



AF Life Cycle Management Center



AFLCMC... Providing the Warfighter's Edge



Aircraft Battle Damage Repair Engineering (ABDRE) Program

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Integrity ★ Service ★ Excellence



Overview



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- ABDR Engineering
 - Mission
 - Repair Example
- Evolving Roles
 - Programmatic partnerships
- Current Repair Strategies
- 5th Generation Repair Strategies
 - Current Capabilities
 - Future Needs



ABDR Engineering Mission



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- Deliver technical support to repair battle damaged aircraft and restore capability to the warfighter
 - Design non-standard repairs
 - Impose flight restrictions
 - Authorize deviations to ABDR Technical Orders
- Integrate with maintenance group and maintain readiness to deploy and triage damaged aircraft when needed



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What is Battle Damage?



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- **Damage sustained during combat operations.**
- **Two Categories:**
 - **Combat Damage** – Caused by munitions
 - Enemy Fire
 - Friendly fire
 - **Mishap Damage** – Ground/Air Operations and or malfunctions
 - Contact With Ground Based Objects
 - Mid-air Collisions
 - Maintenance Accidents



Repair Example



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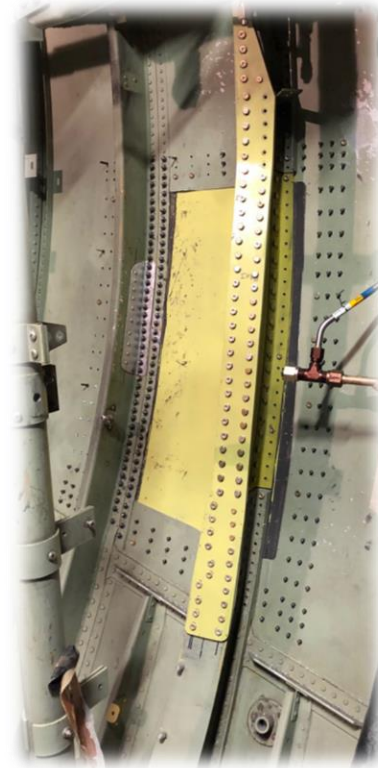
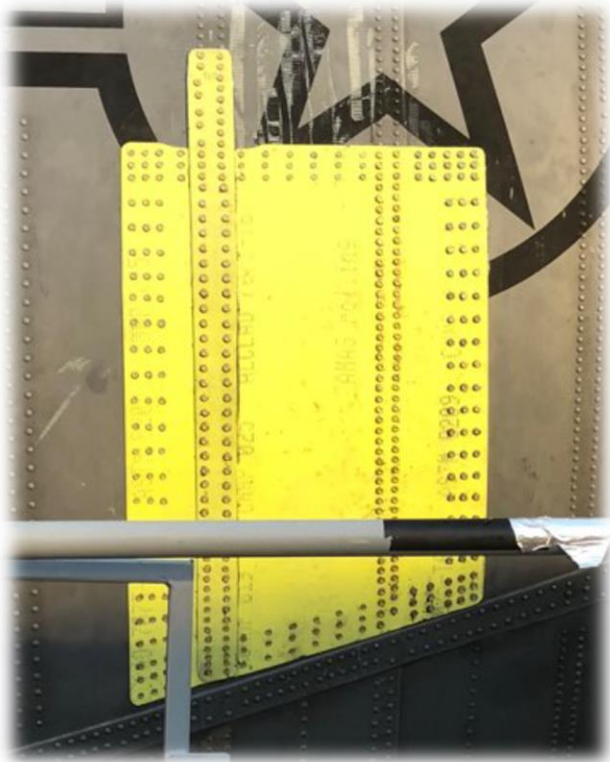
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Repair Example



