



Improving Structural Durability and Aircraft Availability through Innovative Tracking, Analysis and Repair Technology

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Overview

- Importance of F-16 ASIP Data Collection
- Examples of how data collection has supported repair/modification implementation
 - TukLoc – under WAF
 - FS 479 vertical tail attach pads
 - Lower FS 341 bulkhead bonded repair
 - Wing pylon rib repair
- Conclusions



Introduction

- Data collection is important in the process of identifying drivers for:
 - maintenance
 - modification
 - overall aircraft problem areas
- Analysis of the collected data may lead to action for repair and/or aircraft modification



F-16 ASIP Data Collection



- Fatigue Crack Database (FCD) captures current fleet cracking information
- Common Inspection Reporting Engine (CIRE) stores inspection data for various special inspection requests (TCTO, inspections requiring elevated visibility, etc.)
- Individual Aircraft Tracking provides inspection results for a block-specific set of control points





F-16 ASIP Data Collection



- Review current fleet state
- Project future cracking trends
- Assess risk
- Discover underlying causes of fatigue cracking
- Predict potential aircraft modification needs
- Presentation on Thursday ("USAF F-16 ASIP Data Collection") will discuss this in more detail





TukLoc under Wing Attach Fittings

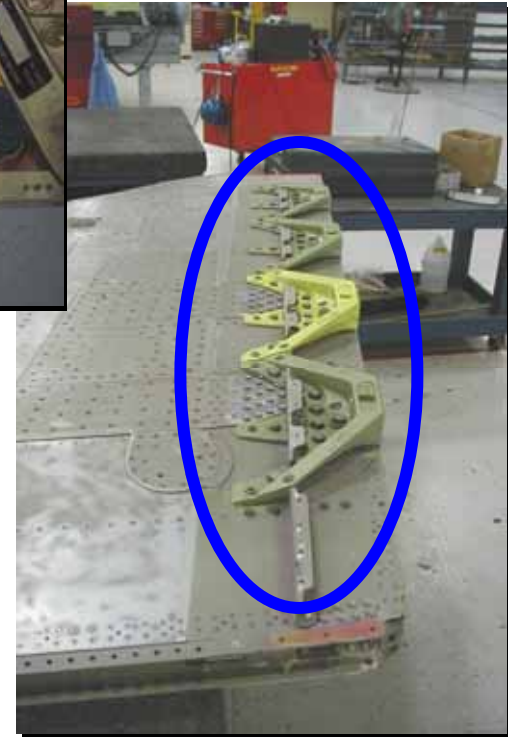


- In 2003 the USAF had 78 aircraft in depot for SLIP modifications
- For these aircraft, 862 extra days of unplanned downtime due to fuel leaks from wing fasteners
 - (ten days per aircraft)
- Aircraft not in depot report fuel leaking as the top driver for maintenance effort and reduced mission capability rates.





Wing Attach Fittings





Wing Attach Fitting Repair / Modification

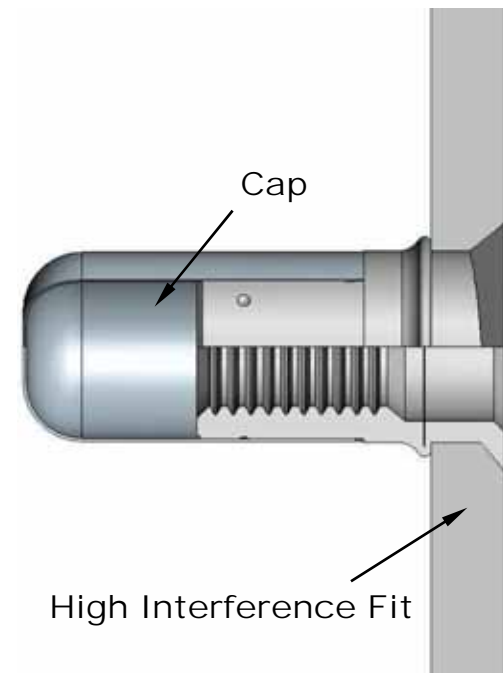
- Replaced NAS1734 blind nuts with TukLoc blind nuts
 - Fixed the leaking problem
 - No leaks on correctly installed fasteners since implementation
 - Enhanced torque resistance
 - Improved fatigue life of the holes
 - Some testing ongoing
 - Fatigue life improvement will be quantified



