



# U.S. ARMY COMBAT CAPABILITIES DEVELOPMENT COMMAND AVIATION & MISSILE CENTER

Army Battle Damage Assessment & Repair (BDAR) Requirements for  
Composite Aircraft Structures

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FCDD-AMR-SF, DAVID STONE, SYSTEMS READINESS DIRECTORATE

# WHAT THE PRESENTATION WILL COVER



- BDAR Goal
- Requirements
- Assumptions
- Intent
- Kit Contents
- Battery Operated Hot Bonder
- Future Work

# GOAL OF ARMY BATTLE DAMAGE ASSESSMENT & REPAIR



Give the commander options to return a battle damaged aircraft to service or recover it for repair or cannibalization

# LATEST GUIDANCE



- ATP 4-31/MCRP 4-11.4A, Recovery and Battle Damage Assessment and Repair (BDAR), August 2014
- ATP 3-04.13. Aircraft Recovery Operations, April 2018
  - BATTLE DAMAGE ASSESSMENT AND REPAIR
    - Combat operations make expediting normal maintenance procedures imperative.
    - Rapidly returns disabled equipment by the field-expedient repair.
      - Facilitate a Damaged Aircraft Recovery Team (DART) mission,
      - Repair a damaged or failing system identified by aircrews or maintenance personnel during inspections or operation.
    - Restores the essential capabilities necessary to support a specific mission
    - Enable equipment self-recovery
      - Bypassing components or safety devices,
      - Fabricating repair parts,
      - Modifying standard maintenance procedures
      - Using substitute fluids, materials, or components.
    - Repairs may not return the aircraft to a fully mission-capable status.

# LATEST GUIDANCE



- ATP 3-04.13. Aircraft Recovery Operations, April 2018

**Table 2-1. Battle damage assessment categories**

<b>CAT I</b>	The aircraft is reparable. The aircraft can be repaired onsite by bringing resources to it depending on the tactical situation. (In other words, there is inadequate time to perform repairs before the amount of support [tactical] exceeds what is available and on hand.)
<b>CAT II</b>	The aircraft is recoverable and still has intrinsic value. For example, assume during landing that an aircraft lost all hydraulic fluid. The crew managed to shut down engines, but the landing was a little hard. No sudden stoppages were involved. In this instance, both engines, as well as the gear boxes, transmission, and drive shaft, are in good working order. Weapon systems subcomponents are also in working order. All these items are recoverable. The fuselage sustained only minor damage on landing. The entire airframe is an asset and a prime candidate for aerial recovery.
<b>CAT III</b>	The aircraft is destroyed. The aircraft is assessed as destroyed and crews have been recovered.
CAT-category	

# LATEST GUIDANCE



## ATP 3-04.13. Aircraft Recovery Operations, APRIL 2018

- Battle-damaged aircraft are inspected, assessed, and classified similar to “triage” (deferment, repairable, and non-repairable). Determines if the aircraft—
  - Can be readily returned to the fight.
  - Can self-recover with BDAR maintenance.
  - Needs a dedicated recovery by either ground or aerial method.
  - Should be sanitized, cannibalized, and destroyed.
- Following assessment:
  - Some are returned to service immediately through deferment.
  - More seriously damaged aircraft are repaired using approved BDAR techniques.
- Manuals contain damage criteria and modified repair procedures. Each aircraft type has its own BDAR manual providing information such as—
  - Inspection and assessment techniques.
  - Maintenance serviceability and deferability criteria.
  - Cannibalization techniques that permit quick, efficient removal of critical components and structures from unrepairable and unrecoverable aircraft.



# LATEST GUIDANCE



## ATP 3-04.13. Aircraft Recovery Operations, APRIL 2018

- SELF-RECOVERY: Preferred Method
  - Dispatching the DART with the needed repair parts, equipment, and materials.
  - DART makes necessary repairs (standard or BDAR) to continue the mission or return to a collection point or facility.
  - Risk is decreased by the shorter duration of a self-recovery and the aircraft is quickly returned to service.
- DEDICATED RECOVERY (AERIAL)
  - Involves attaching the aircraft to suitable airlift recovery equipment, connecting it to the lifting helicopter, and flying it out.
  - Uses Unit Maintenance Aerial Recovery Kit (UMARK)
- DEDICATED RECOVERY (GROUND)
  - Similar rigging as for aerial recovery except uses a crane.
  - Disassembly required due to road obstacles—or size of the transport vehicle—using procedures outlined in the TM.
  - Procedures outlined in the appropriate aircraft shipping manual are used to prepare any devices (cradles, shipping skids) required for loading onto the transport vehicle.
  - With severe damage where the engine, transmission, and/or rotor system were torn from the aircraft, rigging procedures require modification. Primary concerns are to minimize further aircraft damage and ensure ground crew safety.

# ARMY BDAR ORD REQUIREMENTS FOR COMPOSITE STRUCTURES



- BDAR Time Requirements
  - Covering Force: <180 minutes, only 45 minutes is for repair
  - Main Battle Area: <180 minutes, only 45 minutes is for repair
  - Rear Area: <217 minutes, only 109 minutes is for repair
  
- This includes
  - Assessing combat damage
  - Deferring maintenance
    - Damage limits set to fly “as is”
    - Type 1
      - 100 flight hours or 30 days is typical
      - Full flight envelope
      - Inspected after every flight
    - Type 2
      - One time flight
      - Limited flight envelope
  
- Perform battle damage repair
- Cannibalization & controlled substitution



# COMPOSITE BDAR KIT ASSUMPTIONS



- No power to operate a hot bonder
- No compressed air or vacuum



# COMPOSITE BDAR KIT INTENT



- Common kit to repair multiple aircraft types
- Meet repair time requirements set by ORD
  - Mechanically fastened metallic patches



# COMPOSITE BDAR KIT CONTENTS



All packaged in 7 cases ready to go

- Battery operated hot bonder
- Battery operated drill & saw
- 8 faceted carbide drill bits
- Diamond router bits & cutting wheels
- Coin tap hammers
- Core potting material with mixing supplies
- EA9309.3 resin in easy paks
- PPE
- Environmental enclosure thermoplastics



Parts list for kit are available if units want them

# BATTERY OPERATED HOT BONDER



- Single zone hot bonder & separate vacuum pump powered by 48V radio batteries
- Same batteries power the BDAR heat gun to shrink wrap electrical wires
- Batteries can be recharged in HMMMV
- If cure cannot be completed with one set of batteries, a second set can be inserted & the cure continued
- 48V heater blankets are not interchangeable with 120V blankets and have different connectors
- For BDAR core potting, vacuum capability not required



# FUTURE WORK



- Focus on repair for advanced composite primary structure
- Structural substantiation testing for the repairs
- Suggestions from schoolhouse evaluation
  - Router capability
  - Sanding bit
  - Depth gauge
  - 90° straight edge square
  - Specialty patches and vacuum bags

# POINTS OF CONTACT



Dave Stone & Ranae Wright  
DEVCOM AvMC  
Systems Readiness Directorate  
Redstone Arsenal, AL