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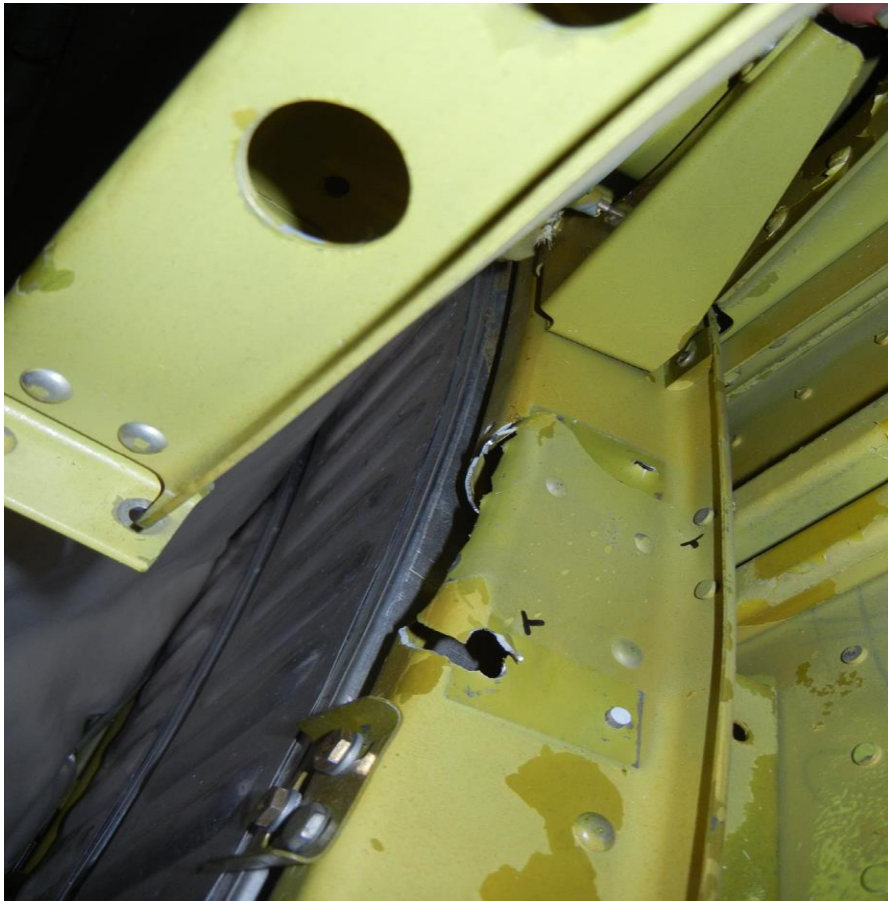
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Repair Example



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Repair Example



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Repair Example



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ABDR Engineering

Evolving Role as a Program



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- DLE Collaboration
 - Direct tie between host maintenance unit and system program office
- EDMX Collaboration
 - ABDRE will integrate and deploy with EDMX teams to provide on-site engineering support
- Tech development and partnership with AFRL
 - Implement tech improvements to accelerate repair processes
- Partnership with LCMC offices
 - Existing partnerships with other branches in LCMC
 - Review and improve curriculum
 - Gain expertise on repair strategies

All roles support crucial wartime missions



Current Repair Strategies

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- Material Ultimate Load (MUL) approach
 - Allows for simple analysis of many metallic structures
 - All work can be done by hand at any location
 - Easy to follow 9-step process

- Calculate margins of safety for evaluated material failure modes



Current Repair Strategies – 9 Step Process



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- Evaluate Damage
- Record material properties
- Evaluate material failure modes
 - Structures and fasteners as applicable
- Verify margins of safety
- Repair configuration and instructions
- Archive



Current Repair Strategies – 9 Step Process



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- Advantages
 - Easily teachable and replicated on many weapon system platforms
 - Can be done in austere environments
- Disadvantages
 - Does not translate well to composite analysis
 - Complexity of structures and accompanying analysis methods
 - Added complexity due to manufacturing challenges



5th Generation Repair Strategy



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- Currently there are many composite repair strategies
 - For depot-level repairs
 - Military and FAA guidance available
 - Engineering analysis available does not follow the current 9-step process
 - Many repairs are more detailed than what can be performed in an ABDR scenario
 - General repairs are in Technical Orders, but aren't analyzed by engineering
 - Require information that may not be readily available to the deployed engineer
- Ideally we will contact the SPO for guidance



5th Generation Repairs – What We Have Now



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- Working on tailoring existing methods for ABDR applications
 - Use existing software applications to expedite analysis
 - Add extra ply/plies to repair design for increased margin of safety
- Use aircraft technical orders for general repairs
 - Allows for general composite repair processes
 - No provision for engineering disposition



5th Generation Repairs – What We Have Now



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- Additional concerns/areas for improvement:
 - Non-destructive inspection capabilities
 - Can be difficult to get certification for various equipment and techniques
 - Training our personnel
 - Materials can pose health hazards
 - Need clean environment for personnel
 - Need to improve containment methods



5th Generation Repairs – What Do We Do Next



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- Can we adapt current analysis strategies for 5th generation?
- If not, how do we come up with new analysis strategies?
- How do we make sure these repair strategies are practical for all aspects of ABDR?



Summary



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Questions?



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