TukLoc™ Benefits Sealing



- Prevents leaking from all potential leak paths
 - High interference fit reduces / eliminates primary leak path
 - Cap eliminates a second leak path (threads)
- Accepts multiple bolt installations without leaking
- No sealant required





FS 479 Bonded Doubler Mod



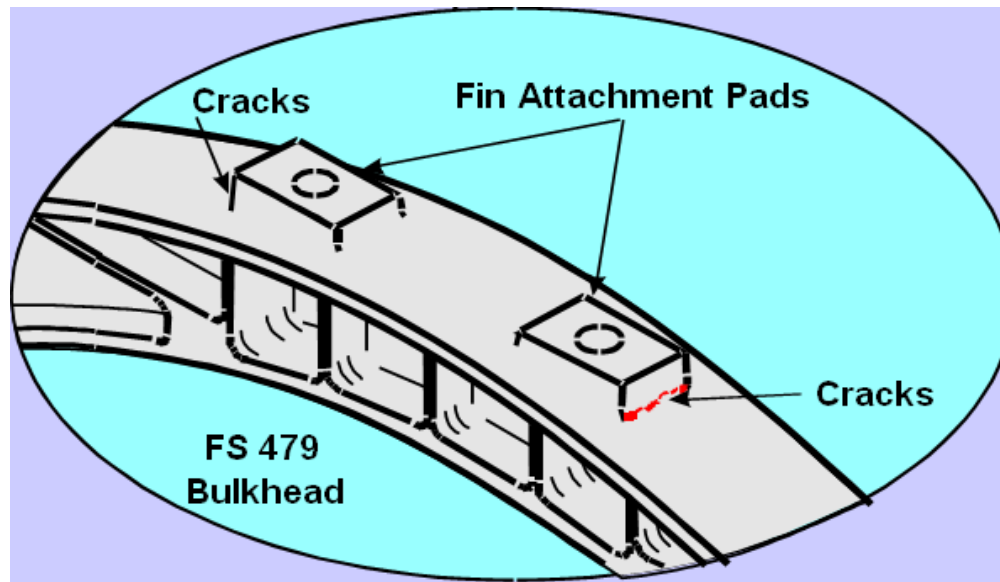
- 479 bulkhead replacement performed during Falcon STAR
 - 479 is the driving mod for blocks 40-52 FS
 - Expensive, intrusive, and time consuming
- 479 bonded doubler will be approved for all blocks
 - Extensive successful testing
 - Repair has flown on 2 jets for years with no problems
 - Can preclude the need for FS 479 bulkhead replacement during FS
 - On-board sensors; health monitoring system being planned
 - Could save \$6-25 million depending on implementation approach





479 Bonded Doubler Modification

- The upper 479 bulkhead cracks at the base of the attach pad
- Sudden change in beam stiffness
- Small radius

