rotates Out of Aircraft

Malcolm Baldrige National Quality Award 2007 Award Recipient

M24E1Mod1 – Added Features



Stowed Inside Aircraft for Regular Egress or Hot Refueling



Pushed Outside Aircraft for Emergency Egress

Applicability of Technology

- How can we apply this technology to other systems, or allow additional weapon systems to be mounted to the CH47
  - Recoil System – The Recoil Cradle that is used on the M24E1 is a simple system that allows the recoil of the weapon to be absorbed through the use of a spring-damper system. Larger versions of this system could allow weapons with higher recoil forces to be mounted on aircraft that typically use the M240H. Special Forces are already mounting additional weapon systems on their aircraft.
  - Structural Rigidity – M24E1 cross bars are essentially thin-walled titanium tubes. Stronger tubes, larger diameter, and thicker cross sections will improve the system's structural integrity, as could the use of different cross sectional profiles.
  - Aircraft Hardpoints – While the system itself could easily be modified to allow the use of heavier or higher recoil weapons, the aircraft hardpoints may not be able to hold up over time. As such, the design team would likely need to beef up these hardpoints in order to allow prolonged use of higher recoil systems.
  - Foreign Military Sales – Many other countries have CH47 aircraft – Great Britain, Australia, Netherlands, Japan, Canada, etc.
  - Additional Applicability to CH47 – Different Locations in Aircraft (Rear Windows, etc.)

Applicability to Other Aircraft/Services

Malcolm Baldrige National Quality Award 2007 Award Recipient

Applicability to Other Weapon Systems

M107

Mk19

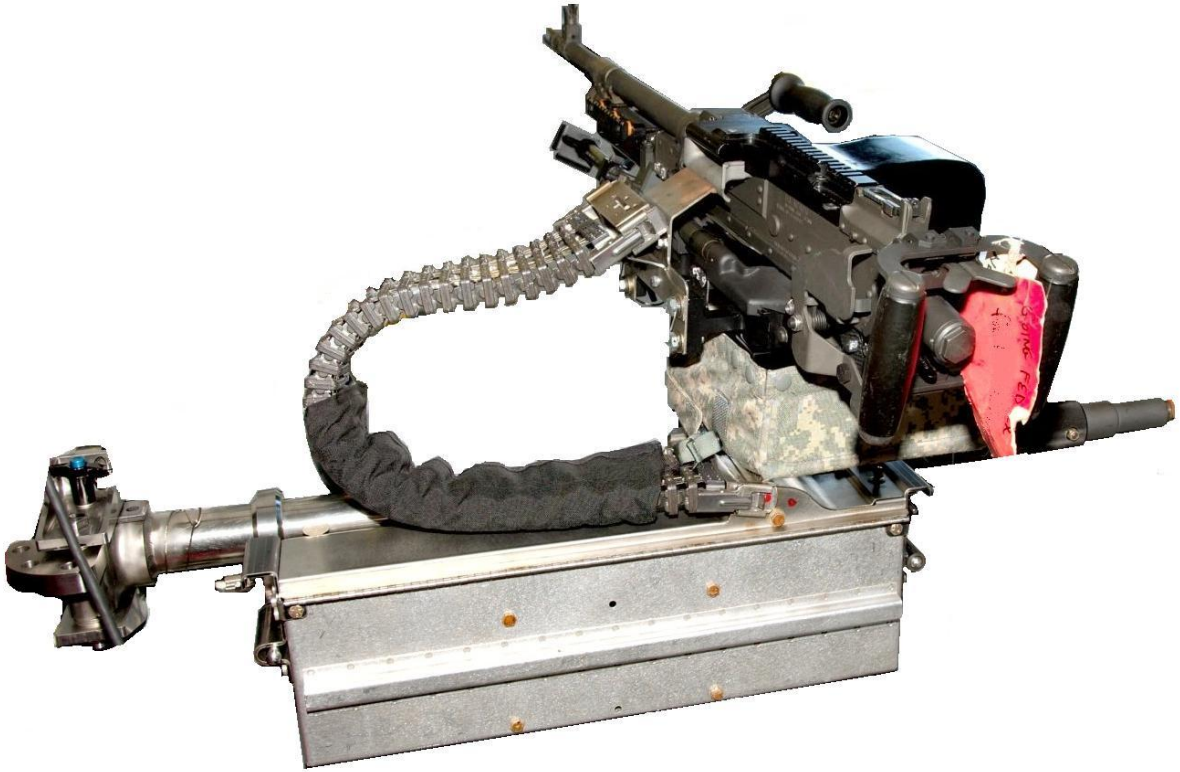
M2

M134

- Many other weapons could be desirable on aircraft
- Special Forces are already using some of these weapons in their aircraft with less than ideal mounting solutions
- Technologies used in the M24E1 and M24E1Mod1 could make this possible

Malcolm Baldrige National Quality Award 2007 Award Recipient

QUESTIONS



Michael Colonnello, (973) 724-9748, michael.colonnello@us.army.mil
Adam M. Jacob, (973) 724-0535, adam.jacob@us.army.mil

Malcolm Baldrige National Quality Award 2007 Award Recipient

References

Photographs of Aircraft and Weapons taken from:

- http://www.gdatp.com
- http://www.dillonaero.com
- http://www.minihelicopter.net
- http://www.barrett.net
- http://en.wikipedia.org
- http://www.sikorsky.com
- http://www.boeing.com