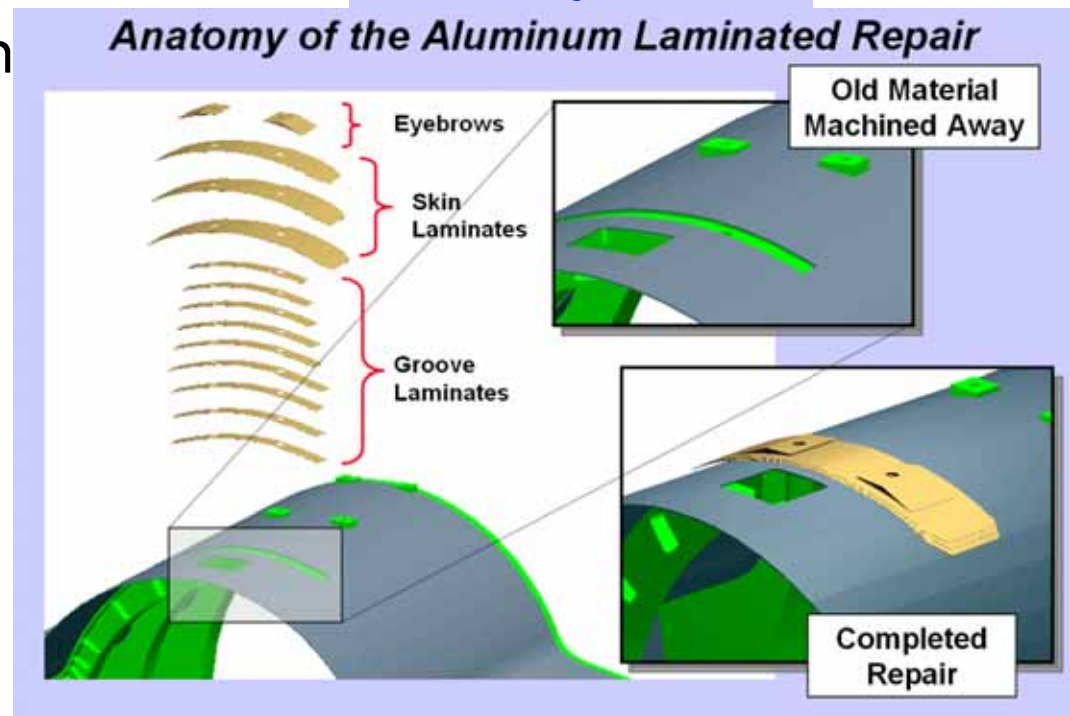




479 Bonded Doubler Modification

- Consists of layers of aluminum bonded together with a high strength adhesive
- Provides a smooth stiffness transition
- Eliminates stress concentration

Courtesy of CSC





479 Bonded Doubler Modification

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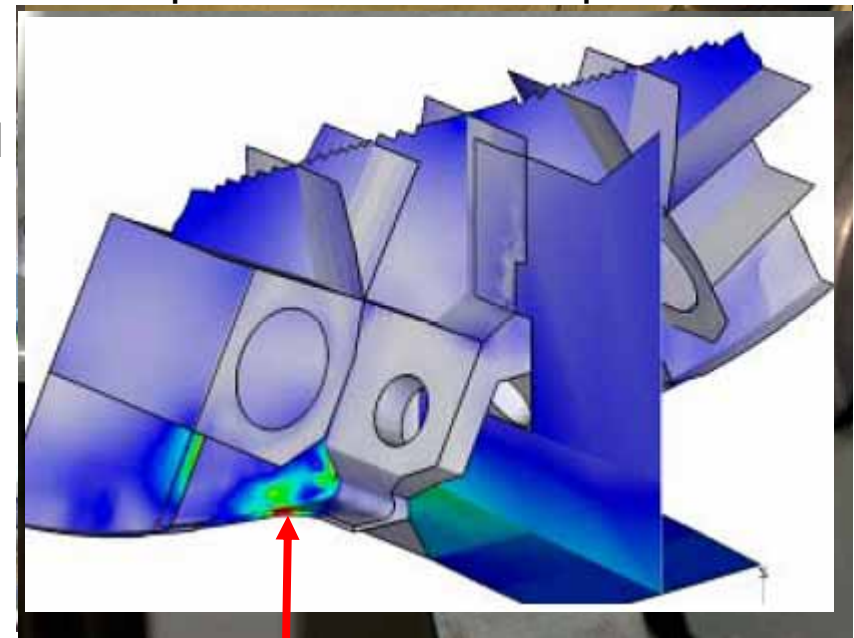




Lower FS 341 Bulkhead Bonded Repair Background / Problem



- Background: OO-ALC in conjunction with AFRL and Southwest Research Institute (SWRI) have developed a Bonded Repair for the FS 341 Bulkhead
- Problem: Cracking on lower 341 Blkhd
- Cracking caused by:
 - Stress Concentration
 - Maintenance Induced Damage
 - Rework exceeding limitations
- Cracks extending to vertical web require bulkhead replacement



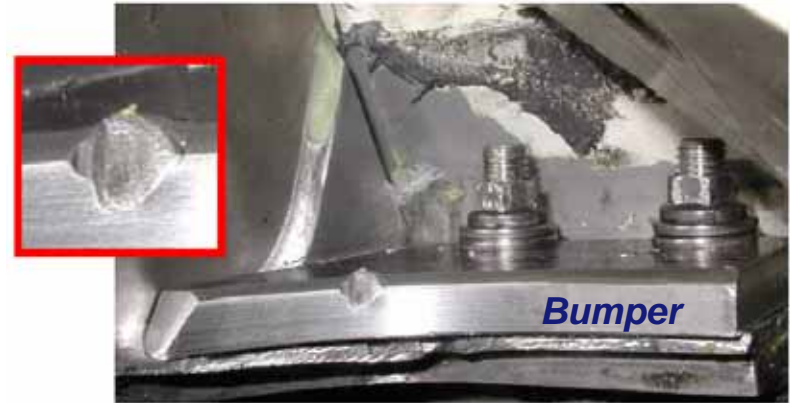
Finite element model shows stress concentration at FS 341 Bulkhead Keel Beam Radius



FS 341 Bulkhead Bonded Repair

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- 6 day repair time vs. 90 day replacement time
- Work accomplished on site
- Repair cost is \$45K
- Replacement costs \$200K+
- Doublers reduce local stress over 60%
- Bumpers prevent future maintenance damage
- Repaired bulkhead coupons survived 6X as long as un-repaired coupons





FS 341 Bulkhead Bonded Repair Installations



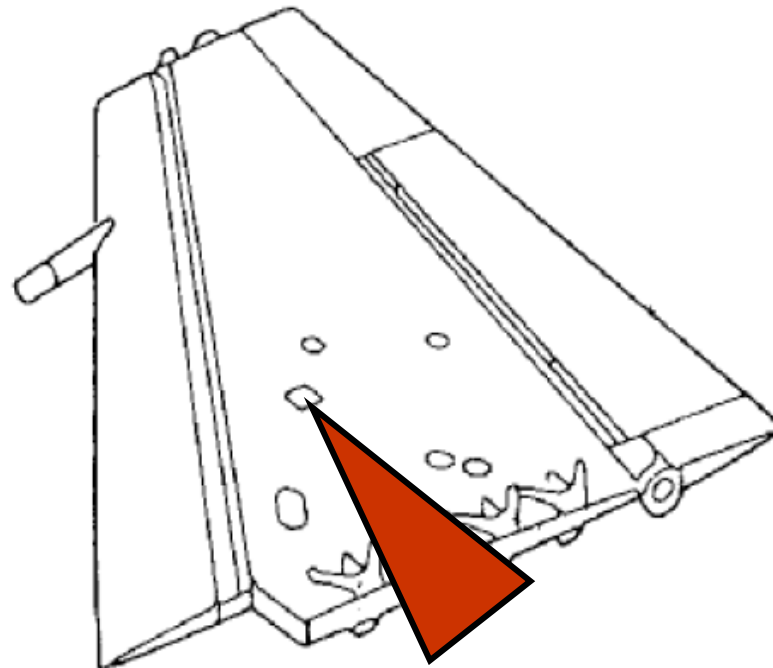
- Installed on Block 42 aircraft in Feb 2004. Aircraft has flown more than 800 hours with no problems noted
- Installed on Block 50 aircraft in March 07, at Shaw AFB - no problems have been noted
- Installed on 2 Block 40 aircraft in June 07, at Osan AB Korea - no problems have been noted





16W112 Wing Rib Pylon Attach Point Repair

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Problem Areas

16W112 Wing Rib Pylon Attach

30+ reports in
one year of
corrosion
and/or gouging





Problem Areas

16W112 Wing Rib Pylon Attach



- Has been problematic for several years
 - Pitting/galvanic corrosion
 - Upward facing “cup” retains water--doesn't evaporate
 - Bare metal requirements per engineering drawings
 - Impacting aircraft Fully Mission Capable rates
- Solutions (1st iteration long-term)
 - Slip fit Al sleeve-type repair (16RW148)
 - Corrosion re-occurring after sleeve repair
 - Sleeve migration observed





Problem Areas

16RW148 "Hone and Sleeve" Repair



- Solutions (short-term) – Engineering Disposition
 - 12 month waivers
- Solutions (2nd iteration long-term)
 - FTI ForceMate bushing-type repair
 - Coated to prevent galvanic issues
 - Reduce recurring maintenance
 - Prevent wing changes and minimize A/C downtime
 - Wing overhaul costs ~\$100k, this repair is ~\$20k on aircraft at location; about 10 hours per wing
 - Implementation expected January 2008





Conclusions

- Data collection, visibility, and analysis capability allows for early problem identification and time for repair development
- Repairs can be substituted for expensive and time consuming part replacement
- Savings from these efforts alone are \$M's
- Maintenance burden reduced
- Aircraft availability greatly improved